METHOW

Subbasin Plan

Prepared for the Northwest Power & Conservation Council

Final

Methow Subbasin Plan

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Prepared for the Northwest Power and Conservation Council

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ACRONYMS AND ABBREVIATIONS

APRE	Artificial Production Review and Evaluation
AREMP	Aquatic and Riparian Effectiveness Monitoring Plan
AU	Assessment Unit
B.C.	British Columbia
BAMP	Biological Assessment and Management Plan
BBS	North American Breeding Bird Survey
BiOP	Biological Opinion
BLM	Bureau of Land Management
BMP	Best Management Practices
BO	Biological Opinion
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
BRT	Biological Review Team
CBC	Christmas Bird Count
CBFWA	Columbia Basin Fish and Wildlife Authority
CCP	Columbia Cascade Province/Ecoprovince
CCT	Colville Tribes (CCT is not contemporary use USE: "Colville Tribes")
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CRB	Columbia River Basin
CREP	Conservation Reserve Enhancement Program
CRFMP	Columbia River Fish Management Plan
CRITFC	Columbia River Inter-Tribal Fish Commission
CRMP	Cultural Resources Management Plan
CRP	Conservation Reserve Program
CSMEP	Coordinated Systemwide Monitoring and Evaluation Program
CWA	Clean Water Act
CWT	Coded Wire Tag
CZM	Conservation
DART	Data Access in Real Time (Columbia Basin database)
DBH	Diameter at Breast Height
DOE	U. S. Department of Energy
DOI	U.S. Department of the Interior

DPS	Distinct Population Segment
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
ECP	Eco-regional Conservation Planning
EDT	Ecosystem Diagnostic & Treatment
EIS	Environmental Impact Statement
EMAP	Environmental Monitoring and Assessment Program
EMS	Energy Management System
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
ESU	Ecologically Significant Unit
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service
FY	Fiscal Year
GCFMP	Grant County Fish Management Plan
GIS	Geographic Information System
GMA	Growth Management Plan
gpm	Gallons Per Minure
GPS	Geographical Positioning System
HCP	Habitat Conservation Plan
HEP	Habitat Evaluation Procedure
HGMP	Hatchery Genetic Management Plan
HUC	Hydrologic Unit Code
HxH	Hatchery x Hatchery
HxW	Hatchery x Wild
IBIS	Interactive Biological Information System
IDFG	Idaho Department of Fish and Game
IHOT	Integrated Hatchery Operations Team
ISAB	Independent Scientific Advisory Board
ISRP	Independent Scientific Review Panel
JARPA	Joint Aquatic Resources Permit Application

JFC	Joint Fisheries Committee
JFP	Joint Fisheries Parties
LFA	Limiting Factors Analysis
M&E	Monitoring and Evaluation
MSY	Maximum Sustainable Yield
NEPA	National Environmental Policy Act
NFH	National Fish Hatchery
NGO	Non-governmental Organization
NMFS	National Marine Fisheries Service
NMFS	National Marine Fisheries Service
NNI	No Net Impact
NOAA	National Oceanic and Atmospheric Administration
NPPC	Northwest Power Planning Council
NRCS	National Resource Conservation Service
ODFW	Oregon Department of Fish and Wildlife
OOSE	Out-of-Subbasin-Effects
OWEB	Oregon Watershed Enhancement Board
PA	Programmatic Agreement
PATH	Plan for Analyzing and Testing Hypotheses
PCSRF	Pacific Coastal Salmon Recovery Fund
PDA	Personal Data Assistant
PHS	Priority Habitats and Species
PIBO	Pacfish/Infish Biological Opinion
PIT	Passive Integrated Transponder
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
PUD	Public Utility District
QA/QC	Quality Assurance/Quality Control
QHA	Qualitative Habitat Assessment
RC&D Council	North Central Washington Resource Conservation & Development Council
RCW	Revised Code of Washington
Rkm	river kilometre
RM	river mile
RTT	Regional Technical Team

SAR	Spawner to Adult Recruit
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
SMP	Shoreline Master Plan
SRFB	Salmon Recovery Funding Board
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
TAPPS	Technical Application (WDFW program)
TMDL	Total Maximum Daily Load
TSS	Total Suspended Sediment
UBC	University of British Columbia
UCRFEG	Upper Columbia Regional Fisheries Enhancement Board
UCSRB	Upper Columbia Salmon Recovery Board
UI	University of Idaho
USDA	United States Department of Agriculture
USDI	United States Department of the Intertior
USFS	U.S. Forest Service
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
UW	University of Washington
VSP	Viable Salmonid Population
WAC	Washington Administrative code
WCC	Washington Conservation Commission
WDOE	Washington Department of Ecology
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDW	Washington Department of Wildlife
WNFH	Winthrop National Fish Hatcher
WQI	water quality index
WRP	Wetlands Reserve Program
WSCC	Washington State Conservation Commission (delete duplicate WCC above)
WSU	Washington State University
WxW	Wild x Wild

Yakama Nation	Confederated Tribes and Bands of the Yakama Nation
YFRM	Yakama Fisheries Resource Management

1 Executive Summary

Updates to the Plan

Several tasks were developed by the Council based upon its review of the independent scientists' report, public comments obtained from June through August 2004, and by applying the standards for adoption set forth in the Northwest Power Act. The purpose of the updates is to fill gaps and increase clarity of the Methow Subbasin Plan so the NPCC will accept it as part of their Fish and Wildlife Plan.

Specific updates include:

1. Addition of a Prioritization Framework for prioritizing projects and strategies, located in Section 5.3.1;
2. Addition of Technical Appendix I: Listed and Proposed Endangered and Threatened Species, Critical Habitat, and Candidate Species that may occur in the Counties of Eastern Washington as listed by the U.S. Fish and Wildlife Service
3. Addition of Technical Appendix J: Final Hatchery and Genetics Management Plan for Mid-Columbia Coho Reintroduction Program;
4. Addition of Technical Appendix K: Projects in the Methow Subbasin by Assessment Unit and Survival Factor;
5. Incorporation of public comment from the Yakama Nation, U.S. Fish and Wildlife Service, and Methow Conservancy throughout the document. The comments from these entities were also added in their entirety at the end of Appendix H as the "Methow Subbasin Plan Supplement to Appendix H".

Purpose of the Plan

The Methow Subbasin Plan is designed to provide the Northwest Power and Conservation Council (NPPC) with strategic direction for allocating fish and wildlife mitigation and restoration funds to support initiatives within the Methow Basin. To involve the community and public, an outreach program was conducted during the development of the plan and will continue as the plan moves towards approval and implementation.

The plan begins with an enunciation of the vision for the subbasin and an outline of the founding principles for the plan tailored specifically to the Methow sub-basin and its citizens. It then moves into an overview of the subbasin, and its fish and wildlife species and their habitats. Current projects and management programs are discussed and a management plan to guide future decision-making is outlined. A brief overview follows.

Vision

Our Vision for the Methow subbasin includes viable, self-sustaining, harvestable, and diverse populations of fish and wildlife and their habitats, along with recognition of the need to support the economies, customs, cultures, subsistence and recreational opportunities within the subbasin.

Subbasin Assessment

The Methow is comprised mostly of large tracts of relatively pristine habitat. Topography varies from mountainous alpine terrain at elevations over 8,500 feet to gently sloping wide valleys down to an elevation of 800 feet. This diverse habitat supports well over 300 species of fish and wildlife - many of which are listed as Endangered, Threatened or as Species of Concern.

Many of the 5,000 people who live within the Methow are seasonal residents with the majority of permanent residents involved with service-based industries. Recreation, tourism, and related development are playing an increasing role in the area's economy with historic economic generators such as logging, mining, farming and ranching on the decline Private land holdings comprise roughly 10% of the subbasin with the remainder largely owned by the federal government. The needs and activities of humans have, in some instances, resulted in habitat disturbances and the associated need to protect targeted portions of remaining habitat and restore disturbed habitat.

Focal fish and wildlife species and focal habitats have been chosen to evaluate the health of the subbasin ecosystem and the effectiveness of management actions. This plan discusses habitat requirements of the focal species and the factors that limit their numbers. These guide the development of the management objectives and strategies for this plan. The review of limiting factors for the focal species of wildlife shows that the presence, distribution, and abundance of wildlife species in the Methow subbasin have been affected by habitat losses. Losses are primarily the result of certain agricultural activities, timber extraction, land use activities, mining, and commercial and residential development. These activities have resulted in habitat fragmentation, conversion of land to different ecotypes, vegetation removal, and invasion by non-native grasses and weeds.

To address factors limiting the focal wildlife species, the plan calls for protection of the full size and condition of core areas, physical connections between areas, and buffer zones to ameliorate impacts from incompatible land uses. Attendant with these steps will be the monitoring of improvements in long-term trends and population status. Monitoring of habitat attributes and focal species will provide a means of tracking progress toward recovery.

Qualitative Habitat Analysis (QHA) has been a useful tool to organize and summarize a large amount of information into a useable format. The QHA process was modified from its original design to meet the specific needs of the Methow subbasin planning process regarding bull trout and westslope cutthroat trout,

The QHA relies on the expert knowledge of natural resource professionals, with experience in a local area, to describe bull trout and westslope cutthroat trout use in the target stream. From this assessment, planners are able to develop hypotheses about the population and environmental relationships of the bull trout and westslope cutthroat trout. The ultimate result is an indication of the relative importance for restoration and/or protection management strategies at the sub-watershed scale addressing specific habitat attributes.

An accommodating and powerful tool called EDT (Ecosystem Diagnosis and Treatment) was used to review the limiting factors for the following focal species of fish: spring Chinook salmon, summer/fall Chinook, and summer steelhead. Coho were not addressed with either the QHA or EDT model. The major results of EDT are captured under the plan sections entitled

Major Findings and Assessment Unit Summaries. In brief, they show that in the Methow Basin habitat losses have chiefly resulted from artificial and natural fish passage barriers, alteration and reduction of riparian habitat, loss of habitat connectivity, instream and floodplain habitat degradation, low flows, and dewatering. Added to these limiting factors within the Methow are out-of-basin problems including fish passage over mainstem dams and harvest.

Thus, the ecosystem diagnosis method used was intended primarily to address the question: *Is there potential to improve anadromous salmonid population status through improvements to habitat conditions in tributary environments?*

Said in a form of a **central subbasin hypothesis** (for fish and adaptable for wildlife): *Improvements in habitat conditions will have a positive effect on habitat productivity and thus, improve fish population status through increased abundance, diversity, and spatial structure.*

To date, much of the effort and resources allocated to addressing the limiting factors of fish has centered on supplementation with hatchery-reared fish. This has resulted in tangible benefits for certain species in certain areas but there are concerns that, at least in some instances, hatchery fish have displaced rather than supplemented wild fish. The Plan states that while the protection of existing wild stocks and the building of self-recruiting wild populations must be paramount, there is a need to continue with hatchery supplementation in a careful, well-planned, and documented fashion. Uncertainty about population structure, poor adult returns, and a desire to spread the risk of hatchery intervention will require long-term monitoring of population trends and changes in gene pools.

Inventory of Existing Activities

The inventory section outlines the extent to which present programs address the limiting factors outlined in the plan. This section also avoids program overlaps and shows the gaps and unknowns that require more research, monitoring and evaluation.

Management Plan

The management plan is the most important part of the document. It presents a vision of what future conditions could be and identifies the route to get there. It is based on the premise that major portions of the Methow subbasin at higher elevation still have relatively intact, high quality fish and wildlife habitat that requires protection from human disturbance while impacted habitats in the middle and lower reaches of the subbasin require restoration.

Fisheries Management

The goals for fish vary depending on the life history requirements of the species.

The goal for both spring and summer/fall Chinook salmon is to achieve run sizes that provide for stock recovery, mitigation of hydrosystem losses and harvestable surpluses.

Specific objectives address the need to provide for an annual tribal and sport fishery, while conserving natural stocks to a minimum of 2000 spawners (3,500 past Wells Dam) by 2013. Determining natural smolt production and overall limitations by 2013, and improving smolt to adult survival is a key management priority. Updating Methow Chinook status reports is recommended every five years.

For Steelhead the goal is a run size that provides for the recovery of steelhead in the Methow subbasin.

Specific objectives include the need to provide for an annual tribal and sport fishery while conserving natural stocks to a minimum of 2,500 spawners by 2013. Artificial production should be maintained using locally adapted broodstock to meet recovery, conservation and harvest needs, while minimizing the impacts on recovering naturally reproducing stocks. Updating the Methow steelhead status reports is recommended every five years.

The goal for bull trout is delist them; a goal that applies broadly across many focal and affected species.

Specific objectives aim to ensure persistence of self-sustaining groups of bull trout across their native range within the Methow subbasin by providing the habitat and access conditions bull trout require at various stages in their life history. In addition, there is a need to improve the knowledge of bull trout in the Methow subbasin.

The goals and objectives for westslope cutthroat are similar to those for bull trout.

The goal for coho salmon includes re-establishment of run sizes that provide for species recovery, mitigation of hydro-system losses, and harvestable surpluses.

Wildlife Management Plan

The Methow subbasin plan directs major conservation efforts towards three focal wildlife habitats; Eastside (Interior) riparian wetlands, shrubsteppe and Ponderosa pine habitats. The goal is to provide sufficient quantity and quality of each of these habitats to support a diversity of wildlife (represented by the focal species).

The objectives for achieving the goal in all of the focal habitats include:

- determine the necessary amount, quality, and juxtaposition of each focal habitat to sustain focal species
- based on the findings from step 1, provide measures to sustain focal species and habitats by 2010
- improve silviculture practices, fire management, weed control, livestock grazing practices and road management on Ponderosa pine habitats.

Additional objectives specifically for Ponderosa pine habitat include the need to show an increase in distribution and population status of white-headed woodpecker, flammulated owl, gray flycatcher, and Pygmy nuthatch, and an inventory of focal species to test the assumption of the "umbrellas species concept" for conservation of other Ponderosa pine obligates.

For shrubsteppe habitat, objectives include the need to determine the population status of the grasshopper sparrow, Brewer's sparrow, sharp-tailed grouse and mule deer by 2008. There is also a plan to reintroduce grouse to at the least the desired minimum viable population by 2024, and maintain and enhance mule deer populations consistent with state/tribal herd management objectives.

Objectives specifically designed for improving wildlife conditions in riparian wetlands included the need to determine the population status of beaver (maintaining and enhancing remaining populations where appropriate based on findings), as well as red-eyed vireo, and yellow-breasted chat by 2008. Also, the plan proposes to inventory other riparian wetlands populations to test the assumption of the “umbrella species concept” for conserving other riparian wetlands obligates.

Linkages

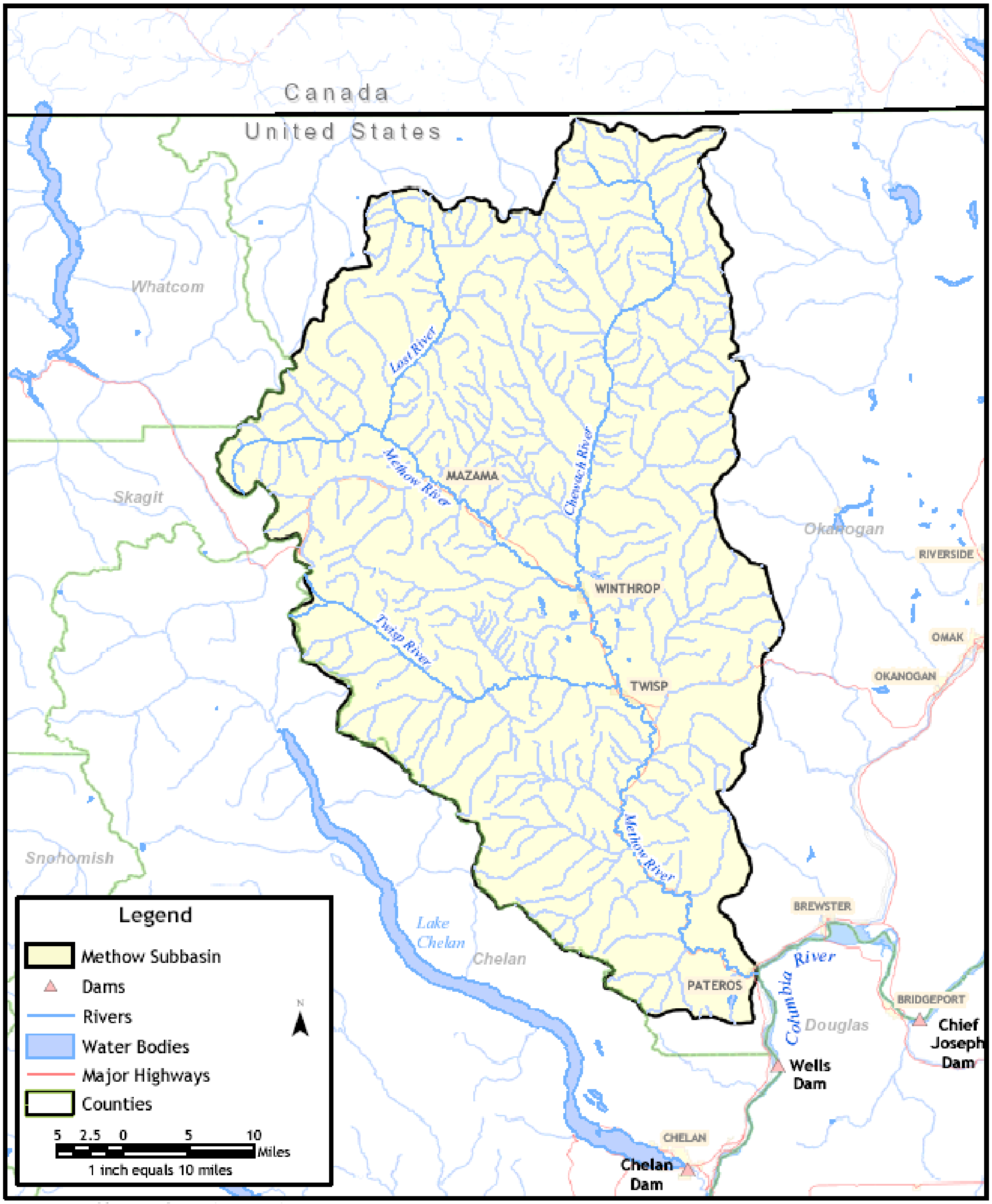
The Methow Subbasin Management Plan wraps up by linking with other major initiatives such as the Northwest Power Act, the Endangered Species Act and the Clean Water Act. It then concludes by recommending a balanced and consistent program framework for monitoring and evaluating progress in meeting (or not) the recommendations, goals and objectives found in the Plan. Adaptive management is an inherent character of this framework that relies upon the monitoring program construct, and then upon subsequent iterations and updates of this plan.

Implementation

It is noted that this plan has limitations, and is, in sum, unfinished in terms of its ability to chart a full term course for sustainability. This is because of the significant resource constraints placed on this process and the fact that the Methow suffered from a lack of an organized planning framework, and a paucity of completed analyses. The fact that this plan was developed within the span of less than a year, unlike any other plan of similar scope or significance, did not escape the planners, initially, or in the end. Nevertheless, they persisted to produce the best product possible, and have in turn, taken a significant step forward to meet a long list of challenges facing natural resources and communities in the region.

Consequently, this plan represents a thoughtful and credible approach; one collectively derived from a tremendous effort on the part of local governments, state, federal and tribal agencies, and the public. Notably, this multifaceted effort was carried out in one of the most complex and politically charged watersheds in the Columbia Basin and in the region to the most imperiled and impacted populations of fish and wildlife.

We are confident that this subbasin plan will now guide state, local, federal and tribal governments, the NPPC, and The Bonneville Power Administration in meeting their respective obligations to implement various programs to conserve and enhance fish and wildlife.



Data Layers: Subbasins and Dams (StreamNet), Counties & Major Rivers (WA Ecology), State Routes (WashDOT) Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 1 Location of Methow subbasin, depicting general features and hydrology

2 Introduction

The Methow subbasin (**Figure 1**) is a truly unique place with a distinctive role in the ecology and economy of the Upper Columbia Basin. Especially beautiful, and both accessible and remote, the Methow subbasin is home to a rich diversity of fish and wildlife species, including some of the uppermost limits of current anadromous salmonid distribution, and is populated by people who care passionately about the place they call home.

Current participation in discussions and decision-making regarding the Methow subbasin's natural resources, involves private citizens, irrigation districts, environmental groups, county government, and state and federal agencies. In addition, both the Colville Tribes and the Yakama Nation have a long history of traditional resource use in the subbasin, and take an active role in fish, wildlife, and habitat management.

The Methow subbasin plan addresses the limiting factors for fish and wildlife ecosystems in the Methow Watershed. However, the needs of watershed residents, and their critical role in ecosystem stewardship, have been clearly considered as part of overall ecosystem recovery and of the benefits of shared stewardship.

2.1 Subbasin planning

Subbasin planning is the foundation for the Northwest Power & Conservation Council's (NPPC) revised Fish and Wildlife Program for the Columbia River, and consists of a comprehensive description of the basin general ecology, including the identification of specific fish and wildlife needs. The new program is intended to be more comprehensive than, but complementary to regional efforts related to address the Endangered Species Act (ESA), Clean Water Act (CWA), and state-sponsored recovery and watershed planning; it serves as a valuable tool to assist local fish and wildlife recovery coordination efforts led by stakeholder groups, Okanogan County, the Colville Tribes, and the fish and wildlife co-managers (Yakama Nation and WDFW).

The revised Program divided the Columbia basin into ecological provinces and associated subbasins, and calls for an ecosystem-based approach for planning and implementing fish and wildlife recovery. Future action strategies and project funding are to be based upon the identified needs in subbasin plans.

The Methow subbasin plan is one of six subbasin plans being generated from within the Columbia Cascade Ecoprovince (CCP). The Okanogan, Wenatchee, Lake Chelan, Entiat, and Upper–middle (mainstem) Columbia River subbasins comprise the remainder of this province.

The Methow subbasin summary presented a compilation of known and existing data on anadromous fish and wildlife and their habitats in the Methow River Watershed (CBFWA 2002). Twenty-three subwatersheds of the Methow were examined, although the overall number of tributaries and irrigation channels is much greater. The report also provided data and context for wildlife, land use, human population patterns, and overall resource management issues. This summary, in combination with the Limiting Factors Analysis (LFA) (WSCC 2000), provided a starting point to develop the Methow subbasin plan.

A significant body of science and analysis was undertaken to support the scientific hypotheses described in this subbasin plan. These hypotheses, and the species-based biological objectives set by senior management agencies, form the basis for management decisions which, based on public policy, will facilitate coordinated recovery planning for the Methow salmon ecosystem. The vision, goals, and supporting principles in this subbasin plan provide the foundation for the implementation of the plan by applying local public jurisdiction to local decisions.

2.2 Methow Subbasin Plan Approach and Public Involvement

Okanogan County and the Washington Department of Fish and Wildlife (WDFW) (the Coordinators) partnered to coordinate subbasin planning for the Methow subbasin. Okanogan County has been largely responsible for the public outreach of the subbasin plan. WDFW has been largely responsible for the technical aspects of the subbasin plan.

The timeline established by the NCCP has necessitated a very compressed process that has allowed limited stakeholder involvement on early drafts completed in May 2004. A total of 43 formal planning team and various communication meetings were convened between August 2003 and May 2004. E-mail circulars and media releases provided regular updates on subbasin planning to more than 250 formal public contacts, providing a description of next steps, and encouraging stakeholder participation.

Early drafts of the subbasin plans were placed in local public libraries, sent to stakeholders on request, and posted on an ‘ftp’ website. Stakeholders were encouraged to submit comments on the first outline draft (February 11, 2004 – April 16, 2004), and given two weeks to comment on the completed draft (April 23, 2004 – May 10, 2004).

The NPCC public review and comment period (June 4 - August 12, 2004), and the proposed three-year rolling review of subbasin plans (2007), should build on these important first contributions. It is expected that the building of the subbasin plan only begins with the drafting of the plan. Future refinement of the plan, based on public and agency comment, and new contributions, knowledge and information will make the subbasin plans more relevant and responsive to the subbasin Vision

Commitment to Public Outreach

Okanogan County staff and contractors have used the media and a series of public meetings to communicate progress. Evening summary meetings were convened to accommodate stakeholders who were not able to attend during the day. Briefings were provided to interested groups on eight occasions, and to media representatives on request. Three formal public meetings were convened to facilitate public dialogue on the direction of the plan and to answer pertinent questions. Regular e-mail circulars and media releases provided regular updates on subbasin planning, next steps, and invitations welcoming additional stakeholder participation. More extensive review, including that by ISRP and the public, will be complete by August 2004.

In September 2003, the Coordinators assembled an initial outreach list comprising about 130 names. The list included representatives of the following interests:

- Agriculture
- Business
- Conservation and Environment

- Government (including local government, and local and regional representatives of state, tribe and federal agencies)
- Media
- Recreation

The list has continued to grow as individuals have expressed interest in subbasin planning. The outreach list has been used throughout subbasin planning to share information and facilitate dialogue among communities of interest, science, and place. The list was also used to distribute public information; an information bulletin describing ongoing progress on the development of subbasin plans, was regularly sent to the stakeholders, enabling them to track the process and any changes to the planning schedule.

Fact sheet

Okanogan County developed a Fact Sheet to introduce subbasin planning to stakeholders and the media, and to explain opportunities for public involvement. The Fact Sheet included a telephone number, and e-mail, postal mail, and web site addresses that individuals could use to obtain more information.

Public comments

Comments collected at public meetings and during public review of draft subbasin plans have been appended to this plan as Appendix H.

2.2.1 Infrastructure and Organization

Habitat and Subbasin Core Teams

Okanogan County, the Washington Department of Fish and Wildlife, and a working group of co-managers and public stakeholders initiated formation of the Methow Habitat Working Group and Subbasin Core Team (SCT). The HWG/SCT met 62 times to review and refine the Ecosystem Diagnosis and Treatment outcomes (EDT), (i.e. to refine hypotheses based on local knowledge), and to develop management strategies).

2.2.2 Local and Regional Socio-economic Conditions

The Methow subbasin is a microcosm of current natural resource management and public policy change to meet the new resource development-conservation challenges. Management for the sustainability of subbasin fish and wildlife populations is challenged by human population growth and land development, increasing demands on fish and wildlife habitats, oversubscribed instream flows, and the downstream Columbia River Hydropower System.

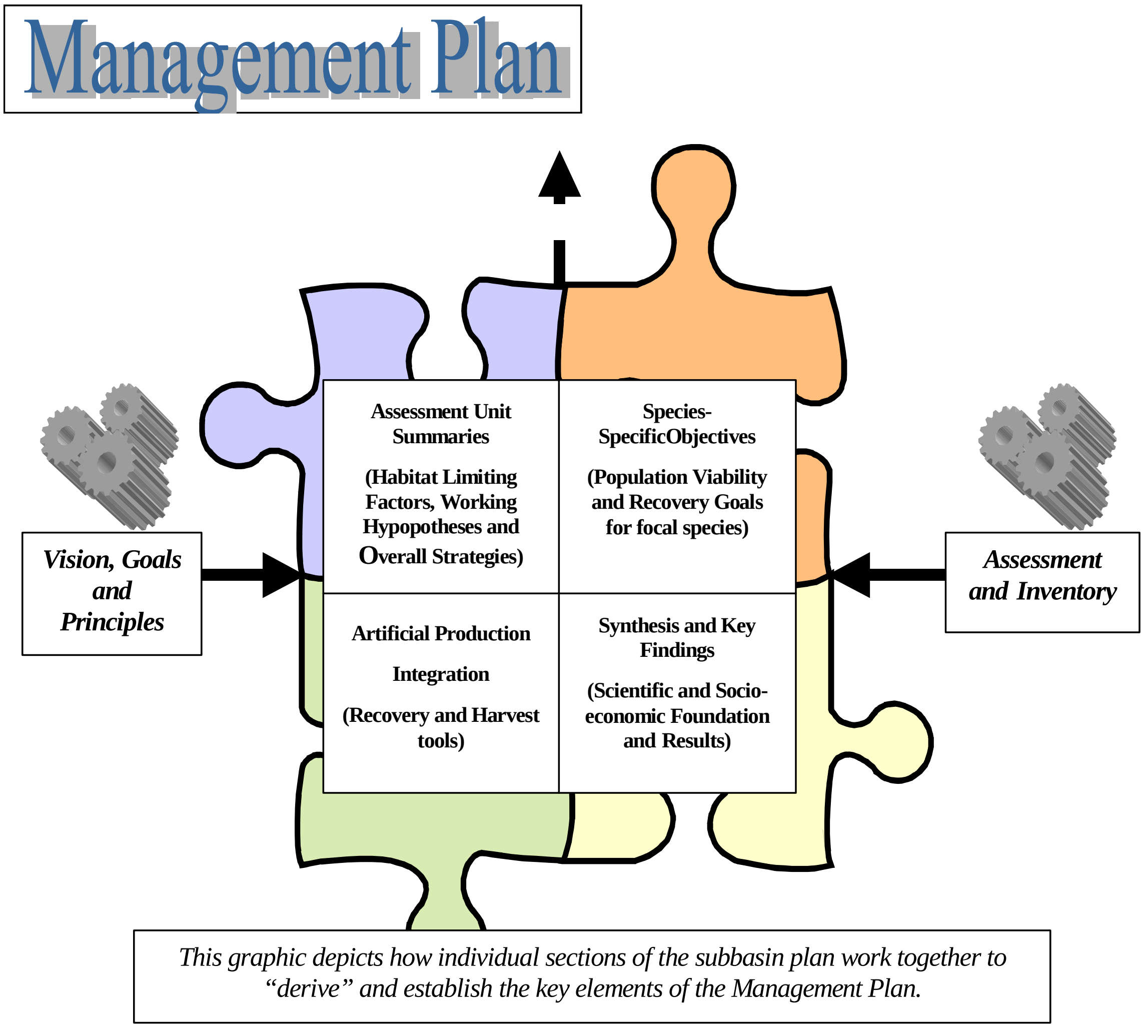
Subbasin plans will contribute to solving these challenges by providing a compendium of resource information and the tools to empower planners and decision-makers to implement programs appropriately and in a coordinated manner at the local level.

2.3 Overall Direction and Goal of Subbasin Plan

The technical components of this subbasin plan will require an integrated (ecosystem-based) approach; the issues are often regional and ecologically interconnected. Moreover, the requirements of each life stage of all indigenous fish species (both historic and existing) linked to the salmon ecosystem must be identified and addressed within each assessment unit to develop a complete picture of the subbasin ecosystem. Unfortunately, at times there is incomplete data or disconnected understanding adding greatly to the difficulty of managing the Methow subbasin. These gaps and the approach to filling them in short- and mid-term plans will likely extend to all management plans and every assessment unit.

The technical components of this subbasin plan are undoubtedly important and useful in the development of projects provided by the framework in this subbasin plan; however, success can only truly occur if the impacts on local communities are considered. Though the continuing balance between technical and community priorities is always a challenge, this and other planning processes must continue to try to strike that balance.

Though it is suggested that the Vision and supporting items be provided in the management plan portion of the document, the subbasin planners have chosen to provide these components at the beginning of the document to “set the tone” for the document. The Vision, planning assumptions, foundation principles, and supporting principles provide the overall direction and goal of this subbasin plan. The logic path for development of the subbasin plan is illustrated in **Figure 2**.



Source: KWA 2004

Figure 2 Logic Path for the Development of the subbasin plan

2.4 Our Vision for the Methow subbasin

Consistent with the 2000 Columbia Basin Fish and Wildlife Program's vision, yet tailored specifically to the geographic region of the Methow subbasin and its citizenry, within 10 to 15 years, it is envisioned that:

The Methow subbasin supports self-sustaining, harvestable, and diverse populations of fish and wildlife and their habitats, and supports the economies, customs, cultures, subsistence and recreational opportunities within the basin. Decisions to improve and protect fish and wildlife populations, their habitats, and ecological functions are made using open and cooperative processes that respect different points of view, statutory responsibilities, and are made for the benefit of current and future generations.

The vision and subbasin plan is the outcome of an open process, and is intended to provide a framework under which future projects can be developed and implemented. Actions taken in the subbasin should be consistent with the Methow subbasin plan, the NPCC Columbia Basin Fish and Wildlife Program, the Clean Water Act, and the Endangered Species Act.

2.4.1 Specific Planning Assumptions

Planning assumptions were developed for incorporation into project plans or actions developed within the framework provided by this subbasin plan. Actions taken in the subbasin should be consistent with these planning assumptions.

As a part of the subbasin Vision, the subbasin plan adopts the following policy considerations and planning assumptions for the Methow subbasin plan:

The ultimate success of the projects, process, and programs used to implement the subbasin plan will require a cooperative and collaborative approach that balances the economies, customs, cultures, subsistence, and recreational opportunities within the basin, with the federal/state mandates to protect fish and wildlife.

The subbasin plan is not a land use management plan, nor contains any regulatory authority, but it is, however, intended to guide Bonneville Power Administration (BPA) in meeting its mitigation obligations.

No single activity is sufficient to recover and rebuild fish and wildlife species in the Methow subbasin or in the Columbia River basin. Successful protection, mitigation, and recovery efforts must involve a broad range of strategies for habitat protection and improvement, for improvements to the operations of the hydrosystem, for effective and equitable harvest management, and for the continued incorporation of artificial production.*

The BPA should make sufficient funds available to implement, in a timely fashion, projects developed within the framework of this plan.*

This is a habitat-based program for rebuilding healthy, naturally producing fish and wildlife populations by protecting, mitigating, and restoring habitats and the biological systems within them, including anadromous fish migration corridors. Artificial production and other non-natural interventions will be used judiciously, and will be consistent with the central effort to protect and restore habitat and to avoid adverse impacts on native fish and wildlife species.

It is important to consider out-of-basin effects (including ocean habitat and predation) on salmonid species when evaluating freshwater habitat management in order to understand all stages of the salmon and steelhead life cycle.

There is an obligation to provide fish and wildlife mitigation where habitat has been permanently lost because of hydroelectric development. Artificial production of fish may be used to replace capacity, bolster productivity, aid recovery, and alleviate harvest pressure on weak, naturally spawning resident and anadromous fish populations. Restoration of anadromous fish into areas blocked by dams should be actively pursued where feasible.

Management and artificial production actions must have an experimental, adaptive management design. This design will allow the region to evaluate benefits, address scientific uncertainties, and improve survival. It is important that actions be integrated with research and monitoring activities to evaluate their effects on the ecosystem.

Harvest can provide significant cultural and economic benefits to the region, and the program should seek to increase harvest opportunities consistent with sound biological management practices. Harvest rates should be based on population-specific adult escapement objectives designed to protect and recover naturally spawning populations.

Achieving the Vision requires that habitat, artificial production, harvest, and hydrosystem actions are thoughtfully coordinated with one another. There must be coordination among actions taken at the subbasin, province, and basin levels, including actions not funded by this program.

Participation of stakeholders, local and regional planning organizations, and/or groups in implementation of subbasin plans should be fostered to the fullest extent possible or where appropriate.

2.4.2 Foundation and Supporting Principles

These foundation principles are reflected in a framework of six key elements, which include natural and cultural systems from which the subbasin plan is built.

- Economies, customs, cultures, subsistence, and recreational opportunities within the basin
- Regulation of land use
- Out-of-basin effects
- Long term sustainability
- Fish and wildlife habitat
- Biological interactions and connectivity

The foundation and supporting principles drafted to guide the subbasin plan are as follows:

Economies, customs, cultures, subsistence and recreational opportunities within the basin.

The people of the Methow subbasin are diverse and independent. They value a wide range of customs and cultures. Actions, strategies, programs and projects for fish and wildlife and their habitats will be more successful if developed in context with the basin’s economic needs and opportunities, and with an understanding of the impacts on the human environment in the basin.

1. Activities associated with the subbasin plan, undertaken to protect and/or restore fish and wildlife, have the potential to improve opportunities for cultural and recreational uses and, thus, the social and economic well-being of the communities. Strategies and projects should be reviewed and evaluated based on the potential for such positive impacts, and methods should be developed to measure and monitor the success of such efforts.
2. The cost of actions to implement the Methow subbasin plan is estimated in relation to benefits. Within the context of priorities established to recover listed species or mitigate for the impacts of the hydropower system, alternatives that achieve the greatest benefits at the least costs are preferred. Consideration of social costs should include the effects (positive and negative) of implementation on short- and long-term economic stability in the subbasin. Consideration should include (but is not limited to) project feasibility, cost-share opportunities, job growth, longevity, effects of increased electrical rates, increased development costs, and increased public land ownership.
3. Actions derived from the Methow subbasin plan are undertaken with the understanding that the natural environment, including its fish and wildlife resources, is the cultural heritage that is common to the diversity of human existence; and such actions play a key role in the long-term sustainability of the common cultural heritage within the subbasin.
4. Acknowledgement, integration, and balancing of human, fish and wildlife needs will be necessary to ensure the successful implementation of this plan. Methow subbasin stakeholders' values are clearly stated and reflected in this process.
5. Programs and actions are monitored and evaluated for effect, and may be altered as necessary to achieve the intended results, recognizing that science, strategies and the art of restoring ecosystems is evolving and adaptive.

Regulation of land use.

The ability to implement protection or restoration strategies will require a close and cooperative relationship among federal, state, tribal and local governments and a wide range of interest groups. Protection and/or restoration strategies that affect land use will require action (both for the adoption and implementation) by local, state, federal and/or tribal governments.

1. No existing water right is affected by actions derived from the Methow subbasin plan without the consent of the holder of that right.
2. The processes of subbasin plan preparation, implementation (including project development and planning), and amendment are open, voluntary, and collaborative.
3. Actions derived from the Methow subbasin plan acknowledge the statutory authority of local, state, federal and tribal governments and of existing plans, programs, and processes.
4. Future land use planning and activities that involve potential impacts on fish and wildlife and their habitats should be fully discussed with those agencies and tribes holding management authority, prior to implementation.

Out-of-basin effects.

The Columbia River basin is characterized by natural environmental variability, fluctuation in production, and established human urban and rural activities. Restoration and management of fish and wildlife and their habitats in the Methow subbasin must consider both in- and out-of-basin effects within the entire Columbia River basin ecosystem, including the natural as well as the cultural effects, and those associated with freshwater, estuary, and ocean.

1. Strategies for recovery or maintenance of self-sustaining populations need to be evaluated within the context of the entire life history of the populations, and not just within the life history stages within the subbasin geographic area.

2. Important environmental attributes that determine the distribution and productivity of fish and wildlife populations have been influenced by natural and cultural activities in and outside the subbasin.

Long-term sustainability.

Life history, genetic diversity, and metapopulation organization reflect the ways that fish and wildlife adapt to their habitat. Diversity and population structure are how fish and wildlife species adapt to spatial and temporal environmental variations. High diversity promotes production and long-term persistence at the species level.

1. In addition to fish and wildlife populations that support the custom, culture, subsistence, and recreational opportunities in the subbasin, indigenous fish and wildlife species should be enhanced and restored to be self-sustaining.

2. For aquatic- and fish-related interests, selection of a broad range of focal species provides a basis for development of holistic management strategies. For terrestrial- and wildlife- related interests, the selection of focal habitats and related focal species provide a basis for developing holistic management strategies.

3. Biological inter- and intra-specific interactions shape fish and wildlife populations. Restoration of individual populations may not be possible without restoring other fish and wildlife populations with which they co-evolved.

4. Most native fish and wildlife populations are linked across large areas and do not consider political borders; therefore, the possibilities for extinctions or extirpations is reduced. An important component for recovery of depressed populations is to work within this framework and maintain or recreate large-scale spatial diversity.

5. Populations with the least amount of change from their historical spatial diversity are the easiest to protect and restore, and will have the best response to restoration actions.

6. Small populations are at greater risk of extinction than large populations, primarily because they are more vulnerable to environmental changes such as catastrophic events.

Fish and wildlife habitat.

Fish and wildlife productivity requires a network of complex, interconnected habitats that are created, altered, and maintained by both natural and human processes in terrestrial, freshwater, estuary, and ocean areas.

1. The habitat in the Methow subbasin should be capable of supporting self-sustaining, harvestable and diverse populations of fish and wildlife.

2. Physical characteristics of the alluvial valley and floodplains of the Methow River have changed ecosystem attributes, and restoring watershed processes, where possible, will require a long-term collaborative commitment to fish and wildlife recovery.

3. The Methow subbasin is a dynamic system that will continue to change through natural events and human activities.

Biological interactions and connectivity.

Population, abundance and diversity, and the biotic community, reflect ecosystem attributes. Co-evolved assemblages of species share requirements for similar ecosystem attributes and require connectivity among them.

1. Sustainable, harvestable, and diverse populations of fish and wildlife are dependent upon properly functioning environments and the processes that sustain them.

2. Changes to the physical characteristics and connectivity of the Methow subbasin have contributed to the changes of native fish and wildlife populations; therefore, reconnecting the native ranges of fish and wildlife species is critical.

Okanogan County Comments on Land Acquisition

In the subbasin plan, a potential management strategy is the protection of existing habitat for both fish and wildlife. Protection currently occurs by two actions – conservation easements and/or land acquisition. The Okanogan County Board of Commissioners (Board) believes that these protection activities potentially impact Okanogan County's economic base and culture. The Board believes that other innovative solutions exist to achieve the same benefit and urges individuals using the plan to propose actions to explore them.

Though the Board strongly opposes further acquisition of private lands in Okanogan County, they respectfully acknowledge a private landowner's right to do with their property as they choose. It has been the Board's experience that, in some instances, government entities often offer a private landowner exorbitant prices for a property, disallowing those in the private sector to compete in purchasing the land.

When the state, federal government or other groups, such as not-for-profits and the Bonneville Power Association, acquire properties in Okanogan County, the Board of County Commissioners desire that the following be considered:

- Consider and mitigate the economic impacts of removing the property from the County tax base or decreasing the amount of revenue generated by the property. (Economic impacts can occur not only from lost taxes but also from money spent in the community to maintain the property, the equipment necessary, and possible wages to individuals working on the property)

- Develop a multi-use land management plan that is consistent with Okanogan County's Comprehensive Plan.

- Incorporate the cost to implement the Land Management Plan (Okanogan County planning division) when requesting funds for the land purchase.

- Implement the Land Management Plan.

The Board also wishes to point out that social and economic impacts occur to rural school districts (decreasing enrollment), hospitals, and to downtown businesses as a result of poorly developed and implemented land acquisition or easement policy. Typically, removing land from private ownership creates nuisances such as noxious weed control and fire danger, often derived due to the lack of proper land management.

With the numerous economic impacts from permanently removing private properties from the County's tax base as well as the increasing disturbance to the County's culture, the Board strongly recommends that other actions other than land acquisition occur to assist in the mitigation of impacts to fish and wildlife (Okanogan County Commissioners, pers. communication).

3 Subbasin Assessment

3.1 Subbasin Overview

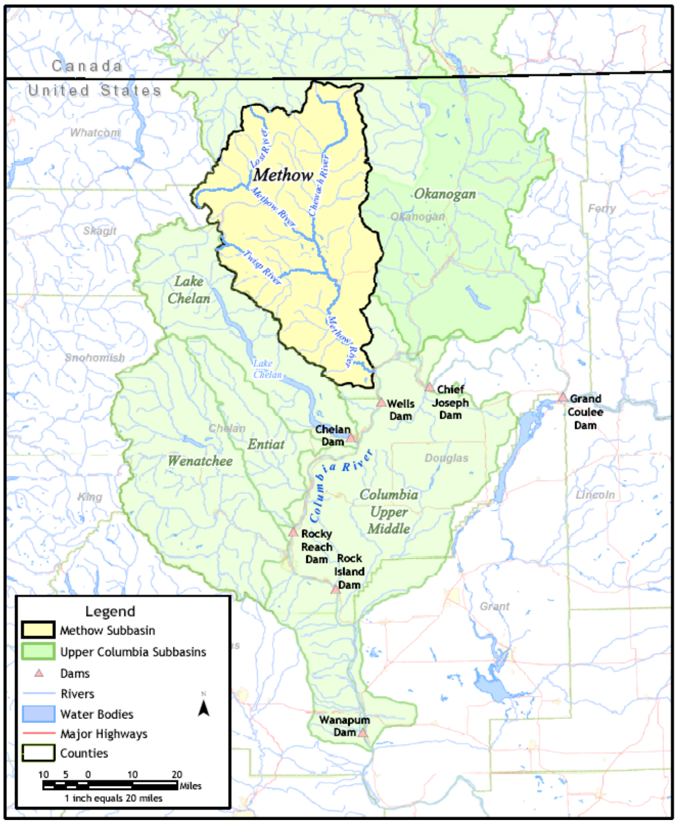
The Methow subbasin is located in north central Washington and lies entirely within Okanogan County. The subbasin comprises 12.7% of the Columbia Cascade Ecoprovince (CCP) and consists of 1,167,764 acres (1,825 $mile^2$) (**Table 1**).

Table 1 Subbasin size relative to the Columbia Cascade Ecoprovince and Washington State

Subbasin	Size		Percent of Ecoprovince	Percent of State
	Acres	Mi^2		
Entiat	298,363	466	3.2	0.7
Lake Chelan	599,925	937	6.5	1.4
Wenatchee	851,894	1,333	9.3	2.0
Methow	1,167,795	1,825	12.7	2.8
Okanogan	1,490,079	2,328	16.2	3.5
U. Mid Mainstem Columbia River	1,607,740	2,512	17.5	3.8
Crab	3,159,052	4,936	34.4	7.4
Total (Ecoprovince)	9,174,848	14,337	100	21.6

(IBIS 2003)

The Methow subbasin is one of more than 20 major Columbia Basin subbasins (seven in the CCP), its confluence being at river mile 524 near Pateros in north central Washington. The valley spans 1,667,742 acres in the northwestern segment of Okanogan County.



The Methow subbasin is characterized by large tracts of relatively pristine habitat contrasted with a close association with the growing population of subbasin citizens. Less than 2% of the subbasin's land is irrigated. Six fish species and fourteen wildlife species are as Endangered, Threatened, or as Species of Concern within the Methow subbasin.

Data Layers: Watersheds & Dams (StreamNet, TRIM), Counties & Major Rivers (WA Ecology, TRIM), Major Highways (WashDOT, ESRI) Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 3 Location of Methow subbasin in relation to upper Columbia River dams and subbasins

Humans have occupied the region in and around the Methow Valley for at least 7,500 years. Ancestors of tribes that are presently part of the Yakama Nation and the Colville Tribes hunted, fished, and gathered food in the Methow subbasin area for thousands of years, and are an integral part of the heritage of the County and the Methow Valley subbasin.

Logging, mining, orcharding, farming, and grazing activities have played a substantial role in the Methow Valley for nearly a hundred years. Timber operations in the Methow watershed played an important role in the subbasin's economy through the 1980s. Activities related to timber harvest take place in the middle and upper reaches of the watershed.

Introduction of unlined irrigation agricultural canals to the Methow subbasin occurred in the 1800s as ranchers and farmers discovered that an irrigation system was required to supply consistent water for crops and livestock. The height of farming and ranching occurred in the Methow subbasin between 1940 and 1968 when 20,240 acres of land were irrigated from unlined surface diversions. Today, about 17,000 acres are under irrigation, and many of the subbasin farmers raise fresh fruit and vegetables to sell locally at the farmer's market, grocery stores and restaurants. (Methow Basin Watershed Plan, March 2004).

Farming and grazing are confined primarily to the lower and mid reaches of the subbasin. Orchards and small farms growing alfalfa and other irrigated crops constitute the majority of the subbasin's agricultural activities.

Recreation, tourism, and related development play an increasing role in the area's economy. The Methow Valley offers an extensive range of tourism- and recreational-related opportunities for the locals and tourists. Its natural setting is a destination for outdoor enthusiasts, and includes hundreds of miles of cross-country ski trails, snowmobile parks, and mountain biking, fishing, camping, and hiking areas. Dog sledding adventures, balloon rides, and llama pack tours are provided, along with many weekend get-a-way opportunities and accommodation options.

The Yakama Nation

The Yakama Nation has treaty rights to utilize Usual and Accustomed sites in the Methow subbasin. Those treaty rights give the Yakama Nation standing as a fish and wildlife co-manager under US vs. Oregon.

The Colville Tribes

The Methow Indians are a Plateau Salish people who speak a dialect of the Okanogan language very similar to the language of their close neighbors and relatives, the Entiat, Wenatchee, Okanogan and Columbia tribes.

The Methows historically relied on deer, elk, bear, mountain sheep, mountain goat, antelope, and many other animals in addition to roots, berries, and nuts for their traditional diet. The most important part of the traditional diet, however, consisted of large amounts of Pacific salmon including Chinook, sockeye, coho salmon and steelhead that were caught in the Methow River drainage and near the mouth of the river along the Columbia.

When the first European trappers arrived at the mouth of the Methow River in 1811, the Methows had at least ten villages stretching from the mouth of the river to the Chewuch. Small numbers of European trappers and travelers visited the region between 1811 and 1848 when the area became part of the United States. In 1855 the first Washington Territorial Governor, Isaac I. Stevens, attempted to involve the Methows in a treaty to cede their territory; however, the tribe chose not to participate.

The Methow tribe remained largely isolated from incoming settlers until the latter part of the 19th century, when their territory was encompassed in what was known as the Moses Columbia Reservation, a reservation set aside by executive orders of 1879 and 1880. As increasing numbers of settlers arrived, the United States negotiated an opening of the reservation amongst several Indian leaders (none of them Methow Indians).

In 1886, the reservation was opened to non-Indian settlement, and the Methows were promised a choice between taking allotments near where they lived and moving to the Colville Reservation. However, only the Methows near the mouth of the river were given the option, and almost all Methows eventually moved to the Colville Reserve where they became a constituent member of the Colville Tribes, the continuing legal representative of the tribes.

Almost all of the Methow Indian allotments in the Methow Valley were lost to non-Indians in ensuing years, and today only a few hundred acres within the Methow subbasin continue to be held in trust for the Methows of the Colville Indian Reservation. Descendents of the Methows, however, continue to hunt, gather, and fish for salmon in their usual and accustomed places, and Methows continue to assert a right to fish for salmon in their ancient ancestral lands.

Jurisdictional Authorities

Private land holdings within the Methow subbasin comprise roughly 15% of the total land. The remainder is managed by the US Forest Service (**Table 2**).

Table 2 Land ownership in the Methow Subbasin

Methow Subbasin	Federal Lands	Tribal Lands	State Lands	Local Gov't Lands	Private Lands	Water	Total (Subbasin)
Area in Acres	985,234	0	55,836	0	126,724	0	1,167,794

Source: IBIS, 2003

Over 80% of all of the lands in the watershed are managed by the U.S. Forest Service (USFS) (Methow Valley Water Pilot Planning Project Planning Committee 1994). The Pasayten Wilderness bounds the upper northern reaches of the Methow watershed, and the Lake Chelan-Sawtooth Wilderness sits along the southwest rim of the basin. Both areas range from over 5,000 feet in elevation to peaks approaching 9,000 feet, and are managed as wilderness ecosystem reserves and wildlife habitat; activities include non-motorized recreation as well as limited mining and grazing activity.

The remainder of the USFS-managed land lies in the Okanogan National Forest, and is managed for multiple use, including commercial logging, cattle grazing, mining, wildlife habitat, and recreation (Methow Valley Water Pilot Planning Project Planning Committee 1994).

The Federal Bureau of Land Management (BLM) manages approximately 1% of the land in the subbasin. BLM land consists mainly of mixed forest and grassland, and is used for commercial logging, grazing and recreation.

The State of Washington manages 5% of the land in the basin. Of this State land, 51% is managed by DNR, and 49% is managed by WDFW. Department of Natural Resources (DNR) manages their land for timber harvest, wildlife habitat, recreation, and grazing. The WDFW lands comprise the Methow Wildlife Area, which is managed for wildlife habitat, recreation, and grazing (Methow Valley Water Pilot Planning Project Planning Committee 1994).

The DNR manages more than 5 million acres of forest, range, agricultural, and aquatic lands. These lands produce income to support state services and to provide other public benefits. Nearly 3 million acres are state trust lands, most of which were given to Washington at statehood by the federal government.

Population and Growth Management

At present, approximately 5,000 people live within the 1,890 square mile Methow subbasin (2000 Census; Washington State Office of Financial Management). The population of major subbasin counties is summarized in **Table 3**.

Between 1990 and 2000, the population of Winthrop increased by 27.5% to reach its current population of approximately 385 people, and the town of Twisp had a population increase of about 13.5%, and Pateros experienced a population gain of 11.4% (Washington State Office of Financial Management).

The populations of unincorporated towns, including Carlson, Mazama, and Methow are unavailable. The County of Okanogan, including the Methow Valley, has a population density of 7.52 persons/mile^2.

Most of the population is concentrated on private lands within and near the towns of Pateros, Twisp, and Winthrop, and the unincorporated areas of Carlton, Mazama, and Methow. The unincorporated total is the tract population minus populations of Twisp and Winthrop that are already included.

Table 3 Population of major Methow subbasin counties (1990-2000)

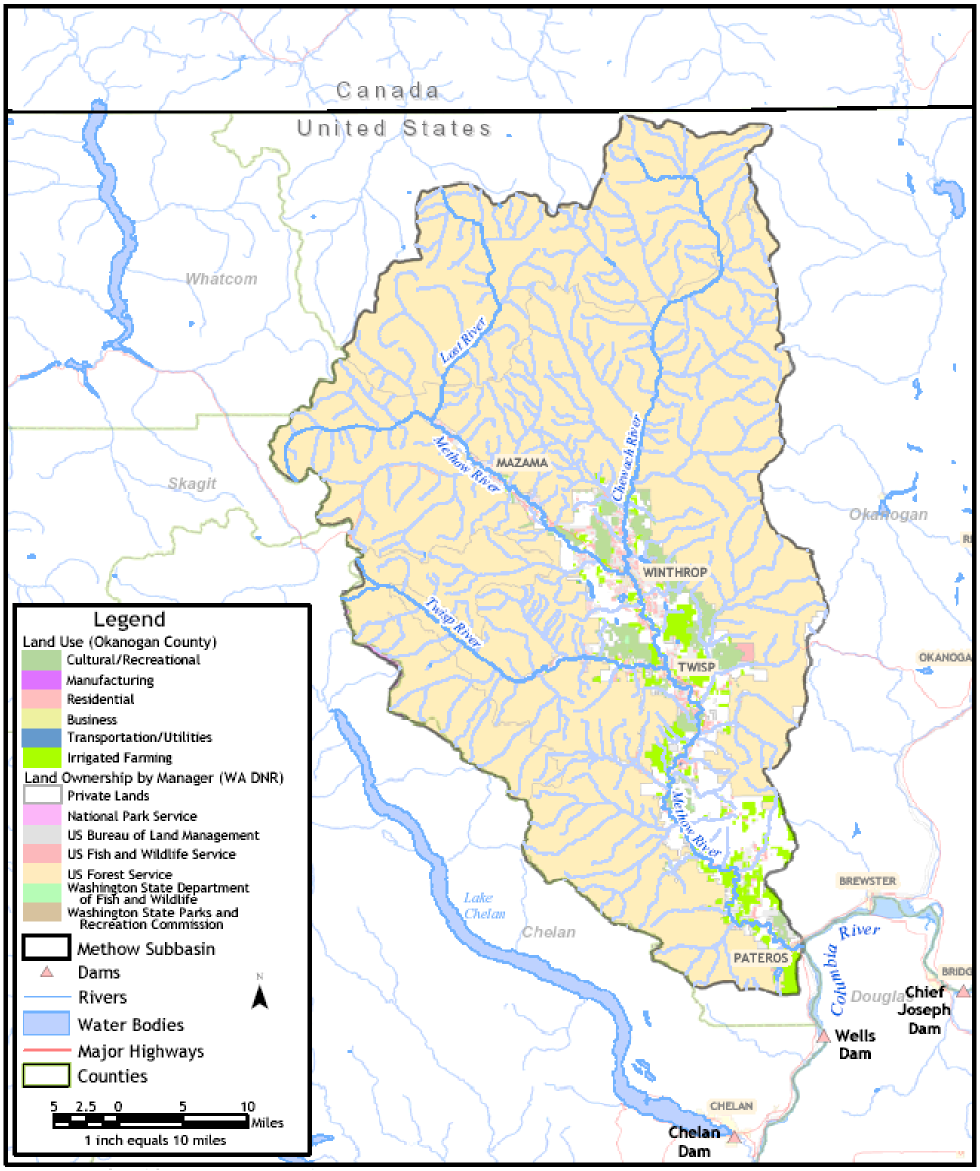
Methow Valley Subbasin	1990 Population	2000 Population	Area (mi^2)	People/mi^2	Population/mi^2
Carlton	332	567		0-15	
Mazama	115	96		0-15	
Methow	623	262		0-15	
Pateros	570	643	0.51	17-40	1261.8
Twisp	872	938	1.16	0-15	899.8
Winthrop	302	349	0.88	0-15	400.7
Methow Subbasin Total		5384			
Unincorporated Total		4097			

Source:U.S. Census Tracts ID #9709 - #9710, Washington State Office of Financial Management)

Agriculture

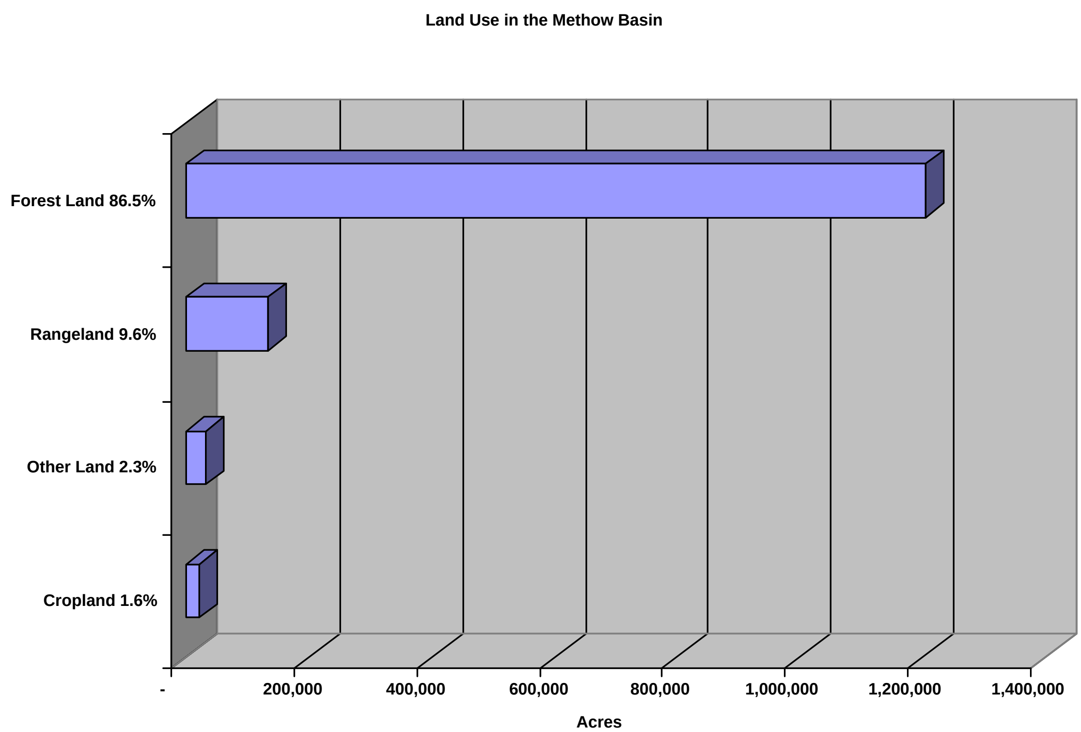
Land use includes significant rangelands, crops, and other uses (**Figure 4** and **Figure 5**) Roughly 12,800 acres of the Methow basin is cultivated (Methow Valley Water Pilot Planning Project Planning Committee 1994). Orchards and small farms growing alfalfa and other irrigated crops constitute the majority of the subbasin's agricultural activities.

Farming and grazing are confined primarily to the lower and mid reaches of the subbasin.



Data Layers: Land Use (Okanogan County, WA DNR), Subbasins and Dams (StreamNet), Counties & Major Rivers (WA Ecology), State Routes (WashDOT).
Projection: Washington State Plane North Zone NAD83.
Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 4 Land use in the Methow Subbasin



Source: PNWRBC 1977a

Figure 5 Land use in the Methow Subbasin

It is noted, however, that not all agricultural activities result in negative impacts to fish and wildlife and their habitats. As such, each situation should be evaluated on an individual-by-individual basis. Additionally, in the U.S. portion of the Okanogan subbasin, land being converted to agriculture is not occurring at previously reported rates. In fact, agriculture as a whole is declining in the US portion of the Okanogan subbasin. In Canada, conversion of land to agriculture is occurring at an increasing rate over the past decade. (J. Dagnon 2004, pers. comm.)

Forest practices

Timber operations in the Methow watershed played an important role in the subbasin's economy through the 1980s. Years of logging have contributed to high road densities in some portions of the watershed. Timber has been harvested extensively from the Beaver Creek drainage since the 1960s (USFS 2000a).

Currently, DNR protects 12 million private and state-owned forested acres from wildfire. DNR administers Forest Practices Board rules on 12 million forested acres.

Mining

Mining activity in the Methow subbasin is currently minimal; however, historically, mining was prevalent in the subbasin.

Transportation

County roads and state highways parallel both sides of the Methow River along its entire length within the subwatershed. Road densities within the Beaver Creek drainage of the subwatershed are the highest in the Methow watershed with 41% of the drainage having road densities of 2.1 to 5 miles/mile^2 (USFS 1997).

Topographic / Physiogeographic Environment

Topography within the subbasin ranges from mountainous sub-alpine and alpine terrain along the Cascade Crest to the gently sloping wide valley found along the middle reaches of the Methow River. Elevation varies from over 8,500 feet in the headwaters of the basin along the crest of the Cascade Mountains, to approximately 800 feet at the confluence of the Methow and Columbia Rivers. Topographic features in and adjacent to the Methow Valley provide evidence of both alpine and continental ice-sheet types of glaciation (Waitt 1972 in NPPC 2002).

The western upper reaches of the Methow watershed carve deeply into the Cascade Crest's peaks. Avalanche chutes, knife-edge ridges, and cirques typify the upper elevations of the watershed following the crest. The upper Methow River valley is a U-shaped, glaciated intermountain valley. The valley margins are bounded by bedrock uplands that rise steeply, and at some locations, nearly vertically, from the valley floor to elevations over 5,000 feet.

The elevation of the valley floor within the upper valley varies from approximately 2,600 feet above Lost River to about 1,765 feet at Winthrop, a distance of roughly 21 miles. The valley floor from Lost River to Winthrop ranges between 0.5 mile to 1.5 miles wide, and consists of irregular terraces, alluvial fans, and floodplain meadows. From Winthrop downstream to the town of Twisp, the valley opens out and the slope decreases to approximately 17.0 feet/river mile (Okanogan County 1996 in NPPC 2002).

Roughly 50 to 65 million years ago, the North Cascade subcontinent docked against the Okanogan subcontinent. As the two continents collided, numerous north-to-south faults formed throughout the region that presently includes the Methow subbasin. The dominant tectonic feature distinguishing the area is the Tertiary Methow-Pasayten Graben. Over millions of years, repeated occurrences of folding transformed and redefined the Methow-Pasayten Graben, with at least four distinct episodes culminating in the present geologic composition of the region (Barksdale 1975 in NPPC 2002).

The resulting bedrock geology of the Methow Valley area is characterized by folded Mesozoic sediments and volcanic rocks down-faulted between crystalline blocks. The sediment strata include varieties of sandstones, shales, siltstones, conglomerates, and andesitic flows, breccias and tuffs. The crystalline rocks include various granitic types, igneous intrusive rocks, and high-grade metamorphic types, including gneiss, marble, and schist (Barksdale 1975 in NPPC 2002).

The valley's bedrock is overlain with a thick sequence of highly permeable unconsolidated sediment composed of pumice, ash, alluvium and glacial outwash. The majority of the subbasin's aquifers rest within this unconsolidated sediment layer, confined from below by the relative impermeability of the underlying bedrock (EMCON 1993 in NPPC 2002). Quartz and feldspar are the dominant minerals in the silt and sand fractions of sediment from the Methow River.

Soils

Methow valley soils are generally coarsely textured compositions of glacial till. The primary constituent materials are granitic, volcanic, and sedimentary (**Figure 6**). Unconsolidated materials including glacial drift, pumice and ash deposits, and alluvial plain and fan deposits, are also present. (EMCON 1973). The valley's topsoil generally consists of sandy loams with permeability ranges between 2.0 to 6.0 inches/hour.

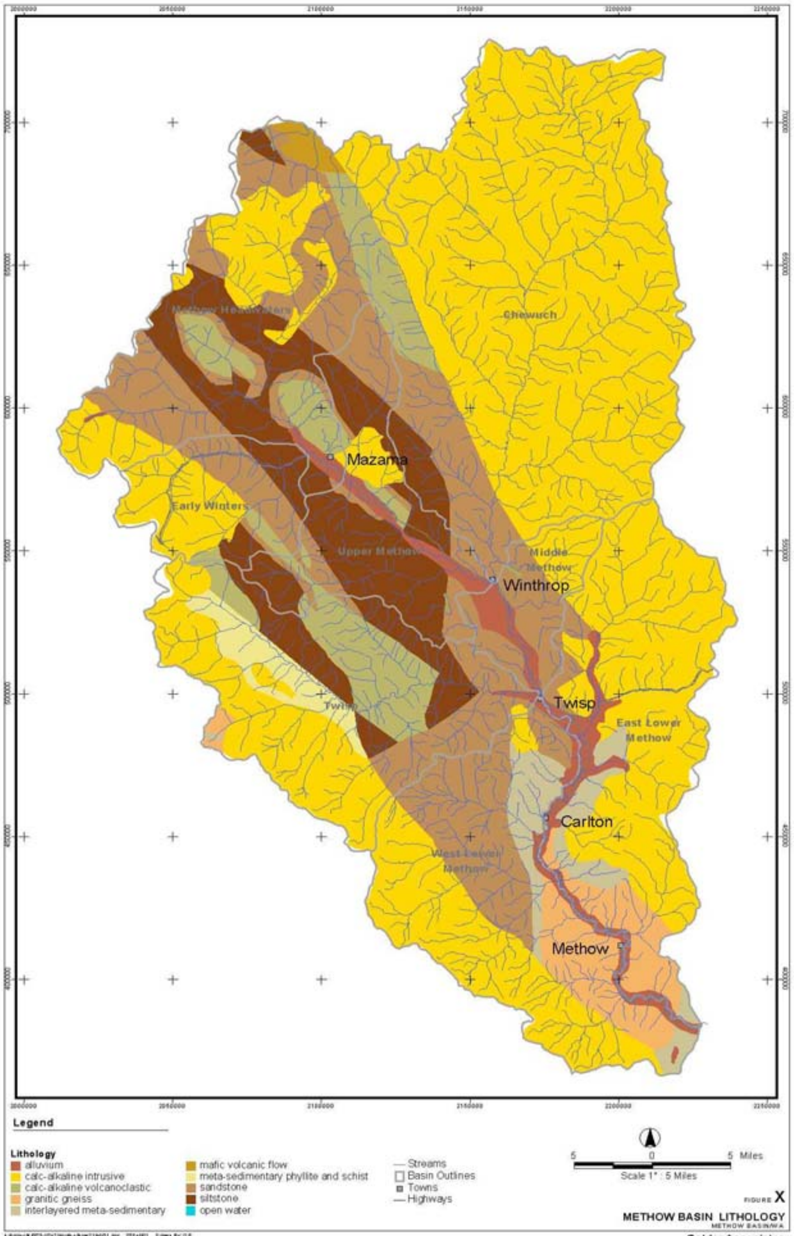


Figure 6 Methow subbasin lithology

Underneath these topsoils lie alluvium and glacial outwash materials that exhibit permeability greater than 6 inches/hour (Waitt 1972). In some areas of the valley, relatively non-porous layers of soils with permeability less than .01 inches/hour lie between the layers of alluvium (Waitt 1972).

Climate and Weather

The Methow subbasin's climate is influenced by maritime weather patterns, elevation, topography, and its location on the leeward side of the Cascade Mountains. Pacific storms driven by prevailing westerly winds are routinely interrupted by the Cascade Mountains, dropping heavy precipitation throughout the upper elevations. Precipitation falls off significantly as elevation decreases and as the distance from the Cascade Crest increases. Continental weather patterns insinuate themselves periodically throughout the winter months, forcing blasts of cold air masses southward from Canada.

The mean annual precipitation in the Methow subbasin is shown in **Figure 7**. Nearly two-thirds of the watershed's annual precipitation occurs between October and March, arriving primarily as snow. In the summer, long spells of hot, dry weather are punctuated by intense, but short-lived, thunderstorms. Fall brings increased precipitation that generally climaxes as winter snowfall between December and February. Snow usually blankets the ground from December through February at lower elevations, while at higher elevations, snow cover lingers from October through June. The upper reaches of the watershed along the Cascade Crest (at elevations of approximately 8,600 feet) receive as much as 80 inches of precipitation a year. This drops to about 60 inches in adjacent upland areas, while the town of Pateros (800 feet), at the far southern end of the subbasin, receives only about 10 inches of precipitation annually (Richardson 1976).

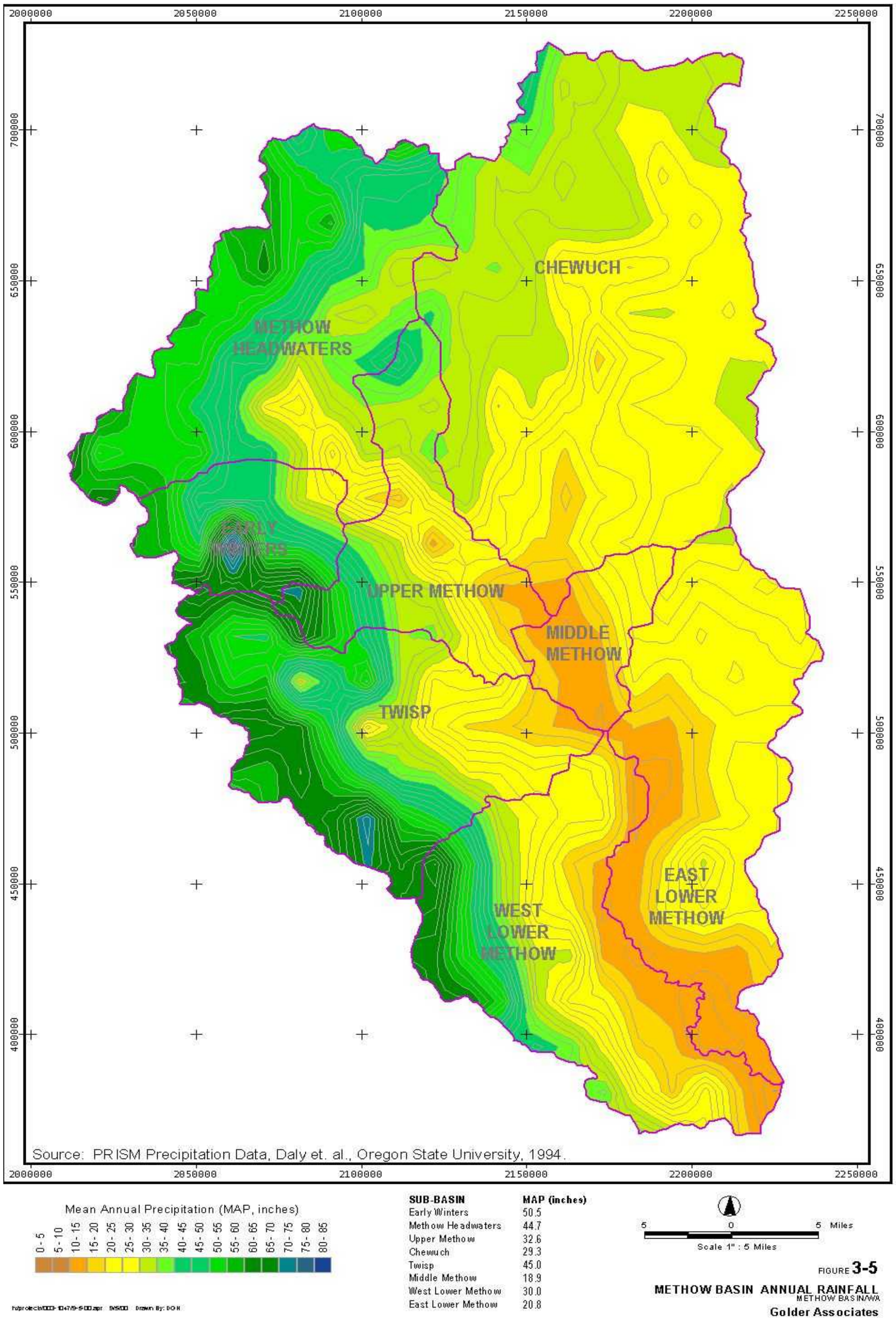
The Methow subbasin falls within the coldest of twenty-four western climate zones. The watershed is at the same latitude as Duluth, Minnesota, and Bangor, Maine. Additionally, temperatures within the basin are dictated by the fact that mean elevation within the basin is roughly a mile above sea level.

Winter low temperatures in the Methow range down to –35° F, with a monthly mean January temperatures, between 1970 and 1990 at Mazama, of 8.6° F. Average maximum temperatures in August for the upper watershed elevations range from 60° F to 70° F, with occasional highs up to 80° F. At lower elevations, August high temperatures range from 80° F to 95° F, with temperatures occasionally exceeding 100° F.

Water Resources

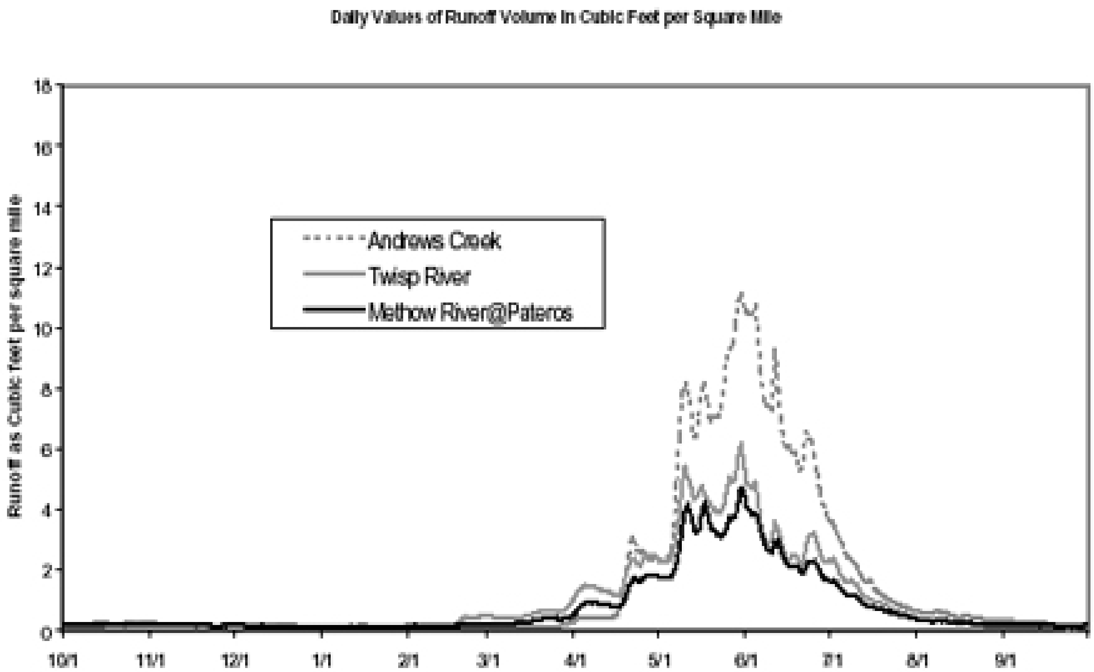
Hydrography and Watersheds

The Methow River near Pateros has a long-term mean discharge rate of 1600 cfs (45 m^3/s), or a mean annual yield of 1.2 x 106 acre-foot/year (1400 x 106 m^3/yr). Average annual runoff from the Methow basin is 12 inches (Figure 8).



Source: Golder and Associates 2003

Figure 7 Mean annual precipitation in the Methow subbasin



Source: Draft Methow River Basin Plan, 1994.

Figure 8 Daily values of runoff volume in cubic feet/mile^2

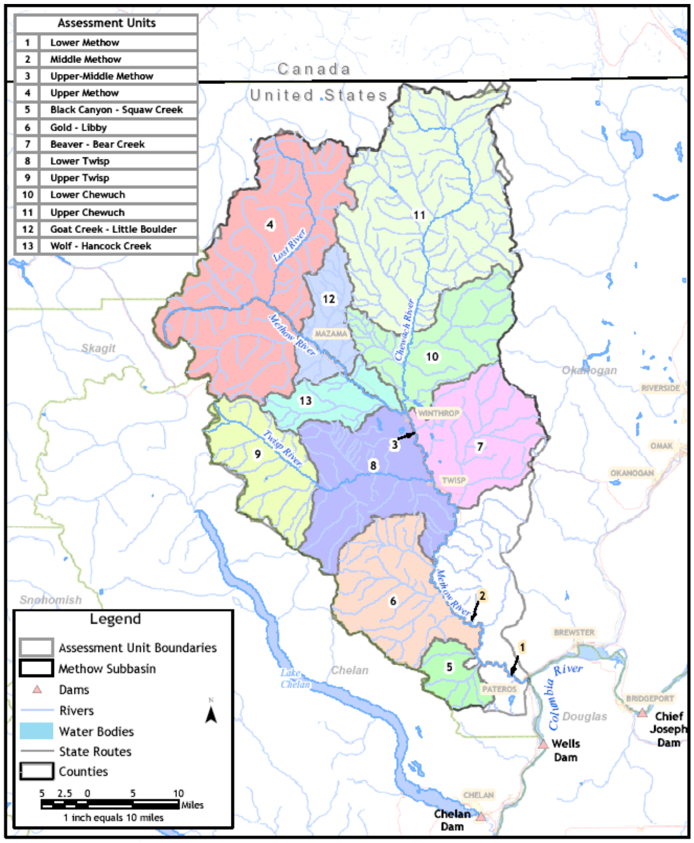
Snowmelt from the upper elevations of the Methow basin in spring and early summer generates most of the runoff in the basin, with 44-71% of the annual runoff volume occurring during May and June. Annual peak discharge occurs during May and June, as well, with the flood of record occurring on May 29, 1948 (Kimbrough et al. 2001).

The timing of spring snowmelt is triggered by a combination of seasonal temperature changes and elevation. Low summer precipitation, higher temperatures, and declining snow pack contribute to receding stream flow beginning in July and continuing through September.

The lowest stream flows occur in mid-winter (December to February) and early autumn (September) when stream flow is primarily the result of groundwater discharge, supplemented to a limited extent by snowmelt and storm runoff. During these periods, surface flow ceases in some streams and along reaches of rivers where stream flow is lost to groundwater, though the relationship between surface and ground water in the Methow subbasin is not fully understood.

Drainage Area

The Methow River drains an area of approximately 1,890 mile^2 (about 1,193,933 acres) (Golder 1993; Methow Valley Water Pilot Planning Project Planning Committee 1994; CRITFC 1995). The Methow River subbasin has seven primary subwatersheds (**Figure 9**): the Upper Methow River, Lost River, Early Winters Creek, Chewuch River, Middle Methow River, Twisp River, and Lower Methow River.



Data Layers: Assessment Units (TTFWI), Subbasins and Dams (StreamNet),
Counties & Major Rivers (WA Ecology), State Routes (WashDOT).
Projection: Washington State Plane North Zone NAD83.
Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 9 The Methow subbasin and primary subwatersheds

The Lost River subwatershed is aligned from north to south. At 107,400 acres, this subwatershed makes up roughly 9% of the Methow subbasin's total acres. Nearly 95% of that land lies within the Pasayten Wilderness. Descending steeply from its nearly pristine headwaters at elevations close to 6,900 feet, Lost River flows roughly 22.5 miles before joining the Methow River (RM 73.0) about six miles upstream from the Early Winters Creek confluence at about 2,600 feet (USFS 1999c). The main creeks and streams are shown in **Table 4**. No towns are located within this drainage.

Table 4 Creeks and streams within the Lost River Subwatershed

Lost River Subwatershed (107,400 acres)		
Drake Creek	Monument Creek	Eureka Creek

The Upper Methow River subwatershed drains an area of approximately 322,385 acres. It is the second largest subwatershed within the Methow subbasin, comprising approximately 27% of the total basin's drainage. Included within this region is the upper Methow River from its headwaters (RM 73.0) downstream to the Chewuch River's confluence (RM 50.1), with the Methow at the town of Winthrop.

Tower Mountain (elevation 8,844 feet), Mt. Hardy (8,880 feet) and Hart's Pass (6,178 feet) rim the upper edges of the Methow's headwaters along the slopes of the Cascade Crest. This stretch of the Methow takes in approximately 35 river miles from the headwaters to the southern tip of the subwatershed at town of Winthrop (1,760 feet). The town of Mazama also lies within the subwatershed about 1.5 miles upstream from Goat Creek's confluence with the Methow River.

The upper reaches of the Methow are shown in **Table 5**. The main tributaries within this drainage, Goat Creek and Wolf Creek, flow through relatively high gradient gorges and steep valleys. The river begins to meander and braid below the Goat Creek confluence where the river's gradient is much lower (approximately 0.37%, a drop of 264 feet in 13.4 miles).

Table 5 Creeks and streams within the Upper Methow River Subwatershed

The Upper Methow River Subwatershed (322,385 acres)		
Brush Creek	Trout Creek	Rattlesnake Creek
Robinson Creek	Gate Creek	Little Boulder Creek
Goat Creek	Fawn Creek	Hancock Creek
Wolf Creek	Little Falls Creek	

The Early Winters Creek drains a north-to-south oriented watershed of some 51,548 acres. The drainage, which is capped by North Gardner Mountain (8974 feet) and Cutthroat Peak (7046 feet), comprises nearly 4% of the entire Methow subbasin (USFS 1996a).

The mainstem originates near Liberty Bell Peak at 6,500 feet, and drops approximately 4,360 feet over the course of 15.7 miles before meeting the Methow River (RM 67.3) some 3.5 miles upstream from the town of Mazama. The drainage's headwaters are defined by cirques and glaciated head walls, which in turn give way to U-shaped glacial valleys and then to valley bottoms lined with glacial till. An impassable waterfall exits at RM 8 of Early Winters Creek. The main tributaries to Early Winters Creek are shown in **Table 6**. There are no towns located within the Early Winters subwatershed.

Table 6 Creeks and streams within the Early Winters Subwatershed

Early Winters Subwatershed (51,548 acres)		
Varden Creek	Cedar Creek	

The Chewuch River drainage is the largest subwatershed within the Methow subbasin. The Chewuch empties a 340,000-acre basin over the course of its 44.8-mile north-to-south journey from its headwaters to its mouth at the town of Winthrop (1,700 feet) (USFS 2000c).

Nearly 108,000 acres (34%) of the subwatershed's northern and western reaches sit within the Pasayten Wilderness. Cathedral Peak (8,601 feet), Windy Peak (8,331feet), and Andrew Peak (8301 feet) stud the subwatershed's defining crest. The U-shaped valley, in the upper reaches of the Chewuch drainage, features dramatically steep slopes often in excess of 60-70%. Upstream migration routes, along the uppermost reaches of all of the Chewuch's tributaries, are blocked by naturally occurring impediments, including waterfalls and steep gradients. The main tributaries to the Chewuch River are shown in **Table 7**.

Table 7 Creeks and streams of note within the Chewuch River Subwatershed

Chewuch River Subwatershed (340,000 acres)		
Dog Creek	Thirtymile Creek	Andrews Creek
Lake Creek	Twentymile Creek	Falls Creek
Eightmile Creek	Cub Creek	Boulder Creek

The Middle Methow River subwatershed contains 15,600 acres (about 1% of the subbasin total). This subwatershed includes the mainstem Methow River from its confluence with the Chewuch River at Winthrop (1,700 feet) downstream to the town of Carlton (1,420 feet), a distance of approximately 23 river miles.

In the lowest reaches of this subwatershed, the river meanders at a low gradient through a floodplain that is largely confined.

The main tributaries to the Middle Methow are shown in **Table 8**.

Table 8 Creeks and streams within the Middle Methow River Subwatershed

Middle Methow River Subwatershed (15,600 acres)		
Bear Creek	Alder Creek	Beaver Creek
Blue Buck Creek	Frazer Creek	Benson Creek

The Twisp River drains a subwatershed of roughly 157,000 acres, comprising approximately 13% of the Methow subbasin. Extending about 28 river miles from its headwaters in the Lake Chelan-Sawtooth Wilderness to its mouth, the river flows generally from east to west before joining the Methow River at the town of Twisp (RM 40.2).

Nearly half of the subwatershed is part of the Lake Chelan-Sawtooth Wilderness, and the upper fringe is ringed by multiple peaks and razor ridges, including Star Peak (8,680 feet) and Gilbert Mountain (8,023 feet). From these steep headwaters, the Twisp descends to an elevation of 1,600 feet at its confluence with the Methow River. In the upper reaches, natural falls block migration passage along some tributaries. Within its lower reaches, the Twisp River follows a low-gradient meander through a floodplain that is somewhat confined. The main tributaries to the Twisp River are shown in **Table 9**.

Table 9 Creeks and streams within the Twisp River Subwatershed (listed from upstream to downstream reading across the table)

Twisp River Subwatershed (157,000 acres)		
North Creek	South Creek	Reynolds Creek
Eagle Creek	War Creek	Buttermilk Creek
Canyon Creek	Little Bridge Creek	Newby Creek
Poorman Creek		

The Lower Methow River subwatershed includes a low gradient, 27-mile stretch of the Methow, starting at the town of Carlton and flowing northwest to southwest towards the town of Pateros. The least studied of the basin's subwatersheds (WSCC 2000), this area includes about 200,000 acres, with the majority of those contained in the Okanogan National Forest.

A small portion of the subwatershed falls within the Lake Chelan-Sawtooth Wilderness. Elevation ranges from 8,646 feet at Hoodoo Peak to 800 feet at the confluence of the Methow and Columbia Rivers (USFS 1999a). The upper valley is about a mile wide, narrowing in the lower reaches to less than a half-mile (USFS 1999a). State Highway 153 parallels and laces the entire stretch of the Methow River in this reach, crossing the river seven times between the towns of Methow and Carlton. The main tributaries to the Lower Methow are shown in **Table 10**.

Table 10 Creeks and streams within the Lower Methow River Subwatershed

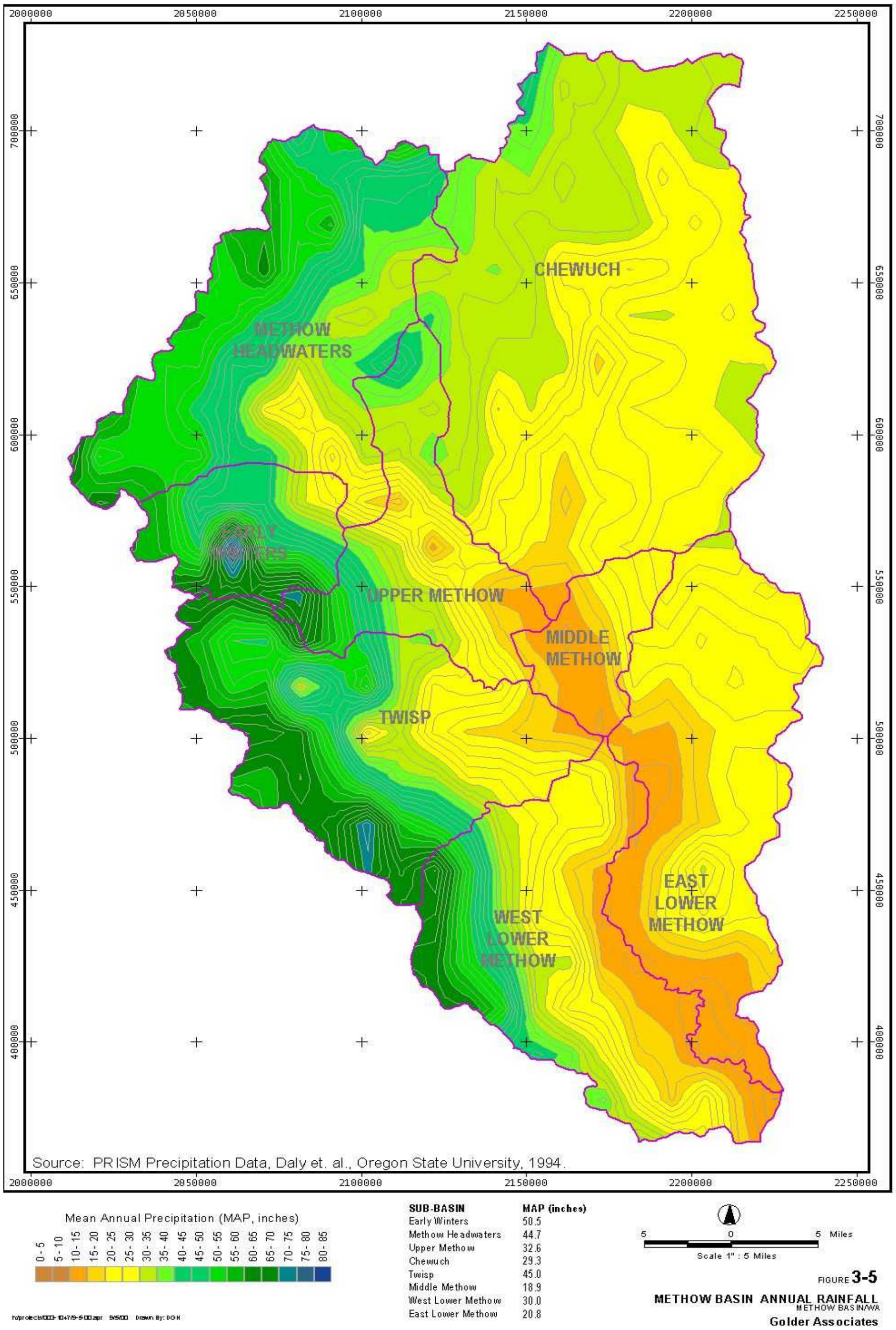
Lower Methow River Subwatershed (200,000 acres)		
Texas Creek	Libby Creek	Gold Creek
McFarland Creek	French Creek	Black Canyon Creek

Hydrologic regimes

The U.S. Geological Survey (USGS) has been collecting stream flow and other hydrologic data, and investigating water resource issues in the Methow River basin since the early 20th century. The USGS operates a network of 15 continuous stream flow gauges in the Methow River basin including eight "real-time" stations that transmit current stream flow information to the USGS's web-accessible database, the National Water Information System. The gauging network extends from the main tributaries of the Methow River to a series of gauges along the mainstem. The stream gauge at Andrews Creek serves as one of the Nation's hydrologic benchmark stations, which provide information on stream flow from basins with limited human influences.

Water resources are important to the residents and ecosystems of the Methow subbasin. People depend on reliable, high-quality water supplies for their domestic and agricultural uses, and aquatic organisms depend on stream flow from snowmelt and groundwater discharge to survive in an otherwise arid environment.

To improve the understanding of the quantity and quality of water resources of the Methow subbasin both spatially and temporally, it is important that hydrologic data are collected throughout the basin over periods spanning a range of climatic conditions. Long-term hydrologic data have been collected at some points in the basin, but generally, the information is limited. Annual precipitation varies from 10 inches annually in the valley bottom, to 70 inches annually in the valley headwaters (**Figure 10**).



Source: Golder Associates, 2001

Figure 10 Annual precipitation in the Methow subbasin

Hydrologic data of interest include long-term records of stream flow discharge, temperature, and sediment loading, irrigation diversions and application rates, and groundwater levels in the unconsolidated sediments of the basin. Currently, an extensive network of 27 stream flow gauges is operated in the Methow River Basin.

Except for seven USGS gauges that have been in operation for more than a decade, most of these gauges have been in operation for about one year. Once continuous records of hydrologic conditions have been measured throughout the basin over a period spanning wet and dry years, the records can be evaluated to determine whether some stations indicate broader conditions and, thus, provide the core physical information for a water resources management system.

The “natural-flow” watershed model in the Methow subbasin needs to be updated by including the effects of diversions. Currently no watershed management tool exists for the Methow River subbasin to estimate the cumulative effects of natural variability in stream flow and irrigation diversions and returns. The USGS recently completed a watershed model that can be used to estimate natural stream flows; however, it needs to be improved by incorporating newly collected data, and by simulating irrigation diversions and returns.

Leaking irrigation canals may return some of the diverted river water to the groundwater system. The valley-fill groundwater system is connected to streams and contributes groundwater discharge to stream flow along selected stream reaches. Increased groundwater levels that may result from leaking irrigation canals may increase groundwater contributions to stream flow.

To date, the timing and amount of the possible increase in groundwater contributions to stream flow are not known. In a current study, the USGS has instrumented part of the Twisp subwatershed to investigate the groundwater/surface-water interactions in the Twisp River. Data have been collected since the beginning of the 2001 irrigation season, and will be analyzed later in 2001 and 2002. Continued data collection in the existing study area and, potentially, other areas of the basin, would improve estimates of irrigation canal leakage and groundwater discharge to streams, particularly during non-drought years.

Forest management, including tree harvesting, road building, and fires, alter the density and type of vegetation in parts of the Methow River Basin. Cumulative effects of these land use changes may affect the accumulation and melting of the snowpack, snowmelt, and rainfall runoff patterns, and soil erosion.

Changing land use may affect stream flow temperatures by changing the quantity and timing of stream flow and by changing the degree of shading from vegetation. If stream flow temperatures are changed significantly from natural conditions, habitat may be less favorable for salmonids. Currently, no modeling has taken place in the Methow River subbasin to predict the effect of land use practices on stream flow temperatures.

Bank protection and flood control projects in the Methow River Basin have modified the development and maintenance of floodplain and off-channel habitat for salmonids.

Impoundments and Irrigation Projects

Figure 11 shows the major streams, dams, and irrigation projects for the Methow. There is currently no hydropower development within the Methow subbasin. A hydroelectric project constructed by Washington Water Power (thought to have been in 1911) blocked fish passage in the Methow River at Pateros until its removal in 1929. The dam blocked all fish passage during those years and by the time it was removed, the Methow River run of coho was extinct, and runs of spring and summer Chinook, as well as steelhead, were severely depressed.

The confluence of the Methow River is located at RM 523.9 of the Columbia River. Today, anadromous fish, migrating to the ocean, encounter Wells Dam just downstream from the Methow's confluence with the Columbia River. Beyond Wells Dam, eight more downstream dams along the Columbia River impede fish passage to the ocean.

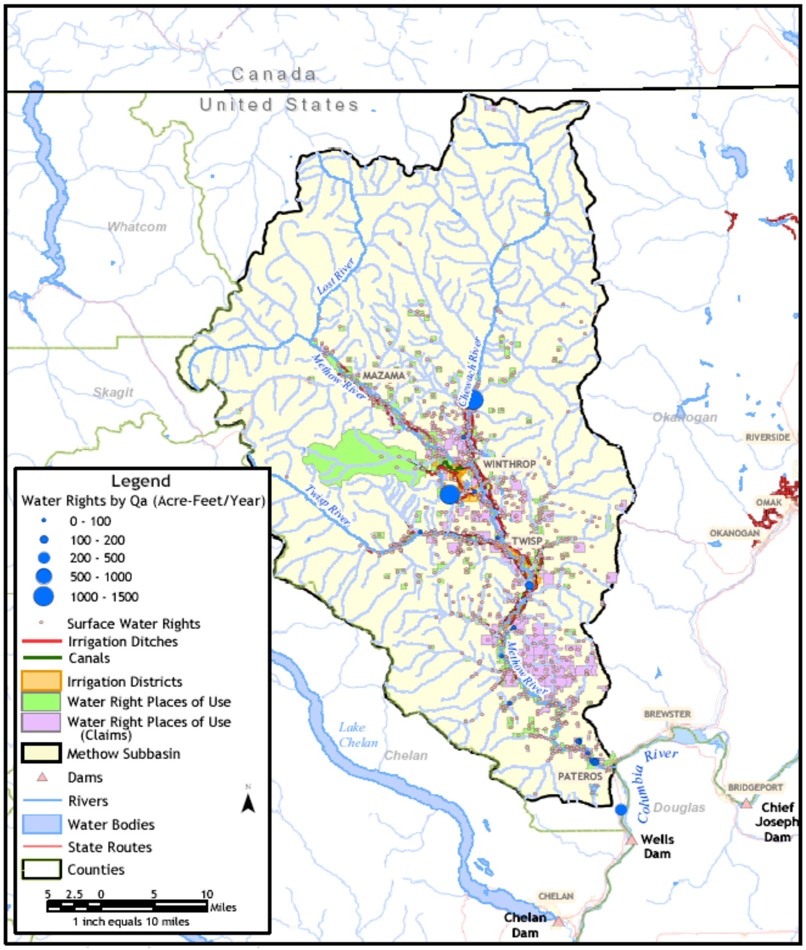


Figure 11 Major streams, dams, irrigation projects, for the Methow subbasin

There are currently two irrigation districts within the Methow subbasin; these are the Wolf Creek Reclamation District and the Methow Valley Irrigation District. All other irrigation ditches in the Methow subbasin are privately owned by their shareholders.

Historically, the majority of irrigation within the basin was delivered through a network of unlined ditches. Currently there are at least 27 irrigation canals operated by both public and private entities in the Methow subbasin (**Table 11**).

Table 11 Preliminary Methow subbasin Irrigation Canal Inventory

Ditch Name	Subwatershed	Estimated Length (Miles)	Estimated Flow (cfs)
Aspen Meadows	Twisp	2	1.3
Barkley	Middle Methow	4.2	18
Beaver	Lower Methow	NA	NA
Black Canyon	Lower Methow	NA	NA
Buttermilk	Twisp	1.2	7
Chewuch	Chewuch	12	28
Culbertson	Twisp	7000' ~1.5 miles	1
Early Winters	Upper Methow	5	12
Eightmile	Chewuch	0.1	1.6 - 2.2
Foghorn	Middle Methow	5.4	18
Foster	Beaver	1200' .0227 miles	1.2 - 3.5
Fulton	Chewuch	4	22
Gold Ck - Campbell	Lower Methow	NA	NA
Gold Ck - Krevlin	Lower Methow	NA	NA
Gold Ck - Umberger	Lower Methow	NA	NA
Hottell	Twisp	0.2	1.3 max
Kumm-Holloway	Upper Methow	2.24	4.7
Libby/ Larson	Lower Methow	NA	none
Mason	Chewuch	600'	0.5
McFarland Creek	Lower Methow	NA	NA
McKinney Mountain	Upper Methow	3.8	6 - 10 cfs
MVID East	Middle and Lower Methow	15.5	21
MVID West	Twisp and Lower Methow	12.5	20
Rockview	Chewuch	5	
Skyline	Chewuch	6.2	26
Twisp Power (TVPI)	Twisp	4	9
Wolf Creek	Middle Methow	5	<16

Many of the irrigation systems within the Methow subbasin have upgraded their facilities in recent years. Those upgrades include, among others, elimination of fish passage barriers and replacement and repair of screens. The Methow Basin (WRIA 48) Watershed Plan (March 2004) discusses water use, including that for irrigation purposes.

Irrigation Districts

Methow Valley Irrigation District

The Methow Valley Irrigation District (MVID) was organized in the early 1900s to supply water for agricultural production. The MVID currently serves roughly 900 acres. MVID facilities comprise two main canals. The West Canal diverts water from the Twisp River, and the East Canal diverts water from the Methow River. The District's east canal also carries Barkley Ditch tail water. The district has installed temporary ESA-compliant screens at its points of diversion, and is expected to complete installation of permanent screens by the end of 2004.

Wolf Creek Reclamation District

Wolf Creek Reclamation District (WCRD) has operated since 1921. WCRD supplies water for approximately 790 acres of irrigated land, including the Methow Valley School District and irrigation and domestic supply for Sun Mountain Resort. Wolf Creek Reclamation District is authorized to divert surface waters from the Wolf Creek and Little Wolf Creek drainage. The diversion structure on Wolf Creek is located approximately four miles from the stream's confluence with the Methow River. Diverted water is stored for future use in Patterson Lake Reservoir. The water right is adjudicated, with irrigation and commercial domestic supply as designated beneficial uses. In 1980, WCRD began the process of lining and making other improvements to many of its ditches. The district is continuing to upgrade its delivery system, including lining many of the remaining unlined ditches, and replacing open ditches with pressurized piping where feasible. The district has also made, and continues to make, improvements to fish screens and to other potential fish passage barriers throughout its service area.

Methow Subbasin Ditches

The Chewuch Basin Council represents three ditches, the Skyline Ditch Company, the Chewuch Canal Company, and the Fulton Ditch Company, each of which operates as a distinct company.

The Skyline Ditch Company (SDC) has operated since approximately 1900. The SDC provides irrigation water for approximately 366 acres along the west side of the Chewuch River. The source of water is a surface water diversion located at approximately RM 7.5 of the Chewuch River. The SDC serves its users through a 6.0-mile delivery system. Historically, it was unlined earthen canal, but in 2003, a multi-year process was completed, and the system became completely line and piped, replacing the diversion headgate, and installing an approved screening facility to meet NMFS and WDFW requirements.

The Chewuch Canal Company (CCC) has operated since approximately 1910. The Chewuch provides irrigation water to support a variety of agricultural, recreational, and fish recovery projects within the Methow subbasin. The CCC's source of water is a surface water diversion at approximately RM 7.0 of the Chewuch River. The CCC has a separate storage reservoir permit for storage of irrigation water within Pearygin Lake. The CCC operates approximately 20 miles of surface canals, is currently completing an efficiency audit, and has upgraded their screening facility to meet NMFS and WDFW requirements.

The Fulton Ditch Company has been in operation since approximately 1909. Fulton Ditch Company provides water for irrigation users. The ditch's source of water is a surface diversion at approximately RM 0.8 of the Chewuch River. Fulton Ditch Company is currently completing an efficiency audit, has lined approximately 1,600 linear feet of their canals, and has installed approved fish screens to meet NMFS and WDFW requirements.

Some other ditches in the Methow subbasin (not part of the Chewuch Basin Council) include Aspen Meadows, Beaver, Black Canyon, Culbertson, Early Winters, Eightmile, Foghorn, Foster, Rockview, and Twisp Power.

Water and Habitat quality

The Methow River is listed on the State of Washington 303(d) list as exceeding water quality temperature criteria at the inflow to the Winthrop National Fish Hatchery, and as supporting inadequate instream flows because of periodic dewatering (1998 303[d] list). Dewatering just upstream of the Weeman Bridge on the Methow River, and dewatering in the Popular Flats Campground area of the Twisp River, are natural seasonal occurrences (Gorman 1899).

The Twisp River is listed on the 1998 Washington State 303(d) list for inadequate instream flow and for temperature exceedences, and Beaver Creek is listed on the Washington 303(d) list for inadequate instream flows.

3.2 Habitat Areas and Quality by Subwatershed

Lost River Subwatershed

Lost River empties into the Methow from the north at RM 73.0, roughly six miles above Early Winters' confluence. About 95% of the drainage lies within the Pasayten Wilderness. Human impact in this drainage is largely restricted to the river's lower mile. Spring Chinook salmon spawn in Lost River to the confluence with Eureka Creek. Summer steelhead spawn and rear in Lost River. Bull trout spawn and rear in Lost River, as well as in several of its tributaries.

Within the channel migration zone of the first river mile, the construction of roads and dikes associated with home developments has constrained floodplain function and the channel, potentially reducing pool quality and quantity, as well as side-channel habitat.

Some riparian habitat in the lower mile has been converted to residential development and pastureland. Residential construction on the alluvial fan may lead to a constrained channel in the future. Large woody debris (LWD) has been removed from the lower mile of the river for flood control and firewood gathering; however, the potential for LWD recruitment is thought to be at natural levels. Low stream flows are a natural condition throughout the Lost River drainage, but water temperatures remain cold.

Upper Methow Subwatershed

The upper Methow River drainage includes the mainstem Methow from its headwaters to the Chewuch River confluence (RM 50.1). Other major tributaries in the drainage include Goat Creek, Wolf Creek, Hancock Creek, Little Boulder Creek, Dawn Creek, Gate Creek, Robinson Creek, Rattlesnake Creek and Trout Creek. Spring Chinook, summer Chinook, steelhead/rainbow trout, westslope cutthroat, and bull trout have all been documented in the Upper Methow River drainage. Between 1987 and 1999, approximately 40% of spring Chinook spawning in the Methow watershed occurred in the Methow River between the Lost River confluence (RM 73.0) and the Winthrop Bridge (RM 49.8) (USFS 1998).

Methow mainstem habitat between the Lost River confluence and Winthrop has been greatly affected by human activity. The river has a low gradient throughout this stretch, and a number of dikes block access to valuable side-channel spawning and rearing habitat, including sites of spring Chinook spawning redds (YN spawning ground surveys 1987-1999). Floodplains are constrained by those same dikes, as well as riprapping and bank stabilization measures.

Riparian habitat has been converted to agricultural and, more recently and increasingly, to residential use along the mainstem between the Early Winters confluence and the Mazama Bridge, which in some areas has resulted in increased bank erosion. Historic timber harvest activities, fire, livestock grazing, and construction of logging related roads throughout the lower reaches of the Goat Creek and Wolf Creek drainages have also resulted in delivery of large sediment loads to the Methow River. Improvement in grazing practices in this Subwatershed and other areas of the basin has helped lessen the current impact of livestock grazing. The amount of sediment delivered to creeks and streams from natural occurrences has not been quantified relative to the amount of sediment contributed through human use within the subbasin.

In the Wenatchee River, Don Chapman Consultants (D. Chapman 1989) described, documented and assessed both intra- and inter-species behavior and movement of juvenile Chinook and steelhead trout related to in-stream habitat factors as affected by seasonal and diurnal changes. Their work and others (Meehan 1991) emphasizes the complex and inter-related factors affecting salmonids in their environment.

There are also some studies that suggest stream habitats are not drastically altered until base flow is reduced 70-80% or more (Wesche 1974; Tennant 1976; Newcombe 1981; Mullan et al. 1992b). Some research suggests that how water fills the stream channel may be more important than the quantity of water in the channel (Binns 1982). Mullan et al. (1992b) showed wetted perimeter decreased much less rapidly than volume of flow. Other studies conclude that salmonids appear to do little to avoid the consequences of severely declining flows, although it appears larger fish are more influenced than smaller fish (Corning 1970; Kraft 1972; Bovee 1978; Randolph 1984; Mullan et al.1992b).

Goat Creek

Goat Creek, drains into the Methow from the north about a mile downstream from the town of Mazama. Portions of the upper third of the Goat Creek drainage have been heavily grazed. The lower two-thirds of the drainage have been logged, roaded and grazed (USFS 1995a). Goat Creek supports small resident and migratory bull trout populations in the upper reaches. Spring Chinook spawn in the Methow River above and below the confluence with Goat Creek and may rear in the mouth of the creek. Summer steelhead/rainbow also spawn and rear in the creek.

The Goat Creek drainage is laced with over 150 miles of roads, more than 4 miles of road per mile^2, with almost all of those located in the lower half of the drainage (USFS 2000e). Sediment from roads and slope failures is carried by Goat Creek to Chinook salmon spawning grounds in the Methow River (USFS 2000e). Livestock use has also damaged, or suppressed re-growth of riparian vegetation in some tributaries. Goat Creek exhibits both elevated water temperatures and low flows and dewatering in August and September (FWS 1998.)

Wolf Creek

Wolf Creek, a Methow River tributary, drains into the Methow about 3 miles above the town of Winthrop. Wolf Creek provides spawning and rearing habitat for resident and fluvial bull trout, westslope cutthroat trout, summer steelhead and spring Chinook. Approximately 80% of the drainage is designated wilderness with very good habitat conditions. The Forest Service manages the remainder of the drainage for multiple uses with the exception of the last 1.5 miles, which is privately owned. Impacts from timber harvest and roads are isolated primarily to the Little Wolf Creek drainage. Introduction of woody debris and pool formation projects have been completed in 2000 along the lower 0.5 miles of the creek.

Early Winters Subwatershed

Early Winters Creek enters the Methow about 3.5 miles upstream from the town of Mazama. The majority of the watershed is in relatively pristine condition. Roughly 99% of the area is managed by the USFS as a Scenic Highway Corridor with the remainder designated as Late Successional Reserve. Highway 20 follows Early Winters Creek to the Cascade Crest crossing over it in three spots. Human impacts are primarily restricted to the lower 2 miles of Early Winters Creek, including its alluvial fan.

The lower half-mile of the river has been riprapped and diked to keep the channel in a stable location in order to accommodate Highway 20 and to protect private property. Levels of LWD in the first two miles are low and pool quality and quantity is poor. Severe low flows persist in the lower 1.4 miles of the creek. Low base flows are naturally occurring during the winter months; however, low flows during late summer and early fall may be exacerbated by two irrigation diversions (USFS 1998c). In 2000 or 2001, the USFS completed a restoration project on this reach of the creek. The restoration included an increase of large woody debris, pools and quality habitat.

The Early Winters Ditch on Early Winters Creek is currently meeting NMFS and USFWS target flow of 35 cfs for spring Chinook and bull trout, and the irrigation district is using wells, that are not in continuity with groundwater and surface water to meet the remainder of its irrigation needs. Fine sediment and chemical runoff from state Route 20 may negatively impact water quality.

Chewuch River Subwatershed

The Chewuch River enters the Methow at the town of Winthrop. About 95% of the drainage is managed by the USFS, with nearly 34% falling within the Pasayten Wilderness. The majority of human impact has occurred in the lower half of the drainage, with the upper 50% remaining generally undisturbed. Spring Chinook salmon spawn in the mainstem Chewuch River (up to Thirtymile Creek), and steelhead spawn and rear in the mainstem and in the tributaries (USFS 2000c).

Bull Trout use of the Lower Chewuch is unknown with the exception as a migratory corridor, however, it is known that they use the Lower Middle Chewuch and the Lake Creek tributary for spawning and rearing. Brook trout are found in the Chewuch River and in all of the fish-bearing tributaries below Twentymile Creek (USFS 2000c). Most are isolated above natural upstream barriers, reducing their potential elimination to the existing bull trout population(s). Natural upstream barriers such as waterfalls or very steep gradients exist on the majority of the Chewuch's tributaries.

Five ditches divert water within the Chewuch subwatershed, and two roads parallel segments of the Chewuch. Low flows in late summer through winter reduce quantity of rearing habitat in the lower Chewuch River. High water temperatures in the lower river may at times cause a migration barrier. The drainage's upper reaches are also characterized by harsh winters and icing.

Roads border most of the tributaries in the lower two-thirds of the drainage. The Chewuch drainage has approximately 1,000 stream crossings, and road densities exceed 3.5 miles/mile^2 along most of the lower eight miles of the Chewuch River (USFS 1994). Skid roads in riparian areas upstream of Boulder Creek have lead to increased recreational use and resulting impacts on the stream and riparian areas. Road density, road placement, past logging activities, and grazing, in concert with highly erodible soils, have led to chronic sediment delivery to streams, particularly in Cub, Eightmile, Doe, and Boulder Creek drainages (USFS 1994). These conditions are aggravated by low levels of LWD, loss of mature riparian habitat, and channelization in the alluvial fans of numerous tributaries.

Extensive riprap for flood control associated with residential development has also occurred on the lower eight miles of the Chewuch, as well as along several tributaries; although, there is some disagreement over the effect this has had on overall habitat quality. Mullan (1992b) suggests that riprap on this section of the river may actually contribute habitat. Other studies document negative impacts on fish populations and stream channel functions associated with human-induced channel confinement and habitat simplification (Murphy and Meehan 1991, Bjornn and Reiser 1991; Leopold et al. 1992; Kohler and Hubert 1999). On the Chewuch River tributaries, Twentymile Creek and Boulder Creek, the alluvial fan has been channelized.

Middle Methow Subwatershed

The Middle Methow drainage includes the mainstem Methow from its confluence with the Chewuch River to the town of Carlton. Summer Chinook, some steelhead, some spring Chinook, and most of the remnant sockeye adults spawn in this portion of the Methow subbasin. Bull trout and westslope cutthroat trout use this portion of the mainstem as a migrational corridor and for overwintering.

County roads and state highways parallel both sides of the Methow River throughout this subwatershed. Diking, conversion of riparian areas to agriculture and residential uses, and LWD removal along the mainstem Methow River, have resulted in loss of side channel access, riparian vegetation, and overall habitat complexity. Much of the habitat within this area has not been adequately inventoried or assessed, and data gaps exist regarding the extent of habitat alterations. The Methow Valley Irrigation District diverts water to its east canal about five miles north of the town of Twisp at RM 44.8. The highest percentage of diversion from the river takes place in September. The average September diversion is 39.3 cfs, about 13% of the mean September flow in the Methow River at this point (BPA 1997). East Canal flows back into the Methow River at RM 26.6.

Beaver Creek

Beaver Creek drains into the Methow five miles downstream from the town of Twisp, and is a tributary in this subwatershed. Previously, steelhead, spring Chinook and bull trout have had limited access to Beaver Creek due to its many obstructions. Most of these obstructions have been removed or are in the process of being modified for passage. All diversions in Beaver Creek have now been screened (L. Clark, Okanogan Conservation District, e-mail communication). Road density in the Beaver Creek drainage is the highest in the Methow subbasin. In 41% of the Beaver Creek drainage, road densities vary between 2.5 and 5 miles/mile^2 (USFS 1997). Nearly 130 million board feet of timber have been harvested from the Beaver Creek drainage since the 1960s, resulting in heavy sediment loading, slope destabilization, and reduction of recruitment potential for LWD (USFS 2000a). Limited grazing activity has also slightly contributed to stream sediment delivery in this section.

In low water years, Beaver Creek goes dry in the fall, with the exception of the uppermost reaches and the lowest 0.3-mile which maintain flows via irrigation return. The subwatershed is an adjudicated drainage where water uses are provided for in excess of available water during some part of the irrigation season (USFS 1997). Eastern brook trout in the Beaver Creek drainage likely provide negative impacts on the remaining bull trout populations.

Twisp River Subwatershed

The Twisp River flows into the Methow at the town of Twisp. Like the Early Winters and Lost River subwatersheds, a substantial portion of the Twisp River subwatershed habitat rests within designated wilderness and is in nearly pristine condition. Nearly 95% of the subwatershed is federally managed, and of that, approximately 50% lies within the Lake Chelan-Sawtooth Wilderness. The remaining land is managed as Late Successional Reserves or Matrix (USFS 1995c). Spring Chinook salmon and summer steelhead spawn and rear in the Twisp River for nearly its entire length. Bull trout are found throughout the mainstem and several of its tributaries. Bull trout use the lower mainstem for overwintering and as a migrational corridor. Most of the spawning areas for bull trout are located in the upper watershed. Westslope cutthroat trout are found in these areas as well.

Most human activity and related habitat changes within the drainage have taken place within the lower 15 miles of the Twisp River. Reduced levels of LWD, road placement, diking, bank hardening, and conversion of riparian areas to agriculture and residential uses have altered habitat conditions in this area, and resulted in loss of channel complexity and floodplain function. After a flood in 1972, the U.S. Army Corps of Engineers used bulldozers to channelize and remove logjams from a tributary of the Twisp River, Little Bridge Creek (Methow Valley News, Vol.70, June 29, 1972). Some effects of these activities still linger.

There are seven irrigation diversions on the Twisp River.

The Twisp River from Buttermilk Creek to the mouth, has been diked and riprapped in places, resulting in a highly simplified channel and disconnected side channels and associated wetlands. Levels of LWD recruitment potential in the lower Twisp River are far below normal.

Little Bridge Creek, a tributary of the Twisp River, contributes large amounts of sediment to the Twisp as a result of historic logging activities. Excessive sediment delivery from both private and U.S. Forest Service (USFS) land in Poorman and Newby drainages also contributes to elevated sediment levels in the lower 15 miles of the Twisp River. The lower two-thirds of the creek have high road densities. Although some restoration activities are currently underway, construction of culverts, erosion, and grazing activities have contributed to habitat degradation in this drainage. Finally, beaver activity is very limited in the lower Twisp River where large cottonwood galleries and low gradients would once have supported beaver colonies.

Lower Methow Subwatershed

The Lower Methow River subwatershed includes the Methow mainstem and its tributaries from the town of Carlton to the mouth of the Methow River. Agriculture use in this subwatershed is primarily field crops and cattle at the upper end, with orchards along the lower end. Portions of the summer Chinook escapement spawns in the lower Methow River. In addition, this reach provides rearing habitat and acts as a migration corridor for all anadromous salmonids and fluvial bull trout.

Timber harvest, livestock grazing, and high road densities characterize much of the Libby Creek drainage, with roads running parallel to every major stream. The lower 2.9 miles of Libby Creek have been channelized. Culverts and irrigation diversion structures impede salmonid passage on a number of tributaries. Upstream passage for salmonids is also limited by heavy beaver activity in some tributaries. Libby Creek has no historical evidence of use by spring Chinook or bull trout. The lower mile is used heavily by summer steelhead for spawning and initial rearing. Ground water discharge is likely the attraction for steelhead.

Timber harvest, livestock grazing, and elevated road densities also characterize Gold Creek. The lower 3.5 miles of Gold Creek have had riprap placed along the banks. Gold and Libby Creeks are characterized by low instream flows, and Gold Creek dewaters in a lower reach between RM3 and RM2 during some low water years. The timing of dewatering may not preclude passage of adult migrants that pass through the reach prior to dewatering; however, dewatering could negatively impact movement of juvenile salmonids. A spring Chinook redd was located in 1987, an extreme drought year, and reported in Mullan et al. (1992b). Standing crop fish estimates for Gold Creek and its main tributary streams are consistently high compared to other creeks (Mullan et al. 1992b).

Fish Species/Aquatic Relationships

The Methow subbasin is considered part of the Upper Columbia River ESU, and several species of anadromous salmonids, Pacific lamprey, and resident fish stocks are considered by National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (FWS) as Endangered, Threatened or locally extirpated.

An estimated 32 species of fish, including seven introduced species, are found in the Methow River subbasin (**Table 12**). Distinct Upper Columbia River population segments exist for Methow/Okanogan River summer steelhead (Endangered) and bull trout (Threatened). Methow subbasin also supports distinct population segments of summer Chinook and spring Chinook (Endangered) in the mainstem, Twisp, Lost River, and Chewuch subwatersheds (SASSI).

Table 12 Fish species of the Methow subbasin

Family & Species	Scientific Name	Habitat	Origin
Lamprey Family	**Petromyzontidae**		
Pacific Lamprey	Entosphenus tridentatus	Larvae found in backwater silt, adults in the ocean	Native
Salmon Family	**Salmonidae**		
Mountain Whitefish	Prosopium williamsoni	Riffles in summer, pools in winter	Native
Brown Trout	Salmo trutta	Streams up to 75 degrees Farenheit	Northern Europe
Cutthroat Trout	Oncorhyncus clarki	Cold water lakes and streams; some are anadromous	Native and stocked from Western states
Rainbow Trout/Steelhead	Oncorhyncus mykiss	Cold water lakes and streams, some are anadromous	Native and stocked from Western states
Chinook Salmon	Oncorhynhcus tshawytscha	Anadromous (spawn in fresh water, runs to ocean)	Native to Pacific Northwest
Sockeye Salmon	Oncorhyncus nerka	Anadromous	Native
Coho Salmon	Oncorhyncus kisutch	Anadromous	Native to Pacific Northwest
Brook Trout	Salvelinus fontinalis	Cold water lakes and streams	Eastern North America
Bull Trout	Salvelinus confluentus	cold water streams and pools; some are anadromous	Native
Minnow Family	Cyprinidae		
Carp	Cyprinus carpio	shallow, quiet water, preferring dense vegetation	Native to Asia
Longnose Dace	Rhinichthys cataractae	Among stones at the bottom of swift streams	Native
Northern Pikeminnow (Squawfish)	Ptychocheilus oregonensis	Lakes and slow streams	Native to the Columbia River
Redside shiner	Richardsonius balteatus	Warmer ponds, lakes, streams	Native to the Columbia River
Sucker Family	**Catostomidae**		
Bridgelip Sucker	Catostomus columbianus	Bottom feeder in backwaters and pools in rivers	Native
Largescale Sucker	Catostomus macrocheilus	Bottom feeder in lakes, and pools in rivers	Native
Sunfish Family	**Centrarchidae**		
Smallmouth Bass	Micropterus dolomieui	Warm streams and lakes	Eastern North America
Largemouth Bass	Micropterus salmoides	Shallow, warm weedy lakes and backwaters	Eastern North America
White Crappie	Pomoxis annularis	Lakes and streams with dense vegetation	Eastern North America
Catfish Family	**Ictaluridae**		
Brown Bullhead	Ictalurus nebulosus	Warm-water ponds, lakes, sloughs	Eastern North America
Sculpin Family	**Cottidae**		
Mottled Sculpin	Cottus bairdi	Cold rivers	Native
Shorthead Sculpin	Cottus confusus	Cold rivers	Native
Torrent Sculpin	Cottus rhotheus	Cold rivers and lakes	Native
Perch Family	**Percidae**		
Walleye	Stizostedion vitreum	Large lakes and streams	Central & Eastern North America

Source: Methow Biodiversity Project, PO Box 175, Winthrop, WA 98862

Fish species not included in the table

Westslope cutthroat trout *Oncorhynchus clarki lewisi*

Interior redband trout *Oncorhynchus mykiss gairdneri*

Additional species possible in the Methow

Western brook lamprey *Lampetra richardsoni*

Mountain sucker *Catostomus platyrhynchus* (state monitor)

Chiselmouth *Acrocheilus alutaceus*

Sandroller *Percopsis transmontana* (state monitor)

Peamouth *Mylocheilus caurinus*

Pygmy whitefish *Prosopium coulteri*

Leopard dace *Rhinichthys falcatus*

Historical anadromous production in the Methow subbasin was represented by spring Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and summer steelhead (O. *mykiss*). Craig and

Suomela (1941) found evidence only of spring Chinook salmon; although, it was possible that some summer Chinook once spawned in the lower Methow River (Mullan et al. 1992b).

The Washington Water Power Company's dam in the lower Methow River near Pateros significantly altered salmonid production in the early decades of the 20th century. Records from 1928 and 1929 indicate some Chinook salmon were dipnetted below the dam and released above it (Mullan 1987; Scribner et al. 1993), but there was no evidence steelhead and coho salmon were passed beyond the dam. When the dam was removed (circa 1929), coho salmon were extirpated, Chinook were nearly extirpated, and steelhead persisted as resident rainbow trout (Mullan et al. 1992b).

Bull trout once filled most every cold-water niche in the Methow subbasin; however, the presence of natural barriers such as waterfalls or small stream size blocked their access to many headwater streams.

Diking, conversion of riparian areas to agriculture and residential uses, and LWD removal along the mainstem Methow River have contributed to the loss of side-channel access, riparian vegetation, and overall habitat complexity. However, much of the habitat within this area has not been adequately inventoried or assessed and data gaps exist regarding the extent of habitat alterations.

Much of the watershed remains undeveloped, and large tracts of high quality fish habitat remain, particularly within the middle and upper elevations. These areas are contained in lands held largely in public ownership, and include several thousand acres managed as wilderness/roadless condition by the Okanogan National Forest. Within these management boundaries, plant communities and succession are shaped largely through such natural processes as fire, avalanches, storms, and temperature ranges.

Fish and Wildlife Focal Species Associations

The wildlife species and their habitat associations, shared with salmonids, are listed in Appendix B. The red-eyed vireo, yellow breasted chat and American beaver share riparian wetland habitats directly with salmonids.

Fish and Wildlife Species Richness

93% of the wildlife and 90% of the salmonid species that occur in the Ecoprovince, occur in the Methow subbasin (Table 13). In addition, 65% of those amphibian species and 84% of the reptile species also occur in the subbasin.

Table 13 Species richness and associations for the Methow subbasin, Washington

Class	Subbasin														
	Entiat	**%**	**Lake Chelan**	**%**	**Wena-tchee**	**%**	**Methow**	**%**	**Oka-nogan**	**%**	**Upper Middle Mainstem**	**%**	**Crab**	**%**	**Total (Eco-prov)**
Amphibians	11	65	11	65	16	94	11	65	9	53	17	100	9	53	**17**
Birds	218	93	221	94	215	92	252	94	222	95	234	100	214	91	**234**
Mammals	91	94	93	96	91	94	93	96	86	89	97	100	78	80	**97**
Reptiles	16	84	16	84	19	100	16	84	13	68	19	100	16	84	**19**
Total	**336**	**92**	**341**	**93**	**341**	**93**	**341**	**93**	**328**	**89**	**367**	**100**	**317**	**86**	**367**
Association															
Riparian Wetlands	72	92	73	94	70	90	73	94	73	94	77	99	73	94	**78**
Other Wetlands (Herbaceous and Montane Coniferous)	30	81	32	86	26	68	32	86	31	84	36	95	33	89	**38**
All Wetlands	102	89	105	91	96	83	105	91	104	90	113	97	106	92	**116**
Salmonids	77	93	75	90	76	93	75	90	71	86	81	98	72	87	**82**
Note: % = % of Total															

Source: Ibis 2003

Wildlife Species/ Terrestrial Relationships

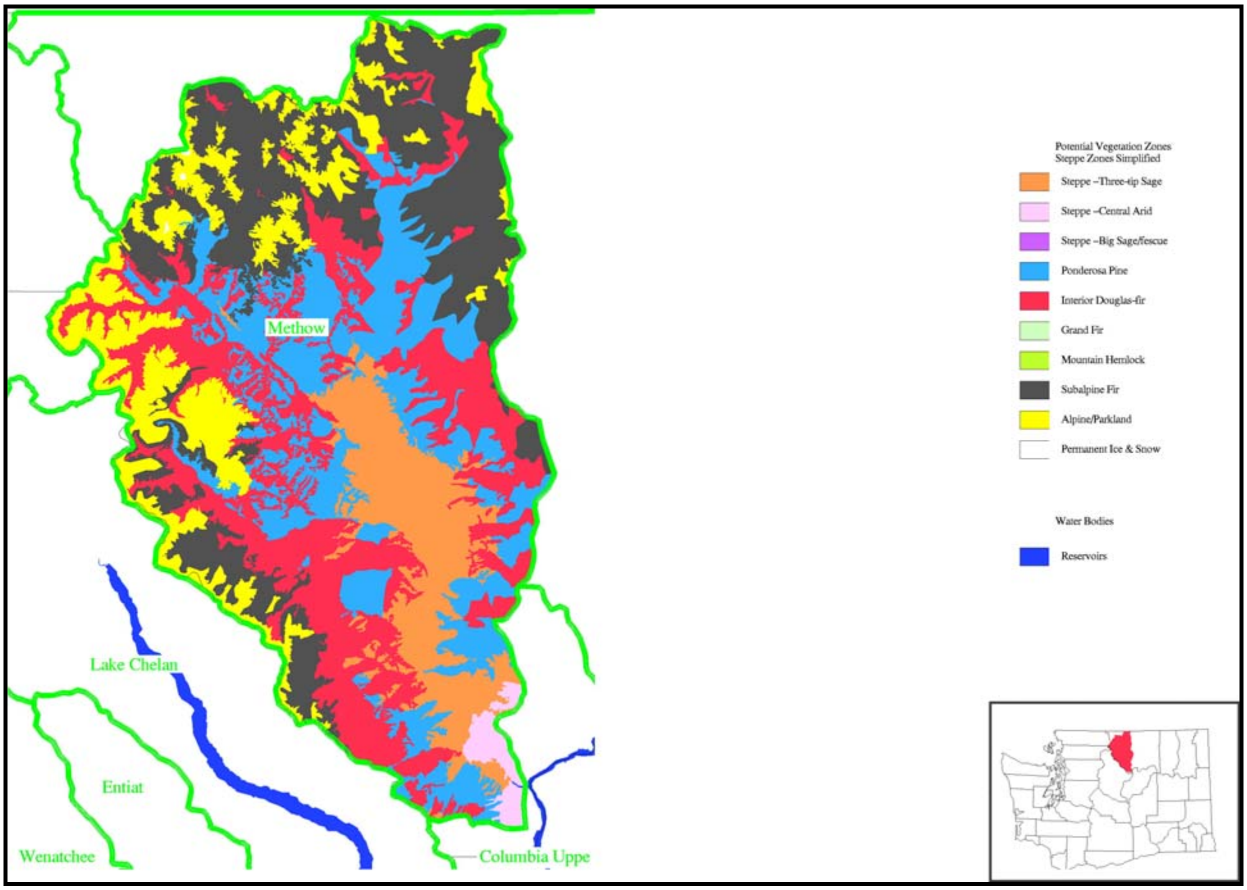
There are an estimated 341 wildlife species that occur in the Methow subbasin. These species, their assemblages, associations and relationship to the CCP are listed in Appendix B. Of those species, 105 (31%) are closely associated with riparian and wetland habitat, and 75 (22%) consume salmonids during some portion of their life cycle. Seventeen wildlife species are non-native. Eight wildlife species that occur in the subbasin are listed federally, and 38 species are listed in Washington and Idaho as Threatened, Endangered, or Candidate species. A total of 98 bird species are listed as Washington or Idaho State Partners in Flight priority and focal species. A total of 57 wildlife species are managed as game species in Washington.

The subbasin consists of 15 wildlife habitat types, which are briefly described in **Table 14** and detailed descriptions of these habitat types can be found in Appendix B of Ashley and Stovall (unpublished report, 2004).

Table 14 Wildlife Habitat Types and Vegetation Zones in the Methow subbasin

Habitat Type	Brief Description
Montane Mixed Conifer Forest	Coniferous forest of mid-to upper montane sites with persistent snowpack; several species of conifer; under-story typically shrub-dominated.
Eastside (Interior) Mixed Conifer Forest	Coniferous forests and woodlands; Douglas-fir commonly present, up to 8 other conifer species present; under-story shrub and grass/forb layers typical; mid-montane.
Lodgepole Pine Forest and Woodlands	Lodgepole pine dominated woodlands and forests; under-story various; mid- to high elevations.
Ponderosa Pine and Interior White Oak Forest and Woodland	Ponderosa pine-dominated woodland or savannah, often with Douglas-fir; shrub, forb, or grass understory; lower elevation forest above steppe, shrubsteppe.
Upland Aspen Forest	Quaking aspen (*Populus tremuloides*) is the characteristic and dominant tree in this habitat. Scattered ponderosa pine (*Pinus ponderosa*) or Douglas-fir (*Pseudotsuga menziesii*) may be present.
Subalpine Parkland	Coniferous forest of subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta*).
Alpine Grasslands and Shrublands	This habitat is dominated by grassland, dwarf-shrubland (mostly evergreen microphyllous), or forbs.
Eastside (Interior) Grasslands	Dominated by short to medium height native bunchgrass with forbs, cryptogamic crust.
Shrubsteppe	Sagebrush and/or bitterbrush dominated; bunchgrass under-story with forbs, cryptogamic crust.
Agriculture, Pasture, and Mixed Environs	Cropland, orchards, vineyards, nurseries, pastures, and grasslands modified by heavy grazing; associated structures.
Urban and Mixed Environs	High, medium, and low (10-29 percent impervious ground) density development.
Open Water – Lakes, Rivers, and Streams	Lakes, are typically adjacent to Herbaceous Wetlands, while rivers and streams typically adjoin Eastside Riparian Wetlands and Herbaceous Wetlands
Herbaceous Wetlands	Generally a mix of emergent herbaceous plants with a grass-like life form (graminoids). Various grasses or grass-like plants dominate or co-dominate these habitats.

Habitat Type	Brief Description
Montane Coniferous Wetlands	Forest or woodland dominated by evergreen conifers; deciduous trees may be co-dominant; under-story dominated by shrubs, forbs, or graminoids; mid- to upper montane.
Eastside (Interior) Riparian Wetlands	Shrublands, woodlands and forest, less commonly grasslands; often multi-layered canopy with shrubs, graminoids, forbs below.



Source: IBIS 2003

Figure 12. Wildlife habitat types of the Methow subbasin

The watershed contains 14 Priority Habitats as identified by WDFW. Priority Habitats are those habitat types or elements with unique or significant value to a diverse assemblage of species. A Priority Habitat may consist of a unique vegetation type or dominant plant species, a described successional stage, or a specific structural element. There are 18 habitat types currently on WDFW's Priority Habitats and Species (PHS) List. The PHS program is explained in Section 3.1 of this plan.

Ninety-three (93) % of the wildlife species that occur in the Ecoprovince occur in the Methow subbasin. In addition, sixty-five 65% of the amphibian species and eighty-four 84% of the reptile species that occur in the Ecoprovince, occur in the subbasin. Fourteen wildlife species are as Endangered, Threatened, or as Species of Concern within the Methow subbasin.

3.3 Focal Species: Population Characterization and Status

The subbasin plan used the concept of "focal species" as a way to manage both the size of the subbasin plan and the scope of the assessment, inventory and management plan. In its truest sense, this was simply a means to target our resources and cover as many species and habitats as possible.

In some limited instances this approach was also used to prioritize some actions across fish and wildlife needs or to more properly ascribe responsibilities (e.g., CWA, PCSRF, Power Act, ESA). Mitigation obligations, ESA listing status, coterminous habitat use and overlapping jurisdictions were some of the considerations used to designate focal species. However, we must clearly point out and caution the reader that it was not the intention of the subbasin planners to impart a value judgment placing an emphasis or de-emphasis on the need or responsibility to protect and/or restore a particular or species or their habitats or to decouple any species from any legal, policy or trust obligations. The subbasin plan used the concept of "focal species" as a way to manage both the size of the subbasin plan and the scope of the assessment, inventory and management plan. In its truest sense, this was simply a means to target our resources and cover as many species and habitats as possible.

A focal species has special ecological, cultural, or legal status and represents a management priority in the Methow subbasin and, by extension, in the Columbia Cascade Ecoprovince. Focal species are used to evaluate the health of the ecosystem and the effectiveness of management actions.

Criteria used in selecting the focal species build upon: a) designation as Federal Endangered or Threatened species, or management priority as designated by a management authority; b) cultural significance; c) local significance, and; d) ecological significance, or provide the ability to serve as indicators of species and ecosystem health. See Appendix C for a full classification of fish and wildlife species in this ESU. Life history summaries are provided below. See referenced literature for more detailed information.

Each of the fish and wildlife focal species, their assemblages, and their associated habitats in the Methow subbasin is summarized in **Table 15**.

Table 15 Fish and Wildlife focal species and their distribution within the Methow subbasin

Focal Species	Focal Habitat Represented		
	Ponderosa pine	Shrubsteppe	Riparian wetlands
Wildlife			
Brewer's sparrow			
Grasshopper sparrow			
Sharp-tailed grouse			
Mule deer			
Red-eyed vireo			
Yellow-breasted chat			
American beaver			

Focal Species	Focal Habitat Represented		
	Ponderosa pine	Shrubsteppe	Riparian wetlands
Wildlife			
Pygmy nuthatch			
Gray flycatcher			
White-headed woodpecker			
Flammulated owl			
Fish			
Spring Chinook			
Summer/Fall Chinook			
Coho			
Steelhead			
Bull Trout			
Westslope cutthroat trout			

3.3.1 Fish Focal Species Selection

Six species in the Columbia Cascade Province are listed as Endangered or Threatened under the ESA (1972). Upper Columbia River ESU steelhead and Upper Columbia River ESU spring Chinook are listed under the ESA as Endangered, and Columbia River Population Segment bull trout are listed as Threatened. The known distribution of these species is illustrated with each species description. In addition, westslope cutthroat trout are a Species of Concern.

The Methow summer steelhead stock is listed in the Washington State Salmon and Steelhead Stock Inventory (SASSI) as Depressed based on chronically low numbers (WDF and WDW 1993). The Methow summer Chinook stocks are considered Depressed based on negative escapement trends (WDF and WDW 1993). WDF et al. (1993) classified Upper Columbia natural summer Chinook as native or mixed origin and wild production. Methow bull trout are considered an important component of Threatened Columbia River stocks. Coho salmon were once extirpated but have since been reintroduced to the Methow River.

3.3.2 Wildlife Focal Species Selection

The wildlife focal species selection process is described in Ashley and Stovall (unpublished report 2004), and important habitat attributes are summarized. An overview of focal species assemblages identified in the Methow subbasin is summarized in **Table 16**. Subbasin planners selected focal wildlife species based on their ability to serve as indicators of environmental health for other species, and in combination with several other factors, including:

1. Primary association with focal habitats for breeding;

3. Specialist species that are obligate or highly associated with key habitat elements/conditions important in functioning ecosystems;

4. Declining population trends or reduction in their historic breeding range (may include extirpated species);
5. Special management concern or conservation status such as Threatened, Endangered, Species of Concern and management indicator species; and
6. Professional knowledge on species of local interest.

Wildlife species associated with focal habitats, including agriculture, are listed in Appendix A.

Table 16 Focal wildlife species selection matrix for the Methow subbasin

Common Name	Focal Habitat[1]	Status[2]		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				
Sage thrasher	SS	n/a	C	Yes	Yes	Yes	No
Brewer's sparrow		n/a	n/a	Yes	No	Yes	No
Grasshopper sparrow		n/a	n/a	Yes	No	Yes	No
Sharp-tailed grouse		SC	T	Yes	Yes	Yes	No
Sage grouse		C	T	Yes	Yes	No	No
Mule deer		n/a	n/a	Yes	Yes	No	Yes
Willow flycatcher	RW	SC	n/a	Yes	No	Yes	No
Lewis woodpecker		n/a	C	Yes	Yes	Yes	No
Red-eyed vireo		n/a	n/a	Yes	No	No	No
Yellow-breasted chat		n/a	n/a	Yes	No	No	No
American beaver		n/a	n/a	Yes	No	No	Yes
Pygmy nuthatch	PP	n/a	n/a	Yes	No	No	No
Gray flycatcher		n/a	n/a	Yes	No	No	No
White-headed woodpecker		n/a	C	Yes	Yes	Yes	No
Flammulated owl		n/a	C	Yes	Yes	Yes	No
Red-winged blackbird	HW	n/a	n/a	Yes	No	No	No

[1] SS = Shrubsteppe; RW = Riparian Wetlands; PP = Ponderosa pine; HW = Herbaceous Wetlands
[2] C = Candidate; SC = Species of Concern; T = Threatened; E = Endangered

Nine bird species and two mammalian species were selected to represent three priority habitats in the subbasin. Life-requisite habitat attributes for each species assemblage were pooled to characterize a "range of management conditions," to guide planners in development of future habitat management strategies, goals, and objectives.

General habitat requirements, limiting factors, distribution, population trends, analyses of structural conditions, key ecological functions, and key ecological correlates for individual focal species are included in Ashley and Stovall (unpublished report 2004). The reader is further encouraged to review additional focal species life history information in Appendix F in Ashley and Stovall (unpublished report 2004).

Establishment of conditions favorable to focal species will benefit a wider group of species with similar habitat requirements. Wildlife species and their association with focal habitats including agriculture are also listed in Appendix A

Assessment of Wildlife

The process used to develop wildlife assessments and management plan objectives and strategies is based on the need for a landscape-level holistic approach to protecting the full range of biological diversity at the Ecoregion scale with attention to size and condition of core areas (subbasin scale), physical connections between core areas, and buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most wildlife populations extend beyond subbasin or other political boundaries, this "conservation network" must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation of wildlife resources.

In response to this need, Ecoregion planners approached subbasin planning at two scales. The landscape scale emphasizes focal habitats and associated species assemblages that are important to Ecoregion wildlife managers, while specific focal habitat and/or species needs are identified at the subbasin level.

Lambeck (1997) proposed that species requirements ("umbrella species concept") could be used to guide ecosystem management. The main premise is that the requirements of a demanding species assemblage encapsulate those of many co-occurring, less demanding, species. By directing management efforts toward the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met. Therefore, managing habitat conditions for a species assemblage should provide life-requisite needs for most other focal habitat obligate species.

Ecoregion/subbasin planners also assumed that by focusing resources primarily on riparian wetland, Ponderosa pine, and shrub-steppe habitats, the needs of most listed and managed terrestrial species, dependent on these habitats, would be addressed during this planning period. While other listed and managed species occur within the subbasin, primarily forested habitat obligates, needs of these species are addressed primarily through the existing land management frameworks of the federal agencies within whose jurisdiction the overwhelming majority of these habitats occur within the Okanogan subbasin (Okanogan/Wenatchee National Forest and Washington Department of Natural Resources).

Ecoprovince/subbasin planners identified a focal species assemblage for each focal habitat type and combined life requisite habitat attributes for each species assemblage to form a "recommended range of management conditions," that, when achieved, should result in functional habitats.

The rationale for using focal species assemblages is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem. The corollary is that factors that affect habitat quality and integrity within the Ecoregion and subbasins also impact wildlife species. As a result, identifying and addressing "factors that affect focal habitats" should support the needs of obligate wildlife populations as well. Planners recognize, however, that addressing factors that limit habitat does not necessarily address some anthropogenic-induced limiting factors such as affects of human presence on wildlife species.

Emphasis in this management plan is placed on the selected focal habitats and wildlife species described in the inventory and assessment. It is clear from the inventory and assessment that reliable quantification of most subbasin-level impacts is lacking; however, many anthropogenic changes have occurred, and clearly impact the focal habitats: riparian wetlands, shrub-steppe and Ponderosa pine forest habitats.

While all habitats are important, focal habitats were selected in part because they are disproportionately vulnerable to anthropogenic impacts, and likely have received the greatest degree of existing impacts within the subbasin. In particular, the majority of shrub-steppe and Ponderosa pine habitats fall within the "low" or "no" protection status categories defined above. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (i.e., USFS adjustments to grazing management).

It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. The context within which this plan was drafted recognizes that human uses do occur, and will continue into the future. Recommendations are made within this presumptive framework.

Landscape level vegetation information is derived from the Washington GAP Analysis Project (Cassidy 1997) and IBIS data (2003).

3.4 Fish Focal Species

3.4.1 Spring Chinook

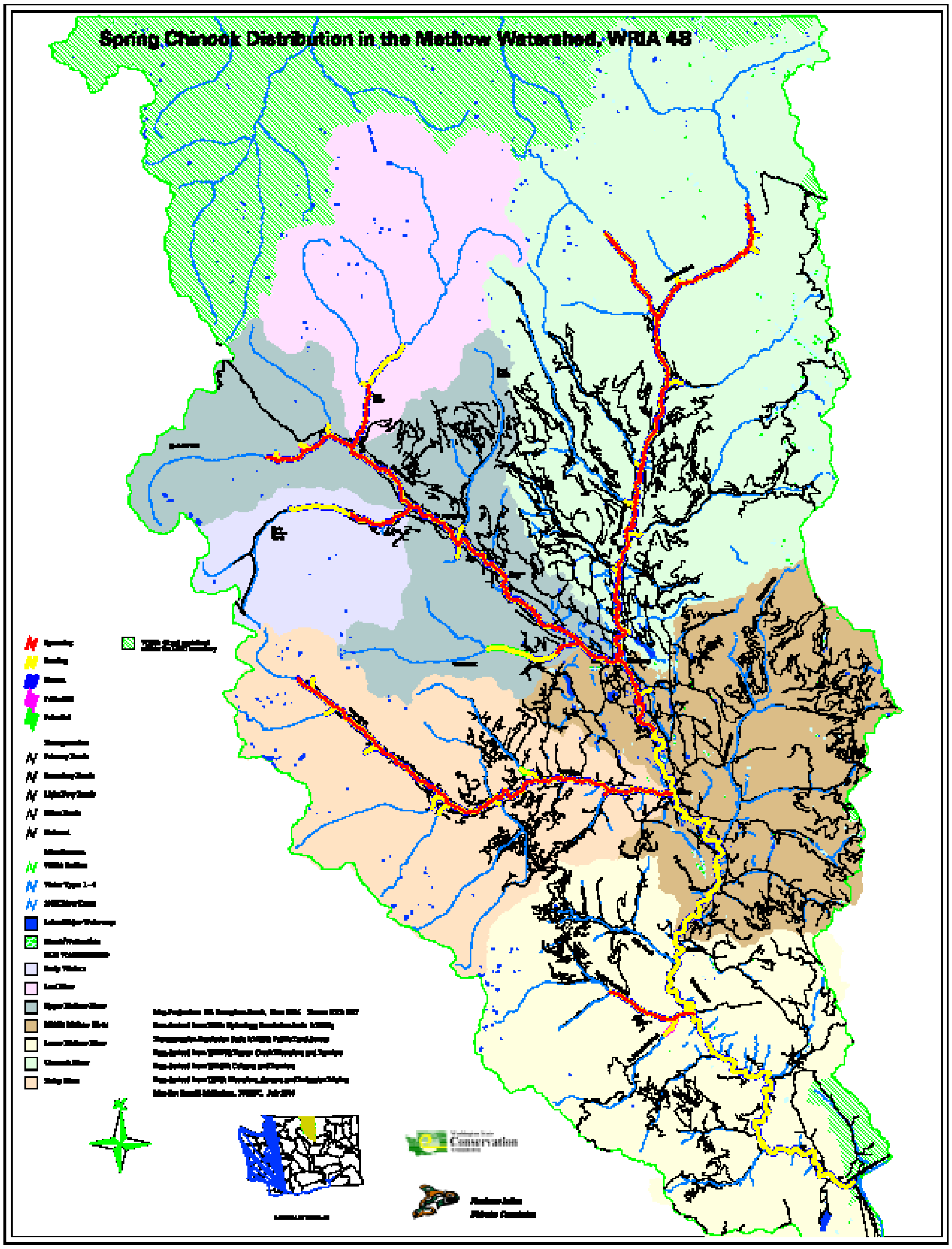
Rationale for Selection

National Marine Fisheries Service (NMFS) listed upper Columbia River spring Chinook (including the Methow Basin populations) as Endangered on March 9, 1999 (NMFS 1999). A detailed description of spring Chinook status is contained in Appendix C.

Representative Habitat

Methow River spring Chinook salmon, returning to the region, spawn primarily in the Upper Methow River and in Wolf Creek, North Fork Gold Creek, Twisp, Chewuch Early Winters and

Lost River. Juvenile rearing occurs throughout the mainstem and in key spawning tributaries. The known distribution of spring Chinook in the Methow watershed is illustrated in **Figure 13**.



Source: Washington State Conservation Commission. Salmon Steelhead and Bull Trout Habitat Limiting Factors, Water Resource Area 48, Final Report, Map Appendix (WSCC 2000).

Figure 13 Spring Chinook distribution in the Methow subbasin

Key Life History Strategies, Relationship to Habitat

The Methow spring Chinook migrate past Wells Dam and enter the subbasin in May and June, peaking after mid-May. Run timing coincides with high spring run-off. Spawning occurs late July through mid-September. Age 4 fish represent the majority of adult returns, but age 5 fish can represent 20-30% of the annual escapement (Bartlett and Bugert 1994; Bartlett 1995-1997). An average of 5% of the escapement is by age 3 fish. Fecundity averages 4,000 eggs/female for age 4 (n=93) and 5,300 eggs/female for age 5 (n=99), with a range 2,938 to 8,056 eggs/female.

Annual escapements of wild spring Chinooks are estimated to range from one to three thousand. A summary of historical spring Chinook redd counts and estimated escapement is provided in **Table 17**.

Table 17 Historical Methow subbasin spring Chinook redd counts and estimated escapement

Year	Wells Dam count	Winthrop NFH collection	Methow Hatchery collection	Wild by subtraction	Redd count	Wild run by redd expansion[1]
1962					552	3973
1963					355	2555
1964					612	4405
1965					369	2659
1966					852	6132
1967	1157			1157	377	2713
1968	4931			4931	350	2519
1969	3599			3599	292	2102
1970	2670			2670	373	2685
1971	3168			3168	319	2296
1972	3618			3618	328	2361
1973	2937			2937	502	3613
1974	3420			3420	244	1756
1975	2225	0		2225	375	2699
1976	2759	0		2759	121	871
1977	4211	0		4211	360	2591
1978	3615	38		3577	532	3829
1979	1103	102		1001	109	785
1980	1182	155		1027	91	655

[1] Index redd counts 1962-1986 (Scribner et al. 1993), total 1987-1999 (Theiss, Yakama Indian Nation, personal communication).

Year	Wells Dam count	Winthrop NFH collection	Methow Hatchery collection	Wild by subtraction	Redd count	Wild run by redd expansion[1]
1981	1935	399		1536	97	698
1982	2401	601		1800	116	835
1983	2869	755		2114	179	1288
1984	3280	900		2380	193	1389
1985	5257	1201		4056	256	1843
1986	3150	836		2315	186	1339
1987	2344	594		1750	681	1481
1988	3036	1327		1709	733	1613
1989	1740	195		1545	517	1137
1990	981	121		860	498	1060
1991	779	92		687	250	550
1992	1623	332	50	1241	738	1624
1993	2444	646	251	1547	617	1357
1994	257	29	32	196	133	293
1995	103	0	14	89	15	33
1996	335	146	318	0	NS	0
1997	971	231	328	412	150	330
1998	409	110	310	0	NS	0
1999	735	118	402	167	36	79

Fry emerge the following spring and are assumed to smolt as yearlings, although fall parr migrations from upper reaches have been observed (Hubble 1993; Hubble and Harper 1995). Juvenile Chinook have been found rearing in most of the spawning areas, mainstem margins and side channels associated with the rivers, as well as in some of the mouths of smaller tributaries (Mullan et al. 1992b; Hubble and Sexauer 1994; Hubble and Harper 1995).

Periodicity of spring Chinook salmon life history in the Methow subbasin is illustrated in **Table 18**.

Table 18 Spring Chinook life history in the Methow subbasin

Stock Group	Life history stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Spring Chinook	Adult migration					■	■	■	■				

Stock Group	Life history stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	Adult spawning								■	■			
	Egg incubation	■	■	■	■				■	■	■	■	■
	Juvenile rearing Smolt migration	■	■	■	■	■	■	■	■	■	■	■	■

Population Delineation and Characterization

Ford et al. (2001) concluded that there were currently three independent populations of spring Chinook within the Upper Columbia spring Chinook ESU; Wenatchee, Entiat, and Methow basins.

Four potentially distinct indigenous stocks of spring Chinook in the Methow Watershed (the upper Methow mainstem, Chewuch, Twisp and Lost River populations) exist in the Methow subbasin as identified in the SASSI process (WDFW et al. 1993a; WDFW et al. 1993b); although, the amount of genetic variability among these groups is low.

In periodic allozyme-based genetic analyses done since 1992, the Twisp, Chewuch, and Methow River populations have exhibited significant differences in allele frequencies (BAMP 1998). Some of the genetic samples, however, contained hatchery-origin fish presumably originated from the non-indigenous stock production at the Winthrop NFH.

The proportion of hatchery-origin fish in the Twisp and Chewuch populations was minimal; however, in the Methow River, above the confluence of the Chewuch River, they constituted the majority collected (BAMP 1998).

Population Status

In 1935, the Methow basin was estimated to have a run of 200 to 400 spring Chinook (Scribner et al. 1993). Although redd counts in the index reaches show a negative trend, Chapman et al. (1995a) recognized large fluctuations in redd counts between 1954 and 1994 (**Table 19**), without long-term declines in numbers.

Population Management Regimes and Activities

The most comprehensive set of spawner survey data covers years 1987 through 1999. Estimated spring Chinook migration past Wells Dam between 1987 and 1999 has ranged from 103 to 2,444 fish.

Table 19 Methow subbasin spring Chinook index redd counts (1962-1999)

Year	Wells Dam count	Winthrop NFH collection	Methow Hatchery collection	Wild by subtraction	Redd count	Wild run by redd expansion[2]
1962					552	3973
1963					355	2555
1964					612	4405
1965					369	2659
1966					852	6132
1967	1157			1157	377	2713
1968	4931			4931	350	2519
1969	3599			3599	292	2102
1970	2670			2670	373	2685
1971	3168			3168	319	2296
1972	3618			3618	328	2361
1973	2937			2937	502	3613
1974	3420			3420	244	1756
1975	2225	0		2225	375	2699
1976	2759	0		2759	121	871
1977	4211	0		4211	360	2591
1978	3615	38		3577	532	3829
1979	1103	102		1001	109	785
1980	1182	155		1027	91	655
1981	1935	399		1536	97	698
1982	2401	601		1800	116	835
1983	2869	755		2114	179	1288
1984	3280	900		2380	193	1389
1985	5257	1201		4056	256	1843
1986	3150	836		2315	186	1339
1987	2344	594		1750	681	1481
1988	3036	1327		1709	733	1613
1989	1740	195		1545	517	1137

[2] Index redd counts 1962-1986 (Scribner et al. 1993), total 1987-1999 (Theiss, Yakama Indian Nation, personal communication).

Year	Wells Dam count	Winthrop NFH collection	Methow Hatchery collection	Wild by subtraction	Redd count	Wild run by redd expansion[2]
1990	981	121		860	498	1060
1991	779	92		687	250	550
1992	1623	332	50	1241	738	1624
1993	2444	646	251	1547	617	1357
1994	257	29	32	196	133	293
1995	103	0	14	89	15	33
1996	335	146	318	0	NS	0
1997	971	231	328	412	150	330
1998	409	110	310	0	NS	0
1999	735	118	402	167	36	79

Many factors have contributed to the decline in abundance of Methow basin spring Chinook, including industrial development of the Columbia River, agricultural, forestry and private development of the Methow subbasin, and in combination with historical intensive fishing. Chapman et al. (1995a) estimated a productivity reduction of at least 43% from the 1950s to the 1980s for upper Columbia River spring Chinook salmon.

Hatchery Effects

Genetic analysis of spring Chinook in the Methow subbasin indicates that the tributary stocks in the Chewuch and Twisp Rivers are, in large part, self-recruiting populations (WDFW et al. 1993; CRITFC 2001) that have maintained or developed within the past 60 years, despite the influence of the GCFMP (WDFW et al. 1993).

Genetic data collected from samples of the Winthrop National Fish Hatchery (NFH) population in 1992 (n=100) and Winthrop Hatchery-origin adults intercepted at Methow Hatchery in 1994 (n=25), and from Twisp and Chewuch Rivers' naturally produced adults in 1992, 1993, and 1994 (n=112 and n=158 in total, respectively) showed significant genetic differentiation among the wild and hatchery populations.

Methow River mainstem natural spawners, sampled in 1993 and 1994, showed significant genetic differentiation from Twisp and Chewuch populations, but were less differentiated from the Winthrop NFH population.

Some of the Methow mainstem spawners were found to have hatchery scale patterns, and were believed to be Winthrop NFH-origin. (See also Artificial Production section). In general, the three naturally reproducing populations, prior to start-up of Methow Hatchery supplementation operations, were more closely aligned with each other than with the Winthrop NFH population, which was genetically closer to the Leavenworth, Entiat and Carson NFH populations. Twisp River spring Chinook were the most highly divergent among the three naturally reproducing Methow Basin populations.

Population divergence within a relatively short period of time has been documented in Chinook introduced in New Zealand (Quinn and Unwin 1993), and similar divergence is expected for the coho reintroduction program. Since 1992, variable broodstock collection and mating schemes of within-basin Chinook stocks (as determined by adult demographics) may have influenced the appearance of stock relationships and stock composition in the Methow subbasin.

In response to uncertainty about population structure and poor adult returns, and to a desire to spread the risk of hatchery intervention strategies, the Hatchery Working Group (HWG) developed a conceptual approach during the development of the Biological Assessment and Management Plan (BAMP) for mid-Columbia River Hatchery Programs. The approach consisted of enlarging the effective hatchery supplementation spawning populations of Methow River and Chewuch River, during periods of low adult returns, by managing them as a single gene pool.

In recent years, there has been a move to reduce the perpetuation of the Carson-origin spring Chinook in the Methow River. Agreement has been reached between the various stakeholders that the Carson stock can be used in various situations (such as in reintroduction of spring Chinook into the Okanogan Basin), and used less so for broodstock purposes in the Methow Basin (Brian Cates FWS, pers. comm).

During years of sufficient adult returns, tributary trapping locations would be utilized to obtain the broodstock components of each tributary population, and within-population mating would be made a priority in an attempt to preserve and enhance discrete population attributes that exist in the Methow Basin.

Hydroelectric Effects

Anadromous salmonids, including upper Columbia River spring Chinook depend on intact, complex and functioning habitat to support healthy populations. Perturbations in habitats throughout the Columbia Basin and Ocean environments are replete, including those associated with mainstem Columbia River hydroelectric development and operation. The development of the hydropower facilities throughout the Columbia River Basin has irrevocably altered terrestrial and aquatic habitats and is a contributor to limiting anadromous fish populations.

In attempts to mitigate for hydro-related impacts in the Mid-Columbia Region, WDFW manages a program in the Methow Basin that is funded by Chelan and Douglas PUDs as mitigation for the operation of their mainstem hydroelectric projects. The goal of the artificial production programs is to provide *no net impact* of unavoidable losses because of operation of Wells Dam, Rocky Reach Dam, and Rock Island Dam, while contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, maintaining genetic and ecological integrity, and supporting harvest operations.

Douglas will continue to fund the operation and maintenance of the Wells Hatchery and Methow Spring Chinook Supplementation Hatchery (Wells HCP 2002).

Harvest Effects

Spring Chinook were abundant in upper Columbia River tributary streams like the Methow River prior to the extensive resource exploitation in the 1860s. By the 1880s, the expanding salmon canning industry and the rapid growth of the commercial fisheries in the lower Columbia River had heavily depleted the mid and upper Columbia River spring and summer Chinook runs (McDonald 1895). The full extent of depletion in upper Columbia River spring Chinook runs is difficult to quantify because of limited historical records.

Few upper Columbia River-origin spring Chinook are currently harvested in marine or freshwater fisheries (TAC 1991). Spring Chinook from the Columbia River move northward along the continental shelf within the first few months of marine life. However, low recovery rates of upper Columbia River spring Chinook in ocean troll fisheries suggests these fish spend more time in far off-shore waters than do upper Columbia River summer Chinook.

Assuming Methow subbasin spring Chinook make similar contributions to the fishery as other upper Columbia River spring Chinook, less than 20% of the run is caught annually. Harvest is limited to incidental catches in the marine fisheries and mainstem Columbia River sport, commercial, and tribal fisheries.

3.4.2 Summer/Fall Chinook

Rationale for Selection

Summer Chinook stocks in the Methow subbasin are considered Depressed based on negative escapement trends (WDF and WDW 1993). WDF et al. (1993) classified Upper Columbia natural summer Chinook as native or mixed origin and wild production.

In the 1997 "Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California," NMFS indicated that summer/fall Chinook salmon in this ESU were not in danger of extinction, nor were they likely to become so in the foreseeable future (Myers et al. 1998). However, highly variable escapements and the desire to increase the proportion of wild origin stock in the upper Columbia River populations make the Methow River summer/fall Chinook an important stock for management attention.

Representative habitat

The known distribution of summer/fall Chinook in the Methow subbasin is illustrated in **Figure 14**.

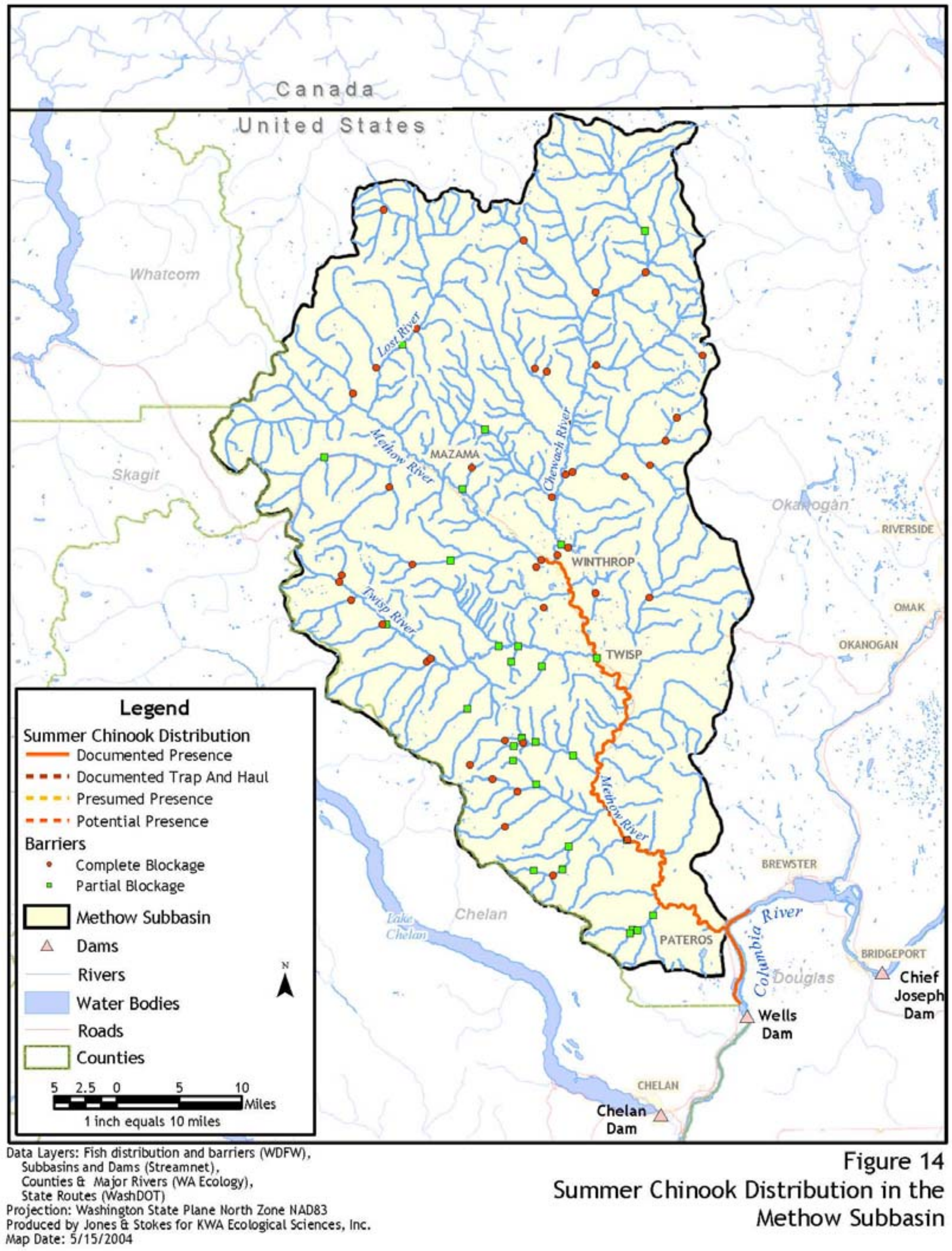


Figure 14 Summer Chinook distribution in the Methow subbasin

Key Life History Strategies, Relationship to Habitat

The dominant age class of Methow summer/fall Chinook varies between age 4 and age 5 years. Adult summer/fall Chinook enter freshwater from mid-June through late August (Wenatchee and

Methow stocks) or mid-September (Okanogan population) (WDF and WDW 1993). Methow summer Chinook, like those in the Wenatchee, begin spawning in late September.

The salmonids spawn in the lower mainstem reaches of the Methow River from the town of Winthrop down to the Methow's confluence with the Columbia River. Spawning ends in early to mid-November, with peak spawning in October (Chapman et al. 1994; WDF and WDW 1993). Methow and Wenatchee fish exhibit the same end and peak spawn timings (Chapman et al. 1994), occurring about one week later than Okanogan stocks.

A summary of spawning ground escapements from 1956-2000 is provided in **Table 20**.

Table 20 Spawning ground escapement from 1956-2000

Spawn year	Total aerial count	Total ground count	Estimated escapement
1956	109	--	605
1957	451	--	2503
1958	335	--	1860
1959	130	--	721
1960	194	--	1077
1961	120	--	666
1962	678	--	3762
1963	298	--	1654
1964	795	--	4411
1965	562	--	3119
1966	1275	--	7075
1967	733	--	4067
1968	659	--	3657
1969	329	--	1826
1970	705	--	3912
1971	562	--	3118
1927	325	--	1803
1973	366	--	2031
1974	223	--	1237
1975	432	--	2397
1976	191	--	1060
1977	365	--	2025
1978	507	--	2813
1979	622	--	3451

Spawn year	Total aerial count	Total ground count	Estimated escapement
1980	345	--	1914
1981	195	--	1082
1982	142	--	788
1983	65	--	360
1984	162	--	899
1985	164	--	910
1986	169	--	938
1987	211	--	1171
1988	123	--	683
1989	126	--	699
1990	229	--	
1990[3]	--	409	1268
1991	120	--	
1991	--	153	474
1992	91	--	
1992	--	107	331
1993	116	--	
1993	--	154	477
1994	280	--	
1994	--	310	961
1995	296	--	
1995	--	357	1107
1996[4]	151	--	
1997	173	--	
1997	--	205	636
1998	192	--	

Spawn year	Total aerial count	Total ground count	Estimated escapement
1998	--	225	698
1999	--	448	1389
2000	--	500	1550

Population Delineation and Characterization

This natural run is a mixture of strays from Wells Dam Hatchery, descendents of remnant native summer Chinook, and stocks transferred during the Grand Coulee Fish Maintenance Project (GCFMP). They are genetically homogenous with other upper- and mid-Columbia River summer and fall Chinook populations, likely because of post-GCFMP and current hatchery practices (Chapman et al. 1994a).

Population Status

The Methow summer Chinook stocks are considered Depressed based on negative escapement trends (WDF and WDW 1993). WDF et al. (1993) classified Upper Columbia natural summer Chinook as native or mixed origin and wild production. In the 1997 "Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California," NMFS indicated that summer/fall Chinook salmon in this ESU were not in danger of extinction, nor were they likely to become so in the foreseeable future (Myers et al.1998).

Population Management Regimes and Activities

Although travel distance and dam passages are essentially equal for fish from the Methow and Okanogan basins, the Methow basin summer Chinook escapement has experienced a significant decline (Chapman et al. 1994a). Chapman et al. (1994a) recommended prompt attention to studies of microhabitat, distribution, growth, egg-to-smolt survival, and pilot riparian modification. Escapement during the years 1980-2000 averaged only 36% of the total during the years 1956-1979. Since 1980, run sizes have ranged from 350 to 1,900 adults based upon redd count expansions, with an average run size of about 1,000 fish (Murdoch et al. 2001). Summer/fall Chinook typically spawn in the Methow River between RM 3.3 and RM 86.

Hatchery Effects

The U.S. Fish and Wildlife Service released summer/fall Chinook intermittently to the Methow River between 1947 and 1973 (Mullan 1987; Peven 1992). Some of these fish were obtained from adults in the Methow and Entiat rivers. From 1977 to 1982, yearling summer/fall juveniles were obtained from Wells Dam stock. The latter was a mix of Similkameen, Okanogan, and perhaps main Columbia River spawners and Wenatchee River "strays."

In those same years, Rocky Reach Hatchery Complex produced summer/fall fish for release at Turtle Rock in Rocky Reach pool. Those releases included fall Chinook from Simpson and Elokomin hatcheries, Bonneville Dam, and Priest Rapids upriver brights, Wells summer/fall fish, and Snake River fall Chinook. A few were fingerling releases, while most were yearlings. The degree to which those releases spawned on return with summer/fall Chinook in the various tributaries, and in the Wells Dam egg-take, likely varied from year to year.

Wells Dam Hatchery production through 1991 was released at Wells Dam, except for one group of presmolts released in the Methow River. In some years, Wells Hatchery mined large portions (49% in 1969) of the summer/fall Chinook destined for the Methow River and other upstream tributaries (Mullan 1987). Upriver bright fall Chinook from Priest Rapids have entered the summer/fall Chinook broodstock complement at Wells Hatchery. We assume that they have also spawned in areas where they may mix with adults from natural spawning in various tributary and mainstem areas.

For several years, before the volunteer entrants at the Priest Rapids Hatchery trap became abundant enough to support broodstock needs, virtually all adult fall-run Chinook destined for upriver spawning areas were trapped at Priest Rapids fishway trap.

That "mining" of upriver fall-run fish probably took some summer-run fish that arrived after the cut-off date for summer Chinook, and prevented late-run Chinook from spawning upstream from Priest Rapids Dam. It, thus, may have mixed late-run Chinook from the mid-Columbia region upstream from Priest Rapids Dam with Hanford Reach late-run Chinook (Chapman et al. 1994).

Hydroelectric Effects

Anadromous salmonids, including upper Columbia River summer Chinook, depend on intact, complex and functioning habitat to support healthy populations. Perturbations in habitats throughout the Columbia Basin and in ocean environments are replete, including those associated with the mainstem Columbia River's hydroelectric development and operation. The development of the hydropower facilities throughout the Columbia River Basin has irrevocably altered terrestrial and aquatic habitats, and is a contributor to limiting anadromous fish populations. In attempts to mitigate for hydro-related impacts in the Mid-Columbia Region, WDFW operates summer Chinook supplementation programs associated with the HCPs of Wells Dam, Rocky Reach Dam.

According to the Chelan HCP 2002 for Rocky Reach and Douglas HCP for Wells Dam, the Districts will provide hatchery compensation for Plan Species, including summer/fall Chinook salmon upstream of Rock Island and Wells Dams. This compensation may include measures to increase the off-site survival of naturally spawning fish or their progeny.

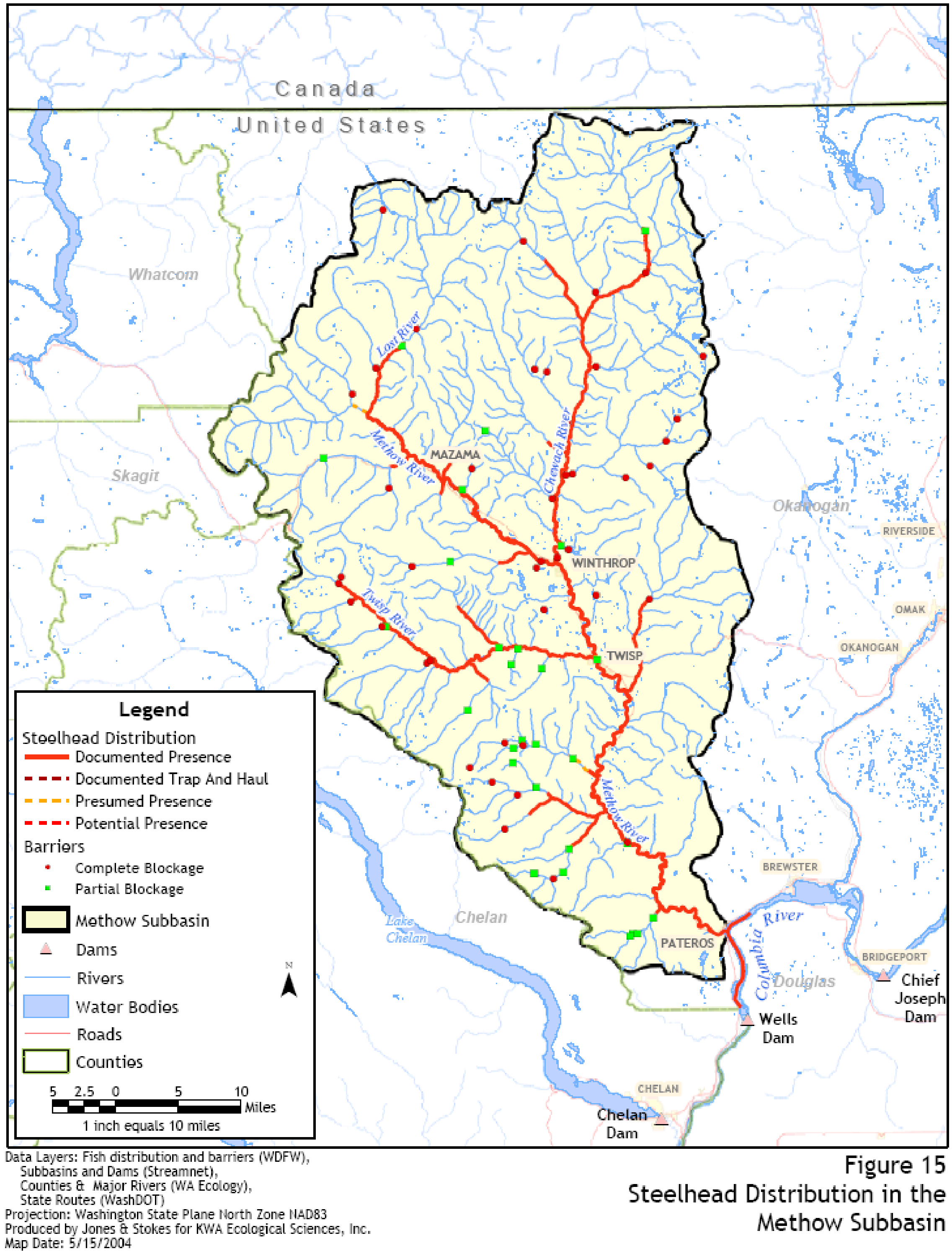
The Districts will implement the specific elements of the hatchery program consistent with overall objectives of rebuilding natural populations and achieving No Net Impact. Species-specific hatchery programs objectives developed by the Joint Fisheries Parties may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Harvest Effects

High harvest rates in the lower Columbia River depleted populations of upper Columbia River summer Chinook by the late 1800s (McDonald 1895). In the 1930s, the fishing rate remained at almost 90% and summer Chinook escapement to Rock Island Dam hovered around 5,600 fish (Chapman et al. 1994a). Industrial development of the Columbia River system, coupled with historical over-harvest, reduced escapement. Harvest rates were reduced in 1951, and the run rebounded to an average escapement range of 20,000 to 35,000 fish at Rock Island Dam.

Summer Chinook from the region are currently harvested only incidentally in lower Columbia River fisheries that are directed at other species, and no directed commercial fisheries on upper Columbia summer-run fish have occurred in the mainstem since 1964 (BAMP 1998). During the years 1982-1989, the brood year average ocean fisheries' exploitation rate for Columbia River stocks was 39%, with a total exploitation rate of 68% estimated for the same years (Myers et al. 1998).

3.4.3 Summer Steelhead



Source: Data Layers: Fish distribution and barriers (WDFW), Subbasins and Dams (StreamNet), Counties & Major Rivers (WA Ecology), State Routes (WashDOT). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004")

Figure 15 Steelhead distribution in the Methow subbasin

Rationale for Selection

The Methow summer steelhead stock is listed in the Washington State Salmon and Steelhead Stock Inventory (SASSI) as Depressed based on chronically low numbers (WDF and WDW, 1993). Upper Columbia summer steelhead were listed as Endangered under the ESA in 1997.

Key Life History Strategies, Relationship to Habitat

It is difficult to summarize one life history strategy (anadromy) without due recognition of the other (resident). The two strategies co-mingle on some continuum with certain residency at one end, and certain anadromy on the other. Upstream distribution is limited by low heat budgets (about 1,600 temperature units) (Mullan et al 1992b).

The response of steelhead/rainbow complex in these cold temperatures is residualism, presumably because growth is too slow within the time window for smoltification. However, these headwater rainbow trout contribute to anadromy via emigration and displacement to lower reaches, where warmer water improves growth rate and subsequent opportunity for smoltification.

Summer steelhead spawn in late winter, spring, and early summer in the mainstem Methow River and its tributary streams. Although steelhead are iteroparis (life after spawning), kelts represent less than 1.0% of the annual spawning population (Brown 1995). The low occurrence of repeat spawners may be related to post-spawn Columbia River discharge or spill frequency, duration, and/or sequential timing (Brown 1995). However, Chapman et al. (1994b) suggested the number of repeat spawners pre-development was never high.

Spawning grounds are not surveyed for steelhead because the adults generally spawn over a four- to five-month period that coincides with high spring flows when water visibility is low and discharge high. Preliminary surveys, conducted during the low water season in 2001, supported expected redd locations (Chapman et al. 1994b). Spawning and rearing distribution correlate closely (Mullan et al. 1992b). Unlike other species in the *Oncorhynchus* genus, steelhead eggs incubate at the same time that temperatures are increasing.

Steelhead, destined for the Methow subbasin, pass Wells Dam in July through the following May, with peak migration in September. Mullan et al. (1992b) was unable to detect a significant difference between run timing of hatchery and wild fish passing Wells Dam. Most adults hold in the mainstem Columbia River through the winter; although, some hold in large, deep pools associated with the Methow River downstream of Winthrop.

The return percentage of hatchery origin adults to and over Wells Dam is provided in **Table 22**.

Table 21 Hatchery and wild steelhead counts at Wells Dam

Year	Run to Wells Dam	Number in broodstock			Wild%	Run over Wells Dam		
		Hatchery	Wild	Total		Hatchery	Wild[5]	Total

[5] Assumes wild fish were representative of the entire run.

Year	Run to Wells Dam	Number in broodstock			Wild%	Run over Wells Dam		
1967	2199			171				2028
1968	2667			413				2254
1969	1299			530				769
1970	2023			399				1624
1971	4257			358				3899
1972	2069			354				1715
1973	2473			627				1846
1974	632			260				372
1975	732			227				505
1976	4973			337				4636
1977	5819			355				5464
1978	1831			356				1475
1979	4138			367				3771
1980	3735			372				3363
1981	4757			650				4107
1982	8395	552	38[6]	590	0.065	7298	507	7805
1983	20200	661	9	670	0.013	19276	254	19530
1984	17353	673	17	690	0.025	16246	417	16663
1985	20462	718	32	750	0.043	18864	848	19712
1986	13901	631	20	650	0.030	12853	398	13251
1987	6168	528	75	603	0.124	4875	609	5565

[6] 1982-1986 wild fish estimated by dorsal fin condition and otoliths. 1987-1999 adipose fins were clipped on all hatchery fish.

Year	Run to Wells Dam	Number in broodstock			Wild%	Run over Wells Dam		
1988	5010	581	70	651	0.108	3888	471	4359
1989	5301	629	95	724	0.131	3977	600	4577
1990	4577	644	91	735	0.124	3366	476	3842
1991	8481	588	70	658	0.107	6986	837	7823
1992	7628	599	34	633	0.054	6617	378	6995
1993	3043	534	46	586	0.079	2263	194	2457
1994	2800	581	38	619	0.062	2045	136	2181
1995	1472	521	0	521	0.123	834	117	951
1996	4523	350	19	369	0.051	3942	212	4154
1997	4534	449	11	460	0.024	3976	98	4074
1998	3083	379	31	410	0.076	2470	203	2673
1999	3958	341	47	388	0.121	3138	432	3570

Table 22 Summary of life history timing for Methow subbasin summer steelhead

Life history stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult migration	■	■	■	■	■		■	■	■	■	■	■
Adult spawning			■	■	■	■	■					
Egg incubation			■	■	■	■	■	■				
Juvenile rearing	■	■	■	■	■	■	■	■	■	■	■	■
Smolt migration				■	■	■						

Population Delineation and Characterization

Summer steelhead, native to the Methow basin, are the exclusive ecotype of the inland waters. Steelhead were not extirpated in the Methow River, as were coho, probably because of headwater resident forms sustaining the run (Mullan et al. 1992b). Anadromy is not obligatory in *O. mykiss* (Rounsefell 1958; Mullan et al. 1992b).

Progeny of anadromous steelhead can spend their entire life in freshwater, while progeny of rainbow trout can migrate seaward. Anadromy, although genetically linked (Thorpe 1987), runs under environmental instruction (Shapovalov and Taft 1954; Thorpe 1987; Mullan et al. 1992b).

Population Status

The Methow subbasin once was a productive wild steelhead system, but has declined significantly since the early 1900s. Wild summer steelhead in the Methow subbasin sustain themselves only at threshold population size today, and were listed as Endangered under the ESA on August 18, 1997.

Population Management Regimes and Activities

In addition to the effects of an obstruction constructed by Washington Water Power's dam, which blocked the Methow River at Pateros in the early 1900s, a historic network of unlined ditches grew with the settlement, along with roads and land clearing.

The mainstem barrier was removed circa 1929, and the network of ditches has now been converted to at least 27 irrigation canals operated by both public and private entities in the Methow subbasin; operations incorporate a range of fish mitigation measures. Many operators have upgraded their facilities in recent years; enhancements include elimination of fish passage barriers, replacement and repair of screens, and improvements to the overall irrigation system. Some of these have established target flows and habitat conservation plans.

Hatchery programs that have been designed to mitigate for losses in the major mainstem Columbia River hydro system, and in non-target or catch-and-release recreational fisheries combined with selective tribal fisheries, appear to have reversed declines in wild populations.

Hatchery Effects

The high hatchery return rate, the genetic homogeneity of hatchery and wild steelhead (Chapman et al. 1994b), and the maintenance of near-maximum sustained yield (MSY) levels in most years suggest a truly wild fish does not exist. Rather, natural production sustains them only at threshold levels; without hatchery supplementation, the Methow River steelhead would suffer dire consequences.

Despite the natural production sustaining them at threshold population size, the biological fitness of the hatchery spawners allows the population to meet pre-development MSY escapement and smolt production in most years (Mullan et al. 1992b).

A high percentage of hatchery males can return after one winter (Brown 1995; Bartlett 1999-2000). This does not mean that the hatchery fish are the "ecological equivalents of wild fish in all life history phases" (Chapman et al. 1994b); although, Mullan et al. (1992b) found no difference in smolt-to-adult survival for hatchery versus wild steelhead. A portion of the hatchery-released steelhead remains in the freshwater for another winter (Bartlett 1997, 1999-2000; K. Williams, pers. comm.), increasing the fitness of returning adults (Chapman et al. 1994b). In addition, the resident form contributes to anadromy at varying degrees, inversely related with the steelhead productivity.

The return percentage of hatchery verses wild origin adult summer steelhead over Wells Dam is provided in (**Table 23**).

Table 23 Hatchery versus wild origin adult summer steelhead over Wells Dam

Release year	Smolts released[7]	Adult return to Wells Dam[8]	1-salt fish[9]	2-salt fish	% to Wells Dam	Adult return over Wells Dam	1-salt fish	2-salt fish	% return over Wells Dam
1966	199720				1.19				1.06
1967	187676	2199	1319	880	1.13	2028	1217	811	0.88
1968	100644	2667	1600	1067	1.57	2254	1352	902	1.10
1969	205457	1299	779	520	1.42	769	461	308	1.23
1970	322462	2023	1214	809	1.05	1624	974	650	0.94
1971	220384	4257	2554	1703	1.02	3899	2339	1560	0.81
1972	327902	2069	1241	828	0.59	1715	1029	686	0.42
1973	170602	2473	1459	1014	0.16	1846	1089	757	0.10
1974	182111	632	145	487	0.90	372	86	286	0.76
1975	249279	732	600	132	2.14	505	414	91	2.00
1976	238405	4973	3929	1044	2.52	4636	3662	974	2.27
1977	147922	5819	4422	1397	0.29	5464	4153	1311	0.24
1978	164259	1831	256	1575	2.99	1475	207	1269	2.72
1979	268252	4138	3972	166	2.69	3771	3620	151	2.36
1980	471420	3735	2801	934	0.95	3363	2522	841	0.94
1981	358234	4757	333	4424	1.25	4107	287	3820	1.24

[7] Includes only smolts planted at or above Wells Dam.
[8] Includes broodstock plus dam count. 1967-1982 is combination of hatchery and wild. 1982-1999 is hatchery fish only.
[9] 1967-1972 ocean age unknown, but estimated by 0.6 and 0.4 for 1-salt and 2-salt, respectively. Return rates prior to 1982 were combination of hatchery and wild.

Release year	Smolts released[7]	Adult return to Wells Dam[8]	1-salt fish[9]	2-salt fish	% to Wells Dam	Adult return over Wells Dam	1-salt fish	2-salt fish	% return over Wells Dam
1982	379472	7849	3689	4160	7.54	7805	3668	4137	7.27
1983	494784	19937	19140	797	3.48	19276	18505	771	3.35
1984	466545	16919	7444	9475	3.95	16246	4148	9098	3.78
1985	413066	19582	9791	9791	1.83	18864	9432	9432	1.71
1986	452844	13484	4854	8630	1.22	12853	4627	8226	1.08
1987	564315	5403	2702	2702	0.57	4875	2437	2437	0.49
1988	826208	4469	1654	2815	0.69	3888	1439	2450	0.59
1989	623003	4607	3040	1566	0.67	3977	2625	1352	0.60
1990	740433	4009	1323	2686	1.19	3366	1111	2255	1.10
1991	656997	7574	4696	2878	0.82	6986	4331	2655	0.71
1992	541610	7216	3067	4149	0.42	6617	2812	3805	0.22
1993	511295	2803	477	2326	0.35	2263	385	1878	0.35
1994	420110	2626	945	1681	0.44	2045	1248	757	0.36
1995	450345	1355	501	840	1.19	834	309	517	1.08
1996	347950	4292	2962	1331	0.99	3942	2720	1222	0.87
1997	427900	4425	2036	2390	0.64	3976	1829	2147	0.57
1998	543030	2849	1453	1396		2470	1260	1210	
1999	843385	3479	2192	1287		3138	1977	1161	

Hydroelectric Effects

As noted in Section 2.1, steelhead populations in the subbasin were severely depressed following the removal of Washington Water Power Company's dam on the Methow River at Pateros in about 1929, with steelhead persisting as rainbow trout (Mullan et al. 1992b).

Anadromous salmonids, including upper Columbia River summer steelhead depend on intact, complex and functioning habitat to support healthy populations. Perturbations in habitats throughout the Columbia Basin and ocean environments are replete, including those associated with mainstem Columbia River's hydroelectric development and operation.

Continued development of the hydropower facilities throughout the Columbia River Basin have irrevocably altered terrestrial and aquatic habitats, and have contributed to limiting anadromous fish populations. Today, anadromous fish migrating to the ocean encounter Wells Dam just downstream from the Methow's confluence with the Columbia River. Beyond Wells Dam, eight more downstream dams along the Columbia River impede fish passage to the ocean.

Wells Dam fishway, which became operational in 1967, estimated wild run size above the dam at 1,500 to 2,000 fish in the late 1960s (**Table 23**). Hatchery fish made up an increasing fraction of the steelhead run after the 1960s, as wild runs were already depleted (Chapman et al. 1994b). Mullan et al. (1992b) spawner-recruit analysis calculated the MSY run size and escapement for the Methow subbasin at 7,234 fish and 2,212 fish, respectively.

In attempts to mitigate for hydro-related impacts in the Mid-Columbia Region, WDFW operates summer steelhead supplementation programs associated with the Wells Dam HCP. The goal of the artificial production programs is two-fold: a) to mitigate for fishery losses because of inundation and to provide No Net Impact of unavoidable losses because of operation of Wells Dam, Rocky Reach Dam and Rock Island Dam, while; b) contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, maintaining genetic and ecological integrity and supporting harvest.

Harvest Effects

Wild fish have been subjected to, and have suffered as a result of, mixed stock fisheries in the lower Columbia River that are directed at their abundant hatchery cohort.

The intensive commercial fisheries in the late 1800s, along with industrial development of the Columbia River, were largely responsible for the decline of the wild steelhead run (Mullan et al. 1992b; Chapman et al. 1994b). Curtailing the commercial fisheries resulted in a resurgence of wild steelhead productivity in the upper Columbia River region, where the run size tripled (5,000 fish to 15,000 fish) between 1941 and 1954 (Mullan et al. 1992b).

Commercial harvest of steelhead by non-tribal members was prohibited beginning in 1975. Incidental catches of steelhead do occur in present-day sockeye and fall salmon fisheries within Zones 1-5, but are minimized with time, area, and gear restrictions.

Above Bonneville, in Zone 6, only the treaty tribes conduct commercial harvest. The Zone 6 tribal commercial fishery does not selectively remove wild steelhead from gill nets, thus, both marked and unmarked fish are retained. Total catches in recent years (1985 through 1996) ranged from 86,000 in 1985 down to 5,300 in 1998. Between 1990 and 1998, tribal catches have averaged 22,100 (WDFW & ODFW 1999). Current information based on GSI analysis, however, indicates an impact of less than 10% for upper Columbia stocks (Rawding et al. 1998).

Recreational fisheries occur throughout the Columbia and Snake River watersheds. Fisheries that harvest upper Columbia steelhead occur in Zone 6 waters above the Snake River confluence, including Hanford Reach up to Chief Joseph Dam and major tributaries in Wenatchee, Entiat, Methow and Okanogan watersheds.

Since 1984, wild steelhead release has been required in these waters (i.e., steelhead with adipose fins), and since 1997, no recreational fishery targeted at steelhead has been permitted above Priest Rapids Dam. The Confederated Tribes of the Colville Indian Reservation (CCT) do take steelhead incidental to their summer Chinook snag fishery below Chief Joseph Dam, and in the Okanogan River net fishery, but Chapman et al. (1994b) concluded tribal fishing above Zone 6 was insignificant, and despite large numbers being taken in some years, the overall percentage of the catch to the total run was low.

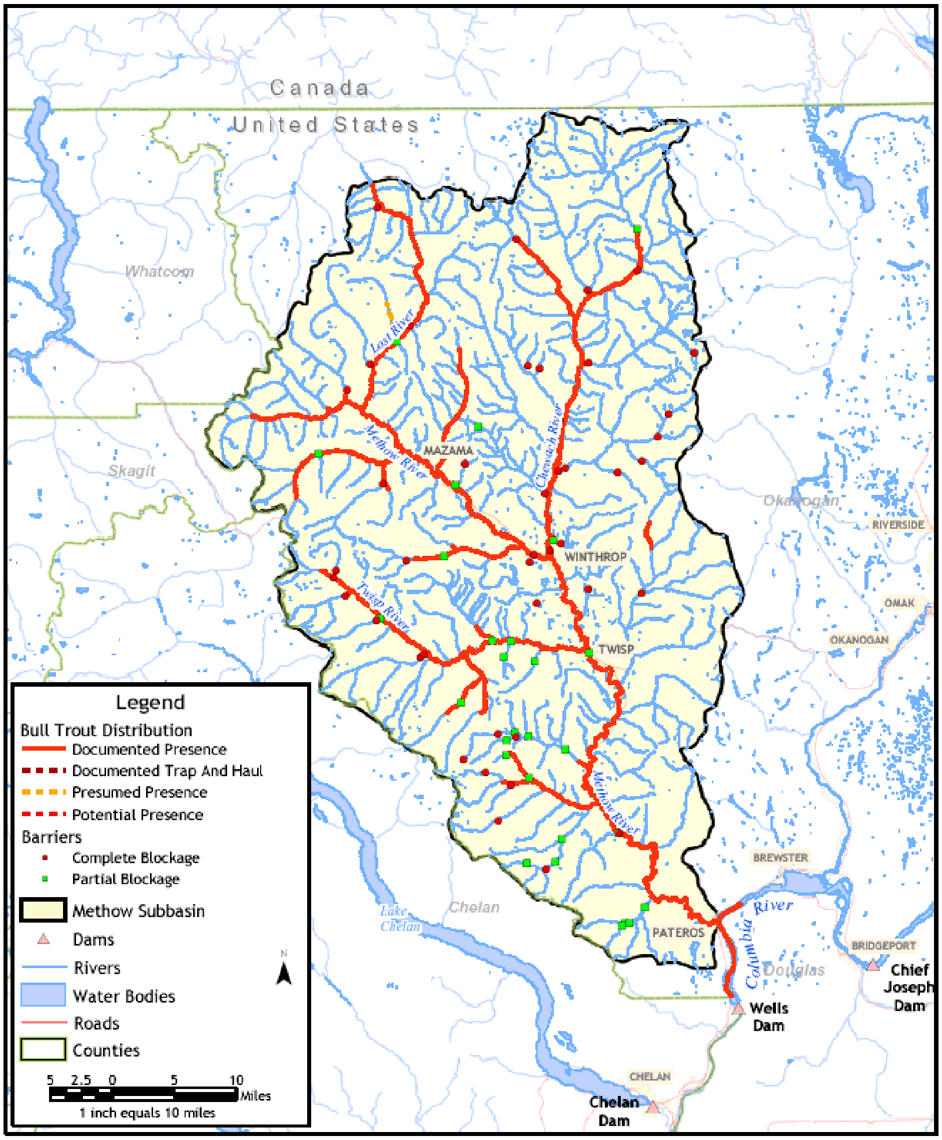
3.4.4 Bull Trout

Historically, four general forms of bull trout are recognized, each with a specific behavioral or life history pattern: anadromous, adfluvial, fluvial, and stream-resident. The Methow River subbasin is known to support fluvial, adfluvial and resident populations of bull trout. Known distribution of bull trout in the Methow subbasin are illustrated in **Figure 16**.

Adfluvial populations of bull trout are found in the Lost River and Lake Creek. Fluvial populations of bull trout are found throughout the Methow subbasin. Resident populations are found in many other streams including upstream of many natural barriers.

Rationale for Selection

The FWS listed the Columbia River Distinct Population Segment (DPS) for bull trout as Threatened under the Endangered Species Act of 1973, as amended on June 10, 1998. Methow subbasin bull trout, as a focal species, will enable subbasin-specific management prescriptions relating to the Columbia River bull trout recovery plan.



Source:Data Layers: Fish distribution and barriers (WDFW), Subbasins and Dams (StreamNet), Counties & Major Rivers (WA Ecology), State Routes (WashDOT). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004")

Figure 16 Bull Trout Distribution in the Methow Subbasin

Key Life History Strategies, Relationship to Habitat

Bull trout distributions in the Methow watershed parallel the habitat conditions; the more pristine the habitat, the more robust the bull trout populations. Proebstel et al. (1998) reported that in general, bull trout were found to be persisting in small headwater populations. The Lost River and Robinson Creek Watershed Analysis (USFS 1999c) states, "Roads, access, and resultant overfishing in most waters are probably the most limiting production factors to bull trout resulting from man's influence."

Bull trout have more specific habitat requirements that do other salmonids. Their habitat components requirements are summed up by the "Four C's" – cold, clean, complex and connected. Bull trout are believed to be among the most temperature sensitive cold-water species found in western North America (Dunham et al. 2003). Water temperatures above 15 degrees Celsius (59 degrees Fahrenheit) are believed to limit bull trout distribution, a limitation that may partially explain their patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995; Dunham et al. 2002).

Bull trout normally reach sexual maturity in 4 to 7 years and have a life span of 12 or more years. Repeat and alternate year spawning has been reported, although repeat spawning frequency and post spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989: Pratt 1992; Rieman and McIntyre 1996).

Adult Methow bull trout migrate from some of the warmest water in their range in the Columbia River, back to cold headwater streams to spawn in the Methow. The coldest water is most often found in isolated headwater stream locations. After entering tributaries, most bull trout remained within them until October-November, when they migrated back to the mainstem Columbia River (BioAnalysts 2002, 2003).

Migration of bull trout from the Columbia River into the Methow subbasin occurs in May through June (BioAnalysts 2002, 2003). Spawning begins in headwater streams in mid-September and continues through October, with temperatures during spawning of 41 to 48 degrees Fahrenheit (3 to 9 degrees Celsius) (Goetz 1989; Brown 1994).

Migratory juveniles usually rear in natal streams for one to four years before emigration (Goetz 1989; Fraley and Shepard 1989; Pratt 1992). Methow subbasin juvenile bull trout rear in the coldest headwater locations until they reach a size that allows them to compete with other fish (75-100 mm) (Mullan et al. 1992 CPb).

Non-migratory forms above barrier falls probably contribute a limited amount of recruitment downstream; nevertheless, this recruitment contributes to fluvial and adfluvial productivity. The fluvial forms migrate to the warmer mainstem Methow and Columbia Rivers (e.g., Twisp River, Wolf Creek), while the adfluvial populations (e.g., Lake Creek, Cougar Lake) migrate to nearby lakes.

In Methow subbasin tributaries, bull trout spawning and early rearing is confined to streams cold enough (less than 1,600 C annual temperature units) to support them in the areas below the falls (Mullan et al. 1992 CPa). In most cases, such reaches are very short (less than 5 miles).

Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

A summary of bull trout spawning surveys in the Methow is provided in . After spawning, fluvial and adfluvial kelts return to their more moderate environments, while resident forms seek winter refuge (**Table 24**).

Table 24 Bull trout survey summary for the Methow subbasin (1992-2003)

Stream	**'92**	**'93**	**'94**	**'95**	**'96**	**'97**	**'98**	**'99**	**'00**	**'01**	**'02**	**'03**
Chewuch River Mainstem										9	11	6
-Lake Creek up stream of Black Lake				22	13*	9	8	0	8	21	11	10*
-Lake Creek down stream of Black Lake									4	1		4
Methow River												
-Goat Creek				0					11*		4	3
-Lost River	5*		0	0*			0					
-Monument Creek	2*	0										
-Crater Creek					2*	2	1	0		0	1	0
-Wolf Creek					3	3*	27	29	15	20	15	18*
-Early Winters Creek					9*	1*	2	0	3	5	6	0*
-Cedar Creek					1	2*		0				
-West Fork Methow River				27	15	13*	11*	1	2	19	54	
Twisp River												
-Twisp River North Fork to Barrier Falls	3*	5*	4*	18	0*	2*	67	38	72	53	67	30
-Twisp River Reynolds Creek to South Creek										19	13	16

-East Fork Buttermilk				4*	0*		0	0*	0	2	3	3
-West Fork Buttermilk											7	9
-Reynolds Creek	1*				0*					1*	0	
_North Creek				3*			19	63	33	0	2	29

*Incomplete counts as to time (single survey) and/or space (only part of index area surveyed).

summarizes redd counts of most known spawning populations. Full inventories of all streams for bull trout presence and redd counts are not complete.

Relationship with Other Species

In the Columbia River basin, bull trout occur with native cutthroat trout (*Oncorhynchus clarki* subspecies), resident (redband) and migratory (steelhead) rainbow trout (*O. mykiss*), Chinook salmon (*O. tshawytscha*), sockeye salmon (*O. nerka*), mountain whitefish (*Prosopium williamsoni*), and various sculpin (*Cottidae*), sucker (*Catostomidae*), and minnow (*Cyprinidae*) species (Mauser et al. 1988; WDF et al. 1993; WDFW 1998).

Bull trout habitat within the Methow River Basin overlaps with the range of several fishes listed as Threatened, Endangered, or proposed for listing under the Endangered Species Act (ESA), including Endangered steelhead and Endangered Upper Columbia River Spring Chinook. Because of short cold water reaches, suitable spawning habitat is largely limited in the east and west forks of Buttermilk Creek, Chewuch River, Crater Creek, Goat Creek, Wolf Creek, Lost River, Early Winters Creek, Cedar Creek, Monument Creek and Reynolds Creek. Behnke (2002) notes that the relatively smaller size of westslope cutthroat trout (WSCT) adults compared to other cutthroat subspecies may be because of their coevolution with two highly piscivorous species: bull trout and northern pikeminnow.

Non-native salmonids have been widely introduced, and have become established in numerous areas throughout the range of bull trout. These species include brook trout (*Salmo fontinalis*), lake trout brown trout (*S. trutta*), Arctic grayling (*Thymallus arcticus*), and lake whitefish (*Coregonus clupeaformis*). Kokanee (a freshwater form of *O. nerka*), non-native strains of rainbow trout, and non-native subspecies of cutthroat trout have also been introduced into areas where they did not occur naturally. Other non-native species that have been introduced into habitat occupied by bull trout include smallmouth bass, walleye, opossum shrimp, channel catfish, American shad, and yellow perch.

Population Delineation and Characterization

A summary of five surveyed bull trout spawning aggregates is illustrated in **Table 25**.

Table 25 Five potential Methow subbasin bull trout spawning aggregates with life history representation

Aggregate	Resident	Fluvial	Adfluvial
Chewuch River (including Lake Creek)			
		X	X
Upper Methow R. (including West Fork Methow, Early Winters/Cedar creeks, Wolf Creek, Goat Creek)			
	X	X	X
Lower Methow R. (including Blue Buck/Beaver creeks, Crater/Gold creeks)			
		X	
Twisp River (including North Creek, Buttermilk Creek, Reynolds Creek)			
	X	X	
Lost River (including upper Lost River, Monument Creek, Cougar and Hidden lakes)			
	X	X	X

The USFWS Draft Bull Trout Recovery Plan (2002) delineated 8 local populations of bull trout within the Methow Core Area. However; the Upper Columbia Bull Trout Recovery Team has modified their delineation to 9 populations. These populations include Gold, Beaver, Wolf, Goat, and Early Winters creeks and Twisp, Chewuch, Lost and Upper Methow rivers (Barbara Kelly-Ringel 2004, pers.comm.). Comprehensive redd surveys, coupled with preliminary radio telemetry work in the Wenatchee basin, suggests the 9 remaining spawning populations may not be complete genetic isolates of one another but rather possibly co-mingle to some degree. It is possible that the nine spawning aggregates represent the Methow subbasin, but more monitoring and DNA analysis is necessary. The Lost River aggregate gene flow occurs only in high water years and not always between all represented groups. Assumptions regarding the historic and current distribution of bull trout in the Methow subbasin as part of the QHA Analysis are summarized in electronic Appendix C.

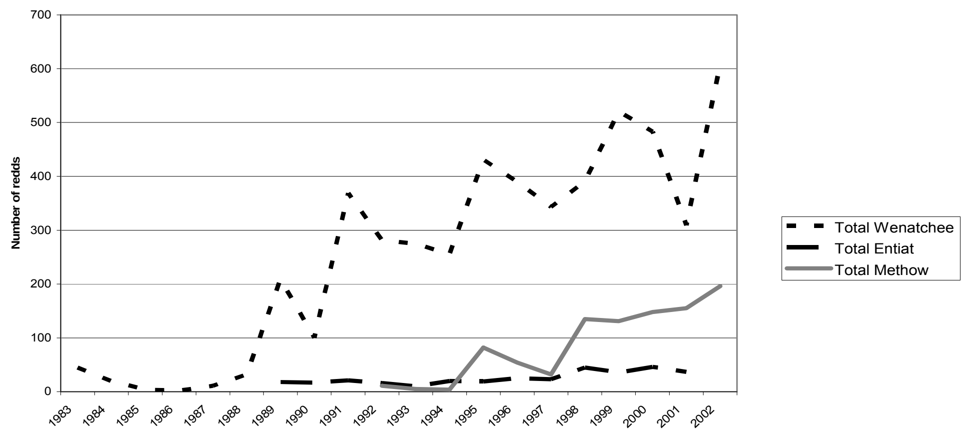
Population Status

Columbia River DPS bull trout are listed as Threatened. The FWS's Bull Trout Recovery Plan is under development and will be finalized within the next year. The FWS is currently in the process of finalizing the Critical Habitat Designation for the Columbia River DPS. This designation will be final on September 23, 2004. (Kate Terrell USFS 2004, pers. comm.). The current version of the recovery plan is available at http://pacific.fws.gov/bulltrout/recovery/Default.htm

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992; Schill 1992; Thomas 1992; Ziller 1992; Rieman and McIntyre 1993; Newton and Pribyl 1994; Idaho Department of Fish and Game, in litt. 1995; McPhail and Baxter 1996). These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors, poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device into diversion channels and dams), and introduced non-native species.

The Methow River Basin has eight local populations (FWS). Of these, only the Lost River is considered healthy; the rest are listed as unknown (WDFW 1998). It appears that most of the local populations of bull trout, and in particular, the non-migratory forms, have little or no information available concerning their status. This is identified by FWS (2002) as a major need to help recover bull trout. Redd surveys began in the Methow River subbasin in the early 1990s to complement other spawning grounds surveys in the upper Columbia.

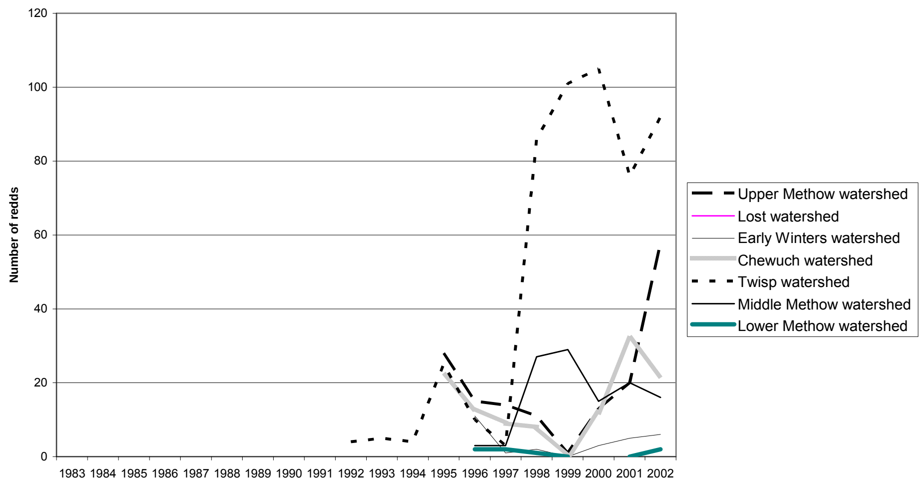
Bull trout redd counts in all subbasins within the CCP show an increase since the mid-1990s, especially within the Methow Basin (**Figure 17**); although, it should be noted that this trend may be a factor of increased effort in redd surveys in recent years (K. MacDonald, USFS, pers. comm.).



Source: Pevan 2004. Data from USFWS and USFS

Figure 17 Comparison of bull trout redd counts between the Wenatchee, Entiat, and Methow Subbasins

Within the Methow subbasin, the Twisp River basin is the largest producer of bull trout, averaging two to three times more redds than any other spawning area within the Methow Basin (**Figure 18**). The average number of redds within the basin has increased from less than 100 in the mid-1990s to greater than 150 since 1998.



Source: Pevan 2004. Data from USFWS and USFS

Figure 18 Bull trout redd counts in the Methow River Basin

Population Management Regimes and Activities

Recent comprehensive redd surveys, coupled with preliminary radio telemetry work in the CPP, suggest that remaining spawning populations are not complete "genetic isolates" of one another, but rather co-mingle to some degree (Foster et al. 2002). This comports with the belief of the prevalence of three independent populations in the CPP (in the Wenatchee, Entiat, and Methow). It is possible that there are separate, local spawning aggregates, but more monitoring and DNA analysis is necessary to be able to empirically determine this.

The chance of finding independent subpopulations within each subbasin would most likely found be in headwater areas upstream of barriers, which prevent immigration from downstream recruits, but not emigration to downstream areas during high water events.

Hatchery Effects

Introduced brook trout threaten bull trout through hybridization, competition, and possibly predation (Thomas 1992; WDW 1992; Clancy 1993; Leary et al. 1993; Rieman and McIntyre 1993; MBTSG 1996h). Hybridization results in offspring that are frequently sterile (Leary et al. 1993), although recent genetics work has shown that reproduction by hybrid fish is occurring at a higher level than previously suspected (Kanda 1998). Hybrids may be competitors; Dunsmoor and Bienz (L. Dunsmoor and C. Bienz, Klamath Tribe, in litt. 1997) noted that hybrids are aggressive and larger than resident bull trout, suggesting that hybrids may have a competitive advantage. Brook trout mature at an earlier age and have a higher reproductive rate than bull trout. This difference may favor brook trout over bull trout when they occur together, often leading to replacement of bull trout with brook trout (Clancy 1993; Leary et al. 1993; MBTSG

1995b). The magnitude of threats from non-native fishes is highest for resident bull trout because they are typically isolated and exist in low abundance.

Non-native brook trout may have an adaptive advantage over sympatric bull trout in degraded habitats where seasonal water temperatures or fine sediments levels, for example, are elevated above historical levels (Clancy 1993; Rich 1996; Dunsmoor and Bienz, in litt. 1997; Adams 1994; MBTSG 1998, 1996h). Because elevated water temperatures and sediments are often indicative of degraded habitat conditions, bull trout may be subject to stresses from both interactions with brook trout and degraded habitat (MBTSG 1996h).

Bull trout are present in Blue Buck and the mainstem of Beaver Creek; however, populations in Eightmile Creek are of unknown status. Cold water is not a deterrent for brook trout, and maturation of brook trout occurs at ages two to four, whereas maturation for bull trout occurs at ages six to nine (Mullan et al. 1992b). Since there are no barriers to block their passage, brook trout found in the Twisp River can easily invade the bull trout zone upstream; competition with other species, however, has probably limited brook trout productivity.

Hydroelectric Effects

Dams affect bull trout by: altering habitats; flow, sediment, and temperature regimes; migration corridors, and by creating additional well-coordinated interactions, mainly between bull trout and non-native species (Rode 1990; WDW 1992; Craig and Wissmar 1993; Rieman and McIntyre 1993; Wissmar et al. 1994; T. Bodurtha, FWS, in litt. 1995; USDA and USDI 1996, 1997). Impassable dams have caused declines of bull trout by preventing migratory fish from reaching spawning and rearing areas in headwaters and recolonizing areas where bull trout have been extirpated (Rieman and McIntyre 1993; MBTSG 1998).

Some of the major effects to bull trout resulting from the Federal Columbia River Power System, and from operation of other hydropower, flood control, and irrigation diversion facilities, include the following: a) fish passage barriers; b) entrainment of fish into turbine intakes and irrigation canals; c) inundation of fish spawning and rearing habitat; d) modification of stream flows and water temperature regimes; e) dewatering of shallow water zones during power peaking operations; f) reduced productivity in reservoirs; g) periodic gas supersaturation of waters downstream of dams; h) water level fluctuations interfering with retention of riparian vegetation along reaches affected by power peaking operations; i) establishment of non-native riparian vegetation along reaches affected by power peaking operations, and; j) severe reductions in reservoir levels to accommodate flood control operations. Recent studies indicate that adult bull trout are passing the Mid-Columbia dams at rates similar to their anadromous salmonid counter parts (BioAnalysts, 2003).

The Chief Joseph and Grand Coulee dams were built without fish passage facilities, and are barriers to bull trout migration. These barriers have contributed to the isolation of local populations of migratory bull trout. The middle Columbia, and lower Columbia River hydropower projects have both adult and juvenile fish passage facilities, but these fishways were designed specifically for anadromous salmonids, not for resident fish such as bull trout. The designs, therefore, address the migration needs of anadromous salmonids, primarily semelparous (i.e., fish that spawn only once in a lifetime) of the genus *Oncorhynchus* (except steelhead, that, in some instances, can spawn more than once in a lifetime). They do not include consideration for iteroparous fish (i.e., those that can spawn more than once), or fish that merely wander both upstream and downstream as adults to forage. Bull trout have been observed using upstream fish passage facilities at many of the hydropower projects on the Columbia River. However, as indicated above, even dams with fish passage facilities may be a factor in isolating bull trout local populations if they are not readily passable by bull trout and/or if the dams do not provide an adult downstream migration route.

Entrainment of bull trout may also occur at various projects in the Columbia River basin, including Rocky Reach, Rock Island, Wells, and Bonneville dams. Fish can be killed or injured when passing the dams. Potential passage routes include through spill, turbines, or the juvenile bypass systems, but the relative passage success of these routes for adult salmonids has not been thoroughly investigated. One study conducted in the early 1970s, however, revealed that passage through turbines resulted in a 22-41% mortality rate for adult steelhead (Wagner and Ingram 1973). Additionally, a 40-50% injury rate for adult salmonids passing through the juvenile fish bypass system at McNary Dam has been noted (Wagner 1991; Wagner and Hilson 1993). Adult bull trout may experience similar mortality rates. Moreover, those adult fish that survive passage at projects that do not have upstream passage facilities are isolated in downstream reaches away from their natal (native) streams. As indicated above, the loss of these larger, more fecund migratory fish is detrimental to their natal populations. A three year radio telemetry study was initiated in 2001 to track bull trout movement within the Upper Columbia region. A total of 79 bull trout were tag at the three Mid-Columbia Dams (Rock Island, Rocky Reach and Wells). During this study, no mortalities of bull trout associated with the dams were documented (BioAnalysts 2002, 2003).

The creation of mainstem Columbia River pools (i.e., the areas of slow moving water behind the dams) combined with introductions of piscivorous species (e.g., bass, walleye) has also affected the habitat of bull trout and other salmonids. An increase in predator populations, both native (e.g., northern pikeminnow) and non-native, as a result of creating artificial habitat and concentrating prey, is discussed as a factor for the decline of each listed Snake River salmon species (NMFS 1991a, b, and c). Ideal predator foraging environments have been created in these pools, particularly for warm water species in the summer. Smolts that pass through the projects are subjected to turbines, bypasses, and spillways that may result in disorientation and increased stress, reducing the smolts' ability to avoid predators below the dams. Creation of the pools above the dams has resulted in low water velocities that increase smolt travel time and increase predation opportunity. Increased water temperatures, also a result of the impoundment of the river, have also been shown to increase predation rates on salmonid smolts (Vigg and Burley 1991). Because bull trout are apex (top) predators of other fish, negative effects to the salmonid smolt prey base, and the resulting decline in adult returns, are likely to affect bull trout negatively as well. Additionally, increased water temperatures, influenced by the presence of dams, also decreases the suitability of the lower Snake and Columbia river pools for bull trout in the late spring through early fall.

Uncontrolled spill, or even high levels of managed spill, at hydropower projects can produce extremely high levels of total dissolved gas that may impact bull trout and other species. These high levels of gas supersaturation can cause gas bubble disease trauma in fish. Gas bubble disease is caused by gas being absorbed into the bloodstream of fish during respiration. Effects can range from temporary debilitation to mortality, and supersaturation can persist for several miles below dams where spill occurs. The states of Oregon and Washington have established a 111% total dissolved gas level as state water quality standards. However, total dissolved gas levels of up to 120% have been experienced during recent years of managed spill in the Federal Columbia River Power System, with involuntary spill episodes resulting in total dissolved gas levels of as high as 140% at some sites (NMFS 2000). At levels near 140%, gas bubble disease may occur in over 3% of fish exposed. At levels of up to 120%, the incidence of gas bubble disease decreases to a maximum of 0.7% of fish exposed (NMFS 2000).

Manipulated flow releases from storage projects alter the natural flow regime, affect water temperature, have the potential to destabilize downstream streambanks, alter the natural sediment and nutrient loads, and cause repeated and prolonged changes to the downstream wetted perimeter (MBTSG 1998). Power peaking operations, that change the downstream flow of the river on a frequent basis, cause large areas of the river margins to become alternately wet and then dry, and adversely affect aquatic insect survival and production (Hauer and Stanford 1997). Changes in water depth and velocity as a result of rapid flow fluctuations and physical loss or gain of wetted habitat, can cause juvenile trout to be displaced, thus, increasing their vulnerability to predation. Additionally, rapid flow reductions can strand young fish if they are unable to escape over and through draining or dewatered substrate. These effects also indirectly adversely affect bull trout by degrading the habitat of their prey (small fish) and the food upon which they depend (aquatic insects).

Most bull trout pass counting windows at mainstem dams on the Columbia during May and June (Chelan PUD, unpublished data). Diel timing of migration at the dams indicates that fish pass primarily during day light hours (Figure CP28).

At mainstem dams on the Columbia River within the CCP, very low numbers of juvenile bull trout have been documented passing through the project between April and August, with the lowest numbers primarily seen in June (Chelan PUD, unpublished data). This may be due to the limited sampling periods of juveniles in the by-pass facilities (Chelan PUD, unpublished data).

Harvest Effects

Currently, the harvest of bull trout is prohibited on all stocks in the Methow subbasin with the exception of the Lost River. Fishing may have been a leading factor in the decline of bull trout. In streams currently open to fishing of other species, bull trout are vulnerable to take due to misidentification, hooking mortality, poaching, and disturbance. Schmetterling and Long (1999) found that 44 percent of anglers correctly identified bull trout and anglers frequently confused similar species. Incidental hooking mortality varies from less than 5% to 24% for salmonids caught on artificial lures, and between16% and 58% for bait caught salmonids (Taylor and White 1992; Pauley and Thomas 1993; Lee and Bergersen 1996; Shcill 1996; Schill and Scarpella 1997). Eggs and alevins in redds are vulnerable to wading-related mortality which can cause mortality of up to 46% from a single wading event (Roberts and White 1992).

The Lost River, above Drake Creek, is open to bull trout harvest. It is thought that the strength of the healthy population and the remote location will keep harvest within a sustainable level. This fishery should continually be monitored for the effects of this fishery on the population.

3.4.5 Westslope cutthroat trout

Westslope cutthroat trout generally exhibit three main life history forms: fluvial (migrate between smaller spawning streams and larger streams to grow); adfluvial (migrate between spawning streams and a lake, where growth occurs); and non-migratory (generally spend their entire lives in the stream they were born). Much of the life history of WSCT in the Methow River is unknown at this time.

WSCT use many of the smaller streams within the Methow Basin as well as the mainstem Methow. Most reside in the upper reaches of higher order streams within the basin, as well as in some of the Alpine lakes.

Limiting factors for WSCT in the Methow River may be channel stability, habitat diversity, obstructions, temperatures, and riparian conditions. These factors need to be considered in relation to the life history of WSCT (e.g., temperatures probably always limited WSCT distribution within Methow River streams; however, conservation of known areas of abundance would increase the likelihood that they could persist in high quality habitats).

Rationale for Selection

Currently, WSCT are thought to be distributed widely within the CCP. Assumptions regarding the historic and current distribution of WSCT in the Methow subbasin as part of the QHA Analysis are summarized in electronic Appendix C.

Thurow et al. (1997) used predictive models to estimate the range and status of WSCT throughout the Interior Columbia Basin. Their models suggest that WSCT populations within the CCP headwater areas are currently “strong” in most areas; however, they are currently listed under ESA as a species of special concern, and, thus, elevated in importance to that of an important stock refuge.

Management Description of Focal Species/Populations

The FWS (1999) identified various factors that may be affecting the WSCT habitat or range in the CCPO. These factors included channelization or stream alteration within the mainstem of the Methow River, increased sediment loading, erosion, and irrigation withdrawals.

Other factors listed include past wild fire activity, flash flooding, timber harvest, and fragmentation of subpopulations by either man-made habitat alterations or natural barriers. Another potential threat mentioned was the introduction of non-native species within each drainage; introductions of brook trout and non-native *O. mykiss* were identified as being of particular concern (K. MacDonald, pers. comm.).

Key Life History Strategies, Relationship to Habitat

Differing potamodromous forms of WSCT may be found together in sympatry throughout their range (reviewed in Behnke 2002; Wydoski and Whitney 2003). Historically, most populations within the CCP were strictly fluvial (non-migratory) or fluvial-adfluvial ecotypes; although, lacustrine-adfluvial forms existed in the Lake Chelan Basin (Williams 1998). Current lacustrine populations (primarily high mountain lakes) are largely a result of hatchery plantings (Williams 1998).

From Foster et al. 2002 (edited), allopatric cold-water species such as cutthroat can flourish in much warmer environments than in sympatry, but they are vulnerable to displacement by species better suited to warmer temperatures, such as the rainbow trout (Mullan et al. 1992 CPa). Westslope cutthroat trout reside in cold-water refugia where interactive threats from other species are absent because: a) many populations are protected from invasion by barrier falls and, b) most invaders are competitively debilitated by cold temperature. The brook trout is the lone exception. Brook trout, a cold-water species itself, may replace cutthroat in low gradient streams with sandy substrates. The threat from brook trout results from stocking them above an existing cutthroat trout population.

Howell et al. (2003) found that genetically "pure" WSCT were found in suspected allopatric zones, which were usually limited to a few [miles] in the upper reaches of WSCT distribution.

Adult migration

WSCT may migrate long distances, depending on the ecotype (Schmetterling 2001; Wydoski and Whitney 2003). Fish in the St. Joe River in Idaho were found to migrate up to 214 kilometres (132 miles) (Trotter 1987). In the Blackfoot River, Schmetterling (2001) found WSCT moved an average of 39 kilometres (24 miles), and ranged from 12 to 72 kilometres (20 to 45 miles) in 1998.

No information is available for WSCT in the CCP for adult migration. However, given the size of some WSCT in the Methow River in recent years (> 500 mm (20 inches) (Mazama Fly Shop, pers. comm., photos), it seems reasonable to assume that these fish are most likely adfluvial ecotypes that probably spawn in the Upper Methow, Twisp and Chewuch rivers, and other tributaries. If this assumption is true, then fish may be easily migrating the average 39 kilometres (24 miles) that Schmetterling (2001) found in the Blackfoot River.

Non-migratory ecotypes usually do not migrate over 1 kilometre (0.6 mile) within the Blackfoot River (Schmetterling 2001), and usually appear in the CCP in areas upstream of physical or temperature barriers (Williams 1998; Wydoski and Whitney 2003).

Depending on life history, juveniles may move to a lake shortly after emergence if adfluvial-lacustrine (Behnke 2002), or may reside in tributaries for up to four years (Wydoski and Whitney 2003). Fluvial-adfluvial ecotypes may either move quickly, or spend up to three years in a stream before moving to a larger stream (Shepard et al. 1984; Liknes and Graham 1988; Behnke 2002). For juveniles that had reared in streams for extended time periods (years), most moved to either lakes or larger streams during high stream flows (Wydoski and Whitney 2003).

WSCT usually mature at four or five years of age (Downs et al. 1997; FWS 1999), and the maximum life span is typically six to eight years (Behnke 2002). Most fluvial-adfluvial ecotypes appear to mature at an earlier age than non-migratory forms (Downs et al. 1997; Schmetterling 2001; Wydoski and Whitney 2003). The oldest fish ever recorded was 13 years old in Wolf Creek, a tributary of the Methow River (Mullan et al. 2002 CPa); although, Downs et al. (1997) cite personal communication with N. Horner of IDFG stating that they have found fish to this age in Idaho as well.

Juveniles may reside for very short time periods in their natal area before migrating to larger streams or lakes, or they may spend up to four years there prior to migrating. While empirical information is limited, if the hypothesis that non-migratory ecotypes may give rise to migratory ecotypes, there may be occasions when fish may begin their migratory life style after four to five years as has been observed in steelhead (Peven 1990; Mullan et al. 1992 CPa).

Non-migratory adult fish are generally 150-250 mm (6-10 inches; Mullan et al. 1992 CPa; Downs 1997; Behnke 2002). Fluvial-adfluvial forms generally reach maximum sizes of between 410-470 millimetres (16-18.5 inches); Schmetterling 2001; Behnke 2002; Wydoski and Whitney 2003); although, Wydoski and Whitney have observed larger lacustrine forms (introduced) over 510 millimetres (20 inches).

Behnke (2002) notes that the relatively smaller size of adults of the WSCT compared to other cutthroat subspecies may be because of their coevolution with two highly piscivorous species: bull trout and northern pikeminnow. WSCT are rarely piscivorous and usually consist on aquatic and terrestrial insects.

Wydoski and Whitney (2003) reviewed length-at-age information for WSCT. At the end of their second year of life, WSCT ranged between 74 and 145 millimetres (3 and 5.8 inches). By the end of their fifth year, WSCT ranged from 140 to 320 millimetres (5.5 to 12.6 inches). WSCT from the CCP (Methow Basin) were consistently smaller at age (represented by the low end of the range at each age class) than WSCT lengths reported elsewhere in the literature.

Downs et al. (1997) found the average sex ratio for WSCT in headwater streams in Montana to be 1.3 males per female across streams (n=8) that they sampled. In the CCP, Mullan et al. (1992 CPa) found 0.9 males per female in the 412 fish sampled in the Methow River, comporting well with values of 0.2 and 0.9 males per female reported in other studies (Bjornn 1957; Johnson 1963; Lukens 1978; Thurow and Bjornn 1978; May and Huston 1983; and Shepard et al. 1984).

Downs et al. (1997) postulated that the differences in their findings compared to others may have been because of angling pressure (males were more readily removed from the population), and because their samples were from non-targeted populations. This may be true; however, Mullan et al.'s samples were primarily from fish that experience very little, if any, angling pressure. Another potential explanation is that it is possible that there are environmental differences that dictate the variation observed between sex ratios of different populations.

Average fecundity, reported in Downs et al. (1997) for Montana headwater populations, ranged from 227 to 459 eggs per female, and showed a relationship to length-at-maturity (length ranged from 162 to 218 millimetres [6.3 to 8.9 inches]). Brown (1984) reported fecundity of WSCT taken in the early hatchery on Lake Chelan for years 1916 through 1927. Fecundity ranged from 667 to 1,107 for fish that were estimated to be between 221 and 363 mm (8.7 and 14.3 inches) long. The probable reason for the difference observed in average size is most likely because of the differing life histories of fluvial-lacustrine Chelan fish and the fluvial ecotype from Montana.

WSCT spawn generally from March to July, when water temperatures rise in the range of 6°C to 9°C (43°F to 48°F) (Behnke 2002; Wydoski and Whitney 2003). Spawning and rearing streams tend to be cold and nutrient- poor.

Individual fish may spawn in alternative years (Shepard et al. 1984; Liknes and Graham 1988). Schmetterling (2001) found that WSCT entered spawning tributaries when the flow began to increase. He found that, while spawning, the fish did not move more than 200 metres (220 yards) within the spawning tributary.

When adults are migrating upstream to spawning areas, they associate with cover: debris, deep pools, and undercut banks. The availability and number of deep pools and cover is important to offset potential prespawning mortality. Adult cutthroat trout need deep, slow moving pools that do not fill with anchor ice, in order to survive the winter. Intact riparian habitat will increase the likelihood of instream cover, and normative channel geofluvial processes will increase the occurrence of deeper pools.

Important habitat needs for redd building include the availability of clean gravel at the appropriate size, as well as proper water depth and velocity. FWS (1999) state that WSCT redds are usually found in water that is about 0.7 feet deep with mean velocities of 1.0 to 1.3 fps.

Eggs incubate for several weeks and emergence occurs several days after hatching (FWS 1999).

Stream conditions (e.g., frequency of flooding, extreme low temperatures) may affect egg survival as well. Floods can scour eggs from the gravel by increasing sediment deposition that reduces oxygen percolation through the redd. Healy (1991) cites Shaw and Maga (1943) as showing that siltation may be more lethal earlier in the incubation period than in later phases.

In the Methow, flooding has a high frequency of occurrence. Westslope cutthroat trout are spring spawners, therefore fall flooding is not an issue with eggs in the gravel. Road building, grazing and mining activities in the upper watersheds may also increase siltation. All three factors were once more prevalent than they are now in the basin; conditions have improved in most watersheds.

After emergence, fry are usually found in shallow, slow backwater side channels or eddies, and in association with fine woody debris.

Conservation and restoration of natural geofluvial processes and riparian areas of natal streams within the Methow Basin would increase the type of habitat that fry utilize.

Juvenile cutthroat trout overwinter in the interstitial spaces of large stream substrate. Hillman and Miller (2002) state that most juvenile WSCT are consistently found in multiple channels and pools.

Downstream movement of juveniles from natal streams probably occurs within the Methow Basin. Movement of juvenile WSCT within streams is most likely related to changing habitat requirements as the fish grow or winter refuge.

Conservation of high functioning habitat in natal tributaries, and restoration of riparian and geofluvial processes in or near known and potential juvenile rearing areas, will have the highest likelihood of increasing parr survival.

Relationship with Other Species

Competition with rainbow and brook trout is another factor that is limiting WSCT production in the Methow Basin. Rainbow trout cross-breed with WSCT, as well as compete for food and space. Rainbow and brook trout are found in many areas that WSCT are found (Mullan et al. 1992).

WSCT are listed as a Species of Concern under the ESA. Additional information on the status of WSCT and non-migratory redband trout is needed. For management purposes, habitat improvement and conservation of tributary spawning and rearing habitat will increase the likelihood of improving and sustaining populations of westslope cutthroat trout.

Population Delineation and Characterization

The primary historic distribution of WSCT occurred in the upper Columbia and Missouri River basins (FWS 1999). WSCT were originally believed to occur in three river basins within Washington State: Methow, Chelan, and Pend O'Reille. They were, however, only abundant in the Lake Chelan Basin (Williams 1998).

Apart from Lake Chelan and the Pend O'Reille River, where an abundance of relatively large cutthroat commanded the attention of pioneers, cutthroat trout in streams were obscured by their headwater location and small body size. Accordingly, the ethnohistorical record is mostly silent on the presence or absence of cutthroat.

The picture is further blurred by the early scattering of cutthroat from the first trout hatchery in Washington (Stehekin River Hatchery, 1903) by entities (Department of Fisheries & Game and County Fish Commissions) dissolved decades ago along with their planting records. The undocumented translocation of cutthroats by interested non-professionals, starting with pioneers, is another confusing factor that challenges determination of historical distribution. Behnke (1992) believed that the disjunct populations in Washington State probably were transported here through the catastrophic ice-age floods.

Recent information, based on further genetic analyses (Trotter et al. 2001; Behnke 2002; Howell et al. 2003), indicates that the historic range of WSCT in Washington State is now believed to be broader. Historic distribution now includes the headwaters of the Wenatchee and Yakima River basins (Behnke 2002).

Mullan et al. (1992 CPa) indicated pure or essentially pure westslope cutthroat trout have been found above natural rainbow/cutthroat hybridization zones and in alpine lakes that have no history of non-native introductions in the Methow Basin.

Westslope cutthroat appear to have expanded their range within the CCP, from historic distribution, primarily from hatchery plants. Currently WSCT are found throughout the Methow Basin (Williams 1998). WSCT are found within streams and lakes throughout the basins, but spawning (for stream populations) usually occurs in the upper portions of each basin.

Population Status

WSCT appear to be more widely distributed now than they were historically. Since no census data are available, it is not possible to determine the status of these local (and independent) populations that occur in the various watersheds of the CCP.

Numerical abundance has not been documented or estimated for WSCT. Westslope cutthroat were not thought to have been very abundant where they occurred in the headwater locations within the Methow, Entiat, and Wenatchee basins (Williams 1998; FWS 1999; Behnke 2002).

Population Management Regimes and Activities

Hatchery Effects

In the Chelan Basin, the establishment of a hatchery near Stehekin in 1903 was devastating to a lake population of WSCT (Brown 1984). This hatchery was a good example of an "egg mining" hatchery, where many gametes were extracted from the population, but either few fish were planted back into the system, or aquaculture methods were so unsophisticated that few fish survived and, therefore, did not replenish the founding population. The result was the eventual collapse of the population (Brown 1984). It appears that fluvial populations remained in the small feeder tributaries of the lake and the headwaters of the Stehekin River.

The replacement of native westslope cutthroat trout in Eightmile Creek (Methow Basin) was because of stocking brook trout in a small, flat stream, ideally suited to the latter species. Brook trout co-inhabit a number of streams with cutthroat, but the effect in production decreases for both species, not in the elimination of either. Hybridization with steelhead/rainbow trout results from the natural spawning interaction of cutthroat and steelhead/rainbow at their distributional point of contact where water temperature favors neither species (Mullan et al. 1992; Williams 1998). These hybridization zones are short, limiting the negative impact to either species.

While most hatchery stocking of WSCT in the CCP has been from the Twin Lakes strain (originally Lake Chelan), there has been some stocking of other sub-species of cutthroat (FWS 1999).

Through stocking programs that began with Washington State's first trout hatchery in the Stehekin River valley in 1903 (WSCT-targeted), WSCT have been transplanted in almost all available stream and lake habitat (Williams 1998). WSCT are found within streams and lakes throughout these basins, but spawning (for stream populations) usually occurs in the upper portions of each basin.

Extensive stocking of Twin Lake cutthroat trout in alpine lakes and mountain streams for decades has vastly increased the distribution of cutthroat in the Methow subbasin (Williams 1998). Furthermore, the hatchery brood stock (indigenous Lake Chelan stock) used was felt by Behnke (1992) to be an excellent representation of pure westslope cutthroat trout. Another factor that most likely affected WSCT in the Chelan Basin was the introduction of *O. mykiss* in 1917.

3.4.6 Coho

Coho salmon had been extirpated in the Upper Columbia River (Fish and Hanavan 1948, Mullan 1984), but have been reintroduced by the Yakama Nation. Mullan (1984) estimated that upstream of the Yakima River, the Methow River and Spokane River historically produced the most coho, with lesser runs into the Wenatchee and Entiat.

Currently the Yakama Nation is leading feasibility plans to reintroduce coho salmon to the Methow by, and in cooperation with Washington Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

Chapman (1986) estimated that the peak run of coho entering the Columbia River in the 1880s was about 560,000 fish. Mullan (1984) pointed out that most coho spawned in the lower Columbia River tributaries. The furthest upstream that coho were known to migrate in the Columbia River was the Spokane River (Fulton 1970).

Mullan (1984) estimated that between 120,000 and 166,500 coho historically ascended the mid-upper Columbia. Of those numbers, he estimated that: 50,000 to 70,000 spawned in the Yakima Basin; 6,000 to 7,000 in the Wenatchee; 9,000 to 13,000 in the Entiat; 23,000 to 31,000 in the Methow, and; 32,000 to 45,000 in the Spokane river basins.

Mid-Columbia basins historically occupied by coho include the Wenatchee, Methow, Entiat, and Okanogan basins. Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee: 6,000-7,000
- Methow: 23,000-31,000
- Entiat: 9,000-13,000
- Okanogan: Although their presence was documented, numbers were not identified.

Long-run coho are unique among a species that usually migrates very short distances to spawn in freshwater. Historical pictures of the native Methow coho indicate the fish were equal in size to the spring Chinook (Mullan et al. 1992b).

Coho (from Fish and Hanavan 1948 and Mullan 1984):

- 1938 – Normal spawning occurred; most juveniles go to sea in 1940.
- 1939 – Fish and Hanavan report only 13 coho counted over Rock Island Dam. No report of their fate (i.e., whether they were used in the program or not).
- 1940 – A few adults received from Rock Island Dam, six of which are spawned at Leavenworth station.
- 1941 – Ten adults spawned of mixed origin (count at Rock Island = 29) at Leavenworth station.
- 1942 – Coho from Lewis River (count at Rock Island = 1) incubated at Leavenworth. Fish released from 1940 brood.
- 1943 - Coho from Lewis River (count at Rock Island = 22) incubated at Leavenworth. Fish released from 1940 brood in Icicle Creek.
- 1944 – River open to migration. Coho from Lewis River (count at Rock Island = 186) incubated at Leavenworth and Entiat. Fish released from 1942 brood in Icicle Creek and Entiat River. Coho from Carson Hatchery reared at Winthrop. 128 fish return to Leavenworth, 123 of which are spawned.
- 1945 – Mullan (1984) reports just under 2,000 fish raised from coho returning to the Icicle (Rock Island count = 166; Fish and Hanavan note that these fish are descendants of Lewis River stock).
- 1946 – No fish raised. Fish released from 1945 brood from Leavenworth.
- 1947 – Fish returning to Leavenworth and Winthrop are raised and released from these stations in 1948 and 1949, respectively

Rationale for Selection

Historically, the Methow River produced more coho than chinook or steelhead (Craig and Suomela 1941). Mullan (1984) estimated that 23,000-31,000 annually returned to the Methow River. Upstream of the Yakima River, the Methow River and Spokane River historically produced the most coho, with lesser runs into the Wenatchee and Entiat (Mullan 1984). Today, coho reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi Wa-Kish-Wit* document (Tribal Restoration Plan) and has been affirmed as a priority by the Northwest Power and Conservation Council.

Coho salmon prefer and occupy different habitat types, selecting slower velocities and greater depths than the other focal species; Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are important for juvenile rearing making coho good biological indicators for these areas.

While the historic stock of coho salmon are considered extirpated in the Upper Columbia River (Fish and Hanavan 1948, Mullan 1984), the species has since been reintroduced to the Methow River Basin. In cooperation with the Washington Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service, the Yakama Nation is currently leading coho salmon recovery efforts in the basin.

Representative Habitat

Currently, coho salmon returning to the Methow Basin are spawning in the mainstem Methow River and small tributaries such as Gold Creek. As the recovery program continues, reintroduction of coho to tributaries within the Methow Basin will help to aid in species dispersal. A map of known coho salmon distribution is not currently available.

Key Life History Strategies, Relationship to Habitat

Coho salmon enter the Methow River in mid-to-late September through late November. Adults ascended the tributaries in the fall and spawning occurred between mid-October and late December, although there is historical evidence of an earlier run of coho salmon (Mullan 1984). As cold water temperatures at that time of year preclude spawning in some areas, it is likely that coho salmon spawn in areas where warmer ground water up-wells through the substrate.

Coho entering in September and October hold in larger pools prior to spawning, later entering fish may migrate quickly upstream to suitable spawning locations. The availability and number of deep pools and cover is important to off set potential pre-spawning mortality. Intact riparian habitat will increase the likelihood of instream cover, and normative channel geofluvial processes will increase the occurrence of deeper pools.

Important habitat needs for redd building include the availability of clean gravel at the appropriate size, and proper water depth and velocity. Burner (1951) reported the range of depths for coho spawning to be between 8 and 51 cm. Coho salmon spawn in velocities ranging from 0.30 to 0.75 m/s and may seek out sites of groundwater seepage (Sandercock 1991).

The length of time required for eggs to incubate in the gravel is largely dependent on temperature. Sandercock (1991) reported that the total heat requirement for coho incubation in the gravel (spawning to emergence) was 1036 (±138) degree (°C) days over zero. The percentage of eggs and alevins that survive to emergence depends on stream and streambed conditions. Fall and winter flooding, low flows, freezing of gravel, and heavy silt loads can significantly reduce survival. Fall flooding may negatively affect incubation and emergence success, especially in years of extreme flow. Road building activities in the upper watersheds, as well as grazing and mining activities, may also increase siltation. All three factors were once more prevalent than they are now in the basin and the conditions have improved in most watersheds. In the Wenatchee subbasin, coho fry emerge from the gravel in April or May; it is likely that emergence timing is similar in the Methow River.

Juvenile coho salmon generally distribute themselves downstream shortly after emergence and seek out suitable low gradient tributary and off channel habitats. They congregate in quiet backwaters, side channels, and shady small creeks with overhanging vegetation (Sandercock 1991). Conservation and restoration of riparian areas and off channel habitat in natal streams within the Methow Basin would increase the type of habitat fry use.

Coho salmon prefer slower velocity rearing areas than chinook salmon or steelhead (Lister and Genoe 1970; Allee 1981; Taylor 1991) Recent work completed by the Yakama Nation supports these findings (Murdoch et al. 2004). Juvenile coho tend to overwinter in riverine ponds and other off channel habitats. Overwinter survival is strongly correlated to the quantity of woody debris and habitat complexity (Quinn and Peterson 1996). Conservation of and restoration of high functioning habitat in natal tributaries and restoration of riparian and geofluvial processes in or near known and potential parr rearing areas will have the highest likelihood of increasing parr survival.

Naturally produced coho smolts in the Wenatchee Basin emigrate between March and May (Murdoch et al. 1994). It is likely that naturally produced coho smolts in the Methow River have similar emigration timing. Suspected or potential impediments to migration and sources of injury or mortality should be identified and investigated. If areas are shown to unnaturally impede emigration or injure or kill fish, they should be fixed.

Population Delineation and Characterization

Coho salmon were once extirpated from mid-Columbia tributaries but have since been reintroduced. Reintroduction initially relied on transfers of coho pre-smolts or eggs from Lower Columbia River hatcheries, but is currently transitioning to reliance upon a developing locally adapted broodstock. The developing broodstock is genetically homogeneous with the Wenatchee River broodstock.

Long-run coho are unique among a species that usually migrates very short distances to spawn in freshwater. Historical pictures of the native Methow coho indicate the fish were equal in size to the spring chinook (Mullan et al. 1992b).

Population Status

Washington Water Power blocked the Methow River at Pateros between 1915 and 1929 preventing all fish passage during those years and by the time it was removed, the Methow River run of coho was extinct. By the 1930s, the coho run into the mid- upper Columbia was virtually extirpated (see Rock Island Dam counts above). Tributary dams on the Wenatchee, Entiat, and Methow rivers appeared to be more destructive to coho than either chinook or steelhead (where genetic "storage" presided in resident forms).

Because the native stock of coho salmon no longer occur in the Upper Columbia River system, the Methow basin coho are not addressed under the ESA or by the WDFW (1994) Salmon and Steelhead Stock Inventory. Coho salmon returning to the Methow Basin are primarily hatchery origin, but include an increasing naturally produced component as a result of ongoing reintroduction efforts (YN et. al. 2002). It is likely that continued broodstock development and hatchery supplementation will be necessary to prevent coho salmon from becoming extirpated in the future.

Population Management Regimes and Activities

In the early 1940s and the mid-1970s, the USFWS raised and released coho as part of their mitigation responsibilities for the construction of Grand Coulee Dam (Mullan 1984).

Recently the Yakama Nation (YN) has begun a more concerted effort to reintroduce coho into the Upper Columbia (Scribner et al. 2002); results so far are promising. Current efforts to rebuild coho populations in the Upper Columbia are concentrated in the Wenatchee and Methow Basins.

The ideal result would be to restore coho populations in these basins to their historical levels. Because of varying degrees of habitat degradation in each of these basins, historical numbers are unlikely ever to be achieved, but remain a goal towards which to strive.

The current coho reintroduction plan, still in the feasibility stage through 2004, relies on existing or temporary facilities. Currently, coho smolts are acclimated and released in the Methow River from the WNFH for the sole purpose of broodstock development, although some natural production does occur. This phase of the program is expected to last through 2004 or 2005, after which the reintroduction program will expand to included acclimated releases in natural production areas of the basin in order to reach the tribal natural production goal.

Coho salmon are collected as volunteers into the Winthrop National Fish hatchery and from the run-at-large at Wells Dam west bank and/or east bank fish traps to support a 250,000 smolt program (YN et al. 2002). Methow basin coho broodstock may be supplement with eyed-eggs transferred from Wenatchee Basin incubation facilities or from hatcheries on the lower Columbia River (Cascade FH, Eagle Creek NFH, or Willard NFH) in years where broodstock collection falls short of production goals. Coho reared at Winthrop NFH are volitionally released into the Methow River or transferred to the Wenatchee River for acclimation and release. Under the current feasibility program, coho releases from the Winthrop National Fish Hatchery are design to contribute to the broodstock development process. Details on mating protocols, rearing and acclimation strategies, size at release and monitoring and evaluation can be found in the Yakama Nation's Mid-Columbia Coho HGMP (YN et al.2002).

Hatchery Effects

The first hatchery in the Methow Basin was built in 1889 (Craig and Suomela 1941) and raised primarily coho salmon. Releases of fish from non-indigenous sources began in the 1940s (Peven 1992CPb).

Between 1904 and 1914, an average of 360 females was used for broodstock from the Methow hatchery annually (Mullan 1984). With the building of a non-passable dam at the Methow River mouth in 1915, this hatchery was moved more towards the confluence with the Columbia.

Between 1915 and 1920, an average of only 194 females was taken, suggesting a 50% decline in the run between this and the previous period. After 1920, no coho were taken from this hatchery and it closed in 1931 (in Mullan 1984).

No further releases of coho into the Methow River occurred until the GCFMP in 1945. The broodstock originated from the Methow River (which were admixtures of various stocks originally captured at Rock Island Dam; Mullan 1984) in only 4 of the 17 years of coho releases from the Winthrop NFH between 1945 and 1969. Most of the coho released at Winthrop originated from Lower Columbia River stocks from the Eagle, Lewis, and Little White Salmon hatcheries (Mullan 1984).

Chelan PUD also had a coho hatchery program until the early 1990s. While some natural production may have occurred from these releases, the programs overall were not designed to re-establish a naturally spawning populations and relied upon lower Columbia River stocks.

Current coho reintroduction efforts focus on local broodstock development to select for traits which are successful in mid-Columbia tributaries with the long-term goal of restoring naturally reproducing populations. The mid-Columbia coho reintroduction feasibility study has a substantial monitoring and evaluation program to determine if the reintroduction of coho salmon into the upper Columbia basin may affect the production of chinook and steelhead. The results of extensive predation and competition studies indicate that a negative effect is unlikely to occur. Similarly, other researchers have found that the introduction of coho did not negatively affect the abundance or growth of naturally produced chinook or steelhead (Spaulding et. al. 1989; Mullan et al. 1992)

Hydroelectric Effects

Habitat alteration, especially tributary dams in the Methow River mainstem, reduced the viability and capability of coho to rebuild themselves locally.

Prior to the 1940's, runs of Methow River coho salmon were essentially destroyed as a result of over-harvest, early hatchery practices, habitat degradation and impassable downstream dams. Much of the failure of the GCFMP to re-establish self-perpetuating populations may have been related to reliance upon stocks lacking genetic suitability (Mullan et al. 1992b).

Recent (after GCFMP) programs to restore coho in the mid-upper Columbia began in the 1960's with releases from WDFW hatcheries for Rocky Reach Dam mitigation. Although this program did produce some initial promising results, (Figure CP15), naturally producing runs were not established, primarily because the program was not designed to re-establish naturally producing runs. The coho were released from the Turtle Rock fish hatchery, located in the middle of the Columbia River above Rocky Reach Dam. The release location likely contributed to the inability to produce a naturally spawning coho run. This reach of the Columbia River does not provide suitable coho spawning and rearing habitat. In the early 1990s, this program was abandoned.

According to the Chelan 2002 HCP, Rocky Reach Hatchery compensation for Methow River coho will be assessed in 2006 following the development of a continuing coho hatchery program and/or the establishment of a Threshold Population of naturally reproducing coho in the Methow Basin (by an entity other than the District and occurring outside this Agreement). The Hatchery Committee shall determine whether a hatchery program and/or, naturally reproducing population of coho is present in the Methow Basin. Should the Hatchery Committee determine that such a program or population exists, then (1) the Hatchery Committee shall determine the most appropriate means to satisfy the 7% hatchery compensation requirement for Methow Basin coho, and (2) the District shall have the next juvenile migration to adjust juvenile protection Measures to accommodate Methow Basin coho. Thereafter, Coordinating Committee shall determine the number of valid studies (not to exceed three years) necessary to make a juvenile phase determination.

Programs to meet NNI for Methow Basin coho may include but are not limited to: (1)provide operation and maintenance funding in the amount equivalent to 7% project passage loss, or (2) provide funding for acclimation or adult collection facilities both in the amount equivalent to 7% juvenile passage loss at the Project. The programs selected to achieve NNI for Methow Basin coho will utilize an interim value of project survival, based upon a Juvenile Project Survival estimate of 93%, until juvenile project survival studies can be conducted on Methow Basin coho.

Harvest Effects

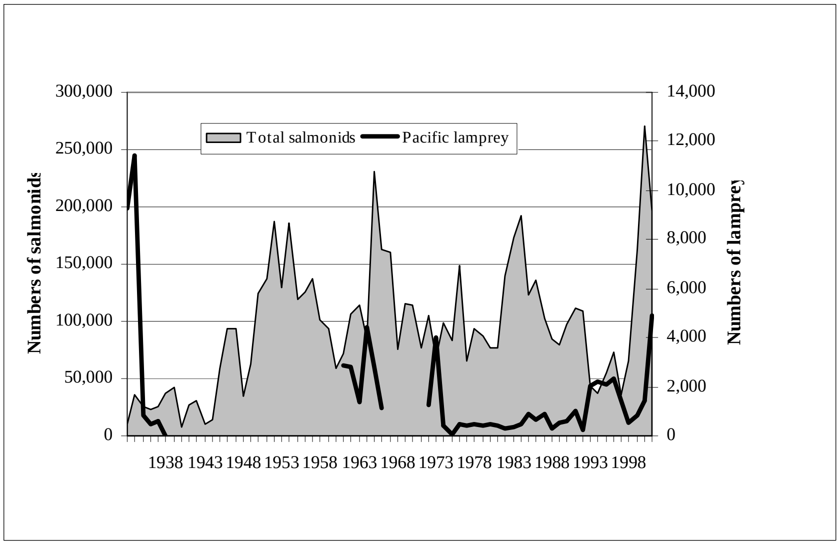
Coho were relatively abundant in upper Columbia River tributaries streams prior to extensive resource exploitation in the 1860's. By the 1880's, the expanding salmon canning industry and rapid growth of the commercial fisheries in the lower Columbia River had heavily depleted the mid and upper Columbia Rive spring and summer chinook runs (McDonald 1895), and eventually the steelhead, sockeye, and coho (Mullan 1984, 1986, 1987; Mullan et al. 1992 CPa).

The runs of coho that ascended the Columbia River were initially reduced from over-harvest in the mainstem and habitat degradation associated with watershed development.

3.5 Other fish species important to management in the Methow subbasin

3.5.1 Pacific Lamprey

Historical distribution of Pacific lamprey in the Columbia and Snake Rivers was coincident wherever salmon occurred (Simpson and Wallace 1978). A record of migration trends illustrates a significant decline in lamprey abundance over the last 50 years (**Figure 19**).



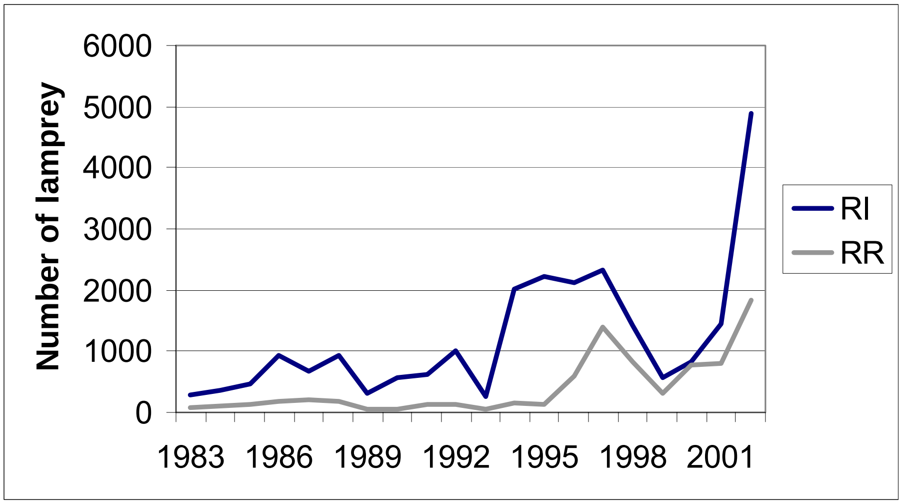
Source: Pevan 2004

Figure 19 Comparison of salmonids adn Pacific lamprey ascending Rock Island Dam (1933–2002)

It is likely that Pacific lamprey occurred historically throughout the Methow subbasin in association with anadromous salmon (Clemens 1939). In the upper Columbia, counts over Rock Island and Rocky Reach dams show a precipitous drop from the 1960s through the 1980s (Close et al. 1995), and appear to be rebuilding once again.

There is little information on the abundance of Pacific lamprey in the upper Columbia region. Abundance estimates are limited to counts of adults and juveniles at dams or juvenile salmonid traps. There are no estimates of redd counts nor juvenile and adult counts in tributaries.

Large declines of adults occurred at most mainstem dams during the late 1960s and early 1970s. During the period between about 1974 and 1993, numbers of adult lamprey counted at Rock Island Dam was quite low (**Figure 20**). Counts of adults have increased since that time; however, this increase corresponds closely with the time that the projects began day and night counts, perhaps having some effect on the comparison. Recent increases in the last few years, however, are far greater than those in the last 10, suggesting that a true increase in abundance is occurring.



Source: Pevan 2004

Figure 20 Numbers of lamprey ascending Rock Island and Rocky Reach Dams since 1983

Counts of adult lamprey at dams cannot be considered total counts because there was no standardized sampling across years and counting was restricted to certain hours (BioAnalysts 2000). For example, fish counters in the past counted for a 16-hour-day shift for the main part of the salmon runs (Close et al. 1995). Because the highest movement of lamprey occurs at night (Close et al. 1995), these day counts should be considered conservative estimates. Currently, fish counting occurs throughout the 24-hour period at most dams. At Rocky Reach and Rock Island dams, videotape or digital video record fish passage over 24 hours per day. This counting method began at Rock Island in 1992 and at Rocky Reach in 1996.

Additional problems with adult counts exist because some lamprey pass dams undetected. For example, adult lamprey can move near the bottom of the fish counting chamber making it difficult to detect them (Jackson et al. 1996). They can also bypass counting station windows by traveling behind the picketed leads at the crowder (Starke and Dalen 1995). Because of these shortcomings, adult counts at dams should only be viewed as crude indices of abundance.

Counts of juvenile lamprey at dams also suffer from sampling inconsistencies. Collection of juvenile lamprey at mainstem dams is incidental to sampling juvenile salmonids. Thus, numbers of migrants outside the juvenile salmonid migration period are unknown, since most of the literature suggests that migration occurs between fall and spring (Pletcher 1963; Beamish 1980; Richards and Beamish 1981). In addition, unknown guidance efficiencies of juvenile lamprey, and unknown spill passage to turbine passage ratios, reduce precise estimates of abundance (BioAnalysts 2000). Juveniles also tend to hide in various locations in the bypass systems (Jackson et al. 1997). These problems, combined with highly variable sampling rates during periods of juvenile salmonid passage, confound estimates of juvenile lamprey abundance (BioAnalysts 2000). Juvenile counts at dams should also be viewed as crude indices of abundance.

Comparing counts among different projects is problematic because of sampling inconsistencies, the behavior of lamprey in counting stations, and the ability of lamprey to bypass counting stations undetected (BioAnalysts 2000).

In summary, while it is difficult to determine the historical abundance of lamprey in the Columbia Basin and the CCP, circumstantial evidence suggests that they have declined. Counts of juvenile and adult lamprey fluctuate widely. It is unknown whether these fluctuations represent inconsistent counting procedures, actual population fluctuations, or both. Although these factors may make actual comparisons difficult, it appears that lamprey in the upper Columbia are increasing.

More information needs to be gathered for Pacific lamprey before any determinations of extinction risks can be made.

The American Fisheries Society's Western Division reviewed the FWS's petition to list four species of lamprey in 2001, and found strong evidence to support listing of Pacific lamprey on the Columbia, Umqua and Snake Rivers (WDAFS, 2001).

3.5.2 White Sturgeon

Historically, white sturgeon moved throughout the mainstem Columbia River from the estuary to the headwaters; although passage was probably limited at times by large rapids and falls (Brannon and Setter 1992). Beginning in the 1930s, with construction of Rock Island, Grand Coulee, and Bonneville dams, migration was disrupted because sturgeon do not pass upstream through fishways that were built for salmon, although they apparently can pass downstream (S. Hays, pers. comm.).

Current populations in the Columbia River Basin can be divided into three groups: fish below the lowest dam, with access to the ocean (the lower Columbia River); fish isolated (functionally but not genetically) between dams; and fish in several large tributaries. In the CCP, construction of Wells, Rocky Reach, Rock Island, and Wanapum Dam have disrupted upstream movement of sturgeon.

Peven (2003) concluded that white sturgeon distribution has been affected by construction of mainstem Columbia River dams. What was believed to be a relatively continuous population, traveling the length of the mainstem Columbia River below migrational barriers, is now a number of potentially disjunct populations between hydroelectric projects. There does, however, appear to be immigration and emigration from downstream recruitment.

3.5.3 Rainbow Trout

Rainbow trout are the freshwater variety of steelhead trout (*O. mykiss*). They are represented in the river and tributaries by both fluvial and adfluvial varieties.

They are present in most of the headwater tributaries, where year-round flows are hospitable, and in the mainstem Methow. The headwater fluvial varieties appear to have one life history pattern: to spawn and rear in upper tributaries. The population size and distribution of rainbow trout in these streams is not known (NMFS, 1998).

3.5.4 Redband trout

Redband trout (*Oncorhynchus mykiss gairdneri*) are indistinguishable from steelhead in the CCP; they are an exclusive ecotype of inland waters (Behnke 2002). For example, steelhead were not extirpated in the Methow River, as were coho, when a dam was constructed near its confluence with the Columbia, probably because headwater resident forms sustained the run (Mullan et al. 1992 CPa).

Anadromy is not obligatory in *O. mykiss* (Rounsefell 1958; Mullan et al. 1992). Progeny of anadromous steelhead can spend their entire life in freshwater, while progeny of rainbow trout can migrate seaward. Anadromy, although genetically linked (Thorpe 1987), runs under environmental instruction (Shapovalov and Taft 1954; Thorpe 1987; Mullan et al. 1992). It is difficult to summarize one life history strategy (anadromy) without due recognition of the other (non-migratory).

The two strategies appear to co-mingle on some continuum with certain residency at one end, and certain anadromy on the other (see further discussion in Life History section). Upstream distribution is limited by low heat budgets (about 1,600 temperature units) (Mullan et al 1992). The response of steelhead/rainbow complex in these cold temperatures is they are "thermally fated" to a nonanadromous ecotype, presumably because growth is too slow within the time window for smoltification. However, these headwater rainbow trout contribute to anadromy via emigration and displacement to lower reaches, where warmer water improves growth rate and subsequent opportunity for smoltification.

Historic distribution

Redband trout originally occurred in the Fraser and Columbia River drainages east of the Cascade Mountains to barrier falls on the Pend O'Reille, Spokane, Snake, and Kootenai rivers (Behnke 1992). It is reasonable to assume that the historical distribution of redband trout was potentially wider than that of steelhead in the CCP because populations would have, and still do, occur in areas upstream of anadromous barriers. This would include all areas (downstream of temperature barriers; Mullan et al. 1992) in the Wenatchee, Entiat, Methow, and upper reaches of the Okanogan River basins.

Current distribution

Currently, because of the admixture with hatchery fish, *O. mykiss* is widespread throughout the CCP. *Oncorhynchus mykiss* is found virtually everywhere in each major subbasin in the CCP, below thermal barriers in the headwater areas. To reiterate, in most areas of occurrence, it is not possible to distinguish between non-migratory and anadromous forms.

In conclusion, because it is not possible to distinguish anadromous from nonanadromous forms of redband trout, it is difficult to determine changes in distribution over historic times (regardless of hatchery plants, which have played an influence also).

3.5.5 Eastern Brook Trout

Eastern Brook trout are an introduced species that is present throughout the basin. In drainages where brook trout and bull trout are both present, they hybridize. Brook trout appear to be more tolerant to disturbed habitat conditions than bull trout. The introduction of brook trout, and resulting hybridization of the two species, has increased inter-species competition with bull trout in the subbasin (NMFS, 1998).

3.6 Focal Wildlife Species

3.6.1 Brewer's Sparrow

General Habitat Requirements

Brewer's sparrow is a sagebrush obligate species that prefers abundant sagebrush cover (Altman and Holmes 2000). Vander Haegen et al. (2000) determined that Brewer's sparrows were more abundant in areas of loamy soil than in areas of sandy or shallow soil, and on rangelands in good or fair condition than those in poor condition. Knopf et al. (1990) reported that Brewer's sparrows are strongly associated throughout their range with high sagebrush vigor.

Brewer's sparrow is positively correlated with shrub cover, above-average vegetation height, bare ground, and horizontal habitat heterogeneity (patchiness). Brewer's sparrows prefer areas dominated by shrubs rather than grass. They prefer sites with high shrub cover and large patch size (Knick and Rotenberry 1995). In southwestern Idaho, the probability of habitat occupancy by Brewer's sparrows increased with increasing percent shrub cover and shrub patch size; shrub cover was the most important determinant of occupancy (Knick and Rotenberry 1995).

Brewer's sparrow abundance in Washington increased significantly on sites where sagebrush cover approached the historic 10% level (Dobler et al. 1996).

In contrast, Brewer's sparrows are negatively correlated with grass cover, spiny hopsage, and budsage (Larson and Bock 1984; Rotenberry and Wiens 1980; Wiens 1985; Wiens and Rotenberry 1981). In eastern Washington, abundance of Brewer's sparrows was negatively associated with increasing annual grass cover; higher densities occurred in areas where annual grass cover (i.e., cheatgrass) was less than 20% (Dobler 1994). Removal of sagebrush cover to less than 10% has a negative impact on populations (Altman and Holmes 2000).

Recommended habitat objectives include the following: patches of sagebrush cover 10-30%; mean sagebrush height greater than 24 inches; high foliage density of sagebrush; average cover of native herbaceous plants greater than 10%, bare ground greater than 20% (Altman and Holmes 2000).

Limiting Factors

Habitat loss and fragmentation, livestock grazing, introduced vegetation, fire, and predators are the primary factors affecting Brewer's sparrows. Direct habitat loss because of conversion of shrublands to agriculture, coupled with sagebrush removal/reduction programs and residential development, have significantly reduced available habitat and contributed towards habitat fragmentation of remaining shrublands. Within the entire Interior Columbia Basin, over 48% of watersheds show moderately or strongly declining trends in source habitats for this species (Wisdom et al. in press) (from Altman and Holmes 2000).

Livestock grazing can trigger a cascade of ecological changes, the most dramatic of which is the invasion of non-native grasses escalating the fire cycle and converting sagebrush shrublands to annual grasslands. Historical heavy livestock grazing altered much of the sagebrush range, changing plant composition and densities. West (1988, 1996) estimates less than 1% of sagebrush steppe habitats remain untouched by livestock; 20% is lightly grazed, 30% moderately grazed with native understory remaining, and 30% heavily grazed with understory replaced by invasive annuals. The effects of grazing in sagebrush habitats are complex, depending on intensity, season, duration, and extent of alteration to native vegetation. Rangeland in poor condition is less likely to support Brewer's sparrows than rangeland in good and fair condition.

Introduced vegetation such as cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires.

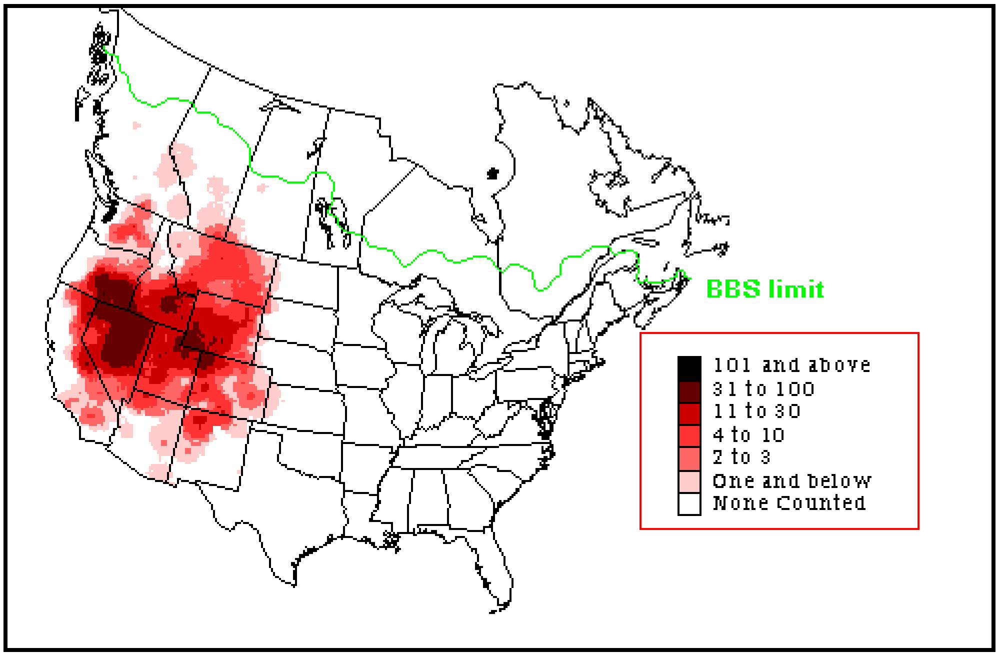
Fire kills sagebrush; as the fire cycle escalates, where non-native grasses dominate, the landscape can be converted to grasslands dominated by introduced vegetation, removing preferred habitat (Paige and Ritter 1998). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrubsteppe, altering shrubland habitats.

Predators (of eggs and nestlings) include gopher snake (*Pituophis melanoleucus*), Townsend's ground squirrel (*Spermohpilus townsendii*); other suspected predators include loggerhead shrike (*Lanius ludovicianus*), common raven (*Corvus corax*), black-billed magpie (*Pica pica*), long-tailed weasel (*Mustela frenata*), least chipmunk (*Eutamias minimus*), western rattlesnake (*Crotalus viridis*), and other snake species. Nest predation is the most significant cause of nest failure.

The American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), coachwhip (*Masticophis flagellum*) have been observed preying on adult sparrows (Rotenberry et al. 1999). Wiens and Rotenberry (1981) observed significant negative correlation between loggerhead shrike and Brewer's sparrow density.

Current Distribution

Undoubtedly, the Brewer's sparrow was widely distributed throughout the lowlands of southeast Washington when it consisted of vast expanses of shrubsteppe habitat. Large-scale conversion of shrubsteppe habitat to agriculture has resulted in populations becoming localized in the last vestiges of available habitat (Smith et al. 1997). Washington is near the northwestern limit of breeding range for Brewer's sparrows (**Figure 21**). Birds occur primarily in Okanogan, Douglas, Grant, Lincoln, Kittitas, and Adams Counties (Smith et al. 1997).

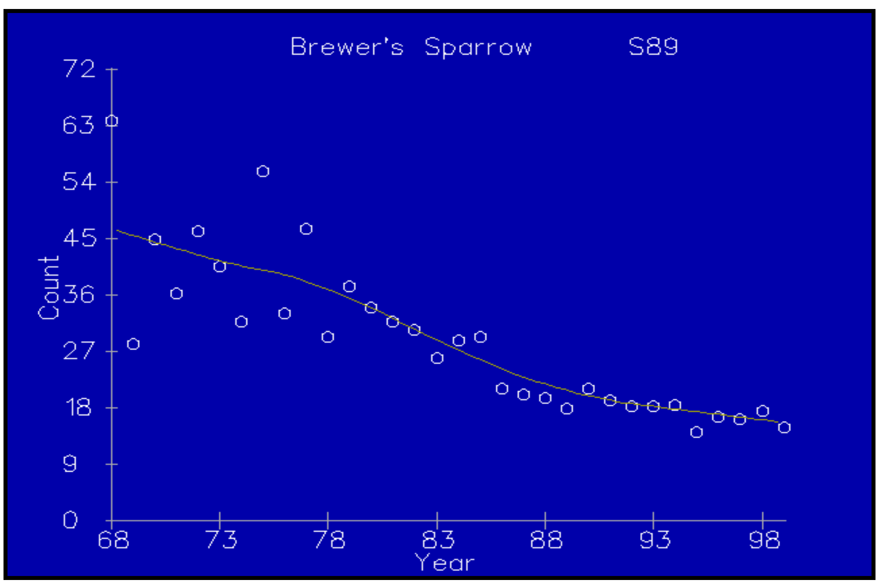


Sauer et al. 2003

Figure 21 Brewer's sparrow breeding range and abundance

Population Trend Status

Brewer's sparrow is often the most abundant bird species in appropriate sagebrush habitats **Figure 22**); however, widespread long-term declines and threats to shrubsteppe breeding habitats have placed it on the Partners in Flight Watch List of conservation priority species (Muehter 1998). Saab and Rich (1997) categorize it as a species of high management concern in the Columbia River Basin.



Source: BBS data; Sauer et al. 2003

Figure 22 Brewer's sparrow trend results for the Columbia Plateau

Historically, the Brewer's sparrow may have been the most abundant bird in the Intermountain West (Paige and Ritter 1998), but BBS trend estimates indicate a range-wide population decline during the last twenty-five years (Peterjohn et al. 1995).

Brewer's sparrows are not currently listed as Threatened or Endangered on any state or federal list. Oregon-Washington Partners in Flight consider the Brewer's sparrow a focal species for conservation strategies for the Columbia Plateau (Altman and Holmes 2000).

Breeding Bird Survey data for the period of 1966 to 1996 show significant and strong survey-wide declines averaging -3.7% per year (n = 397 survey routes). Significant declines in Brewer's sparrow are evident in California, Colorado, Montana, Nevada, Oregon, and Wyoming, with the steepest significant decline evident in Idaho (-6.0% average per year; n = 39). These negative trends appear to be consistent throughout the 30-year survey period. Only Utah shows an apparently stable population. Sample sizes for Washington are too small for an accurate estimate.

Note that, although positively correlated with presence of sage thrashers (*Oreoscoptes montanus*), probably because of similarities in habitat relations (Wiens and Rotenberry 1981), thrashers are not exhibiting the same steep and widespread declines evident in BBS data (see Sauer et al. 1997).

3.6.2 Grasshopper Sparrow

General Habitat Requirements

Grasshopper sparrows prefer grasslands of intermediate height and are often associated with clumped vegetation interspersed with patches of bare ground (Bent 1968; Blankespoor 1980; Vickery 1996). Other habitat requirements include moderately deep litter and sparse coverage of woody vegetation (Smith 1963; Bent 1968; Wiens 1969, 1970; Kahl et al. 1985; Arnold and Higgins 1986). In east central Oregon, grasshopper sparrows occupied relatively undisturbed native bunchgrass communities dominated by *Agropyron spicatum* and/or *Festuca idahoensis*, particularly on north-facing slopes on the Boardman Bombing Range in the Columbia Basin (Holmes and Geupel 1998). Vander Haegen et al. (2000) found no significant relationship with vegetation type (i.e., shrubs, perennial grasses, or annual grasses), but did find a relationship with the percent cover perennial grass.

In portions of Colorado, Kansas, Montana, Nebraska, Oklahoma, South Dakota, Texas, Wisconsin, and Wyoming, abundance of grasshopper sparrows was positively correlated with percent grass cover, percent litter cover, total number of vertical vegetation hits, effective vegetation height, and litter depth; abundance was negatively correlated with percent bare ground, amount of variation in litter depth, amount of variation in forb or shrub height, and the amount of variation in forb and shrub heights (Rotenberry and Wiens 1980).

Grasshopper sparrows occasionally inhabit cropland, such as corn and oats, but at a fraction of the densities found in grassland habitats (Smith 1963; Smith 1968; Ducey and Miller 1980; Basore et al. 1986; Faanes and Lingle 1995; Best et al. 1997).

Limiting Factors

The principal post-settlement conservation issues affecting grasshopper sparrow populations include: habitat loss and fragmentation resulting from conversion to agriculture, habitat degradation and alteration from livestock grazing, invasion of exotic vegetation, and alteration of historic fire regimes.

Fragmentation resulting from agricultural development, or large fires fueled by cheatgrass, can have several negative effects on land birds. These include: insufficient patch size for area-dependent species, and increases in edges and adjacent hostile landscapes that can result in reduced productivity through increased nest predation, nest parasitism, and reduced pairing success of males. Additionally, habitat fragmentation has likely altered the dynamics of dispersal and immigration necessary for maintenance of some populations at a regional scale. In a recent analysis of neotropical migratory birds within the Interior Columbia Basin, most species identified as being of "high management concern" were shrubsteppe species (Saab and Rich 1997); this list included the grasshopper sparrow.

Making this loss of habitat even more severe is that the grasshopper sparrow like other grassland species shows a sensitivity to the grassland patch size (Herkert 1994; Samson 1980; Vickery 1994; Bock et al. 1999). Herkert (1991) found that grasshopper sparrows in Illinois were not present in grassland patches smaller than 74 acres despite the fact that their published average territory size is only about 0.75 acres. Minimum requirement size in the Northwest is unknown.

Grazing can trigger a cascade of ecological changes, the most dramatic of which is the invasion of non-native grasses escalating the fire cycle and converting sagebrush shrublands to annual grasslands. Historical heavy livestock grazing altered much of the sagebrush range, changing plant composition and densities. West (1988, 1996) estimates less than 1% of sagebrush steppe habitats remain untouched by livestock; 20% is lightly grazed, 30% moderately grazed with native understory remaining, and 30% heavily grazed with understory replaced by invasive annuals. The effects of grazing in sagebrush habitats are complex, depending on intensity, season, duration and extent of alteration to native vegetation. Extensive and intensive grazing in North America has had negative impacts on this species (Bock and Webb 1984).

The grasshopper sparrow has been found to respond positively to light or moderate grazing in tallgrass prairie (Risser et al. 1981); however, it responds negatively to grazing in shortgrass, semi-desert, and mixed grass areas (Bock et al. 1984).

The degree of degradation of terrestrial ecosystems is often diagnosed by the presence and extent of alien plant species (Andreas and Lichvar 1995); frequently, their presence is related to soil disturbance and overgrazing. Increasingly, however, aggressive aliens are becoming established wherever their seed can reach, even in ostensibly undisturbed bunchgrass vegetation.

Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush, and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998).

Studies on the effects of burns on grassland birds in North American grasslands have shown similar results as grazing studies, namely, that bird response is highly variable. Confounding factors include timing of burn, intensity of burn, previous land history, type of pre-burn vegetation, presence of fire-tolerant exotic vegetation (that may take advantage of the post-burn circumstances and spread even more quickly), and grassland bird species present in the area.

It should be emphasized that much of the variation in response to grassland fires lies at the level of species, but that even at this level, results are often difficult to generalize. For instance, mourning doves have been found to experience positive (Bock and Bock 1992; Johnson 1997) and negative (Zimmerman 1997) effects by fire in different studies. Similarly, grasshopper sparrows have been found to experience positive (Johnson 1997), negative (Bock and Bock 1992; Zimmerman 1997; Vickery et al. 1999), and no significant (Rohrbaugh 1999) effects of fire. Species associated with short and/or open grassy areas will most likely experience short-term benefits from fires. Species that prefer taller and denser grasslands most likely will demonstrate a negative response to fire (CPIF 2000).

Mowing and haying affects grassland birds directly and indirectly. It may reduce height and cover of herbaceous vegetation, destroy active nests, kill nestlings and fledglings, cause nest abandonment, and increase nest exposure and predation levels (Bollinger et al. 1990). Studies of the grasshopper sparrow have indicated higher densities and nest success in areas not mowed until after July 15 (Shugaart and James 1973; Warner 1992); grasshopper sparrows are vulnerable to early mowing of fields, while light grazing, infrequent and post-season burning or mowing can be beneficial (Vickery 1996).

Grasshopper sparrows may be multiply-parasitized (Elliott 1976, 1978; Davis and Sealy 2000). In Kansas, cowbird parasitism cost grasshopper sparrows about two young/parasitized nest; there was a low likelihood of nest abandonment occurring because of cowbird parasitism (Elliott 1976, 1978).

Current Distribution

Grasshopper sparrows are found from North to South America, Ecuador, and in the West Indies (Vickery 1996; AOU 1957). They are common breeders throughout much of the continental United States, ranging from southern Canada, south to Florida, Texas, and California. Additional populations are locally distributed from Mexico to Colombia, and in the West Indies (Delany et al. 1985; Delany 1996; Vickery 1996).

The subspecies breeding in eastern Washington is *Ammodramus savannarum perpallidus* which breeds from northwest California, where it is uncommon, into eastern Washington, northeast and southwest Oregon, where it is rare and local, into southeast British Columbia, where it is considered Endangered, east into Nevada, Utah, Colorado, Oklahoma, Texas, and possibly Illinois and Indiana (Vickery 1996).

Grasshopper sparrow structural conditions and association relationships (IBIS 2003) are shown in **Table 26**.

Table 26 Grasshopper sparrow structural conditions and association relationships (IBIS 2003)

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Grasshopper Sparrow	Shrubsteppe	Grass/Forb-Closed	B	C
		Grass/Forb-Open	B	C
		Low Shrub-Open Shrub Overstory-Mature	B	A
		Low Shrub-Open Shrub Overstory-Old	B	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Medium Shrub-Open Shrub Overstory-Old	B	A
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	A

3.6.3 Sharp-tailed Grouse

General Habitat Requirements

The Columbian sharp-tailed grouse (CSTG) is one of six subspecies of sharp-tailed grouse and the only one found in Washington. Native habitats important for CSTG include grass-dominated nesting habitat and deciduous shrub-dominated wintering habitat, both of which are critical for sharp-tailed grouse (Giesen and Connelly 1993; Connelly et al. 1998).

Residual grasses and forbs are necessary for concealment and protection of nests and broods during spring and summer (Hart et al. 1952; Parker 1970; Oedekoven 1985; Marks and Marks 1988; Meints 1991; Giesen and Connelly 1993). Preferred nest sites are on the ground in relatively dense cover provided by clumps of shrubs, grasses, and/or forbs (Hillman and Jackson 1973). Fields enrolled in agricultural set-aside programs are often preferred. Giesen (1987) reported density of shrubs less than three feet tall was five times higher at nest sites than at random sites, or at sites 33 feet from the nest.

Meints (1991) found that mean grass height at successful nests averaged less than one foot, while seven inches was the average at unsuccessful nests. Hoffman (2001) recommended that the minimum height for good quality nesting and brood-rearing habitat is eight inches, with one foot being preferred. Bunchgrasses, especially those with a high percentage of leaves-to-stems, such as bluebunch wheatgrass, is preferred over sod-forming grasses such as smooth brome by nesting sharp-tailed grouse

Columbian sharp-tailed grouse are able to tolerate considerable variation in the proportion of grasses and shrubs that comprise suitable nesting habitat; the most important factor is that a certain height and density of vegetation is required. Canopy coverage and visual obstruction are greater at nest sites than at independent sites (Kobriger 1980; Marks and Marks 1987; Meints 1991).

After hatching, hens with broods move to areas where succulent vegetation and insects can be found (Sisson 1970; Gregg 1987; Marks and Marks 1987; Klott and Lindzey 1990). In late summer, riparian areas and mountain shrub communities are preferred (Giesen 1987).

Food items in the spring and summer include wild sunflower (*Helianthus* spp.), chokecherry, sagebrush, serviceberry, salsify (*Tragopogon* spp.), dandelion (*Taraxacum* spp.), bluegrass, and brome (Hart et al. 1952; Jones 1966; Parker 1970). Although juveniles and adults consume insects, chicks eat the greatest quantity during the first few weeks of life (Parker 1970; Johnsgard

1973). In winter, CSTG commonly forage on persistent fruits and buds of chokecherry, serviceberry, hawthorn, snowberry, aspen, birch, willow, and wild rose (Giesen and Connelly 1993; Schneider 1994).

Columbian sharp-tailed grouse numbers have drastically declined in Washington over the past 100 years, and they are now a federally and state listed species. The breeding population of sharp-tailed grouse in Washington is currently estimated at 380. Shrubsteppe and riparian habitat are critical habitat for sharp-tailed grouse, and both have been heavily manipulated in the basin (OWSAC 2000). The FWS recently issued a 90-day Finding on a petition to list sharp-tailed grouse as Threatened under the ESA (FWS, 1999).

According to early explorers sharp-tails used to be plentiful in Eastern Washington. A total of 112 sharp-tailed grouse leks (courtship areas) were documented between 1954 and 1994. Lek counts are used to estimate population size and stability. The number of males per lek and active leks also indicate stability of the population. Males per lek declined from 13 in 1954 to five in 1994. In Douglas County, from 1954 to 1994, 46% of active leks disappeared, 65% disappeared in Okanogan County, and 61% disappeared in Lincoln County.

Limiting Factors

The primary factors affecting the continued existence of sharp-tailed grouse in Washington relate to habitat loss and alteration and the precarious nature of small, geographically isolated subpopulations. Three of the major factors that contributed to the decline of sharp-tailed grouse and their habitat in Washington are still threats today: conversion to agriculture, conversion to residential development, and overgrazing. The removal of shrubs reduces the quantity and quality of winter habitat, and the degradation of shrub and meadow steppe habitat, as a result of livestock management, reduces the quality of breeding habitat. The remaining subpopulations are small and isolated from one another, increasing the risk of extirpation.

Population isolation is potentially a major factor influencing the continued existence of sharp-tailed grouse in Washington. As grouse populations naturally fluctuate, because of environmental conditions, the lower the population level, the greater the risk of extirpation. The isolation of populations may have important ramifications for their genetic quality and recruitment (Lacy 1987). It may require human transport of individuals to counteract loss of fitness because of genetic drift.

It is not clear if the Washington populations are declining because of their isolation, or because of a combination of other factors. Initial evidence (M. Schroeder, pers. comm.) indicates that most movements of radio-marked birds are insufficient to allow interchange of individuals among populations in north-central Washington. Although current estimates of the total population range up to 1000 individuals, it is divided among eight small isolated subpopulations. Four of these populations are estimated to contain fewer than 25 birds. These populations are under immediate threat of extirpation (Reed et al. 1986).

Near-term extirpation risks because of population size are present for two of three other populations remaining outside the Colville Indian Reservation (Gilpin 1987); less than 100 individuals are estimated at each site (M. Schroeder, pers. comm.). These populations are likely much less tolerant of environmental changes, such as habitat degradation and weather extremes, than are populations in Lincoln County and the Colville Indian Reservation. Predation is more of a concern for these very small populations than it would be for larger populations in good habitat.

A wide variety of genetic problems can occur with small populations, and these genetic problems can interact with demographic and habitat problems and lead to extinction (Gilpin and Soule 1986). Overall threats to sharp-tailed grouse are greater when individuals are spread through small subpopulations rather than being one larger population.

Sharp-tails in Douglas and Okanogan counties, and to a lesser degree in Lincoln County, are now restricted to high-elevation areas, and specifically, in those areas that have both shrubs and grasses (Schroeder 1996). High winter mortality, resulting from declining quantity and quality of winter habitat, is likely the most significant factor causing the decline in the sharp-tail population in Washington (Schroeder 1996). Protecting and enhancing high quality habitat where sharp-tails continue to concentrate, and restoring key low-elevation winter sites is vital to conservation of sharp-tailed grouse in Washington.

Habitat quality overall is improving for sharp-tailed grouse in Lincoln County, where WDFW and the Bureau of Land Management (BLM) are actively managing habitat for sharp-tailed grouse. Continuation of lands enrolled in the Conservation Reserve Program is also important to improve habitat quality in Lincoln and Douglas Counties. WDFW acquisition of lands in Okanogan County near Tunk Valley, Chesaw, and Conconully should also result in improved habitats. Private and tribal lands that are grazed change in habitat quality with the intensity of grazing. Trends on these grazed lands are not predictable.

Increases in grazing pressure on currently occupied sharp-tailed grouse habitat are a principal threat to the continued existence of populations. In general, when grazing by livestock reduces the grass and forb component, sharp-tailed grouse are excluded (Hart et al. 1950, Brown 1966b, Parker 1970, Zeigler 1979). Loss of deciduous cover is especially severe near riparian areas that attract livestock in summer because of water and shade; this cover provides critical foraging areas and escape cover for sharp-tails throughout the year (Zeigler 1979, Marks and Marks 1987a). Trampling, browsing, and rubbing decrease the annual grass and forbs, deciduous trees, and shrubs needed for food and shelter in winter (Parker 1970, Kessler and Bosch 1982, Marks and Marks 1987a). Mattise (1978) found overgrazing very detrimental in nesting and brood-rearing habitat.

In Montana, Brown (1968) reported that the reduction in habitat, because of intensive livestock grazing, resulted in the elimination of sharp-tails in particular areas. Sharp-tails were observed shifting use to ungrazed areas following livestock use of traditional sites (Brown 1968). Marks and Marks (1988) also found sharp-tails in western Idaho selecting home ranges that were least modified by livestock grazing.

The reported effects of grazing on sharp-tailed grouse vary and appear to depend primarily on intensity, duration of grazing, type of livestock, site characteristics, precipitation levels, and past and present land use practices. Grazing systems currently used in range management include seasonal, deferred, and rotation grazing (Stoddard, et al. 1975). Hart et al. (1950) found light to moderate grazing benefiting landowners and sharp-tails on the foothills and benchlands of Utah. Weddell (1992) concluded that rest rotation and deferred grazing were less detrimental to sharp-tailed grouse than season-long grazing, and suggested the disadvantages of increasing grazing under any of these systems outweigh the advantages for sharp-tailed grouse. Even light to moderate grazing can be detrimental in areas with a history of overgrazing, as it may prevent recovery of the native vegetation.

Kessler and Bosch (1982) surveyed sharp-tailed grouse management practices and concluded that grazing, and the resulting habitat loss, are the most serious threats to sharp-tailed grouse survival. Their survey of states and provinces with past or present Columbian sharp-tailed grouse populations found respondents regarded low intensity grazing as beneficial, and high intensity grazing to be negative in its effects on sharp-tails (Kessler and Bosch 1982). Twenty percent more respondents found moderate grazing negative in its effects, and twice as many preferred deferred and rest rotation over continuous grazing. Five of the seven states or provinces with Columbian sharp-tailed grouse listed overgrazing as a major issue/problem related to maintaining this species and its habitat (Braun 1991).

Grazing is a continuing threat to sharp-tailed grouse because of unpredictable changes in land ownership, grazing economics, and the needs of private landowners. Grazing pressure is increasing in several important sharp-tail areas in Washington (M. Schroeder, pers. comm.).

The removal of CRP habitat in Lincoln, Douglas, and Okanogan Counties could cause further declines in sharp-tailed grouse numbers. Contracts for approximately 318,000 hectares expired in 1997. Washington farmers submitted applications for new contracts on 239,000 hectares, and nearly 196,000 hectares were accepted. CRP lands placed back into grain production could cause further declines in the number of sharp-tailed grouse, depending upon how the sharp-tailed grouse use these areas. CRP land and other habitat enhancement areas must be near existing sharp-tail populations to be beneficial (Meints et al. 1992). Although the WDFW is assisting landowners in applying for CRP funding, the long-term status of these areas is uncertain.

The loss of deciduous trees and shrubs by chemical control was associated with declining sharp-tail populations in Washington (Zeigler 1979) and Utah (Hart et al. 1950). Chemical treatment of vegetation in sharp-tailed grouse habitat is detrimental because of the direct loss of vegetation (McArdle 1977, Blaisdell et al. 1982, Oedekoven 1985, Klott 1987). Kessler and Bosch (1982) found most biologists regarded chemical brush control as a negative management practice for sharp-tails. However, in Michigan, herbicidal treatment was used to open dense areas, and to provide more adequate sharp-tailed grouse habitat (Van Etten 1960). In Washington, continued use of herbicides to control sagebrush and other vegetation may cause additional reductions in sharp-tailed grouse habitat.

Fire is a continual threat to sharp-tailed grouse populations. Fire has become a major tool for altering large blocks of sagebrush rangelands. In Lincoln County, three large prescribed fires and one chemical control of sagebrush in the 1980s, in areas containing active leks, were believed to be directly responsible for the decline of both sharp-tailed and sage grouse populations (Merker 1988). McArdle (1977) found less use by sharp-tails in burned areas compared to when other vegetation manipulations had occurred. Likewise, Hart et al. (1950) reported Columbian sharp-tails abandoning a lek site following a fire; the fire also caused accelerated erosion, loss of nests, and loss of winter food and cover.

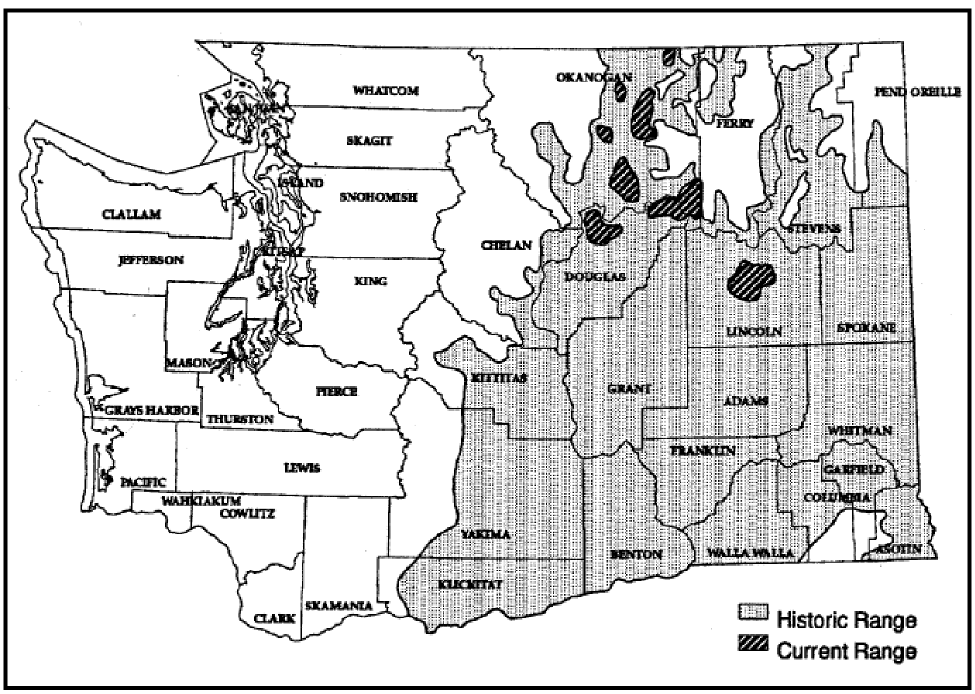
Under some circumstances, burning can help improve sharp-tailed grouse habitat. Burning dense sagebrush and thickly wooded areas was found to improve sharp-tailed grouse habitat in Utah (Hart et al. 1950), North Dakota (Kirsh et al. 1973), Colorado (Rogers 1969), and Wyoming (Oedekoven 1985). In Manitoba and British Columbia, a large movement of sharp-tailed grouse occurred from a high-use lek site to a burned area following a fire that eliminated all residual grass and forbs, but did not greatly affect shrub or tree cover.

Modern fire suppression policies have allowed conifers to invade bunchgrass-prairie habitats in some areas, to the detriment of sharp-tailed grouse populations. In these situations, prescribed burning may be effective in maintaining suitable habitats (Giesen and Connelly 1993). In Washington, prescribed fire is not recommended in shrub/meadow steppe, but may be acceptable for creating habitat where conifers have invaded traditional shrub/meadow steppe areas.

Current Distribution

Currently, Columbian sharp-tails occupy <10% of their historic range in Idaho, Montana, Utah, Wyoming, and Washington, approximately 50% in Colorado, and 8% in British Columbia (Oedekoven 1985; Sullivan 1988; Ritcey 1995). Columbian sharp-tailed grouse are extirpated from California and possibly Oregon and Nevada (Wick 1955; Evanich 1983; Oedekoven 1985). Possible sightings in Nevada (Goose Creek south of Twin Falls, Idaho) and Oregon (Baker County) were recently reported (Braun 1991). Columbian sharp-tails are being reintroduced in Oregon (Starkey and Schnoes 1979; Crawford 1986).

The current range of Columbian sharp-tailed grouse in Washington consists of eight small, severely fragmented populations in Douglas, Lincoln, and Okanogan Counties (**Figure 23**). Sightings of sharp-tails were reported in Asotin County in the mid-1980s; however, the Idaho Department of Fish and Game (IDFG) transplanted sharp-tails in Idaho at that time, some likely dispersing to Asotin County. Sharp-tailed grouse found outside Douglas, Lincoln, and Okanogan Counties are likely transient birds that periodically occupy pockets of remaining shrub/meadow steppe. They contribute little to the statewide population in terms of reproduction or genetics.



Source: Hays et al. 1998

Figure 23 Historic and current range of sharp-tailed grouse in Washington

Population Trend Status

The 1997 breeding population of sharp-tailed grouse in Washington has been estimated through lek counts and a population model. During spring surveys, 358 grouse were counted on 44 leks in three counties (**Table 27**). A model, based on scientific literature, input, and survey data from WDFW biologists and current research in Washington, was used to estimate the size of the 1997 breeding population.

Table 27 Results of 1997 sharp-tailed grouse lek counts in Washington (Hays et al. 1998)

County	Birds	Leks	Birds/lek
Okanogan	169	17	9.9
Lincoln	88	10	8.8
Okanogan (off Colville Reservation)	59	9	6.5
Douglas	42	8	5.3
TOTAL	358	44	8.1

The model assumed all leks were known and surveyed, all males were on leks during counts, and the male to female sex ratio was 1:1. This model would underestimate actual population size if some leks were not located, if all males were not on leks during counts, if the sex ratio was not 1:1, and if surveys were flawed (e.g., bad weather, incomplete counts, etc.).

The model would overestimate actual population size if lek counts included females (which are difficult to distinguish). The population estimate, based on the model, is 716 sharp-tailed grouse in Washington in 1997 (**Table 28**). Allowing for additional unsurveyed habitat, M. Schroeder (pers. comm.) suggests that as many as 1000 sharp-tailed grouse may remain in Washington.

Table 28 Estimated size of the Washington sharp-tailed grouse breeding population

Sex	Population Estimate	Estimate Source
Male	358	Statewide lek counts
Female	358	1:1 sex ratio
TOTAL	716	Males + Females

The remaining sharp-tailed grouse in Washington are distributed in eight fragmented subpopulations. Of these, the subpopulation on the Colville Indian Reservation is the largest remaining in the state (**Table 28**). It is estimated to include 352 grouse and is considered self-sustaining. Of the subpopulations outside of the Reservation, the largest population is in western Lincoln County (177 birds).

The subpopulation south of Bridgeport in Douglas County contains approximately 31 birds. Outside the reservation, Okanogan County supports a total of only 138 birds. This includes four subpopulations that each support less than 25 grouse; these are likely unstable and near extirpation. Sharp-tailed grouse in each of the eight geographic areas appear to be isolated (Schroeder 1996).

Structural Condition Associations

Several environmental and habitat changes appear to have led to improved sage grouse and sharp-tailed grouse populations. Sharp-tails are present in Douglas, Lincoln, and Okanogan counties. Areas supporting the most sharp-tails include: West Foster Creek, East Foster Creek, Cold Springs Basin, and Dyer Hill in Douglas County; Swanson Lakes Wildlife Area in Lincoln County; and the Tunk Valley and Chesaw Units of the Scotch Creek Wildlife Area in the Okanogan Basin. Ziegler (1979) documented a 51% decline in waterbirch and aspen from 1945 to 1977 in Johnson Creek.

Waterbirch buds are the primary food of sharp-tailed grouse during the winter (Hays et al., 1988). In addition, 13% of landowners contacted in Okanogan County were planning to remove waterbirch or aspen (OWSAC 2000). Much winter habitat in Okanogan County has been lost to residential development. One lek was destroyed by a recreational subdivision (OWSAC 2000). Hofmann and Dobler (1988a) also reported the loss of waterbirch in two locations in Okanogan County in less than three months of observation. Sharp-tails no longer used these areas after waterbirch was removed (Hofmann and Dobler, 1988a).

WDFW has an active survey and management program for sharp-tailed grouse because of their state-listed status, and the Okanogan population is considered to be one of the last strongholds for the species. There is an augmentation program underway. Populations and habitat are surveyed annually. Birds are transplanted from elsewhere, research is underway, and WDFW is pursuing land acquisition for habitat.

The CCT is currently managing sharp-tailed grouse within the Reservation boundaries to eliminate the habitat alteration, fragmentation, and human-caused events that put these populations at risk. The CCT has recently begun a study of this species, in coordination with Washington State University, to address limiting factors and habitat restoration within the region.

Sharp-tailed grouse structural conditions and association relationships (IBIS 2003) are shown in **Table 29**.

Table 29 Sharp-tailed grouse structural conditions and association relationships (IBIS 2003)

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Sharp-tailed Grouse	Shrubsteppe	Grass/Forb-Closed	B	C
		Grass/Forb-Open	B	C
		Low Shrub-Open Shrub Overstory-Mature	B	C
		Low Shrub-Open Shrub Overstory-Old	B	A
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	C
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Medium Shrub-Open Shrub Overstory-Old	B	P
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	C

3.6.4 Mule Deer

General Habitat Requirements

Mule deer occupy a variety of habitat types across eastern Washington. Consequently, habitat requirements vary with vegetative and landscape components contained within each herd range. Forested habitats provide mule deer with forage, snow intercept, thermal, and escape cover.

Mule deer occupying mountain-foothill habitats live within a broad range of elevations, climates, and topography that includes a wide range of vegetation; many of the deer using these habitats are migratory. Mule deer are found in the deep canyon complexes along the major rivers and in the channeled scablands of eastern Washington; these areas are dominated by native bunch grasses or shrubsteppe vegetation. Mule deer also occupy agricultural areas that once were shrubsteppe.

Limiting Factors

Mule deer and their habitats are being impacted in a negative way by dam construction, urban and suburban development, road and highway construction, over-grazing by livestock, inappropriate logging operations, competition by other ungulates, drought, fire, over-harvest by hunters, predation, disease, and parasites.

Weather conditions can play a major role in the productivity and abundance of mule deer. Drought conditions can have a severe impact on mule deer because forage does not replenish itself on summer or winter range, and nutritional quality is low. Drought conditions during the summer and fall can result in low fecundity in does, and poor physical condition going into the winter months. Severe winter weather can result in high mortality, depending on severity. Severe weather can result in mortality of all age classes, but the young, old, and mature bucks usually sustain the highest mortality. If mule deer are subjected to drought conditions in the summer and fall, followed by a severe winter, the result can be high mortality rates and low productivity the following year.

Habitat conditions in the Ecoprovince have deteriorated in some areas and improved dramatically in others. The conversion of shrubsteppe and grassland habitat to agricultural croplands and residential development has resulted in the loss of thousands of acres of mule deer habitat. This has, however been mitigated to some degree by the implementation of the CRP. Noxious weeds have invaded many areas resulting in a tremendous loss of good habitat for mule deer.

Fire suppression has resulted in a decline of habitat conditions in the mountains and foothills of the Cascade Mountains. Browse species need to be regenerated by fire in order to maintain availability and nutritional value to big game. Lack of fire has allowed many browse species to grow out of reach for mule deer (Leege 1968; 1969; Young and Robinette 1939).

The reservoirs created by dams on the Columbia River inundated prime riparian habitat that supported many species of wildlife, including mule deer. This riparian zone provided high quality habitat (forage/cover), especially during the winter months. The loss of this important habitat, and the impact it has had on the mule deer population along the breaks of the Columbia River, may never be fully understood.

Current Distribution

Deer damage is a chronic problem in the Omak district. During severe winters, deer are often forced onto low elevation private property in close proximity to human development. At such times, damage to orchards, haystacks, and landscaping can be significant" (OWSAC 2000).

The WDFW conducts annual mule deer and whitetail deer population surveys, and manages its wildlife areas for winter mule deer range. The USFS and WDNR also manage portions of their lands for winter deer range.

The CCT is a major financial contributor to, and is involved in, an ongoing long-term mule deer study with WFWD, Chelan Co. PUD, U.S. Forest Service, Inland NW Wildlife Council, WSU, UW, and UI. The CCT is actively monitoring habitat, limiting factors and population trends, and performs annual aerial surveys, regulates tribal hunting seasons and manages hunter check stations.

Population Trend Status

Mule deer structural conditions and association relationships (IBIS 2003) are shown in **Table 30**. Mule deer populations have varied dramatically throughout recorded history of the region. In the 1800s, mule deer populations were reported to be extremely low (OWSAC 2000). In the 1900s, deer populations fluctuated widely, with historic highs in the 1950s and 1960s.

Population lows are because of a number of factors, including severe weather conditions, overused winter range, and hunting pressure. Severe winter weather conditions have significantly reduced mule deer populations since 1992. The winter of 1996/1997 was especially hard on the local herds.

"Qualitative observations from land managers, biologists, and long time residents, as well as harvest figures, suggest the populations may be half of what it was in the mid 1980s and early 1990s" (OWSAC 2000). A shorter season and reduced number of hunters in 1997 along with easier overwintering conditions during the 1997/98 winter has been beneficial to the herds (OWSAC 2000).

Mule deer on the reservation are suffering long-term declines attributed to habitat changes, habitat fragmentation, severe weather conditions, and overgrazing. Data from Colville Tribes aerial trend counts indicate severe declines in both mule deer and whitetail populations (Snappily Subbasin Summary). Mule deer are important for cultural and subsistence reasons.

Table 30 Mule deer structural conditions and association relationships (IBIS 2003)

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Mule Deer	Shrubsteppe	Grass/Forb-Closed	B	A
		Grass/Forb-Open	B	A
		Low Shrub-Closed Shrub Overstory-Mature	B	A
		Low Shrub-Closed Shrub Overstory-Old	B	A
		Low Shrub-Closed Shrub Overstory-Seedling/Young	B	A
		Low Shrub-Open Shrub Overstory-Mature	B	A
		Low Shrub-Open Shrub Overstory-Old	B	A
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Medium Shrub-Closed Shrub Overstory-Mature	B	A
		Medium Shrub-Closed Shrub Overstory-Old	B	A
		Medium Shrub-Closed Shrub Overstory-Seedling/Young	B	A
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Medium Shrub-Open Shrub Overstory-Old	B	A
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Tall Shrub-Closed Shrub Overstory-Mature	B	A
		Tall Shrub-Closed Shrub Overstory-Old	B	A
		Tall Shrub-Closed Shrub Overstory-Seedling/Young	B	A
		Tall Shrub-Open Shrub Overstory-Mature	B	A
		Tall Shrub-Open Shrub Overstory-Old	B	A
		Tall Shrub-Open Shrub Overstory-Seedling/Young	B	A

3.6.5 Red-eyed Vireo

General Habitat Requirements

Partners in Flight established biological objectives for this species in the lowlands of western Oregon and western Washington. These include providing habitats that meet the following definition: mean canopy tree height greater than 50 feet, mean canopy closure greater than 60%, young (recruitment) sapling trees greater than 10% cover in the understory, and riparian woodland greater than 64 feet wide (Altman 2001). Red-eyed vireos are closely associated with riparian woodlands and black cottonwood stands, and may use mixed deciduous stands.

The patchy distribution in Washington for this species correlates with the distribution of large black cottonwood (*Populus trichocarpa*) groves, which are usually limited to riparian areas. The red-eyed vireo is one of the most abundant species in northeastern United States, but is much less common in Washington because of limited habitat.

The Methow subbasin is host to some of Eastern Washington's best remaining tracts of cottonwood gallery forests, which are found in the wide floodplain portions of the Methow River valley and its major tributaries. Almost all of this habitat type is in private ownership, of which, much has been converted to residential development or agriculture;significant forest parcels remain along the Methow River between Winthrop and Lost River.

Additional significant stands are located along the Twisp and Chewuch rivers, and more fragmented pockets can be found along the Methow between Winthrop and Carlton. Below Carlton, a higher stream gradient and a more constrained channel preclude the development of large patches of this habitat type (J. Foster, WDFW, pers. comm.). Because of its proximity to roads and other developed areas, much of the remaining riparian/floodplain habitat may be at risk of conversion to housing development.

Limiting Factors

Habitat loss because of hydrological diversions and control of natural flooding regimes (e.g., dams) has resulted in an overall reduction of riparian habitat for red-eyed vireos through the conversion of riparian habitats and inundation from impoundments.

Like other neotropical migratory birds, red-eyed vireos suffer from habitat degradation resulting from the loss of vertical stratification in riparian vegetation, lack of recruitment of young cottonwoods, ash (*Fraxinus latifolia*), willows (*Salix* spp.), and other subcanopy species.

Streambank stabilization (e.g., riprap) narrows stream channels and reduces the flood zone and extent of riparian vegetation. The invasion of exotic species such as canarygrass (*Phalaris* spp.) and blackberry (*Rubus* spp.) also contributes to a reduction in available habitat for the red-eyed vireo. Habitat loss can also be attributed to overgrazing, which can reduce understory cover. Reductions in riparian corridor widths may decrease suitability of riparian habitat, and may increase encroachment of nest predators and nest parasites to the interior of the stand.

Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have a high density of nest parasites, such as brown-headed cowbirds and domestic predators (cats), and can be subject to high levels of human disturbance. Recreational disturbances, particularly during nesting season, and particularly in high-use recreation areas, may have an impact on red-eyed vireos.

Increased use of pesticide and herbicides may reduce the insect food base for red-eyed vireos.

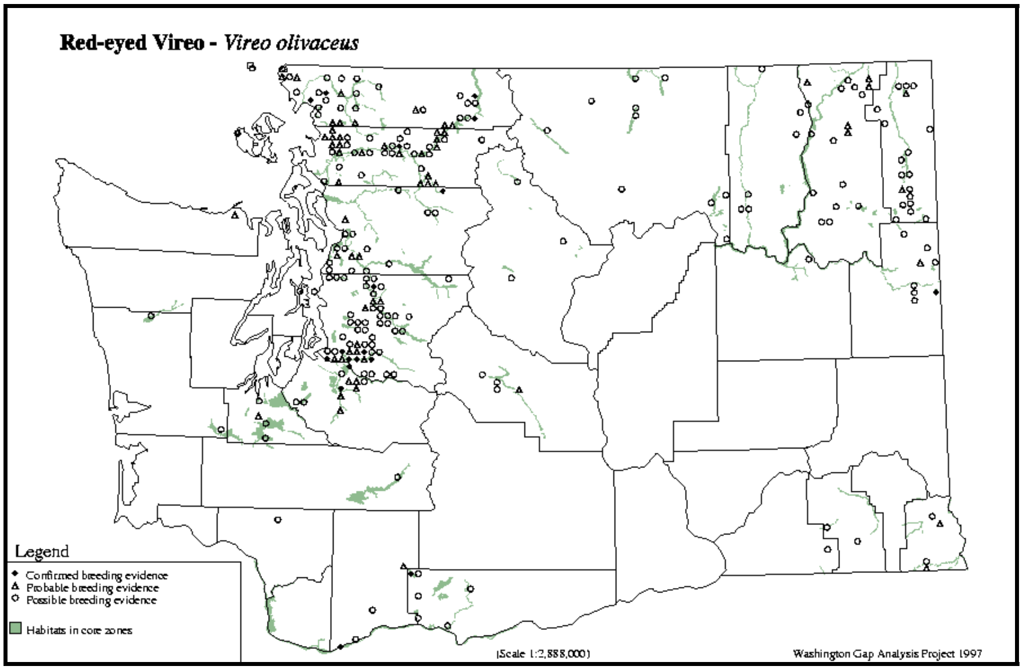
Current Distribution

The North American breeding range of the red-eyed vireo extends from British Columbia to Nova Scotia, north through parts of the Northwest Territories, and throughout most of the lower United States ((Washington GAP Analysis Project 1997)

Figure 24). The birds migrate to the tropics for the winter.

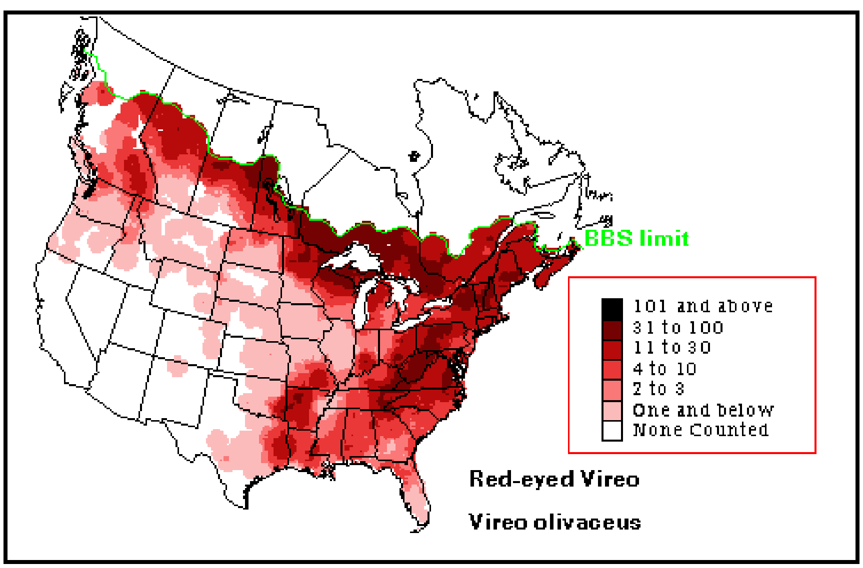
The patchy distribution in Washington for this species correlates with the distribution of large black cottonwood (*Populus trichocarpa*) groves that are usually limited to riparian areas. The red-eyed vireo is one of the most abundant species in the northeastern United States, but is much less common in Washington because of limited habitat. Red-eyed vireo breeding and summer distribution are illustrated in **Figure 25** and (Sauer et al. 2003)

Figure 26 respectively.



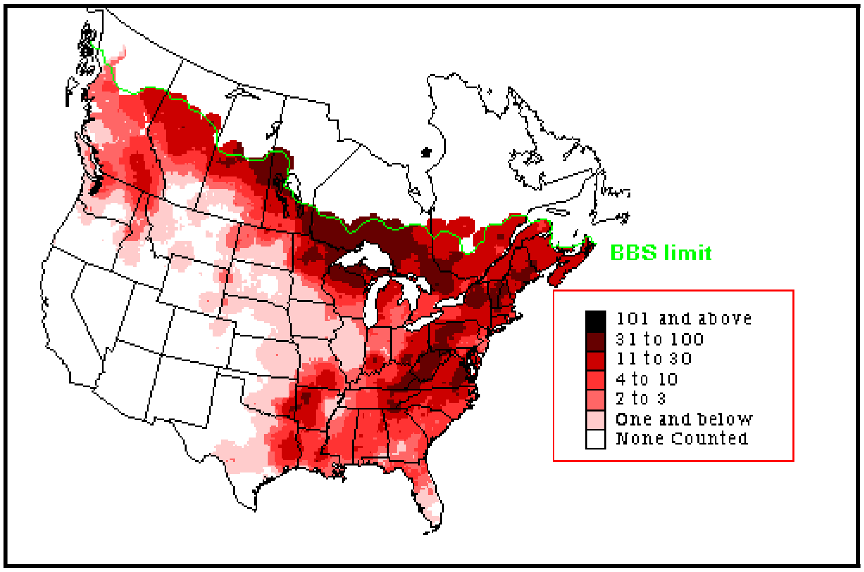
(Washington GAP Analysis Project 1997)

Figure 24 Breeding bird atlas data (1987-1995) and species distribution for red-eyed vireo



(Sauer et al. 2003)

Figure 25 Red-eyed vireo breeding distribution



(Sauer et al. 2003)

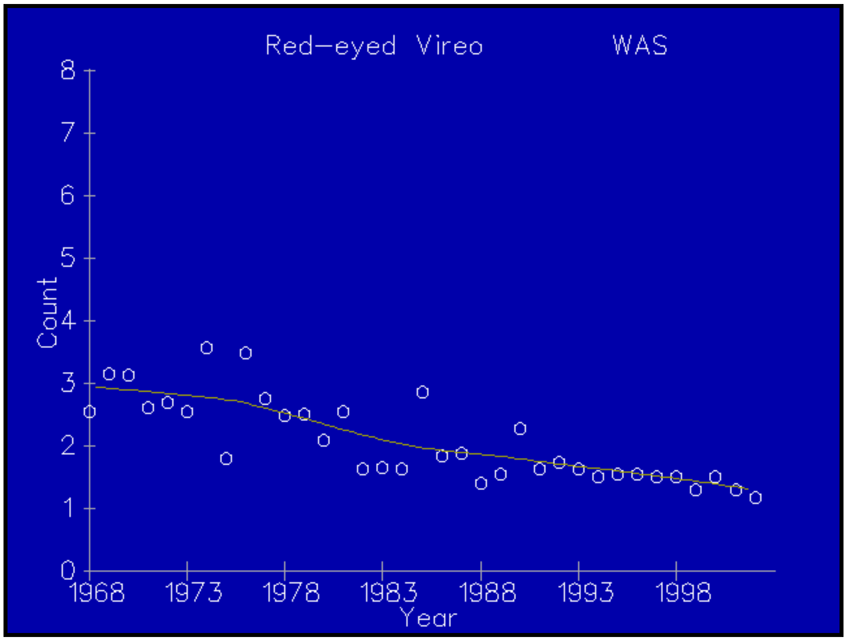
Figure 26 Red-eyed vireo summer distribution

Population Trend Status

The red-eyed vireo is secure, particularly in the eastern United States. Within the state of Washington, the red-eyed vireo is locally common, more widespread in northeastern and southeastern Washington, and not a conservation concern (Altman 1999).

Red-eyed vireos are currently protected throughout their breeding range by the Migratory Bird Treaty Act (1918) in the United States, the Migratory Bird Convention Act (1916) in Canada, and the Convention for the Protection of Migratory Birds and Game Mammals (1936) in Mexico.

In Washington, BBS data show a significant population increase of 4.9% per year from 1982 to 1991 (Peterjohn 1991). However, in the long-term results, a population decline in Washington of 2.6% per year has been observed (Figure 27), although the change is not statistically significant largely because of scanty data (Sauer et al. 2003). Because the BBS dates back only about 30 years, population declines in Washington resulting from habitat loss dating prior to the survey would not be accounted for by that effort.



Source: BBS data, Washington; Sauer et al. 2003

Figure 27 Red-eyed vireo counts (1968-1998)

3.6.6 Yellow-breasted Chat

General Habitat Requirements

Yellow-breasted chats are found in second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps. They have been found in thickets with few tall trees, early successional stages of forest regeneration, and commonly, in sites close to human habitation. In winter, yellow-breasted chats establish territories in young second-growth forest and scrub (Dennis 1958, Thompson and Nolan 1973, Morse 1989).

Limiting Factors

Threats include habitat loss because of successional changes and clearing of land for agricultural or residential development. Frequently parasitized by the brown-headed cowbird (*Molothrus ater*), but it is not well known whether this has a significant impact on reproductive success.

Current Distribution

Yellow-breasted chat breeding range includes southern British Columbia across southern Canada and the northern U.S. to southern Ontario and central New York, south to southern Baja California, to Sinaloa on Pacific slope, to Zacatecas in interior over plateau, to southern Tamaulipas on Atlantic slope, and to Gulf Coast and northern Florida (AOU 1998).

Yellow-breasted chat non-breeding range includes southern Baja California, southern Sinaloa, southern Texas, southern Louisiana, and southern Florida south (rarely north to Oregon, Great Lakes, New York, or New England) to western Panama (AOU 1998).

Population Trend Status

North American Breeding Bird Survey (BBS) data indicate a significant population decline in eastern North America from 1966 to 1988, and a significant increase in western North America from 1978 to 1988 (Sauer and Droege 1992). In North America overall, from 1966 to 1989, there was a non-significant decline, averaging 0.8% per year from 1966 to 1989 (Droege and Sauer 1990), a non-significant 9% decline from 1966 to 1993, and a barely significant increase of 8% from 1984 to 1993 (Price et al. 1995).

Yellow-breasted chats may have declined in south-central and southeastern New York between the early 1900s and mid-1980s (Eaton, in Andrle and Carroll 1988). Numbers have steadily declined in some areas of Ohio, though the range has not changed much since the 1930s (Peterjohn and Rice 1991).

Yellow-breasted chats have declined in Indiana and Illinois since the mid-1960s; they have declined along the lower Colorado River with the loss of native habitat (Hunter et al. 1988). In Canada, they are thought to be slowly declining because of habitat destruction in British Columbia; populations in Alberta and Saskatchewan appear to be stable; population has declined at Point Pelee National Park in Ontario, which contains a considerable proportion of the province's small population, and; there no longer are breeds at Rondeau Provincial Park (Ontario). The population on Pelee Island (Ontario), however, appears to be stable (Cadman and Page 1994).

Washington trends are illustrated in Figure 28.Yellow-breasted chat breeding season abundance (from BBS data) is illustrated in Figure 29, and winter season abundance (from CBC data) is illustrated in Figure 30.

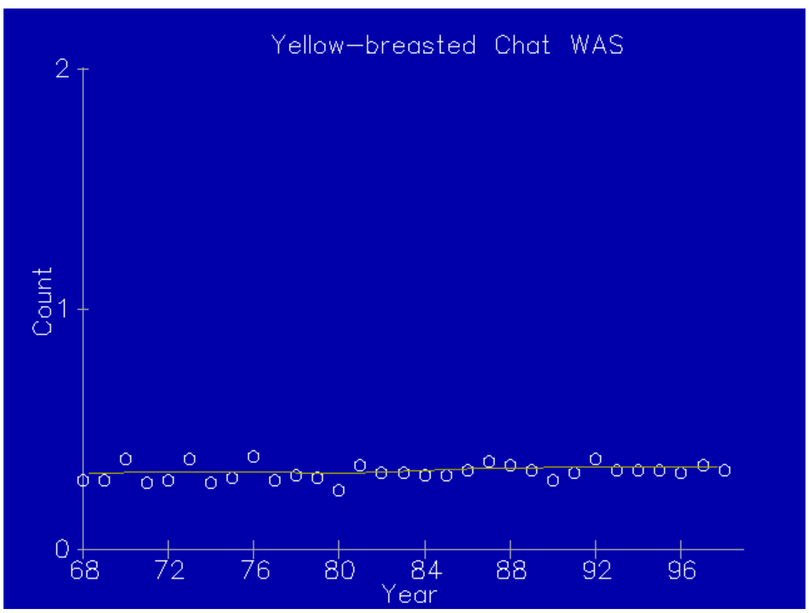
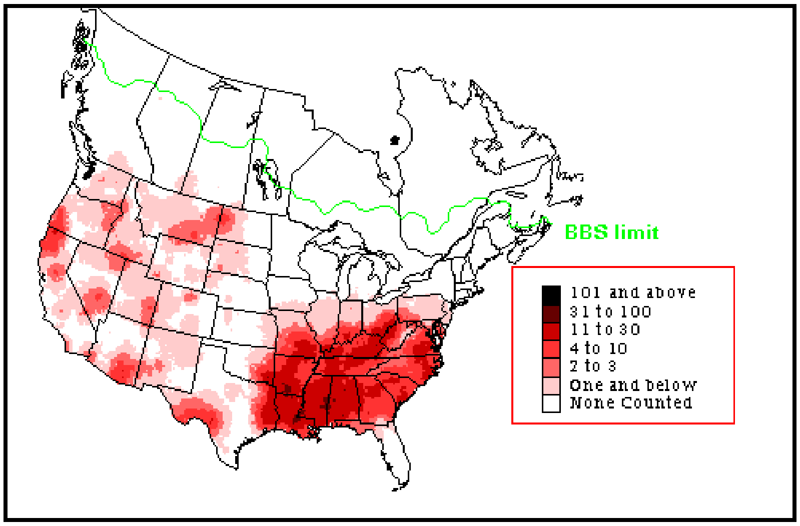
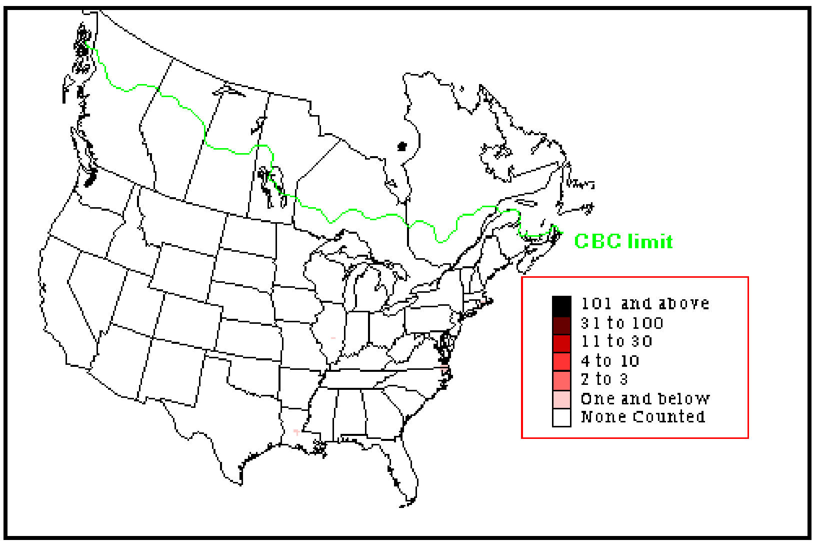


Figure 28 Population trends for Yellow-breasted Chat in Washington State



Source: BBS data; Sauer et al. 2003

Figure 29 Seasonal abundance of Yellow-breasted Chat in Washington State from the BBS



Source: CBC data

Figure 30 Winter abundance of Yellow-breasted Chat in Washington State from CBC Data

3.6.7 American Beaver

General Habitat Requirements

Suitable beaver habitat in all wetland cover types (e.g., herbaceous wetland, riparian wetland, and deciduous forested wetland) must have a permanent source of surface water with little or no fluctuation (Slough and Sadleir 1977). Lakes and reservoirs that have extreme annual or seasonal fluctuations in the water level will be unsuitable habitat for beaver. Similarly, intermittent streams, or streams that have major fluctuations in discharge (e.g., high spring runoff) or a stream channel gradient of 15% or more, will have little year-round value as beaver habitat. Assuming that there is an adequate food source available, small lakes less than 20 acres in surface area are assumed to provide suitable habitat. Large lakes and reservoirs greater than 20 acres in surface area must have irregular shorelines (e.g., bays, coves, and inlets) in order to provide optimum habitat for beaver.

Beavers are generalized herbivores and appear to prefer herbaceous vegetation such as duck potato (*Sagittaria* spp.), duckweed (*Lemna* spp.), pondweed (*Potamogeton* spp.), and water weed (*Elodea* spp.) to woody vegetation during all seasons of the year, if it is available (Jenkins 1981). The leaves, twigs, and bark of woody plants are eaten, as well as many species of aquatic and terrestrial herbaceous vegetation.

Beaver show strong preferences for particular woody plant species and size classes (Jenkins 1975; Collins 1976a; Jenkins 1979). Denney (1952) reported that beavers preferred, in order of preference, aspen, willow, cottonwood, and alder. Woody stems cut by beavers are usually less than three to four inches diameter at breast height (DBH) (Bradt 1947; Hodgdon and Hunt 1953; Longley and Moyle 1963; Nixon and Ely 1969). Jenkins (1980) reported a decrease in mean stem size cut and greater selectivity for size and species with increasing distance from the water's edge. Food preferences may vary seasonally, or from year to year, as a result of variation in the nutritional value of food sources (Jenkins 1979). Specific habitat attributes are shown in **Table 31**.

Table 31 Focal Species, Focal Habitat Types, and Key Habitat Relationships

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
Sage thrasher	Shrub-steppe	sagebrush height	sagebrush cover 5-20%	not area-sensitive (needs > 40 ac); not impacted by cowbirds; high moisture sites w/ tall shrubs	Food, Reproduction	The sage thrasher is a shrubsteppe obligate species and an indicator of healthy, tall sagebrush dominated shrubsteppe habitat.
			sagebrush height > 80 cm		Food, Reproduction	
			herbaceous cover 5-20%		Food, Reproduction	
			other shrub cover > 10%		Food, Reproduction	
			non-native herbaceous cover < 10%		Food, Reproduction	
Brewer's sparrow	Shrubsteppe	sagebrush cover	sagebrush cover 10-30%		Food, Reproduction	The Brewer's sparrow is a shrubsteppe obligate species and is an indicator of healthy sagebrush dominated shrubsteppe habitat.

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
			sagebrush height > 60 cm		Food, Reproduction	
			herbaceous cover > 10%		Food, Reproduction	
			open ground > 20%		Food, Reproduction	
			non-native herbaceous cover < 10%		Food, Reproduction	
Grasshop per sparrow	Shrubsteppe	Native steppe/ grasslands	native bunchgrass cover > 15% and comprising > 60% of the total grass cover		Food, Reproduction	The grasshopper sparrow is an indicator of healthy steppe habitat dominated by native bunch grasses.
Sharp-tailed grouse	Shrubsteppe	Deciduous trees and shrubs	mean VOR > 6"		Reproduction	Sharp-tailed grouse is a management priority species and an indicator of healthy steppe/shrubstep pe habitat w/ healthy imbedded mesic draws.
			> 40% grass cover		Reproduction	
			> 30% forb cover		Reproduction	
			< 5% cover introduced herbaceous cover		Reproduction	

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
			> 50% optimum area providing nest/brood cover		Reproduction	
			> 0.25 km between nest/brood rearing habitat and winter habitat		Reproduction	
			> 75% cover deciduous shrubs and trees		Winter	
			> 10% optimum area providing winter habitat		Winter	
Sage grouse	Shrubsteppe	diverse herbaceous understory, sagebrush cover	sagebrush cover 10-30%	area sensitive; needs large blocks	Reproduction	shrubsteppe obligate; State threatened, Federal Candidate species
			forb cover > 10%		Food	
			open ground cover > 10%			
			non-native herbaceous cover < 10%			
Pygmy rabbit	Shrubsteppe	deep, rock-free soil	sagebrush cover 21-36%	area sensitive, needs large blocks	Reproduction	Shrubsteppe obligate; Federal, State endangered species
			shrub height 32"			

Focal Species	Focal Habitat Type	Key Habitat Relationships: Conservation Focus	Key Habitat Relationships: Habitat Attribute (Vegetative Structure)	Comments	Life Requisite	Selection Rationale
Mule deer	Shrubsteppe	antelope bitterbrush	30-60% canopy cover of preferred shrubs < 5 ft.		Food	The mule deer is a management priority species and an indicator of healthy diverse shrub layer in east-slope shrubsteppe habitat.
			number of preferred shrub species > 3			
			mean height of shrubs > 3 ft.			
			30-70% canopy cover of all shrubs < 5 ft.			
Willow flycatcher	Eastside (Interior) Riparian Wetlands	shrub density	dense patches of native vegetation in the shrub layer > 35 $ft.^2$ in size and interspersed with openings of herbaceous vegetation	> 20 ac; frequent cowbird host; sites > 0.6 mi from urban/residential areas and > 3 mi from high-use cowbird areas	Reproduction	Indicator of healthy, diverse riparian wetland habitat
			shrub layer cover 40-80%		Reproduction	
			shrub layer height > 3 ft. high		Reproduction	
			tree cover < 30%		Reproduction	
Lewis' woodpecker	Eastside (Interior) Riparian Wetlands	large cottonwood trees/snags	> 0.8 trees/ac > 21" dbh	Dependent on insect food supply; competition from	Food	Indicator of healthy cottonwood

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
				starlings detrimental		stands with snags
			canopy cover 10-40%			
			shrub cover 30-80-%			
Red-eyed vireo	Eastside (Interior) Riparian Wetlands	canopy foliage and structure	canopy closure > 60%		Food, Reproduction	The red-eyed vireo is an obligate species in riverine cottonwood gallery forests and an indicator of healthy canopy cover.
			riparian zone of mature deciduous trees > 160 ft.		Food, Reproduction	
			> 10% of the shrub layer should be young cottonwoods		Food, Reproduction	
Yellow-breasted chat	Eastside (Interior) Riparian Wetlands	dense shrub layer	shrub layer 1-4 m tall	vulnerable to cowbird parasitism; grazing reduces understory structure	Food, Reproduction	The yellow-breasted chat is an indicator of healthy shrub dominated riparian habitat and is a management priority species in the Canadian Okanogan.
			30-80% shrub cover		Food,	

Focal Species	Focal Habitat Type	Key Habitat Relationships: Conservation Focus	Key Habitat Relationships: Habitat Attribute (Vegetative Structure)	Comments	Life Requisite	Selection Rationale
					Reproduction	
			scattered herbaceous openings		Food, Reproduction	
			tree cover < 20%		Food, Reproduction	
Beaver	Eastside (Interior) Riparian Wetlands	canopy closure	40-60% tree/shrub canopy closure		Food	The beaver is an indicator of healthy regenerating aspen stands and an important habitat manipulator.
			trees < 6" dbh; shrub height ≥ 6.6 ft.			
		permanent water	stream channel gradient ≤ 6% with little to no fluctuation		Water (cover for food and reproductive requirements)	
		shoreline development	woody vegetation ≤ 328 ft. from water		Food	
Red-winged blackbird	Herbaceous Wetlands	Open water with emergent wetlands				Wetland obligate species
Pygmy nuthatch	Ponderosa Pine	large trees	> 10/ac > 21" dbh with > 2 trees > 31" dbh	large snags for nesting; large trees for foraging	Food, Reproduction	The pygmy nuthatch is a species of management concern and is an obligate for healthy old-growth

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
						Ponderosa pine forest with an abundant snag component.
			> 1.4 snags/ac > 8" dbh with > 50% > 25"			
Gray flycatcher	Ponderosa Pine	shrubsteppe/ pine interface; pine savannah w/ shrub-bunchgrass understory	Nest tree diameter 18" dbh		Reproduction	The gray flycatcher is an indicator of healthy fire-maintained regenerating ponderosa pine forest.
			Tree height 52'		Food	
White-headed woodpecker	Ponderosa Pine	large patches of old growth forest with large trees and snags	> 10 trees/ac > 21" dbh w/ > 2 trees > 31" dbh	large high-cut stumps; patch size smaller for old-growth forest; need > 350 ac or > 700 ac	Reproduction	The white-headed woodpecker is a species of management concern and it is an obligate species for large patches of healthy old-growth Ponderosa pine forest.
Flammulated owl	Ponderosa Pine	interspersion; grassy openings and dense thickets	> 10 snags / 40 ha > 30 cm dbh and 1.8m tall	thicket patches for roosting; grassy openings for foraging	Food	The flammulated is an indicator of a healthy landscape mosaic in Ponderosa pine and Ponderosa

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
						pine/Douglas-fir forest and it is a Washington State priority species.

Limiting Factors

Beavers readily adapt to living in urban areas near humans and are limited primarily by the availability of permanent water with limited fluctuations and accessibility of food.

Riparian habitat along many waterways has been removed, thus, removing important habitat and food sources for beaver.

Beavers that create dams, that restrict fish passage, are removed in order to restore fish passage.

Current Distribution

The beaver is found throughout most of North America except in the Arctic tundra, peninsular Florida, and the Southwestern deserts (Figure 31) (Allen 1983; VanGelden 1982; Zeveloff 1988).

Source: Linzey and Brecht 2002.

Figure 31 North American distribution of beaver.

3.6.8 Pygmy Nuthatch

General Habitat Requirements

Among all breeding birds within Ponderosa pine forests, the density of Pygmy nuthatches is most strongly correlated with the abundance of Ponderosa pine trees (Balda 1969). In Colorado, 93% of breeding bird atlas observations occurred in coniferous forests, 70% of those in Ponderosa pines. Indeed the distribution of Pygmy nuthatches in Colorado coincides with that of Ponderosa pine woodlands in the state (Jones 1998).

Several studies identify the Pygmy nuthatch as the most, or one of the most abundant species in Ponderosa forests (e.g., Mt. Charleston, Nevada, Arizona's mountains and plateaus, New

Mexico, Colorado statewide, and Baja California) (Reassumes 1941; Brandt 1951; Norris 1958; Stallcup 1968; Balda 1969; Farris 1985; Travis 1992; Kingery 1998), as well as in other yellow long-needled pines such as those of coastal California and Popocatépetl, Mexico (Norris 1958, Paynter 1962).

In California's mountains, the Pygmy nuthatch favors open park-like forests of Ponderosa and Jeffrey pines in the Sierra Nevada Mountains (Gaines 1988), but also ranges to 3,050 metres (10,007 feet) in open stands of large lodgepole pine in the White Mountains of California (Shuford and Metropulos 1996). In the Mogollon Rim region of central Arizona, the bird breeds and feeds in vast expanses of Ponderosa pine that extend throughout the Colorado plateau, and is also common in shallow snow-melt ravines that course through the pine forests. These snowmelt drainages contain white fir (*Abies concolor*), Douglas-fir, Arizona white pine (*Pinus strobiformis*), quaking aspen (*Populus tremuloides*), and an understory of maples (*Acer* spp.) (Kingery and Ghalambor 2001).

In New Mexico, it is most common in Ponderosa pine, including Ponderosa/oak and Ponderosa/Douglas-fir forests (Kingery and Ghalambor 2001). In Washington, it uses Douglas-fir zones rarely, and then only those in or near Ponderosa pines (Smith et al. 1997). In Summit County, Colorado, a small group of Pygmy nuthatches occupy a small section of lodgepole pine at the edge of an extensive lodgepole forest (Kingery and Ghalambor 2001).

In coastal California (Sonoma, Marin, Monterey, San Luis Obispo Counties) Pygmy nuthatches occur in the "coastal fog belt" (Burridge 1995) in Bishop pine (*Pinus muricata*), Coulter pine (*Pinus coulteri*), natural and planted groves of Monterey pine (*Pinus radiata*) (Roberson 1993, Shuford 1993), other pine plantations (Burridge 1995), and wherever Ponderosa pines grow (e.g., Santa Lucia Mountains, Monterey County) (Roberson 1993).

In Mexico, where it occurs in arid pine forests of the highlands, the Pygmy nutchatch follows pines to their upper limits at the tree line on Mount Popocatépetl (Paynter 1962) and Pico Orizaba (Cox 1895). Almost no other contemporary information is available on the habitat preferences of Pygmy nuthatches in Mexican mountain ranges (S. Howell, J. Nocedal, A. Sada, pers. comm.). They are known to favor pine and pine-oak woodlands; these pine species include Ponderosa-type pines: *Pinus engelmanii*, *P. arizonica*, *P. montezumae*, as well as non-Ponderosa-types: *Pinus teocote*, *P. hartwegii*, *P. leiophylla*, and *P. cooperi*. Associated Mexican tree species in Pygmy nuthatch habitat include oaks (*Quercus rugosa*, *Q. castanea*, *Q. durifolia*, and *Q. hartwegii*), madrones (*Arbutus xalpensis* and *A. glandulosa*), and alders (*Alnus firmifolia*; Nocedal 1984, 1994, A. Sada, pers. comm.). The species also occurs, in small numbers, in fir (*Abies religiosa*) forests (Nocedal 1984, 1994).

Limiting Factors

There is good evidence for at least two main limiting factors in Pygmy nuthatch populations: the availability of snags for nesting and roosting, and sufficient numbers of large cone-producing trees for food.

Pygmy nuthatches are dependent on snags for nesting and roosting, and reduced snag availability has been shown to have negative effects on populations. Because Pygmy nuthatches nest and roost in excavated tree cavities, the importance of snags is manifested during both the breeding and non-breeding season. During the breeding season, numerous studies have documented a decline in the number of breeding pairs and a reduction in population density on sites where timber harvesting reduced the number of available snags. During the non-breeding season, studies show that timber harvests, that remove the majority of snags, cause communally roosting groups to use atypical cavities with poorer thermal properties.

Pygmy nuthatches choosing roost sites during the non-breeding season use a different set of characteristics compared to nest sites. A considerable reduction in snag densities may affect overwinter survivorship, and possibly reproduction, by forcing Pygmy nuthatches to use cavities in snags they would normally avoid (Hay and Güntert 1983; Matthysen 1998). More research on the differences among snags is clearly needed in order to distinguish those factors that make some snags more desirable than others.

Pygmy nuthatch populations rely heavily on the availability of pine seeds and arthropods that live on pines. In comparison to other nuthatches and woodpeckers, Pygmy nuthatches forage more amongst the foliage of live trees rather than on the bark. The preferred foraging habitat for Pygmy nuthatches appears to contain a high canopy density, low canopy patchiness, and increased vertical vegetation density, a common feature of mature undisturbed forests.

Pygmy nuthatch populations are very sedentary. Young birds have been observed to only move 940 feet (287 metres) from their natal territories. Such limited dispersal reduces the number of individuals that emigrate and immigrate from local populations, which in turn, reduces gene flow and demographic stability. Thus, in contrast to the majority of North America's songbirds, movement and dispersal patterns in Pygmy nuthatch populations are limited to a relatively small geographic area. Pygmy nuthatches may, therefore, need a greater amount of connectivity between suitable habitat in comparison to other resident birds.

In a recent review of the effects of recreation on songbirds within Ponderosa pine forests, Marzluff (1997) hypothesized that nuthatches would experience moderate decreases in population abundance and productivity in response to impacts associated with established campsites (the Pygmy nuthatch was not specifically identified).

Impacts associated with camping that might negatively influence nuthatches include changes in vegetation, disturbance of breeding birds, and increases in the number of potential nest predators (Marzluff 1997). Other recreational activities associated with resorts and recreational residences may, however, moderately increase nuthatch population abundance and productivity (Marzluff 1997). This positive effect on nuthatch populations is likely to occur through food supplementation, such as bird feeders, that are frequently visited by Pygmy nuthatches.

Current Distribution

The Pygmy nuthatch is resident in Ponderosa and similar pines from south-central British Columbia and the mountains of the western United States to central Mexico. The patchy distribution of pines in western North America dictates the patchy distribution of the Pygmy nuthatch throughout its range. The reliance on pines distinguishes Pygmy nuthatches from other western nuthatches, such as the red-breasted and white-breasted nuthatches, which are associated with fir/spruce and deciduous forests respectively (Ghalambor and Martin 1999). The following is a review of the distribution of populations in the United States, Canada, and Mexico (based on Kingery and Ghalambor 2001).

The Pygmy nuthatch occurs in southern interior British Columbia, particularly in the Okanagan and Similkameen valleys and adjacent plateaus (Campbell et al. 1997), south into the Okanagan Highlands, and into the northeast Cascades of Washington. It is scattered along the eastern slope of the Cascades from central Washington (Jewett et al. 1953; Smith et al. 1997) into Oregon and in the Blue Mountains in southwest Washington (Garfield County only) (Smith et al. 1997), but widespread in Oregon along the west slope of the Cascades (Gabrielson and Jewett 1940; Jewett et al. 1953; Gilligan et al. 1994). It ranges south from the Cascades in Oregon into northern California, and south into the Sierra Nevadas and nearby mountains of Nevada (Brown 1978).

In the southern Sierra Nevadas, it is found on the east and west side of the range in the Mono Craters and Glass Mountain region (Gaines 1988, Shuford and Metropulos 1996) and in the White Mountains of Nevada and California (Norris 1958; Brown 1978; Shuford and Metropulos 1996). It is also found throughout the mountain ranges of southern California, including the Sierra Madres in Santa Barbara County, the Mt. Pinos area (Kern and Ventura Counties), the San Gabriel and San Bernardino Mountains in Los Angeles and San Bernardino Counties (Norris 1958; B. Carlson, K. Garrett, pers. comm.), the San Jacinto and Santa Rosa Mountains in Riverside County (Norris 1958; B. Carlson, pers. comm.), in the Laguna and Cuyamaca Mountains, as well as at Mt. Palomar and the Volcan and Hot Springs Mountains of San Diego County (San Diego County Breeding Bird Atlas preliminary data, B. Carlson, P. Unitt, pers. comm.). The range extends south into the Sierra Juarez and Sierra San Pedro Mártir Mountains in Baja California Norte, Mexico (Grinnell 1928; Norris 1958;).

In eastern Washington, the Pygmy nuthatch is common in the pine forests of Spokane County (Jewett et al. 1953; Smith et al. 1997) and adjacent Kootenai County, Idaho (Burleigh 1972). Only scattered records exist for the rest of Idaho’s mountains (Burleigh 1972; Stephens and Sturts 1991), but Pygmy nuthatches are well distributed in the Rocky Mountains of far western Montana (Montana Bird Distribution Committee 1996).

Population Trend Status

Survey-wide estimates of all BBS routes suggest Pygmy nuthatch populations are stable (Sauer et al. 2000); however, these estimates are based on small samples that do not provide a reliable population trend nor reliable trends for any states or physiographic regions, because of too few routes, too few birds, or high variability (Sauer et al. 2000). The lack of reliable data is most obvious in the Black Hills, where there are too few data to perform even the most basic trend analysis (Sauer et al. 2000).

Where long-term data are available for particular populations, natural fluctuations in population numbers have been documented. For example, a constant-effort nest-finding study in Arizona recorded a major population crash. On this site between 1991 and 1996, the number of nests found each year varied from 23 to 65 (mean = 50.2), whereas in the same site from 1997 to 1999, only two to five nests were found each year (Kingery and Ghalambor 2001). Likewise, Scott’s (1979) study also portrays a Pygmy nuthatch population swing, but no clear factor has been identified as being responsible for these rapid changes in population numbers. No definitive explanation currently exists for why some Pygmy nuthatch populations may be prone to large fluctuations, but it is suspected that an intolerance to cold winter temperatures and/or a poor cone crop may play a role.

3.6.9 Gray Flycatcher

General Habitat Requirements

Limiting Factors

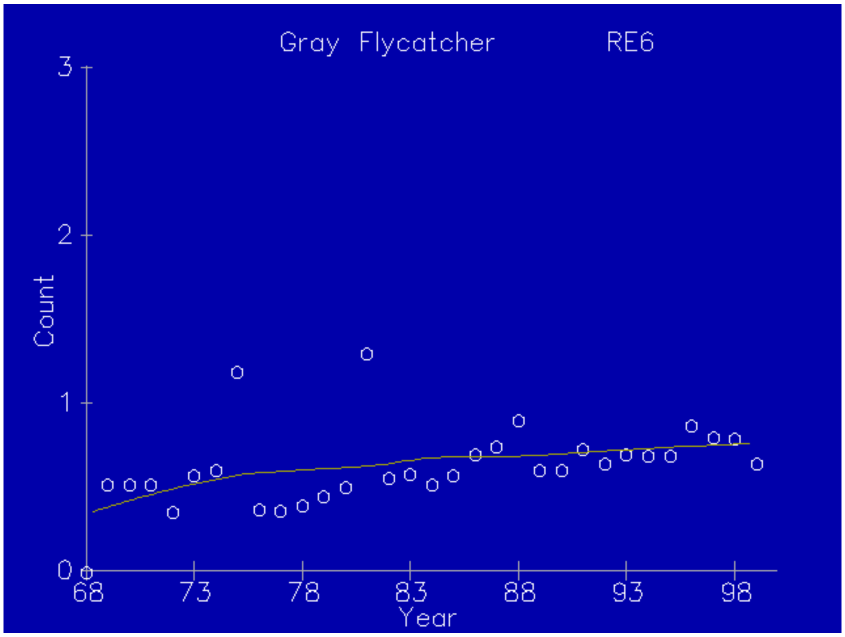
Gray flycatchers will be vulnerable to land clearing, but generally are found in very arid environments that are not usually converted to agriculture (USDA Forest Service 1994). Clearing of pinyon-juniper for mining of coal and oil shale deposits, or in favor of grassland for livestock grazing, or for widespread harvesting of pinyon-juniper could be detrimental (O'Meara et al. 1981, cited in Sterling 1999).

Current Distribution

Gray flycatchers are found in extreme southern British Columbia (Cannings 1992) and south-central Idaho, and south to southern California, southern Nevada, central Arizona, south-central New Mexico, and locally western Texas (Terres 1980, AOU 1983). Gray flycatchers during the non-breeding season occur in southern California, central Arizona, south to Baja California and south-central mainland of Mexico (Terres 1980).

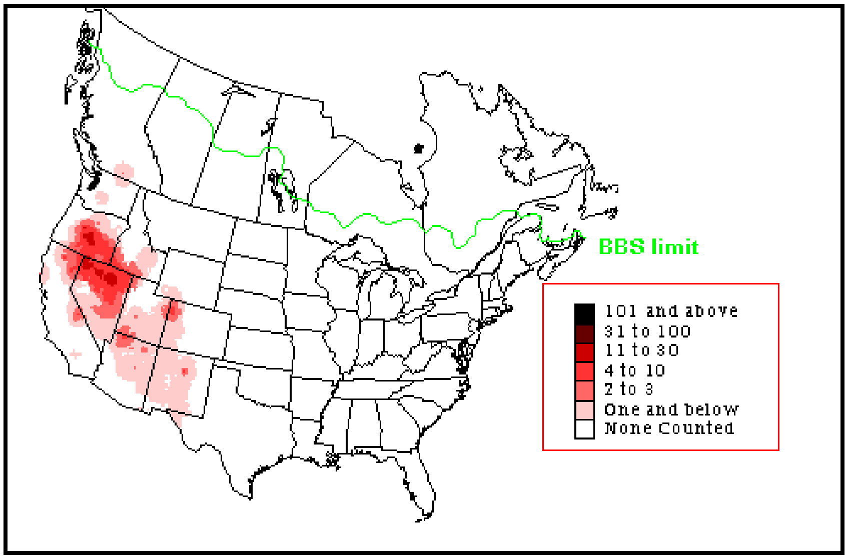
Population Trend Status

North American Breeding Bird Survey (BBS) shows a survey-wide significantly increasing trend of 10.2% average per year (n = 89) from 1966 to 1996, a nonsignificant decline of -1.0% average per year (n = 22) from 1966 to 1979, and a significant increase from 1980 to 1996 of 10.0% average per year (n = 84) (**Figure 32**). Data for Oregon reflect strong long-term increase of 7.9% average per year (n = 29) from 1966 to 1996. Sample sizes were too low for accurate trend estimates in other states (Sauer et al. 1997). Gray flycatcher breeding season abundance is illustrated in **Figure 33**.



Source: BBS data; Sauer et al. 1997

Figure 32 Gray flycatcher population trend data



(Sauer et al. 1997)

Figure 33 Gray flycatcher breeding season abundance (from BBS)

Christmas Bird Count (CBC) data for 1959 to 1988 show a significant survey-wide increase of 4.3% average per year, and a significant increase in Arizona (4.6% average per year, n = 28). Trend for California is apparently stable over the period (non-significant increase of 0.2% average per year, n = 21; Sauer et al. 1996).

The Gray flycatcher is reportedly declining as a wintering bird in southern California; extensions in Washington and California at western edges of breeding range were noted in the 1970s (USDA Forest Service 1994).

3.6.10 White-headed Woodpecker

General Habitat Requirements

White-headed woodpeckers prefer a conifer forest with a relatively open canopy (50 to 70% cover) and an availability of snags (i.e., a partially collapsed, dead tree) and stumps for nesting. The birds prefer to build nests in trees with large diameters, preference increasing with diameter. The understory vegetation is usually very sparse within the preferred habitat, and local populations are abundant in burned or cut forest where residual large-diameter live and dead trees are present. In general, open Ponderosa pine stands with canopy closures between 30% and 50% are preferred. The openness, however, is not as important as the presence of mature or veteran cone-producing pines within a stand (Milne and Hejl 1989).

The highest abundances of white-headed woodpeckers occur in old-growth stands, particularly ones with a mix of two or more pine species. The birds are uncommon or absent in monospecific Ponderosa pine forests and in stands dominated by small-coned or closed-cone conifers (e.g., lodgepole pine or knobcone pine).

Limiting Factors

Logging has removed, from throughout this species' range, much of the old growth cone-producing pines, which provide winter food and large snags for nesting. The impact from the decrease in old growth cone-producing pines is even more significant in areas where no alternate pine species exist for the white-headed woodpecker to utilize.

Fire suppression has altered the stand structure in many of the forests. Lack of fire has allowed dense stands of immature Ponderosa pine as well as the more shade tolerant Douglas-fir to establish. This has led to increased fuel loads, which has resulted in more severe stand-replacing fires where both the mature cone producing trees and the large suitable snags are destroyed. These dense stands of immature trees has also led to increased competition for nutrients as well as a slow change from a Ponderosa pine climax forest to a Douglas-fir dominated climax forest.

Predation does not appreciably affect the woodpecker population. Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers. There is also limited predation by the great horned owl on adult white-headed woodpeckers.

Current Distribution

White-headed woodpeckers live in montane, coniferous forests from southern British Columbia in Canada, to eastern Washington, southern California and Nevada and northern Idaho in the United States).

Source: Sauer et al. 2003

Figure 34 Distribution of white-headed woodpeckers

Population Trend Status

The current distribution/year-round range of white-headed woodpeckers (Sauer et al. 2003) is shown in northern Idaho in the United States (**Figure 34**).

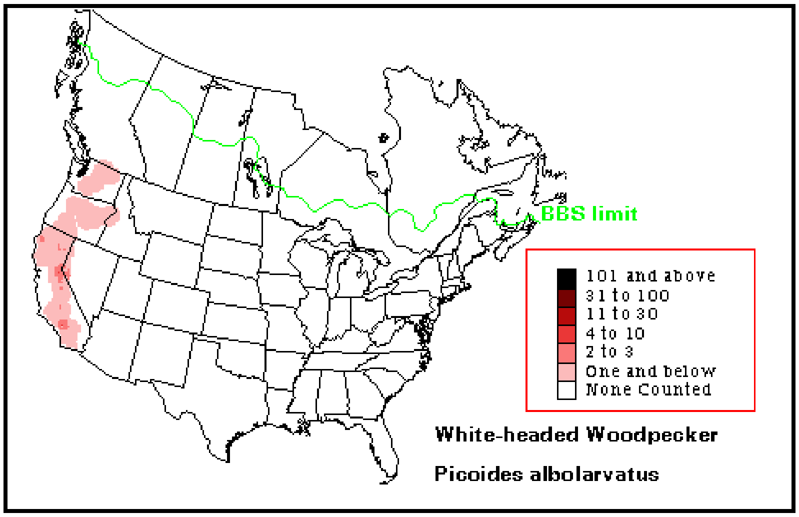
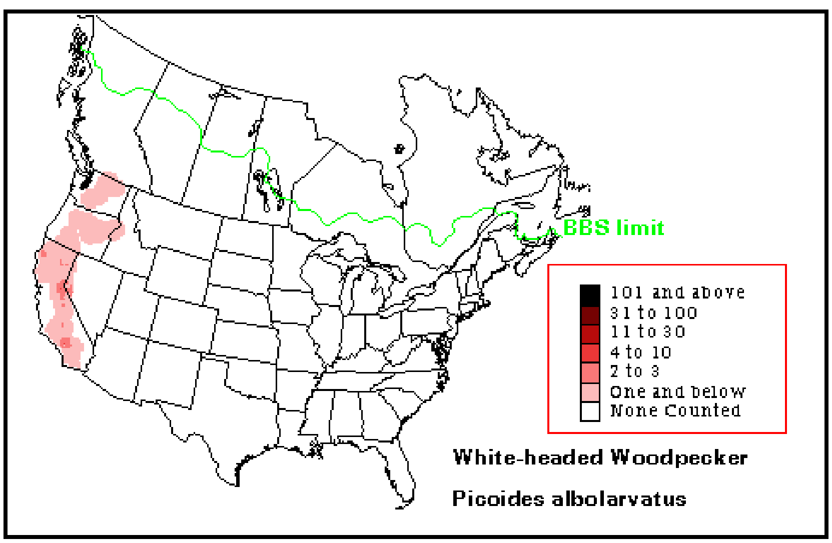


Figure 35 Distribution of white-headed woodpeckers

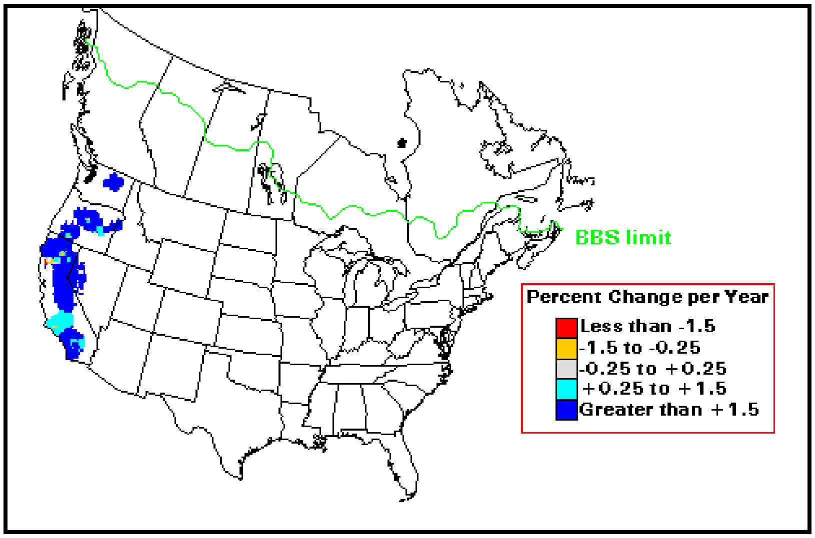
White-headed woodpecker abundance appears to decrease north of California. They are uncommon in Washington and Idaho, and rare in British Columbia; however, they are still common in most of their original range in the Sierra Nevada and mountains of southern California.

The species is of moderate conservation importance because of its relatively small and patchy year-round range (**Figure 36**) and its dependence on mature, montane coniferous forests in the West. Knowledge of this woodpecker's tolerance of forest fragmentation and silvicultural practices will be important in conserving future populations. BBS population trend data are illustrated in **Figure 37**.



Source: Sauer et al. 2003

Figure 36 Current distribution/year-round range of white-headed woodpeckers



Source: Sauer et al. 2003

Figure 37 White-headed woodpecker BBS population trend: 1966-1996

Structural Condition Associations

Structural conditions (IBIS 2003) associated with white-headed woodpeckers are summarized in **Table 32**. White-headed woodpeckers feed and reproduce (F/R) in, and are generally associated (A) with a multitude of structural conditions within the Ponderosa pine habitat type. Similarly, white-headed woodpeckers are present (P), but not dependent upon sapling/pole successional forests. According to IBIS (2003) data, white-headed woodpeckers are not closely associated (C) with any specific Ponderosa pine structural conditions.

Table 32 White-headed woodpecker structural conditions and association relationships (IBIS 2003)

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
White-headed Woodpecker	Ponderosa Pine	Giant Tree-Multi-Story	F/R-HE	A
		Grass/Forb-Closed	F/R-HE	A
		Grass/Forb-Open	F/R-HE	A
		Large Tree-Multi-Story-Closed	F/R-HE	A
		Large Tree-Multi-Story-Moderate	F/R-HE	A
		Large Tree-Multi-Story-Open	F/R-HE	A
		Large Tree-Single Story-Closed	F/R-HE	A
		Large Tree-Single Story-Moderate	F/R-HE	A
		Large Tree-Single Story-Open	F/R-HE	A
		Medium Tree-Multi-Story-Closed	F/R-HE	A
		Medium Tree-Multi-Story-Moderate	F/R-HE	A
		Medium Tree-Multi-Story-Open	F/R-HE	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Medium Tree-Single Story-Closed	F/R-HE	A
		Medium Tree-Single Story-Moderate	F/R-HE	A
		Medium Tree-Single Story-Open	F/R-HE	A
		Sapling/Pole-Closed	F/R-HE	P
		Sapling/Pole-Moderate	F/R-HE	P
		Sapling/Pole-Open	F/R-HE	P
		Shrub/Seedling-Closed	F/R-HE	A
		Shrub/Seedling-Open	F/R-HE	A
		Small Tree-Multi-Story-Closed	F/R-HE	A
		Small Tree-Multi-Story-Moderate	F/R-HE	A
		Small Tree-Multi-Story-Open	F/R-HE	A
		Small Tree-Single Story-Closed	F/R-HE	A
		Small Tree-Single Story-Moderate	F/R-HE	A
		Small Tree-Single Story-Open	F/R-HE	A

3.6.11 Flammulated Owl

General Habitat Requirements

The flammulated owl is a Washington State candidate species. Limited research on the flammulated owl indicates that its demography and life history, coupled with narrow habitat requirements, make it vulnerable to habitat changes. The flammulated owl occurs mostly in mid-level conifer forests that have a significant Ponderosa pine component (McCallum 1994b) between elevations of 1,200 to 5,500 feet in the north, and up to 9,000 feet in the southern part of its range in California (Winter 1974).

Flammulated owls are typically found in mature to old, open canopy yellow pine (Ponderosa pine and Jeffrey pine [*Pinus jeffreyi*]), Douglas-fir, and grand fir (Bull and Anderson 1978; Goggans 1986; Howie and Ritchie 1987; Reynolds and Linkhart 1992; Powers et al. 1996). It is a species dependent on large-diameter Ponderosa pine forests (Hillis et al. 2001) and are obligate, secondary cavity nesters (McCallum 1994b), requiring large snags in which to roost and nest.

Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990). The owls selectively nest in dead Ponderosa pine snags, and prefer nest sites with fewer shrubs in front than behind the cavity entrance, possibly to avoid predation and obstacles to flight.

Limiting Factors

Logging disturbance and the loss of breeding habitat associated with it has a detrimental effect on the birds (USDA 1994a). The owls prefer late seral forests. The main threat to the species is the loss of nesting cavities as this species cannot create its own nest and relies on existing cavities. Management practices such as intensive forest management, forest stand improvement, and the felling of snags and injured or diseased trees (potential nest sites) for firewood effectively remove most of the cavities suitable for nesting (Reynolds et al. 1989). The owls will nest in selectively logged stands; however, as long as they contain residual trees (Reynolds et al. 1989).

Wildfire suppression has allowed many Ponderosa pine stands to proceed to the more shade-resistant fir forest types, that are is less suitable habitat for these species (Marshall 1957; Reynolds et al. 1989).

Roads and fuelbreaks, often placed on ridgetops, result in removal of snags for safety considerations (hazard tree removal); as well, removal of firewood can result in the loss of existing and recruitment nest trees.

Pesticides including aerial spraying of carbaryl insecticides to reduce populations of forest insect pests may affect the abundance of non-target insects important in the early spring diets of flammulated owls (Reynolds et al. 1989). Although flammulated owls rarely take rodents as prey, they could be at risk, like other raptors, of secondary poisoning by anticoagulant rodenticides. Possible harmful doses could cause hemmorhaging upon the ingestion of anticoagulants such as Difenacoum, Bromadiolone, or Brodifacoum (Mendenhall and Pank 1980).

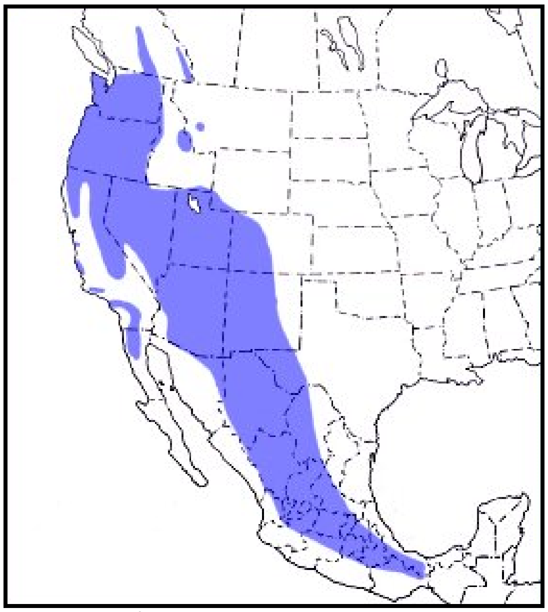
Predators/competitors include spotted owl and other larger owls, accipiters, long-tailed weasels (Zeiner et al. 1990), felids, and bears (McCallum 1994b). Nest predation has also been documented by the northern flying squirrel in the Pacific Northwest (McCallum 1994a). Saw-whet owls, screech owls, and American kestrels compete for nesting sites, but flammulated owls probably have more severe competition for nest cavities with non-raptors, such as woodpeckers, other passerines, and squirrels (Zeiner et al. 1990, McCallum 1994b).

Birds, from the size of bluebirds upward, are potential competitors. Owl nests containing bluebird eggs and flicker eggs suggest that flammulated owls evict some potential nest competitors (McCallum 1994b). Any management plan that supports pileated woodpecker and northern flicker populations will help maintain high numbers of cavities, thereby minimizing this competition (Zeiner et al. 1990). Flammulated owls may compete with western screech-owls and American kestrels for prey (Zeiner et al. 1990) as both species have a high insect component in their diets. Common poorwills, nighthawks, and bats may also compete for nocturnal insect prey especially in the early breeding season (April and May) when the diet of the owls is dominated by moths. (McCallum 1994b).

Exotic species impact flammulated owl populations. Flicker cavities are often co-opted by European starlings, reducing the availability of nest cavities for both flickers and owls (McCallum 1994a). Africanized honeybees will nest in tree cavities (Merrill and Visscher 1995), and may be a competitor where natural cavities are limiting, particularly in southern California where the bee has expanded its range north of Mexico.

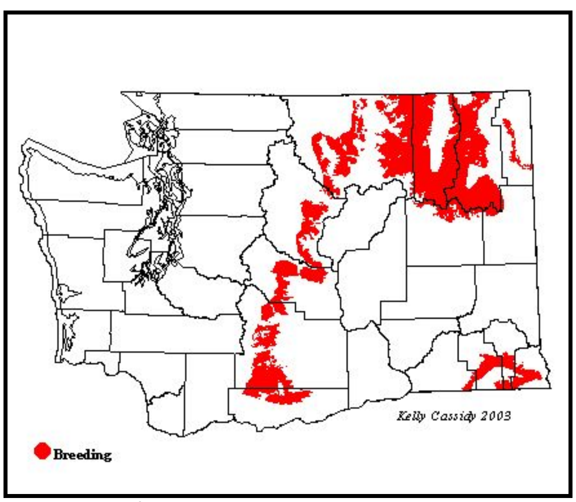
Current Distribution

Flammulated owl distribution is illustrated in **Figure 38** and **Figure 39**. Flammulated owls are uncommon breeders east of the Cascades in the Ponderosa pine belt from late May to August. There have been occasional records from western Washington, but they are essentially an east-side species. Locations where they may sometimes be found include Blewett Pass (straddling Chelan and Kittitas Counties), Colockum Pass area (Kittitas County), and Satus Pass (Klickitat County).



Source: Kaufman 1996

Figure 38 Flammulated owl distribution, North America



Source: Kaufman 1986

Figure 39 Flammulated owl distribution, Washington

Population Trend Status

Because old-growth Ponderosa pine is more rare in the northern Rocky Mountains than it was historically, and little is known about local flammulated owl distribution and habitat use, the USFS has listed the flammulated owl as a Sensitive species in the Northern Region (USDA 1994b). It is also listed as a Sensitive species by the USFS in the Rocky Mountain, Southwestern, and Intermountain Regions, and receives special management consideration in the states of Montana, Idaho, Oregon, and Washington (Verner 1994).

So little is known about flammulated owl populations that even large-scale changes in their abundance would probably go unnoticed (Winter 1974). Several studies have noted a decline in flammulated owl populations following timber harvesting (Marshall 1939; Howle and Ritcey 1987); however, more and more nest sightings occur each year, most likely due, however, to the increase in observation efforts.

Structural Condition Associations

Structural conditions (IBIS 2003) associated with flammulated owl are summarized in **Table 33**.

Table 33 Structural conditions associated with flammulated owls

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Flammulated Owl	Ponderosa Pine	Giant Tree-Multi-Story	F/R-HE	C
		Large Tree-Multi-Story-Closed	F/R-HE	C
		Large Tree-Multi-Story-Moderate	F/R-HE	C
		Large Tree-Multi-Story-Open	F/R-HE	A
		Large Tree-Single Story-Closed	F/R-HE	P
		Large Tree-Single Story-Moderate	F/R-HE	P
		Medium Tree-Multi-Story-Closed	F/R-HE	C
		Medium Tree-Multi-Story-Moderate	F/R-HE	C
		Medium Tree-Multi-Story-Open	F/R-HE	A
		Medium Tree-Single Story-Closed	F/R-HE	P
		Medium Tree-Single Story-Moderate	F/R-HE	P
		Small Tree-Multi-Story-Closed	F/R-HE	A
		Small Tree-Multi-Story-Moderate	F/R-HE	A
		Small Tree-Multi-Story-Open	F/R-HE	P

Flammulated owls feed and reproduce (F/R) in and are closely associated (C) with medium to large, multi-story, moderate to closed canopy Ponderosa pine forest conditions. Similarly, flammulated owls are associated (A) with medium to large multi-story/open canopy forest, and will utilize dense stands of small trees. In contrast, flammulated owls are present (P), but not dependent upon open canopy forest (IBIS 2003). Of the three Ponderosa pine focal species, flammulated owls are the most structural-dependent species.

3.7 Wildlife Focal Habitats and Focal Species

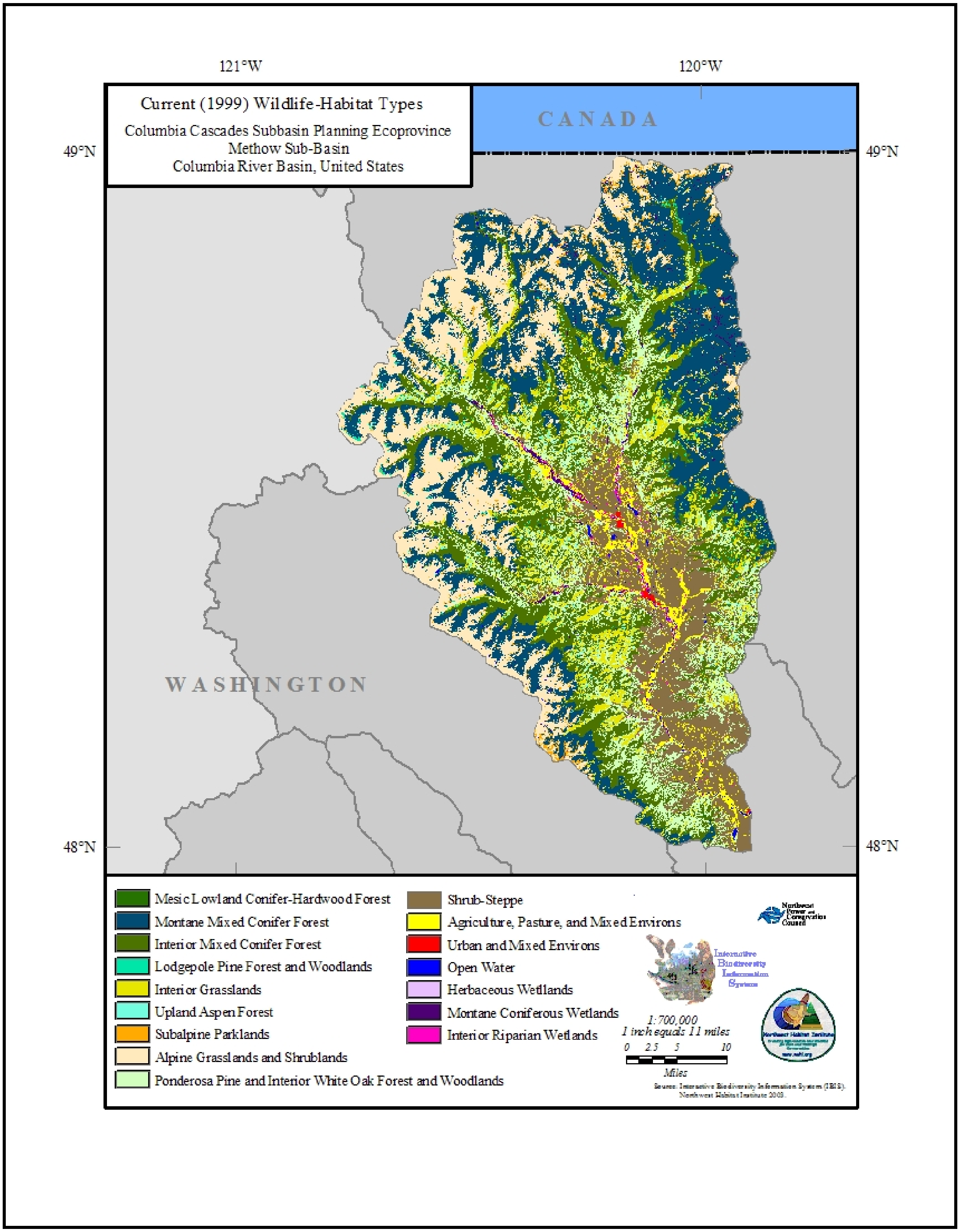
Since wildlife distribution is related more to habitat type than stream or creek reach, the following discussion of wildlife habitat is presented in terms of habitat assemblages rather than the subwatershed format used to describe fish habitat. Management across aquatic and terrestrial ecosystems, therefore, must explore the connection through habitat relationships and focal species relationships.

Ecoregion/subbasin planners assumed that by focusing resources primarily on selected habitat types, the needs of most listed and managed terrestrial species, dependent on those habitats, would be addressed during this planning period. While other listed and managed species occur within the subbasin (primarily forested habitat obligates), needs of those species are addressed primarily through the existing land management frameworks of the federal agencies within whose jurisdictions the overwhelming majority of forested habitats occur within the Okanogan subbasin (Okanogan/Wenatchee National Forest and Washington Department of Natural Resources).

Ecoprovince/subbasin planners then identified an assemblage of focal species for each focal habitat type. The focal species that compose the assemblage for each focal habitat type will serve as indicators of environmental health for species that use that habitat type. The planners combined life requisite habitat attributes for each species assemblage to form a recommended range of management conditions, that, when achieved, should result in functional habitats. The rationale for using focal species assemblages is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem. The corollary is that factors that affect habitat quality and integrity, within the Ecoregion and subbasins, also impact wildlife species. As a result, identifying and addressing limiting factors that affect focal habitats should support the needs of obligate wildlife populations as well.

3.8 Wildlife Focal Habitats

The subbasin consists of 15 wildlife habitat types, which are illustrated in **Figure 40**. Detailed descriptions of these habitat types can be found in Appendix B of Ashley and Stovall (unpublished report, 2004). A comparison of the amount of current focal habitat types for each subbasin in the Columbia Cascade Ecoprovince is summarized in **Table 34** Additional information, including information about habitat requirements, limiting factors, distribution, and population trends, which will be useful to recovery project planners, is included in Ashley and Stovall (unpublished report, 2004).



Source: IBIS 2003

Figure 40 Habitat types in the Methow subbasin

Table 34 A comparison of the amount of current focal habitat types for each subbasin in the Columbia Cascade Ecoprovince, Washington (IBIS 2003)

Subbasin	Focal Habitat		
	Ponderosa Pine (acres)	Shrubsteppe (acres)	Riparian Wetlands (acres)
Entiat	55,807	32,986	94
Lake Chelan	45,480	45,018	5,079
Wenatchee	51,912	24,248	141
Methow	139,853	107,655	4,232
Okanogan	140,738	562,763	9,920
Upper Middle Mainstem Columbia River	50,843	753,073	3,898
Crab	4,660	991,397	12,227

Focal habitats selected for the subbasin include Ponderosa pine, shrubsteppe, and riparian wetlands. The planners also identified rugged lands as a habitat of concern. Neither the IBIS nor the Washington GAP Analysis data recognize the historic presence of riparian wetlands in the Methow subbasin.

The current extent of riparian wetlands, as reflected in these databases, is suspect at best; however, this habitat is a high priority habitat wherever it is found in the Ecoprovince. Agriculture, a habitat of concern, is not included or reported as a focal habitat type (but reflected in Appendix A).

Focal species and their association with focal habitat types are summarized in **Table 35**. The focal species will be used in other planning efforts in the subbasin and the Ecoregion, including Ecoregional Planning and Priority Habitat and Species planning.

Table 35 Wildlife Focal Species occurrence by habitat type in the Methow subbasin, Washington (IBIS 2003)

Common Name	Focal Habitat[1]	Status[2]		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				
Sage thrasher	SS	n/a	C	Yes	Yes	Yes	No
*Brewer's sparrow		n/a	n/a	Yes	No	Yes	No
*Grasshopper sparrow		n/a	n/a	Yes	No	Yes	No
*Sharp-tailed grouse		SC	T	Yes	Yes	Yes	No
Sage grouse		C	T	Yes	Yes	No	No
Pygmy rabbit		E	E	Yes	Yes	No	No
*Mule deer		n/a	n/a	Yes	Yes	No	Yes
Willow flycatcher	RW	SC	n/a	Yes	No	Yes	No

Common Name	Focal Habitat[1]	Status[2]		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				
Lewis woodpecker		n/a	C	Yes	Yes	Yes	No
*Red-eyed vireo		n/a	n/a	Yes	No	No	No
*Yellow-breasted chat		n/a	n/a	Yes	No	No	No
*American beaver		n/a	n/a	Yes	No	No	Yes
*Pygmy nuthatch	PP	n/a	n/a	Yes	No	No	No
*Gray flycatcher		n/a	n/a	Yes	No	No	No
*White-headed woodpecker		n/a	C	Yes	Yes	Yes	No
*Flammulated owl		n/a	C	Yes	Yes	Yes	No
Red-winged blackbird	HW	n/a	n/a	Yes	No	No	No

[1] SS = Shrubsteppe; RW = Riparian Wetlands; PP = Ponderosa pine; HW = Herbaceous Wetlands
[2] C = Candidate; SC = Species of Concern; T = Threatened; E = Endangered

* Identifies a focal species

3.9 Wildlife Focal Habitat Summaries

Focal wildlife habitat types are fully described in Ashley and Stovall (unpublished report, 2004). Only subbasin-specific focal habitat type anomalies and differences are described in this section.

3.9.1 Ponderosa Pine

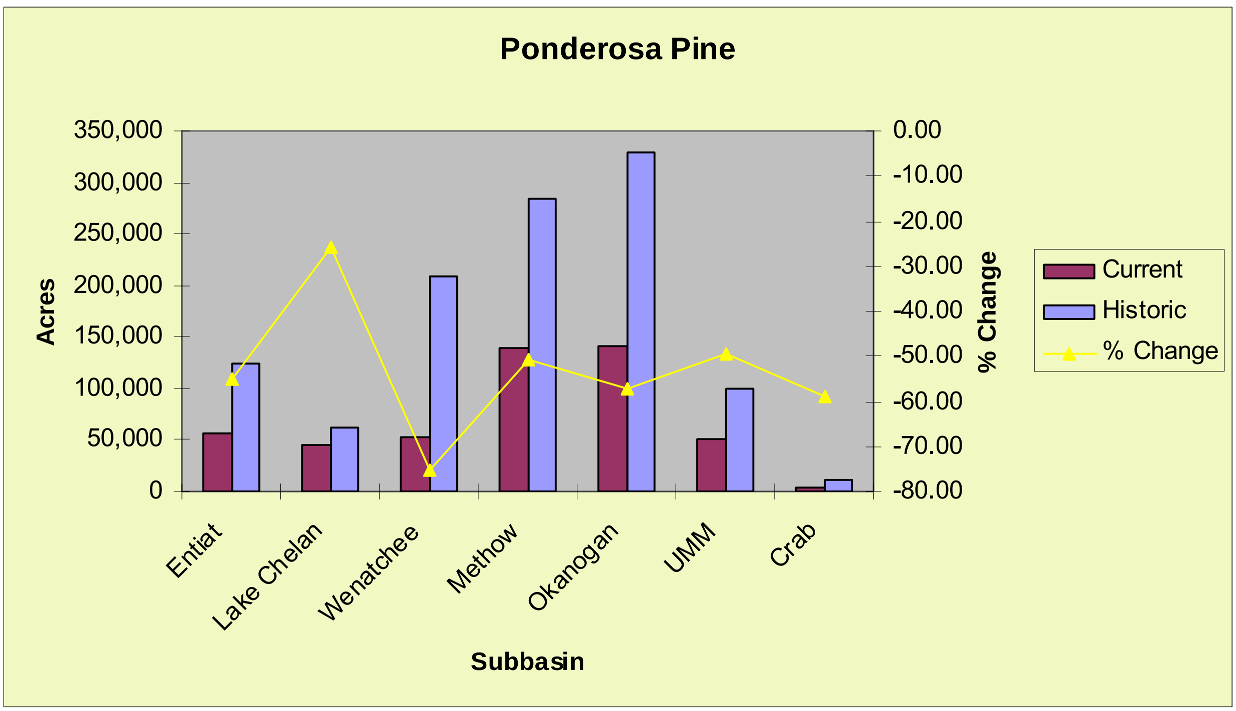
The Ponderosa pine habitat type is described in Ashley and Stovall (unpublished report, 2004). Historically in the subbasin, old-growth Ponderosa pine forests occupied large areas between the shrubsteppe zone and moister forest types at higher elevations. Large, widely spaced, fire-resistant trees and an understory of forbs, grasses, and shrubs characterized these forests. Periodic fires maintained this habitat type. With the settlement of the subbasin, most of the old pines were harvested for timber, and frequent fires have been suppressed. As a result, much of the original forest has been replaced by dense second growth of Douglas-fir and Ponderosa pine with little understory.

Extant Ponderosa pine habitat within the subbasin currently covers a wide range of seral conditions. Forest management and fire suppression have led to the replacement of old growth Ponderosa pine forests by younger forests with a greater proportion of Douglas-fir.

Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multi-layered canopy. For example, this habitat includes previously natural fire-maintained stands in which grand fir can eventually become the canopy dominant. Large late-seral Ponderosa pine and Douglas-fir are harvested in much of this habitat type. Under most management regimes, typical tree size decreases and tree density increases. In some areas, patchy tree establishment at forest-steppe ecotones has created new woodlands.

Introduced annuals, especially cheatgrass and invading shrubs under heavy grazing pressure, have replaced native herbaceous understory species. Four exotic knapweed species (*Centaurea* spp.) are spreading rapidly through the Ponderosa pine zone, and threatening to replace cheatgrass as the dominant increaser after grazing (Roche and Roche 1988). Dense cheatgrass stands eventually change the fire regime of these stands, often resulting in stand replacing, catastrophic fires. Bark beetles, primarily of the genus *Dendroctonus* and *Ips*, kill thousands of pines annually, and are the major mortality factor in commercial saw timber stands.

Current and historic acreages and percent change for the Ponderosa pine habitat type in the CCP are compared by subbasin in **Figure 41**. All subbasins in the Ecoprovince experienced a significant loss (25 to 75%) of Ponderosa pine habitat from historic (circa 1850) amounts (IBIS 2003).

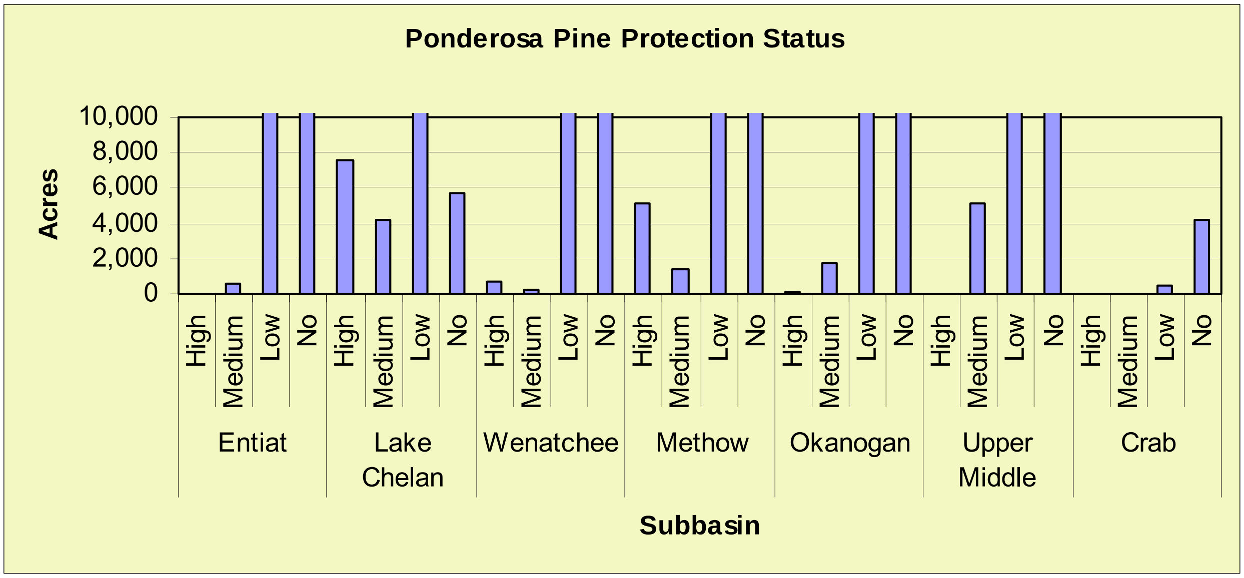


Source: IBIC 2003

Figure 41 A comparison of the Ponderosa pine habitat type in Ecoprovince subbasins

Protection Status

The protection status of Ponderosa pine habitat for the CCP subbasins is compared in **Figure 42**. The protection status of remaining Ponderosa pine habitat, in all subbasins, fall primarily within the "low" to "no protection" status categories. As a result, this habitat type will likely suffer further degradation, disturbance, and/or loss in all Ecoprovince subbasins. Protection status of Ponderosa pine habitat within the Methow subbasin is illustrated in **Table 36**.



Source: IBIS 2003

Figure 42 Protection status of Ponderosa pine in the Columbia Cascade Ecoprovince, Washington

Table 36 Ponderosa pine habitat GAP protection status in the Methow subbasin, Washington (IBIS 2003)

GAP Protection Status	Acres
High Protection	5,151
Medium Protection	1,381
Low Protection	119,451
No Protection	13,851

Factors Affecting Ponderosa Pine Habitat

Factors affecting Ponderosa pine habitat are explained in detail in Ashley and Stovall (unpublished report, 2004) and are summarized below:

- Timber harvesting, particularly at low elevations, has reduced the amount of old growth forest and associated large diameter trees and snags.
- Urban and residential development has contributed to loss and degradation of properly functioning ecosystems.
- Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees. High risk of loss of remaining Ponderosa pine overstories from stand-replacing fires because of high fuel loads in densely stocked understories.
- In those minimal instances where overgrazing has occurred, this has resulted in lack of recruitment of sapling trees, particularly pines.
- Invasion of exotic plants has altered understory conditions and increased fuel loads.

- Fragmentation of remaining tracts has negatively impacted species with large area requirements.
- The timing (spring/summer versus fall) of restoration/silviculture practices such as mowing, thinning, and burning of understory removal may be especially detrimental to single-clutch species.

Recommended Future Condition

Recommended future conditions are described in Ashley and Stovall (unpublished report, 2004). Recommended conditions for Ponderosa pine habitat are summarized below:

- Condition 1a – mature Ponderosa pine forest: The white-headed woodpecker represents species that require/prefer large patches (greater than 350 acres) of open mature/old growth Ponderosa pine stands with canopy closures between 10 and 50%, and snags and stumps for nesting (nesting stumps and snags grater than 31 inches DBH). Abundant white-headed woodpecker populations can be present on burned or cut forest with residual large-diameter live and dead trees and understory vegetation that is usually very sparse. Openness, however, is not as important as the presence of mature or veteran cone-producing pines within a stand (Milne and Hejl 1989).
- Condition 1b – mature Ponderosa pine forest: The Pygmy nuthatch represents species that require heterogeneous stands of Ponderosa pine with a mixture of well-spaced, old pines and vigorous trees of intermediate age, and those species that depend on snags for nesting and roosting, high canopy density, and large-diameter (greater than 18 inches DBH) trees characteristic of mature undisturbed forests. Connectivity between suitable habitats is important for species, such as the Pygmy nuthatch, whose movement and dispersal patterns are limited to their natal territories.
- Condition 2 – multiple-canopy Ponderosa pine mosaic: Flammulated owls represent wildlife species that occupy Ponderosa pine sites that are comprised of multiple-canopy, mature Ponderosa pine stands or mixed Ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990), two-layered canopies, tree density of 508 trees/acre (9-foot spacing), basal area of 250 feet^2/acre (McCallum 1994), and snags greater than 20 inches DBH, and three to 39 feet tall (Zeiner et al. 1990). Food requirements are met by the presence of at least one snag greater than 12 inches DBH/10 acres and eight trees/acre greater than 21 inches DBH.
- Condition 3 – Pine/shrubsteppe interface: Gray flycatchers represent wildlife species that occupy the pine/shrubsteppe interface (pine savannah) with a shrub/bunchgrass understory. Gray flycatchers require nest trees 18 inches DBH and a tree height of 52 feet for their reproductive life requisites.

3.9.2 Shrubsteppe

The shrubsteppe habitat type is described in Ashley and Stovall (unpublished report, 2004). Historically, sage-dominated steppe vegetation occurred throughout the majority of the lower elevations in the subbasin, and variations of shrubsteppe habitat once occupied most of the non-forested land in eastern Washington. The moister draws and permanent stream courses, imbedded in the shrubsteppe landscape, supported strands of riparian vegetation dominated by moisture-loving shrubs and small trees, including thick stands of water birch, a major component of the winter diet of sharp-tailed grouse. The drastic reduction of water birch in the subbasin by early settlers is likely a major factor in the decline of sharp-tailed grouse (NPPC 2002).

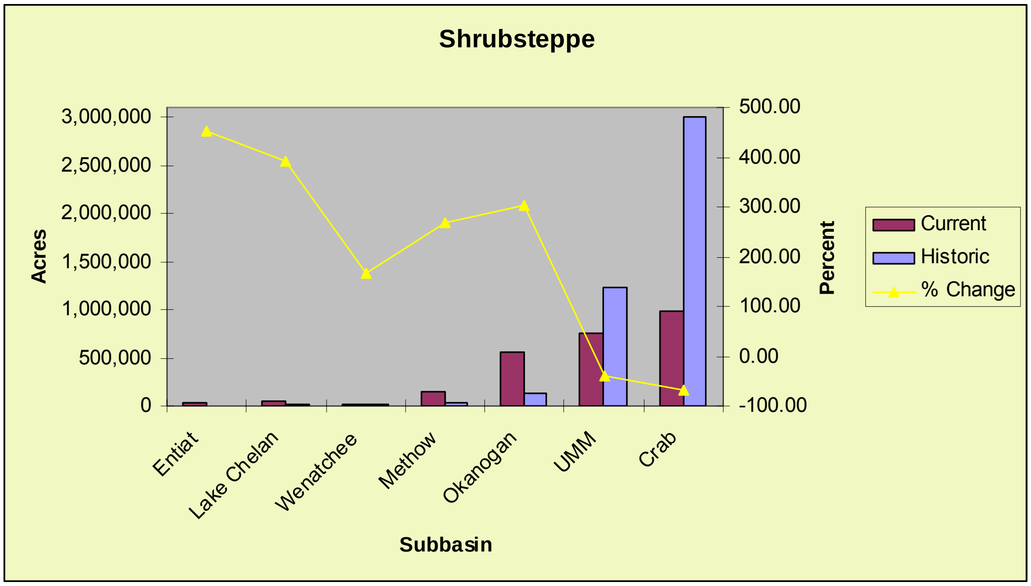
The greatest changes in shrubsteppe habitat from historic conditions are the reduction of bunchgrass cover in the understory and an increase in sagebrush cover. Soil compaction is also a significant factor in heavily grazed lands, affecting water percolation, runoff and soil nutrient content. A long history of grazing, fire, and invasion by exotic vegetation has altered the composition of the plant community within much of the extant shrubsteppe in this region (Quigley and Arbelbide 1997; Knick 1999), and it is difficult to find stands which are still in relatively natural condition.

Fire has relatively little effect on native vegetation in the three-tip sagebrush zone, since three-tip sagebrush and the dominant graminoids resprout after burning. Three-tip sagebrush does not appear to be much affected by grazing, but the perennial graminoids decrease and are eventually replaced by cheatgrass (*Bromus tectorum*), plantain (*Plantago* spp.), big bluegrass (*Poa secunda*), and/or gray rabbitbrush (*Chrysothamnus nauseosus*). In recent years, diffuse knapweed (*Centaurea diffusa*) has spread through this zone, and threatens to replace other exotics as the chief increaser after grazing (Roche and Roche 1998).

In areas of central arid steppe, with a history of heavy grazing and fire suppression, true shrublands are common and may even be the predominant cover on non-agricultural land. Most of the native grasses and forbs are poorly adapted to heavy grazing and trampling by livestock. Grazing eventually leads to replacement of the bunchgrasses with cheatgrass, Nuttall's fescue (*Festuca microstachys*), eight-flowered fescue (*F. octofiora*), and Indian wheat (*Plantago patagonica*) (Harris and Chaney 1984). In recent years, several knapweeds (*Centaurea* spp.), have become increasingly widespread. Russian star thistle (*Centaurea repens*) is particularly widespread, especially along and near major watercourses (Roche and Roche 1988 in Cassidy 1997).

Sizable areas of healthy shrubsteppe still remain. These areas occur primarily on public lands and the few remaining large private ranches in the Methow valley. Much of the deeper soil shrubsteppe habitat on flat bench lands has been converted to agriculture or developed as home sites. As agriculture increasingly gives way to subdivision and housing developments in the valley, private land parcels containing healthy shrubsteppe habitat may be lost (NPPC 2002). Currently, the largest block of undeveloped shrubsteppe in private ownership is located north of Twisp just south of WDFW land in the vicinity of the last known active sharp-tailed grouse lek in the subbasin.

Current and historic acreages and percent change for the shrubsteppe habitat type are compared by subbasin in **Figure 43**. The Upper Middle Mainstem Columbia River and Crab subbasins have experienced considerable losses (39% and 67%, respectively), while the remaining subbasins show increases in shrubsteppe habitat ranging from 165 to 462% over historic (circa 1850) amounts (IBIS 2003).

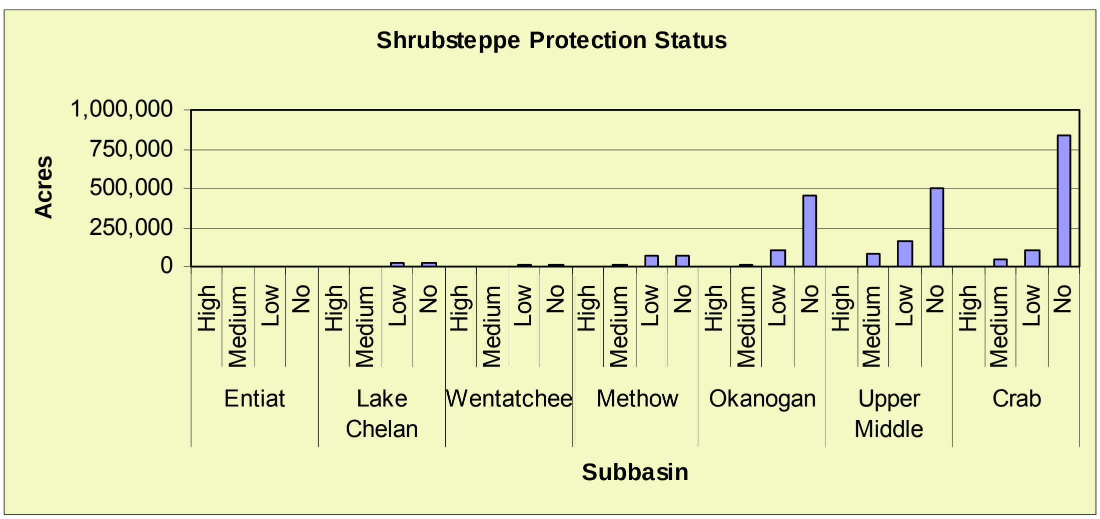


Source: IBIS 2003

Figure 43 A comparison of the shrubsteppe habitat type in Ecoprovince subbasins

Protection Status

The protection status of shrubsteppe habitat for Ecoprovince subbasins is compared in Figure 44. The protection status of remaining shrubsteppe habitats, in all subbasins, fall primarily within the "low" to "no' protection status categories. As a result, this habitat type will likely suffer further degradation, disturbance, and/or loss in all Ecoprovince subbasins. Protection status of shrubsteppe habitat within the Methow subbasin is summarized in **Table 37**.



Source: IBIS 2003

Figure 44 GAP protection status of shrubsteppe habitat in the Columbia Cascade Ecoprovince, Washington

Table 37 Shrubsteppe habitat GAP protection status in the Methow subbasin, Washington (IBIS 2003)

GAP Protection Status	Acres
High Protection	42
Medium Protection	8,274
Low Protection	65,670
No Protection	73,647

Factors Affecting Shrubsteppe Habitat

Factors affecting shrubsteppe habitat are explained in detail in Ashley and Stovall (unpublished report, 2004) and are summarized below:

- Permanent habitat conversions of shrubsteppe/grassland habitats (e.g., approximately 60% of shrubsteppe in Washington [Dobler et al. 1996]) to other uses (e.g., agriculture, urbanization).
- Fragmentation of remaining tracts of moderate to good quality shrubsteppe habitat.
- Degradation of habitat from intensive grazing and invasion of exotic plant species, particularly of annual grasses, such as cheatgrass, and woody vegetation, such as Russian olive.
- Degradation and loss of properly functioning shrubsteppe/grassland ecosystems resulting from the encroachment of urban and residential development and conversion to agriculture. Most of the remaining shrubsteppe in Washington is in private ownership (57%).
- Loss of big sagebrush communities to brush control (may not be detrimental relative to interior grassland habitats).
- Conversion of CRP lands back to cropland.
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.
- Fire management, either suppression or over-use.
- Invasion and seeding of crested wheatgrass and other introduced plant species that reduces wildlife habitat quality and/or availability.

Recommended Future Condition

Recommended future conditions are described in Ashley and Stovall (unpublished report, 2004). Recommended conditions for shrubsteppe habitat are summarized as follows:

3.9.3 Sagebrush-dominated Shrubsteppe

Condition 1 – Diverse shrubsteppe habitat: Mule deer were selected to represent species that require and prefer diverse, dense (30 to 60% shrub cover less than five feet tall) shrubsteppe habitats (Ashley and Berger 1999) comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species (Leckenby 1969; Kufeld et al. 1973; Sheehy 1975; Jackson 1990), with a palatable herbaceous understory exceeding 30% cover (Ashley and Berger 1999).

Condition 2 – Sagebrush dominated shrubsteppe habitat: Brewer's sparrow was selected to represent wildlife species that require sagebrush-dominated sites. Brewer's sparrow prefers a patchy distribution of sagebrush clumps, 10-30% cover (Altman and Holmes 2000), lower sagebrush height (between 20 and 28 inches) (Wiens and Rotenberry 1981), 10 to 20% native grass cover (Dobler 1994), less than 10% non-native herbaceous cover, and bare ground greater than 20% (Altman and Holmes 2000). It should be noted, however, that Johnsgard and Rickard (1957) reported that shrublands comprised of snowberry, hawthorne, chokecherry, serviceberry, bitterbrush, and rabbitbrush were also used by Brewer's sparrows for nesting in southeast Washington. Specific, quantifiable habitat attribute information for this mixed shrub landscape could not be found.

3.9.4 Steppe/Grassland-dominated Shrubsteppe:

Condition 1 – Shrubsteppe habitat with multi-structured deciduous trees and shrubs: Sharp-tailed grouse was selected to represent species that require multi-structured fruit/bud/catkin-producing deciduous trees and shrubs dispersed throughout the landscape (10 to 40% of the total area). Other habitat conditions include:

- Native bunchgrass greater than 40% cover
- Native forbs at least 30% cover
- Visual obstruction readings (VOR) of at least 6 inches
- At least 75% cover deciduous shrubs and trees
- Exotic vegetation/noxious weeds less than 5% cover

Condition 2 – Shrubsteppe habitat with native bunch grasses: Grasshopper sparrow was selected to represent species that require healthy steppe habitat dominated by native bunch grasses. Grasshopper sparrow require native bunchgrass cover greater than 15% and comprising greater than 60% of the total grass cover.

3.9.5 Eastside (Interior) Riparian Wetlands

The eastside (interior) riparian wetlands habitat type refers only to riverine and adjacent wetland habitats in both the Ecoprovince and individual subbasins. Historic (circa 1850) and, to a lesser degree, current data concerning the extent and distribution of riparian wetland habitat are a significant data gap at both the Ecoprovince and subbasin level.

The lack of data for this habitat type is a major challenge as Ecoprovince and subbasin planners attempt to quantify habitat changes from historic conditions, and develop strategies that address limiting factors and management goals and objectives.

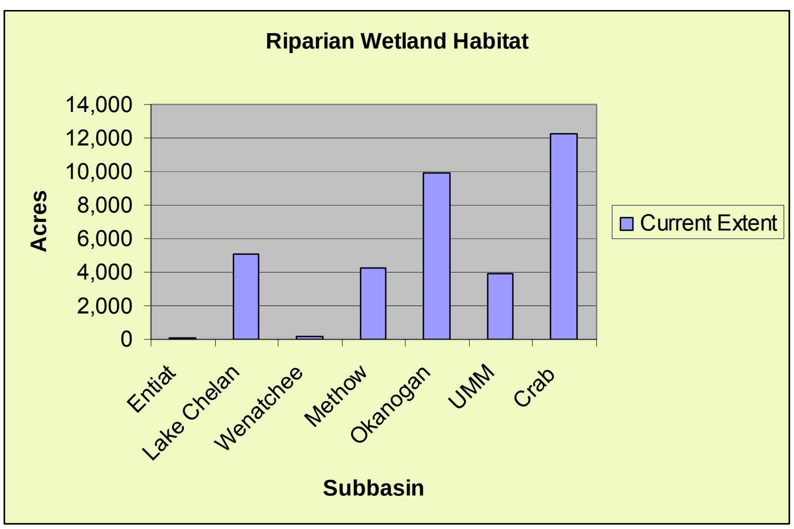
Because of the lack of historic riparian wetland data, the IBIS database cannot be relied upon for comparisons, in the Ecoprovince and individual subbasins, between the historic and current extent of riparian wetlands. According to the IBIS database (2003), there are an estimated 3,898 acres of riparian wetland habitat currently in the subbasin. Although there are no historic data, the actual number of acres or absolute magnitude of the change is less important than recognizing that the loss of riparian habitat and lack of permanent protection continues to place this habitat type at further risk.

Historically, riparian wetland habitat was characterized by a mosaic of plant communities occurring at irregular intervals along streams, and dominated singularly, or in some combination, by grass-forbs, shrub thickets, and mature forests with tall deciduous trees. Beaver activity and natural flooding are two ecological processes that affected the quality and distribution of riparian wetlands.

Today, agricultural conversion, altered stream channel morphology, and water withdrawal have played significant roles in changing the character of streams and associated riparian areas. The subbasin, however, is still host to some of eastern Washington's best remaining tracts of cottonwood gallery forests, found in the wide floodplain portions of the Methow Valley and its major tributaries.

Significant riparian habitat remains along the Methow River between Winthrop and Lost River. Additional stands are located along the Twisp and Chewuch rivers, and more fragmented pockets can be found along the Methow between Winthrop and Carlton. Large areas once dominated by cottonwoods, which contribute considerable structure to riparian habitats, are being lost. Because of its proximity to roads and other developed areas, much of the remaining riparian/floodplain habitat may be at risk of conversion to housing development.

The current extent of riparian wetland habitat throughout the Columbia Cascade Ecoprovince is illustrated in **Figure 45**.

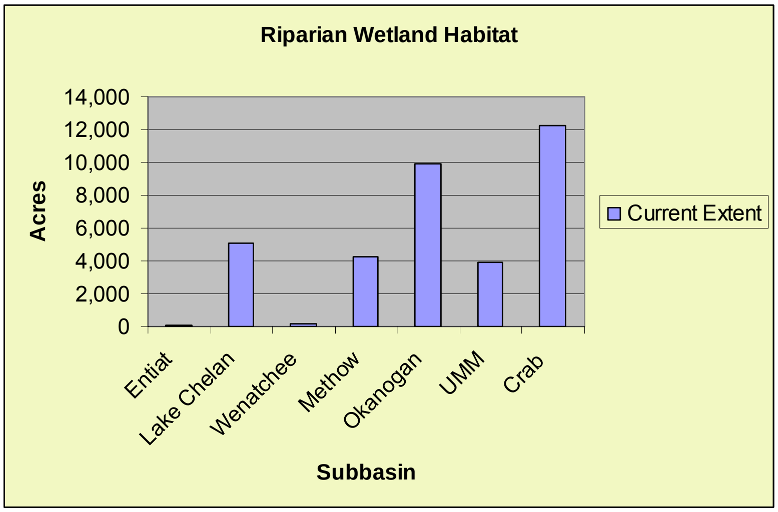


Source: IBIS 2003

Figure 45 Current extent of riparian wetland habitat in the Columbia Cascade Ecoprovince, Washington

Protection Status

The protection status of riparian habitat is compared by subbasin in **Figure 46**. Riparian habitats are provided high protection status predominantly in the Lake Chelan subbasin. The vast majority of Ecoprovince riparian habitat is designated "low" or "no" protection status, and is at risk for further degradation and/or conversion to other uses. The GAP protection status of riparian wetland habitat in the Methow subbasin is depicted in **Table 38**.



Source: IBIS 2003

Figure 46 Protection status of riparian wetlands in the Columbia Cascade Ecoprovince, Washington

Table 38 Eastside (interior) riparian wetlands GAP protection status in the Methow subbasin, Washington (IBIS 2003)

GAP Protection Status	Acres
High Protection	0
Medium Protection	168
Low Protection	434
No Protection	3,632

Factors Affecting Eastside (Interior) Riparian Wetland Habitat

Factors affecting grassland habitat are described in Ashley and Stovall (unpublished report, 2004) and summarized below:

- Loss of habitat because of numerous factors including riverine recreational developments, inundation from impoundments, cutting and spraying of riparian vegetation for eased access to water courses, gravel mining, etc.;
- Habitat alteration from: a) hydrological diversions and control of natural flooding regimes (e.g., dams) resulting in reduced stream flows and reduction of overall area of riparian habitat, loss of vertical stratification in riparian vegetation, and lack of recruitment of young cottonwoods, ash, willows, etc., and; b) stream bank stabilization which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation;
- Habitat degradation from livestock overgrazing which can widen channels, raise water temperatures, and reduce understory cover;

- Habitat degradation from conversion of native riparian shrub and herbaceous vegetation to invasive exotics such as reed canary grass, purple loosestrife, perennial pepperweed, salt cedar, indigo bush, and Russian olive;
- Fragmentation and loss of large tracts necessary for area-sensitive species such as yellow-billed cuckoo;
- High energetic costs associated with high rates of competitive interactions with European starlings for cavities may reduce reproductive success of cavity-nesting species such as Lewis' woodpecker, downy woodpecker, and tree swallow, even when outcome of the competition is successful for these species, and;
- Recreational disturbances (e.g., ORVs), particularly during nesting season, and, in particular, in high-use recreation areas.

Recommended Future Condition

Recommended future conditions are described in detail in section 4.1.7.3.3 in Ashley and Stovall (unpublished report, 2004). Recommended conditions for riparian wetland habitat are summarized in the following paragraphs.

Condition 1a – Cottonwood gallery forests with healthy canopy cover: Red-eyed vireo was selected to represent species that require greater than 60% canopy closure. For their food and reproductive requirements, red-eyed vireo require mature deciduous trees greater than 160 feet tall; greater than 10% of the shrub layer should be young cottonwoods.

Condition 1b – Deciduous riparian zone with high canopy closure: Beaver was selected to represent species that require 40-60% tree/shrub canopy closure and shrub height greater than 6.6 feet. Beavers also require trees less than 6 inches DBH.

Condition 2 – Riparian habitat with a dense shrub layer: Yellow-breasted chat was selected to represent species that require riparian habitat with a shrub layer one to four metres (three to 13 feet) tall, 30-80% shrub cover, scattered herbaceous openings, and less than 20% tree cover.

The change in extent of the riparian wetland habitat type from circa 1850 to 1999 is not included because of inaccurate IBIS (2003) data/GIS products.

3.9.6 Agriculture (Habitat of Concern)

Agricultural habitat varies substantially in composition among the cover types it includes. Cultivated cropland includes at least 50 species of annual and perennial plants, and hundreds of varieties, ranging from vegetables such as carrots, onions, and peas, to annual grains such as wheat, oats, barley, and rye. Row crops of vegetables and herbs are characterized by bare soil, plants, and plant debris along bottomland areas of streams and rivers and areas having sufficient water for irrigation. Annual grains, such as barley, oats, and wheat are typically produced in almost continuous stands of vegetation on upland and rolling hill terrain without irrigation.

Improved pastures are used to produce perennial herbaceous plants for grass seed and hay. Alfalfa and several species of fescue and bluegrass, orchardgrass (*Dactylis glomerata*), and timothy (*Phleum pratensis*) are commonly seeded in improved pastures. Grass seed fields are single-species stands, whereas pastures maintained for haying are typically composed of several species.

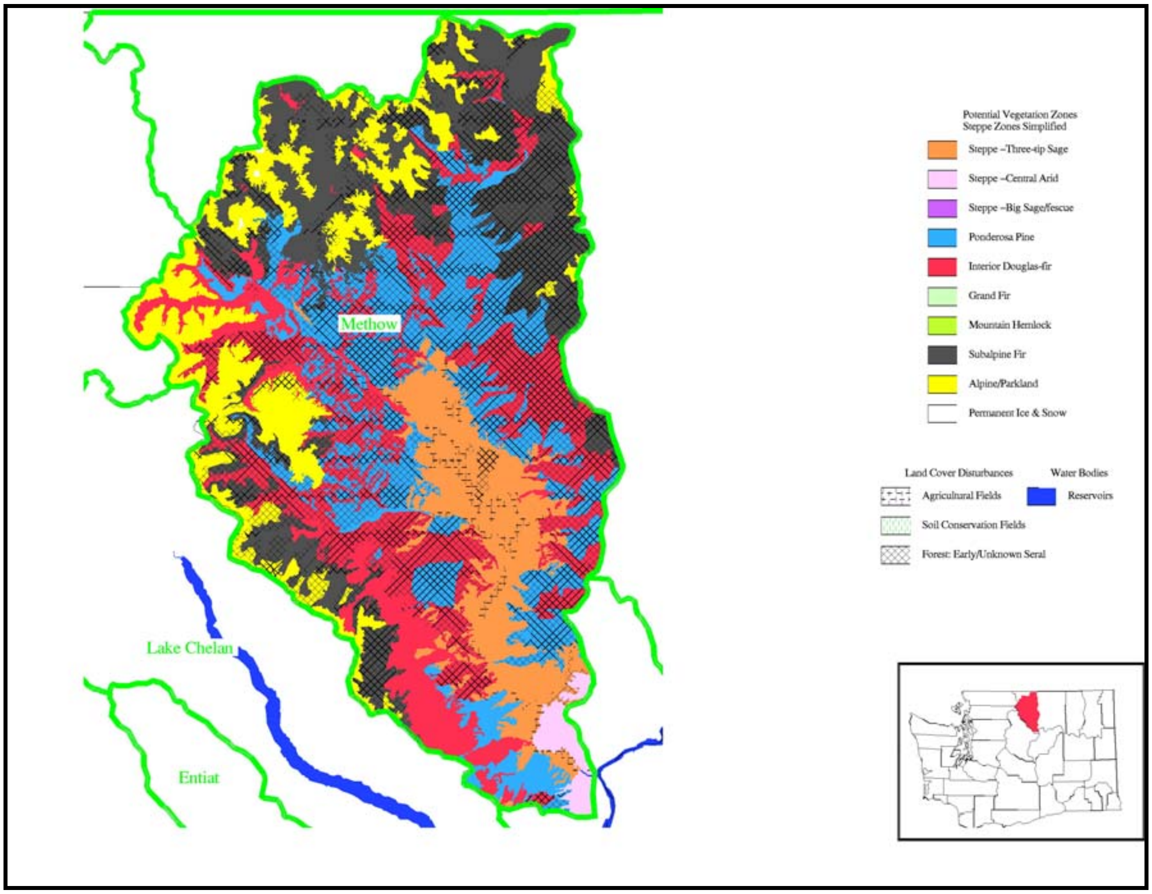
Unimproved pastures are predominantly grassland sites and often abandoned fields that have little or no active management such as irrigation, fertilization, or herbicide applications. These sites may or may not be grazed by livestock. Unimproved pastures include rangelands planted to exotic grasses that are found on private land, state wildlife areas, federal wildlife refuges, and CRP sites. Grasses commonly planted on CRP sites include crested wheatgrass (*Agropyron cristatum*), tall fescue (*F. arundinacea*), perennial bromes (*Bromus* spp.), and wheatgrasses.

Intensively grazed rangelands have been seeded to intermediate wheatgrass (*Elytrigia intermedia*), crested wheatgrass to boost forage production, or are dominated by increaser exotics such as Kentucky wheatgrass or tall oatgrass (*Arrhenatherum elatius*). Other unimproved pastures have been cleared and intensively farmed in the past, but are allowed to convert to other vegetation.

These sites may be composed of uncut hay, litter from previous seasons, standing dead grass and herbaceous material, invasive exotic plants including tansy ragwort (*Senecio jacobea*), thistle (*Cirsium* spp.), Himalaya blackberry (*Rubus discolor*), and Scot's broom (*Cytisus scoparius*) with patches of native black hawthorn, snowberry, spirea (*Spirea* spp.), poison oak (*Toxicodendron diversilobum*), and various tree species, depending on seed source and environment.

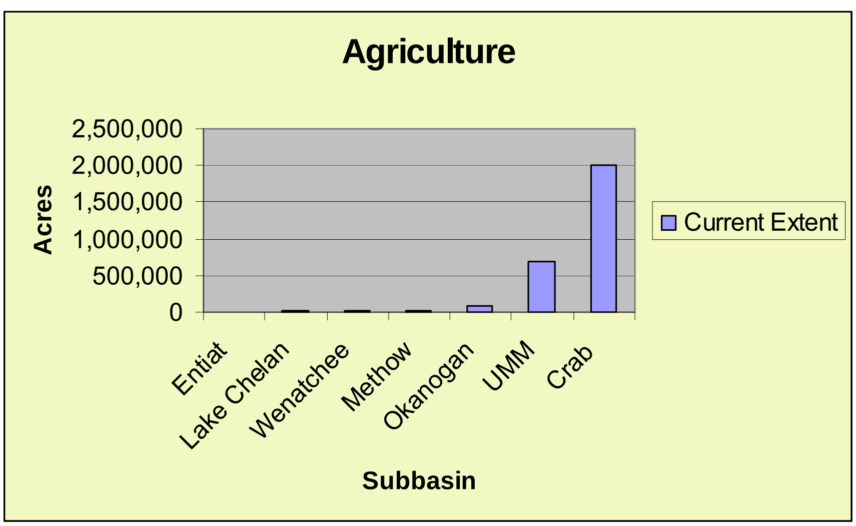
Because agriculture is not a focal wildlife habitat type, and there is little opportunity to effect change in agricultural land use at the landscape-scale, Ecoprovince and subbasin planners did not conduct a full-scale analysis of agricultural conditions. Agricultural lands converted to CRP, however, can significantly contribute toward benefits to wildlife habitat and other species that utilize agricultural lands.

Agricultural extent in the Methow subbasin is illustrated in Figure 47.



Source: Cassidy 1997

Figure 47 Agricultural extent in the Methow subbasin, Washington

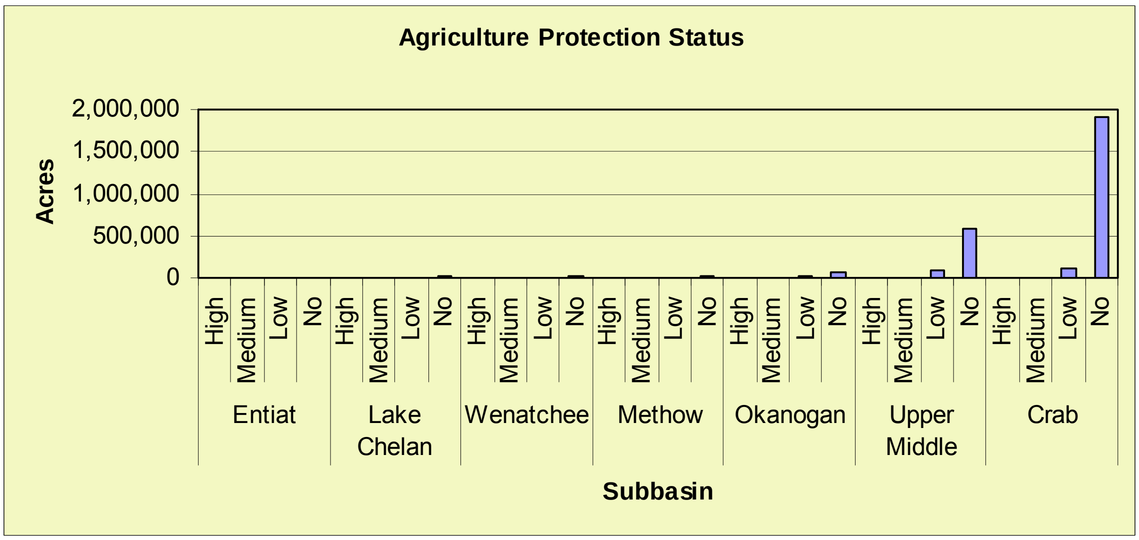


Source: IBIS 2003

Figure 48 Current extent of agriculture in the Columbia Cascade Ecoprovince, Washington

Protection Status

The protection status of agricultural habitat is compared by subbasin in **Figure 49**. IBIS (2003) data clearly indicate that nearly all of this cover type has been provided protection status across the Ecoprovince. Small amounts of agricultural lands, however, are given “low” and “medium” protection status. “Low” and “medium” protection is limited to lands enrolled in conservation easements, or to those that are under other development restrictions, such as County planning ordinances. The GAP protection status of agricultural habitat in the subbasin is illustrated in Table 39



Source: IBIS 2003

Figure 49 Protection status of agriculture in the Columbia Cascade Ecoprovince, Washington

Table 39. Agriculture GAP protection status/acres in the Methow subbasin, Washington (IBIS 2003).

GAP Protection Status	Acres
High Protection	412
Medium Protection	710
Low Protection	8,004
No Protection	22,873

3.10 Environmental Conditions

3.10.1 Changes in Wildlife Habitats

Dramatic changes in wildlife habitat have occurred throughout the subbasin since pre-European settlement (circa 1850). IBIS data limitations for describing historic and current habitat conditions at the subbasin level are described in Section 1.1 (Ashley and Stovall, unpublished report, 2004). Because of the limitations and inaccuracies associated with the IBIS mapping, the IBIS historic versus current characterizations of habitats is not used for subbasin level analyses.

Summary of Factors Affecting Focal Wildlife Habitats and Species

The presence, distribution, and abundance of wildlife species in the Methow subbasin have been affected by habitat losses due primarily to:

- agricultural development;
- timber management;
- livestock grazing;
- mining; and
- commercial and residential development

Agricultural Development

Agricultural development in the Methow subbasin has altered or destroyed vast amounts of native shrubsteppe habitat and fragmented riparian/floodplain habitat. Agricultural operations have increased sediment loads and introduced herbicides and pesticides into streams.

Conversion to agriculture has decreased the overall quantity of habitat for many native species, but the loss of specific communities may be particularly critical for habitat specialists. However, conversion of land to agriculture has practically diminished, and there has been an actual decrease in agricultural lands in the Methow subbasin within the last 30 years.

Timber Management

Timber management activities, including extensive timber harvest in sections of the Methow subbasin, have negatively impacted wildlife habitat, particularly in the Chewuch River and Beaver Creek drainages (NPPC 2002).

Historic timber harvest activities and related road building have contributed to erosion and sediment loading, loss of shading for creeks and streams, loss of recruitment material for LWD, and overall decrease in nutrients. Construction of logging roads also resulted in the construction of numerous culverts in the subbasin. However, timber harvest activities have dramatically decreased in the last 20 years in the Methow subbasin, to being very limited.

Livestock Grazing

Livestock grazing has negatively impacted wildlife habitat in the subbasin, particularly in the Chewuch River and Beaver Creek drainages. Mismanaged grazing has contributed to increased soil erosion and displaced native plant communities. In the 1950s and 1960s, approximately 12,000 mother cows were producing in the subbasin. Currently, there are approximately 100 mother cows in the subbasin.

Mining

Mining activity in the Methow Subbasin is currently minimal; however, abandoned mine sites pierce the valley hillsides and historically have contributed sediment, which, in some cases, is relatively toxic loads to rivers and creeks (WCC, 2000).

Mining degrades aquatic habitats, used by bull trout, by altering water chemistry (e.g., pH), by altering stream morphology and flow, and by altering the substrate composition and benthic insect community composition where in-channel mining activity occurs, causing sediment, fuel, and heavy metals to enter streams (Martin and Platts 1981; Spence et al. 1996; Thomas 1985).

Commercial and Residential Development

While urban areas comprise only a small percentage of the land base within the subbasin (0.1%), their habitat impacts are significant. Residential growth within the subbasin is largely occurring along creeks and rivers. Channelization and development along water courses has been altered, and in some cases, replaced riparian and wetland habitats.

Environmental / Ecological Relationships

Expansion of residential areas affects drainage, and homes built along streams have affected both water quality and the ability of the floodplain to function normally. Residential development has resulted in the loss of large areas of all focal habitat types. Disturbance by humans in the form of highway traffic, noise and light pollution, and various recreational activities have the potential to displace wildlife and force them out of their native areas, or force them to use less desirable habitat.

The conversion of forested uplands and riparian habitat to residential use has negatively affected wildlife habitat connectivity and composition. Road construction and dispersed residential development have impeded stream access and changed vegetative communities, resulting in the reduction of wildlife range and quality.

Human activities have increased the number of fire starts, but historic fire control policies have kept the size of fires small, resulting in a buildup of fuel in the forested uplands of the subbasin. This absence of fire has resulted in changes to the composition of the forest and plant communities and the related capacity to store and transport water.

3.10.2 Changes in Fish habitats

Diking, conversion of riparian areas to agriculture and residential uses, and LWD removal along the mainstem Methow River, have resulted in loss of side-channel access, riparian vegetation, and overall habitat complexity. Much of the habitat within this area, however, has not been adequately inventoried or assessed and data gaps exist regarding the extent of habitat alterations.

As noted in Section 2.1, Washington Water Power Company’s dam near the mouth of the Methow River significantly altered salmonid production in the early decades of the 20th century. The dam is thought to have had significant effects on production of coho, Chinook, and steelhead.

When the dam was removed in 1930, coho salmon, once the most abundant salmonid in the Methow subbasin (Craig and Suomela 1941) were extirpated, Chinook were nearly extirpated, and steelhead persisted as resident rainbow trout (Mullan et al. 1992b).

Much of the watershed remains undeveloped, and large tracts of high quality fish habitat remain, particularly within the middle and upper elevations. These areas are contained in lands held largely in public ownership, and include several thousand acres managed as wilderness/roadless condition by the Okanogan National Forest. Within these management boundaries, plant communities and succession are shaped largely through such natural processes as fire, avalanches, storms, and temperature ranges.

Current Reference Condition

Within these management boundaries, plant communities and succession are shaped largely through such natural processes as fire, avalanches, storms and temperature ranges. Early successional habitats are underrepresented, however, due largely to historic emphasis on fire suppression.

Outside of these protected areas, little habitat has been lost to development at middle and upper elevations, but acreage within the lower elevations has been altered and/or degraded through road building, grazing, and timber harvest. The most significant changes in wildlife habitat have occurred in the dry forest, riparian/floodplain, and shrubsteppe habitats at lower elevations.

Native habitats have been lost or altered by commercial and residential development, conversion to agricultural use, grazing, timber harvest and road building. Fire suppression and noxious weed invasion have also altered the landscape and native plant communities considerably.

There are 29 fish and wildlife species listed as Endangered, Threatened, or as Species of Concern within the Methow subbasin. The watershed contains 14 Priority Habitats as identified by WDFW.

The riparian and wetlands of the Methow subbasin support the greatest wildlife diversity and abundance, but occupy the lowest percentage of acreage within the watershed. It has been widely quoted that in semi-arid environments like the Methow, riparian habitats typically occupy less than 10% of the land area, but are used by more than 90% of the wildlife species for some or all of their life history requirements.

The Methow subbasin is host to some of Eastern Washington’s best remaining tracts of cottonwood gallery forests, found in the wide floodplain portions of the Methow River valley and its major tributaries. Almost all of this habitat type is in private ownership and much has been converted to residential development or agriculture; significant forest parcels remain along the Methow River between Winthrop and Lost River.

Additional significant stands are located along the Twisp and Chewuch rivers, and more fragmented pockets can be found along the Methow between Winthrop and Carlton. Below Carlton, a higher stream gradient and a more constrained channel preclude the development of large patches of this habitat type (J. Foster, WDFW, pers. comm.). Because of its proximity to roads and other developed areas, much of the remaining riparian/floodplain habitat may be at risk of conversion to housing development.

Protection status

Much of the land within the subbasin is set aside as protected, particularly in the upper elevations. Protected areas (**Figure 50**) include two wilderness areas: the Pasayten Wilderness Area and the Lake Chelan-Sawtooth Wilderness Area. The WDFW also manages the Methow Valley Wildlife Area.

The subbasin contains the largest amount (27% or 317,865 acres) of permanently protected lands than any other subbasin in the Ecoprovince. The Pasayten Wilderness Area and the Lake Chelan-

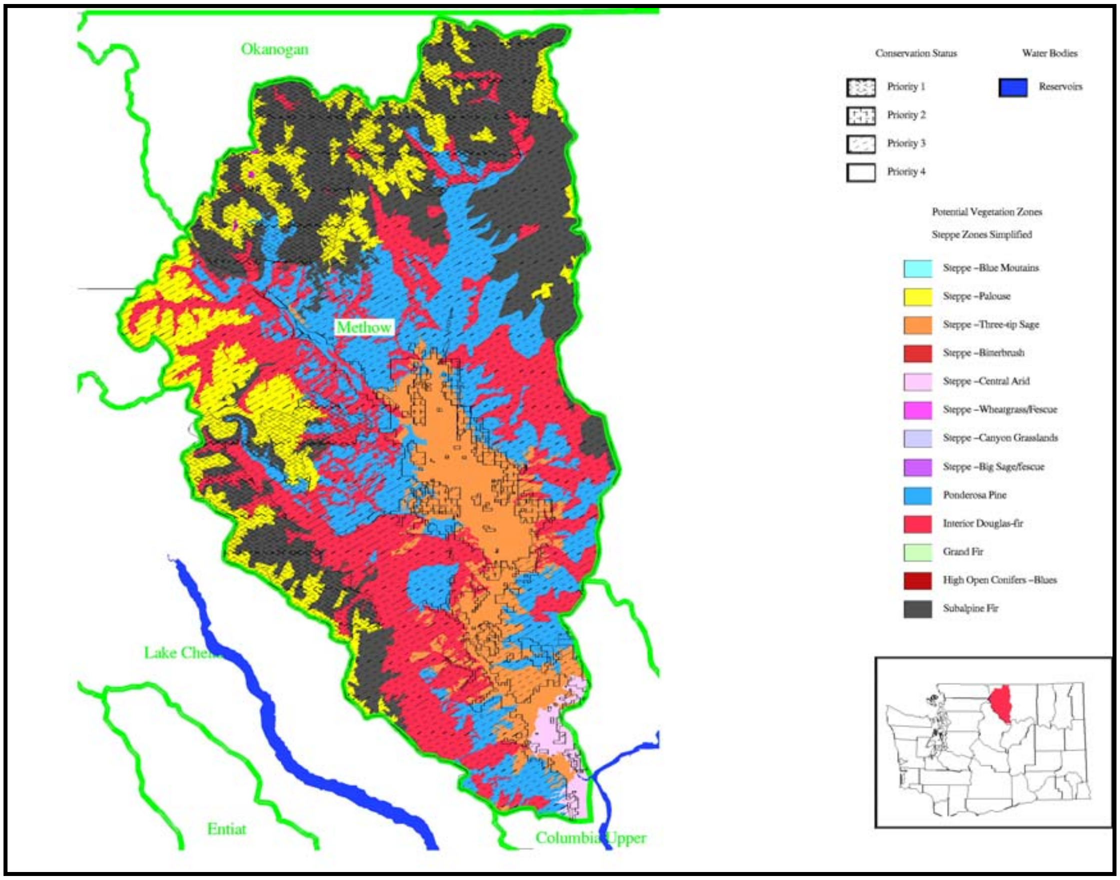
Sawtooth Wilderness Area have permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events of natural type are allowed to proceed without interference.

Approximately 1.2% (14,078 acres) of the subbasin has permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state (“medium” protection status). The majority of lands in the subbasin (60% or 706,058 acres) has permanent protection from conversion of natural land cover for the majority of the area, but is subjected to uses of either a broad, low intensity type or localized, intense type (“low” protection status).

The NPPC designated a number of river reaches throughout the Columbia Basin as protected areas. Those protected river reaches total approximately 178.8 miles within the Methow subbasin, and include portions of Bear Creek, Buttermilk Creek, Chewuch River, Early Winters Creek, Lost River, Methow River, South Creek, War Creek, and the Twisp River (StreamNet 2001).

Approximately 80% of the Upper Methow subwatershed is managed by the U.S. Forest Service (USFS) as Congressionally Withdrawn (Wilderness), Late-Successional Reserve, or Riparian Reserve (USFS 1998d). These designations provide a high level of protection of aquatic areas and the surrounding uplands.

The Lost River subwatershed contains 102,100 acres (95% of the subwatershed) that is protected within the Pasayten Wilderness.



Source: Cassidy 1997

Figure 50 Protection status and vegetation zones of the Methow subbasin

The Early Winters Creek subwatershed contains approximately 51,548 acres (approximately 99% of the subwatershed) that are managed by the USFS. The majority of that land is designated as a Scenic Highway Corridor along state Route Highway 20, with the remainder designated as a Late Successional Reserve.

In the Chewuch River subwatershed, 108,000 acres (34% of the subwatershed) are protected within the Pasayten Wilderness. Other lands within the subwatershed include 5,000 acres (1.5%) that are managed by WDFW.

The Twisp River subwatershed, including the headwaters and much of the uplands, contains approximately 72,000 acres (approximately 50% of the subwatershed) that fall within the Lake Chelan-Sawtooth Wilderness area. Additional federally managed land within the Twisp subwatershed is managed as Late Successional Reserves or Matrix (USFS 1995c). Lower elevation Forest Service land above the confluence with Buttermilk Creek has been allocated as Late Successional Reserves.

The majority of the Lower Methow River is federally owned and managed by the National Forest Service as the Okanogan National Forest, with a small portion of upper Libby Creek lying within the Lake Chelan-Sawtooth Wilderness.

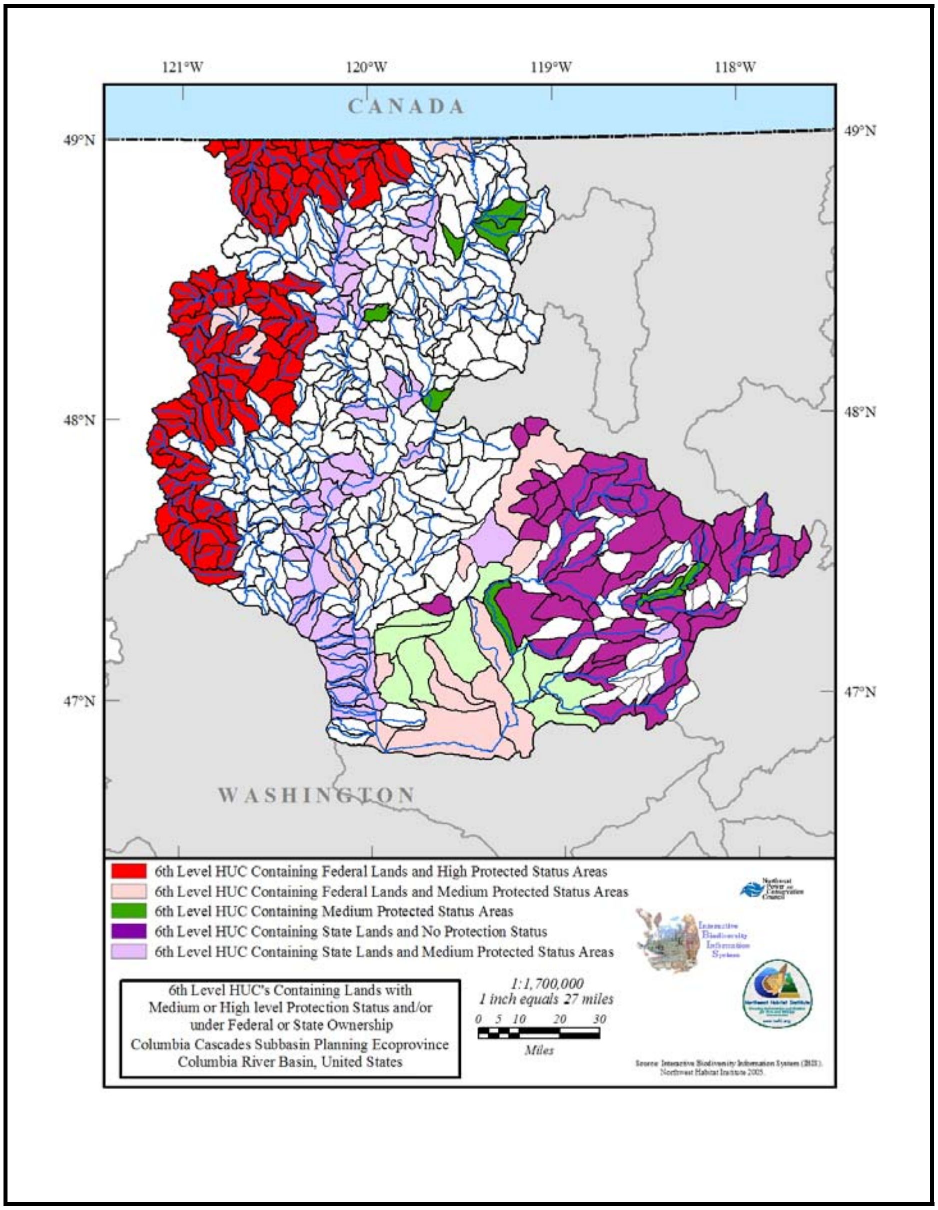
The Methow Conservancy works to provide successful, voluntary, private land conservation easements. To date, the Methow Conservancy protects a total of 3,774 acres.

Approximately 11% (129,794 acres) of the lands within the subbasin lack irrevocable easements or mandates to prevent conversion of natural habitat types to anthropogenic habitat types ("no" protection). Lands owned by WDFW fall within the "medium" and "low" protection status categories.

GAP protection status acreage for each Ecoprovince subbasin is compared in **Figure 51**. As illustrated, the Upper Middle Mainstem Columbia River subbasin and the Crab subbasin are the only subbasins in the Ecoprovince without "high" protection status lands (status 1). "Medium," "low," and "no" protection status lands (status 2, 3, and 4 respectively) show similar trends as those found in other Ecoprovince subbasins.

Additional habitat protection, primarily on privately owned lands, is provided through the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP is intended to reduce soil erosion on upland habitats through establishment of perennial vegetation on former agriculture lands. Similarly, CREP conservation practices reduce stream sedimentation and provide protection for riparian/riverine habitats using buffer strips comprised of herbaceous and woody vegetation.

Both programs provide short-term (CRP-10 years; CREP-15 years), high protection of habitats enrolled in either program. The U.S. Congress authorizes program funding/renewal, while the USDA determines program criteria. Program enrollment eligibility and sign-up is decentralized to state and local NRCS offices (R. Hamilton, FSA, pers. comm., 2003).



Source: IBIS 2003

Figure 51 GAP protection status for all Ecoprovince/subbasin habitat types

Ecological Features

Vegetation

The following landscape-level vegetation information is derived from the Washington GAP Analysis Project (Cassidy 1997) and IBIS data (2003).

Cassidy (1997) identified six historic (potential) vegetation zones that occur within the subbasin in Section 2.2 (**Table 14**). The three-tip sage, central arid steppe, and Ponderosa pine vegetation zones are described in detail in Ashley and Stovall (unpublished report, 2004). These vegetation zones constitute focal habitat types. Douglas-fir, subalpine fir, and alpine parkland are not focal habitat types, but these vegetation zones occur throughout the subbasin.

Vegetation zone status has been summarized in **Figure 50**. An estimated 1.5% of central arid steppe and 5.2% of three-tip sage has been lost to agriculture. Similarly, 1.1% of the Ponderosa pine vegetation zone has been converted to agriculture. Historic and current extent of GAP vegetation zones in the Methow subbasin is illustrated in **Figure 52** and **Figure 53**.

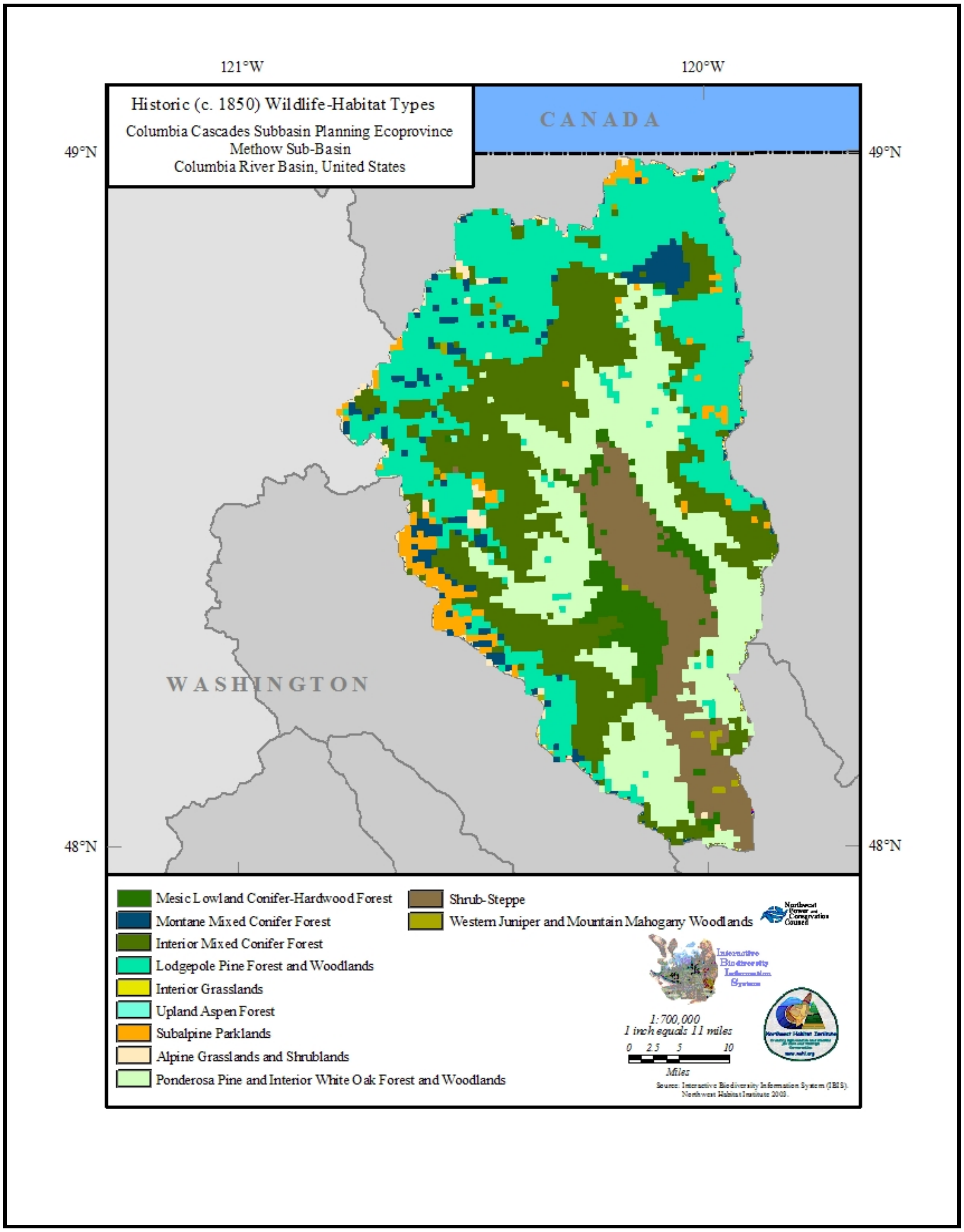


Figure 52 Historic wildlife habitat types of the Methow subbasin, Washington (IBIS 2003)

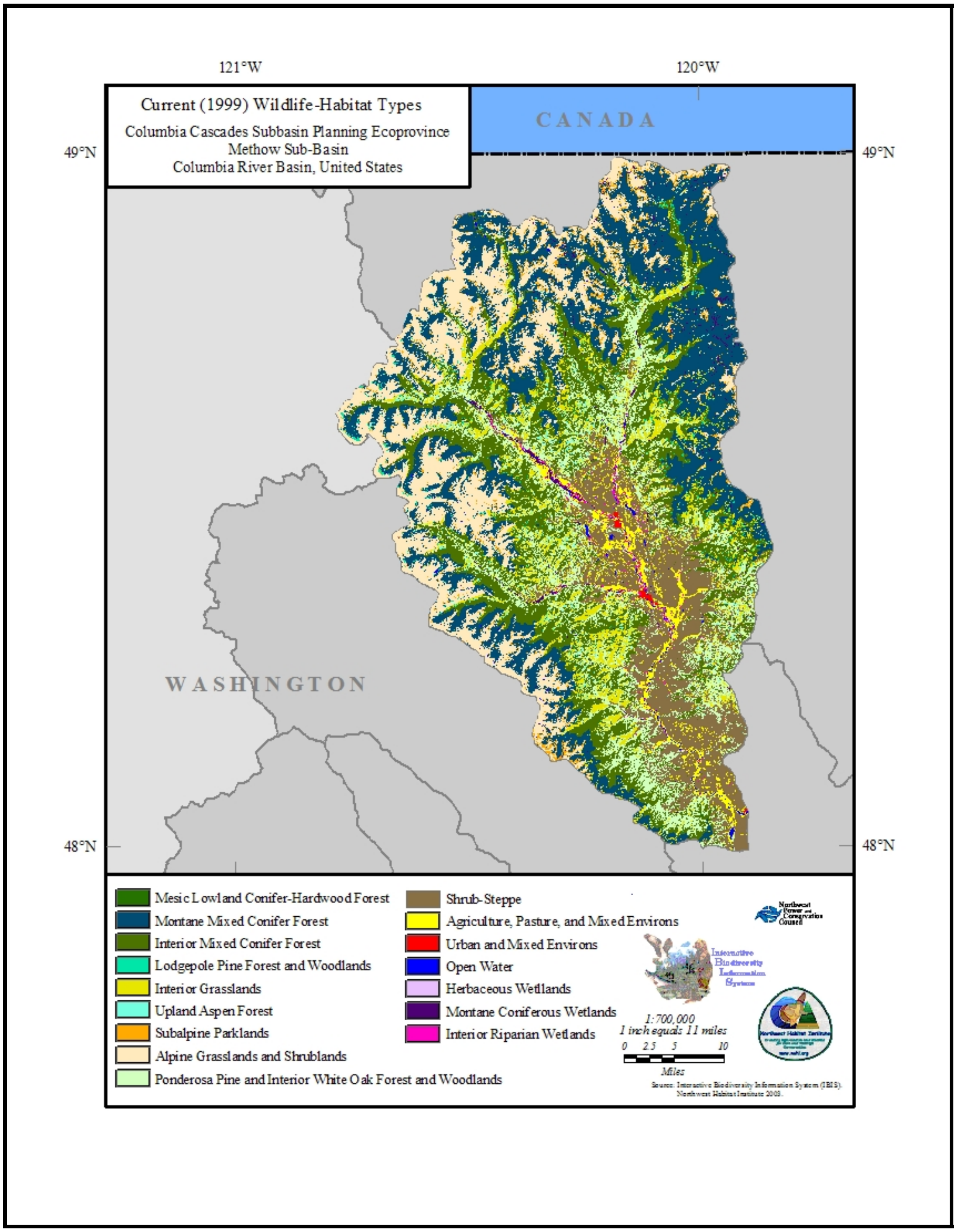


Figure 53 Current wildlife habitat types of the Methow subbasin, Washington (IBIS 2003)

Rare Plant Communities

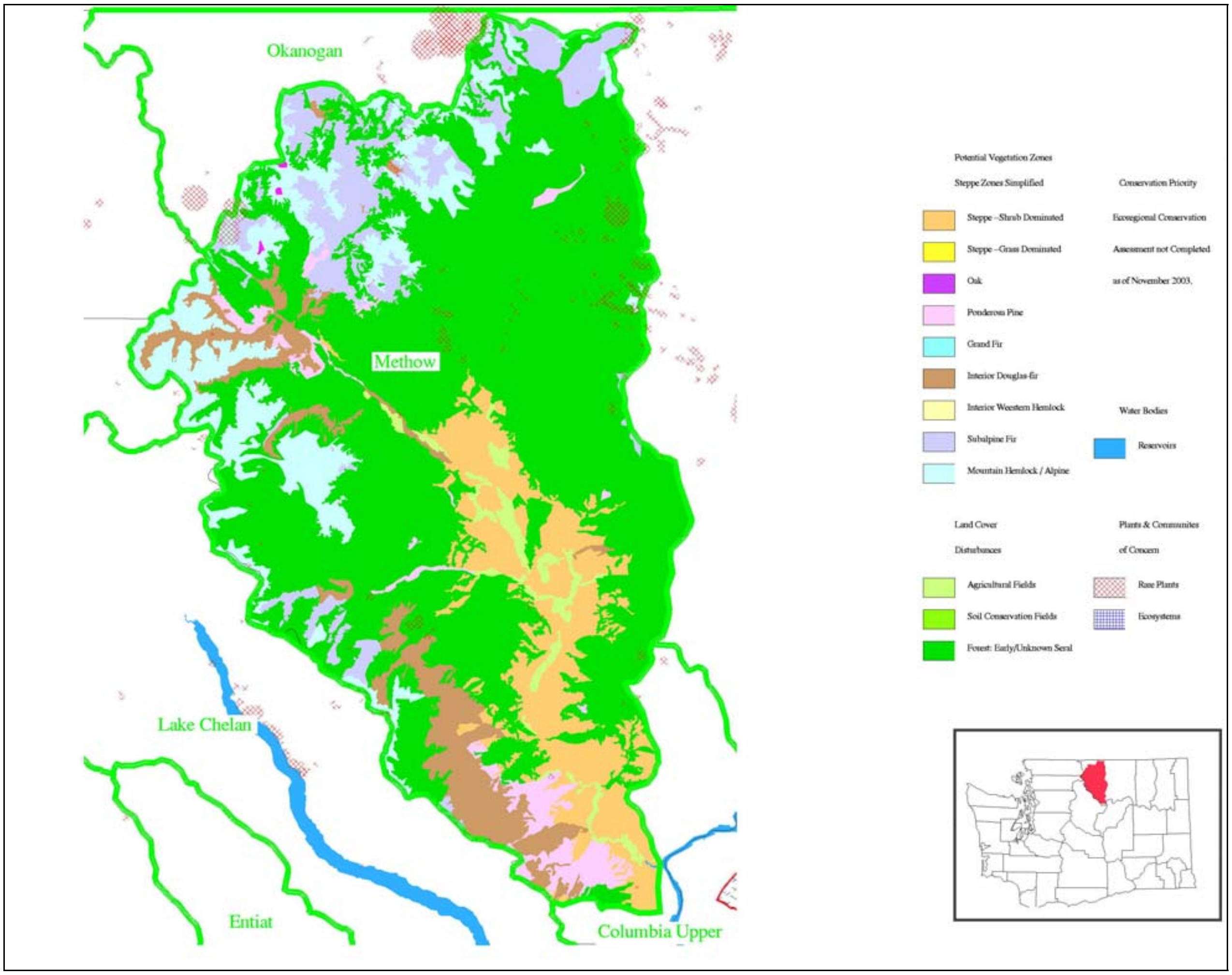
The subbasin contains 50 rare plant communities (Appendix C). Approximately 28% of the rare plant communities are associated with shrubsteppe habitat, 16% with riparian or wetland habitats, and 56% with upland forest habitat. Rare/high-quality plant occurrences and communities are illustrated in **Figure 54**.

Introduced wildlife

A list of 17 species of introduced or exotic wildlife species has been developed by the WDFW (**Table 40**).

Table 40 Introduced/exotic wildlife present in the Methow subbasin (IBIS 2003)

Common Name	Scientific Name
Bullfrog	*Rana catesbeiana*
Chukar	*Alectoris chukar*
Gray Partridge	*Perdix perdix*
Ring-necked Pheasant	*Phasianus colchicus*
Wild Turkey	*Meleagris gallopavo*
California Quail	*Callipepla californica*
Rock Dove	*Columba livia*
European Starling	*Sturnus vulgaris*
House Sparrow	*Passer domesticus*
Virginia Opossum	*Didelphis virginiana*
Eastern Cottontail	*Sylvilagus floridanus*
Cascade Golden-mantled Ground Squirrel	*Spermophilus saturatus*
Eastern Gray Squirrel	*Sciurus carolinensis*
Black Rat	*Rattus rattus*
Norway Rat	*Rattus norvegicus*
House Mouse	*Mus musculus*
Nutria	*Myocastor coypus*



(Cassidy 1997; WNHP 2003)

Figure 54 Rare plant occurrence and high-quality plant communities in the Methow subbasin, Washington

Noxious Weeds

Changes in biodiversity have been closely associated with changes in land use. Grazing, agriculture, and accidents have introduced a variety of exotic plants, many of which are vigorous enough to earn the title "noxious weed." Twenty-six species of noxious weeds occur in the Subbasin (**Table 40**).

Noxious weeds alter riparian vegetative cover by reducing the complexity of vegetative layering and diversity, on which indigenous aquatic and semi-aquatic species rely (USDA 2000). Infestations on stream banks may lead to increased sediment delivery when weeds replace native, fibrous-rooted plants with tap-rooted weeds, such as knapweed. The weeds use available water, but do not provide enough ground cover to prevent erosion. (USDA 2000).

Herbicide treatment of weeds also impacts streams if the herbicide reaches the channel. Herbicides may enter surface or shallow groundwater when sprayed directly on running or standing water, through drift or soil erosion, or in the case of an accidental spill.

Herbicides may indirectly affect surface waters by reducing the riparian zone vegetation, leading to increased water temperatures (USDA 2000). Herbicides may contaminate water through accidental spills, direct application to water bodies, surface runoff, or movement through the soil (USDA 2000).

Table 41 Exotic terrestrial plant/noxious weeds in the Methow subbasin and their origin (Callihan and Miller 1994)

Common Name	Scientific Name	Origin
Babysbreath	*Gypsophila paniculata*	
Canadian thistle	*Cirsium arvense*	Eurasia
Cheat grass	*Bromus tectorum*	
Cocklebur	*Xanthium spionosum*	
Dalmatian toadflax	*Linaria dalmatica*	Mediterranean
Diffuse knapweed	*Centaurea diffusa*	Eurasia
Hounds tongue	*Cunoglossum officinale*	
Japanese knotweed	*Polygonum cuspidatum*	
Kochia	*Kochia scoparia*	
Leafy spurge	*Euphorbia esula*	Eurasia
Longspine sandbur	*Cenchrus longispinus*	
Meadow hawkweed	*Hieracium caespitosum*	Europe
Mullein	*Verbascum thapsus*	
Musk thistle	*Carduus nutans*	Eurasia
Orange hawkweed	*Hieracium aurantiacum*	Europe
Oxeye daisy	*Leucanthemum vulgare*	
Perennial sowthistle	*Sonchus arvengis*	
Plumeless thistle	*Carduus acanthoides*	
Puncturevine	*Tribulus terrestris*	Europe
Purple loosestrife	*Lythrum salicaria*	Europe
Russian knapweed	*Centaurea repens*	Southern Russia and Asia
Russian thistle	*Salsola iberica sennen*	
Scotch cottonthistle	*Onopordum acanthium*	Europe
Scotchbroom	*Cytisus scoparius*	Europe
Spotted knapweed	*Centaurea maculosa*	Europe
Spurge flax	*Thymelaea passerina*	
St. Johnswort	*Hypericum perforatum*	
Sulfur cinquefoil	*Potentilla recta*	
Tansy ragwort	*Senecio jacobaea*	Eurasia
Whitetop	*Cardaria draba*	Europe
Wild Four o'clock	*Mirabilis nyctaginea*	
Yellow star thistle	*Centaurea solstitialis*	Mediterranean and Asia
Yellow toadflax	*Linaria vulgaris*	Europe

3.11 Ecological Relationships

The biotic communities of aquatic systems in the Upper Columbia Basin are highly complex. Within communities, assemblages and species have varying levels of interaction with one another. Direct interactions may occur in the form of predator-prey, competitor, and disease- or parasite-host relationships. In addition, many indirect interactions may occur between species.

These interactions continually change in response to shifting environmental and biotic conditions. Human activities that change the environment, the frequency and intensity of disturbance, or species composition can shift the competitive balance among species, alter predatory interactions, and change disease susceptibility. All of these changes may result in community reorganization.

3.12 Community Structure

Few studies have examined the fish species assemblages within the Upper Columbia Basin. Most information available is from past surveys (e.g., Dell et al. 1975; Dobler et al. 1978; McGee et al. 1983; Burley and Poe 1994; Hillman 2000; Duke Engineering 2001), dam passage studies (e.g., Mullan et al. 1986; Tonseth and Petersen 1999; Chelan PUD unpublished data), and northern pikeminnow studies (e.g., Burley and Poe 1994; West 2000).

The available information indicates that about 41 species of fish occur within the Upper Columbia Basin (from the mouth of the Yakama River upstream to Chief Joseph Dam) (**Table 12**). This is an underestimate because several species of cottids (sculpins) live there. Of the fishes in the basin, 15 are cold-water species, 18 are cool-water species, and eight are warm-water species. Most of the cold-water species are native to the area; only four were introduced: brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), lake whitefish (*Coregonus clupeaformis*), and Atlantic salmon (*S. salar*). Four of the 18 cool-water species are exotics: pumpkinseed (*Lepomis gibbosus*), walleye (*Stizostedion vitreum*), yellow perch (*Perca flavescens*), and smallmouth bass (*Micropterus dolomieu*), while all warm-water species are exotics.

Table 42 Fish Species of the Upper Columbia River Basin (Pevan 2004)

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column				Primary prey			
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Cold-water species:										
White sturgeon	*Acipenser transmontanus*	N			x	x	x	x	X	x
Chinook salmon (juv)	*Oncorhynchus tshawytscha*	N	X	x	x				X	
Coho salmon (juv)	*Oncorhynchus kisutch*	N	X	x	x				X	

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column				Primary prey			
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Sockeye/kokanee (juv)	*Oncorhynchus nerka*	N	x	X	x			x	X	
Steelhead/ rainbow	*Oncorhynchus mykiss*	N	x	X	x				X	x
Interior redband trout	*Oncorhynchus mykiss gairdneri*	N	x	X	x				X	x
cutthroat trout	*Oncorhynchus clarki*	N	X	x	x				X	x
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	N	X	x	x				X	x
Brown trout	*Salmo trutta*	E	x	X	x				X	x
Atlantic salmon	*Salmo salar*	E	x	X	x				X	x
Bull trout	*Salvelinus confluentus*	N	x	x	X				X	x
Brook trout	*Salvelinus fontinalis*	E	x	X	x				X	x
Mountain whitefish	*Prosopium williamsoni*	N	x	x	X				X	
Lake whitefish	*Coregonus clupeaformis*	E		x	X				X	x
Longnose sucker	*Catostomus catostomus*	N			X	x	x	x	x	
Sculpins	*Cottus spp.*	N			X				X	x
Cool-water species:										

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column				Primary prey			
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Longnose dace	*Rhinichtys cataractae*	N			X				X	
Peamouth	*Mylocheilus caurinus*	N			X				X	x
Chiselmouth	*Acrocheilus alutaceus*	N			X	X			x	
Northern pikeminnow	*Ptychocheilus oregonensis*	N	x	x	X				X	x
Redside shiner	*Richardsonius balteatus*	N	x	X	x				X	
Sand roller	*Percopsis transmontana*	N			X				X	
Bridgelip sucker	*Catostomus columbianus*	N			X	X			x	
Mountain sucker	*Catostomus platyrhynchus*	N			X	X	x	x	x	
Largescale sucker	*Catostomus macrocheilus*	N			X	X	x	x	x	
Pacific lamprey (juv)	*Lampetra tridentata*	N			X	x		X	x	
Western brook lamprey (juv)	*Lampetra richardsonii*	N			X	x	X	x		
Threespine stickleback	*Gasterosteus aculeatus*	N	x	X	x				X	
Pumpkinseed	*Lepomis gibbosus*	E		X	x				X	x

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column				Primary prey			
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Walleye	*Stizostedion vitreum*	E		x	X				x	X
Yellow perch	*Perca flavescens*	E	x	X	x				X	x
Smallmouth bass	*Micropterus dolomieu*	E	x	x	X				X	x
Sculpin	*Cottus spp.*	N			X				X	x
Warm-water species:										
Channel catfish	*Ictalurus punctatus*	E			X				X	x
Black bullhead	*Ameiurus melas*	E			X	x			X	
Brown bullhead	*Ameiurus nebulosus*	E			X	x	x	x	X	x
Tench	*Tinca tinca*	E			X	x			X	
Common carp	*Cyprinus carpio*	E			X	x	x	x	X	
Bluegill	*Lepomis macrochirus*	E	x	X	x				X	x
Black crappie	*Pomoxis nigromaculatus*	E	x	X	x				X	x

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column				Primary prey			
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Largemouth bass	*Micropterus salmoides*	E	x	X	x				x	X

Anadromous species within the upper basin include spring and summer/fall Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), steelhead (*O. mykiss*), and Pacific lamprey (*Lampetra tridentata*). Atlantic salmon (*Salmo salar*) and exotic species are also anadromous, but their status in the basin is largely unknown. White sturgeon (*Acipenser transmontanus*), which may have been anadromous historically, are present as a resident population.

Fish community interactions, interspecies competition, and species that are likely to interact with Chinook and steelhead, in particular, have been described for the Upper Columbia Basin in order to provide some management context for multi-species and ecosystem management objectives.

3.13 Competition

Competition among organisms occurs when two or more individuals use the same resources and when availability of those resources is limited (Pianka 2000). That is, for competition to occur, demand for food or space must be greater than supply (implies high recruitment or that the habitat is fully seeded), and environmental stresses few and predictable. Two types of competition are generally recognized: a) interference competition, where one organism directly prevents another from using a resource through aggressive behavior, and b) exploitation competition, where one species affects another by using a resource more efficiently. Salmonids likely compete for food and space both within species (intraspecific), and between species (well-coordinated). Well-coordinated interactions are more likely to occur between native and exotic species, rather than between species that coevolved together.

Although coevolved sympatric species should segregate (i.e., partition resources in space or time or both), native species may still interact along the margins of their spatial and temporal distributions. An example of this may occur between Chinook salmon and steelhead. This interaction was studied in the Wenatchee Basin by Hillman et al. (1989a, 1989b), and found to be relatively unimportant in limiting the production of the species. Interaction between the species was minimized because of disparate times of spawning, which tended to segregate the two species.

Currently, there is no evidence that the focal species interact with bull trout or westslope cutthroat trout. Indeed, Martin et al. (1992) indicated that juvenile bull trout and Chinook have different habitat preferences and, thus, do not interact competitively.

Significant interaction between redside shiners, Chinook, and steelhead may occur as a result of changes or modifications in water quality (e.g., temperature). In both field and laboratory studies, Hillman (1991) found that redside shiners displaced Chinook salmon from rearing areas at temperatures greater than 64°F (18°C). In fact, at these warmer temperatures, shiners negatively affected the distribution, behavior, and production of Chinook salmon. Reeves et al. (1987) documented similar results with redside shiners and juvenile steelhead. Thus, if water temperatures increase within the basin, one can expect increased interactions between shiners and Chinook and steelhead.

Exotic species may be more likely to interact with Chinook and steelhead because exotics have not had time to segregate spatially or temporally in their resource use. For example, there is a possibility that brook trout interact with Chinook and steelhead in the upper basin. Welsh (1994), however, found no evidence that brook trout displaced Chinook salmon. On the other hand, Cunjak and Green (1986) found that brook trout were superior competitors to rainbow/steelhead at colder temperatures (48°F or 9°C), while rainbow/steelhead were superior at warmer temperatures (61°F or 16°C).

A potentially important source of exploitative competition occurring outside the geographic boundary of the ESUs may be between the exotic American shad (*Alosa sapidissima*) and juvenile Chinook and steelhead. Palmisano et al. (1993a, 1993b) concluded that increased numbers of shad likely compete with juvenile salmon and steelhead.

Although coho salmon were native to the upper basin, they have been absent for many decades. Recently, there have been efforts to re-establish them in the upper basin (Murdoch et al. 2002). There is the potential that reintroduced coho will interact negatively with Chinook and steelhead; however, studies conducted in the Wenatchee Basin indicate that there is little to no interaction between the species (Spaulding et al. 1989; Murdoch et al. 2002).

3.14 Predation

Fish, mammals, and birds are the primary natural predators of Chinook and steelhead in the Upper Columbia Basin. Although the behavior of Chinook and steelhead precludes any single predator from focusing exclusively on them, predation by certain species can, nonetheless, be seasonally and locally important. Recent changes in predator and prey populations along with major changes in the environment, both related and unrelated to development in the Upper Columbia basin, have reshaped the role of predation (Mullan et al. 1986; Li et al. 1987).

About half of the resident species in the upper basin are piscivorous (eat fish). Ten cold-water species, seven cool-water species, and five warm-water species are known to eat fish. About 59% of these piscivores are exotics. Although 59% of the piscivores are exotics, these exotics constitute a small fraction of the total fish biomass within the project area (S. Hays, Chelan PUD, pers. comm.).

Before the introduction of exotics, northern pikeminnow (*Ptychocheilus oregonensis*), sculpin (*Cottus* spp.), white sturgeon, bull trout (*Salvelinus confluentus*), rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), and burbot (*Lota lota*) were the primary piscivores in the region (Li et al. 1987; Poe et al. 1994). Presently, burbot are rare in the upper basin (Dell et al. 1975; Burley and Poe 1994), and probably have little effect on the abundance of juvenile Chinook and steelhead in the region. The status of white sturgeon in the upper basin is mostly unknown, although their numbers appear to be quite low (DeVore et al. 2000).

Introduced species such as walleye, smallmouth bass, and channel catfish (*Ictalurus punctatus*) are important predators of Chinook and steelhead in the Columbia River (Poe et al. 1994). Channel catfish are rare (Dell et al. 1975; Burley and Poe 1994) and likely have little to no effect on abundance of Chinook and steelhead. Other piscivores, such as largemouth bass (*M. salmoides*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), yellow perch, and pumpkinseed are either rare or not known to prey heavily on juvenile anadromous fish (Dell et al. 1975; Burley and Poe 1994).

Although several fish species can consume Chinook and steelhead in the upper basin, northern pikeminnow, walleyes, and smallmouth bass have the potential for significantly affecting the abundance of juvenile anadromous fish (Gray and Rondorf 1986; Bennett 1991; Poe et al. 1994; Burley and Poe 1994). These are large, opportunistic predators that feed on a variety of prey and switch their feeding patterns when spatially or temporally segregated from a commonly consumed prey.

Most adult salmonids within the upper basin are opportunistic feeders and are, therefore, capable of preying on juvenile Chinook and steelhead. Those likely to have some effect on the survival of Chinook and steelhead include adult bull trout, rainbow/steelhead trout, cutthroat trout, brook trout, and brown trout. Of these, bull trout and rainbow trout are probably the most important. These species occur together with Chinook and steelhead in most tributaries, hence the probability for interaction is high. The presence of both fluvial and adfluvial stocks of bull trout in the region further increases the likelihood for interaction there.

Predation by piscivorous birds on juvenile anadromous fish may represent a large source of mortality. Fish-eating birds that occur in the upper basin include great blue herons (*Ardea herodias*), gulls (*Larus* spp.), osprey (*Pandion haliaetus*), common mergansers (*Mergus merganser*), American dippers (*Cinclus mexicanus*), cormorants (*Phalacrocorax* spp.), Caspian terns (*Sterna caspia*), belted kingfishers (*Ceryle alcyon*), common loons (*Gavia immer*), western grebes (*Aechmophorus occidentalis*), black-crowned night herons (*Nycticorax nycticorax*), and bald eagles (*Haliaeetus leucocephalus*) (T. West, Chelan PUD, pers. comm.).

These birds have high metabolic rates and require large quantities of food relative to their body size. In the Columbia River estuary, avian predators consumed an estimated 16.7 million smolts (range, 10 to 28.3 million smolts), or 18% (range, 11 to 30%) of the smolts reaching the estuary in 1998 (Collis et al. 2000). Caspian terns consumed primarily salmonids (74% of diet mass), followed by double-crested cormorants (*P. auritus*) (21% of diet mass) and gulls (8% of diet mass). The NMFS (2000) identified these species as the most important avian predators in the Columbia River basin.

Mammals may be an important agent of mortality to Chinook and steelhead in the upper basin. Predators such as river otters (*Lutra canadensis*), raccoons (*Procyon lotor*), mink (*Mustela vison*), and black bears (*Ursus americanus*) are common in the upper basin. These animals, especially river otters, are capable of removing large numbers of salmon and trout (Dolloff 1993). Black bears consume large numbers of salmon, but generally scavenge post-spawned salmon.

Pinnipeds, including harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*), and Stellar sea lions (*Eumetopia jubatus*) are the primary marine mammals preying on Chinook and steelhead originating from the Upper Columbia basin (Spence et al. 1996). Pacific striped dolphin (*Lagenorhynchus obliquidens*) and killer whale (*Orcinus orca*) may also prey on adult Chinook and steelhead. Seal and sea lion predation is primarily in saltwater and estuarine environments though they are know to travel well into freshwater after migrating fish. All of these predators are opportunists, searching out locations where juveniles and adults are most vulnerable.

3.15 Disease and Parasitism

Chinook and steelhead can be infected by a variety of bacterial, viral, fungal, and microparasitic pathogens. Numerous diseases may result from pathogens that occur naturally in the wild or that may be transmitted to wild fish via infected hatchery fish. Among these are bacterial diseases, including bacterial kidney disease (BKD), columnaris, furunculosis, redmouth disease, and coldwater disease; virally induced diseases, including infectious hepatopoietic necrosis (IHN), infectious pancreatic necrosis (IPNV), and erythrocytic inclusion body syndrome (EIBS); protozoan-caused diseases, including ceratomyxosis and dermocystidium; and fungal infections, such as saprolegnia (Bevan et al. 1994).

Chinook in the Columbia River have a high incidence of BKD (Chapman et al. 1995). Incidence appears higher in spring Chinook (Fryer 1984), and can be a major problem in hatchery-reared Chinook in the upper Columbia region (Chapman et al. 1995). Viral infections such as IPNV have been detected in hatchery steelhead in the upper Columbia region (Chapman et al. 1994). Other epizootics, including *Ceratomyxa shasta* and tuberculosis, are endemic to the Columbia River basin, but it is unknown if these affect the production of Chinook and steelhead in the upper Columbia region.

Generally, one thinks of epizootics killing fish outright. However, sublethal chronic infections can impair the performance of Chinook and steelhead in the wild, thereby contributing secondarily to mortality or reduced reproductive success. Fish weakened by disease are more sensitive to other environmental stresses. Additionally, they may become more vulnerable to predation (Hoffman and Bauer 1971), or less able to compete with other species. For example, both Hillman (1991) and Reeves et al. (1987) found that water temperature affected interactions between redside shiners and the focal species. Both researchers noted that outcomes of interactions were, in part, related to infection with *F. columnaris*. In their studies, most Chinook and steelhead were infected at warmer temperatures, whereas shiners showed a higher incidence of infection at cooler temperatures.

3.16 Competition

As noted in the Ecological Interactions section, competition among organisms occurs when two or more individuals use the same resources, and when availability of those resources is limited (Pianka 2000). Although competition is difficult to demonstrate, a few studies conducted within the Upper Columbia Basin indicate that competition may affect the production of Chinook salmon and steelhead in the basin.

3.16.1 Chinook/Steelhead

It is possible that competition may occur between juvenile Chinook and steelhead along the margins of their spatial and temporal distributions. Hillman et al. (1989a, 1989b) investigated the interaction between these species in the Wenatchee River between 1986 and 1989. They reported that Chinook and steelhead used dissimilar daytime and nighttime habitat throughout the year.

During the daytime in summer and autumn, juvenile Chinook selected deeper and faster water than steelhead. Chinook readily selected stations associated with brush and woody debris for cover, while steelhead primarily occupied stations near cobble and boulder cover. During winter days, Chinook and steelhead used similar habitat, but Hillman et al. (1989a) did not find them together. At night, during both summer and winter, Hillman et al. (1989b) found that both species occupied similar water velocities, but subyearling Chinook selected deeper water than steelhead.

Within smaller streams, Hillman and Miller (2002) found that Chinook were more often associated with pools and woody debris during the summer, while steelhead occurred more frequently in riffle habitat. Hillman et al. (1989a, 1989b) concluded that interaction between the two species would not strongly negatively affect production of either species, because disparate times of spawning tended to segregate the two species. This conclusion is consistent with the work of Everest and Chapman (1972) in Idaho streams.

3.16.2 Redside shiners

Under appropriate conditions, well-coordinated interaction may also occur between redside shiners and juvenile Chinook and steelhead. Hillman (1991) studied the influence of water temperature on the spatial interaction between juvenile Chinook and redside shiners in the field and laboratory. In the Wenatchee River during summer, Hillman (1991) noted that Chinook and shiners clustered together, and that shiners were aggressive toward salmon. He reported that the shiners used the more energetically profitable positions, and that they remained closer than Chinook to instream and overhead cover.

In laboratory channels, shiners affected the distribution, activity, and production of Chinook in warm (64-70°F or 18-21°C) water, but not in cold (54-60°F or 12-15°C) water (Hillman 1991). In contrast, Chinook influenced the distribution, activity, and production of shiners in cold water, but not in warm water. Reeves et al. (1987) documented similar results when they studied the interactions between redside shiners and juvenile steelhead. Although Hillman (1991) conducted his fieldwork in the lower Wenatchee River, shiners are also present in the Entiat, Methow, and Okanogan rivers, and are abundant in the mainstem Columbia River. At warmer temperatures, shiners likely negatively affect the production of Chinook salmon and steelhead in the upper basin.

3.16.3 Coho salmon

It is possible that the re-introduction of coho salmon into the Upper Columbia Basin may negatively affect the production of Chinook and steelhead. One of the first studies in the upper basin that addressed effects of coho on Chinook and steelhead production was conducted by Spauling et al. (1989) in the Wenatchee River.

This work demonstrated that the introduction of coho into sites with naturally produced Chinook and steelhead did not affect Chinook or steelhead abundance or growth. However, because Chinook and coho used similar habitat, the introduction of coho caused Chinook to change habitat. After removing coho from the sites, Chinook moved back into the habitat they used prior to the introduction of coho.

Steelhead, on the other hand, remained spatially segregated from Chinook and coho throughout the study. More recent studies conducted by Murdoch et al. (2002) found that juvenile coho, Chinook, and steelhead used different microhabitats in Nason Creek, and at the densities tested, coho did not appear to displace juvenile Chinook or steelhead from preferred microhabitats.

In addition, Mullan et al. (1992) studied the growth and survival of juvenile coho, chinook, and steelhead in Icicle Creek and concluded that little interaction was apparent among age-0 chinook salmon, coho salmon, and steelhead, and that the introduced coho did not negatively affect the abundance or growth of chinook and steelhead.

These studies indicate that the re-introduction of coho should have little to no effect on the production of Chinook and steelhead.

3.16.4 Various salmonids

Most adult salmonids within the upper basin are capable of preying on juvenile Chinook and steelhead. Those likely to have some effect on the survival of Chinook and steelhead include adult bull trout, rainbow/steelhead trout, cutthroat trout, brook trout, and brown trout. Because brown trout are rare in the region, they probably have little effect on the survival of Chinook and steelhead.

The other salmonids often occur in the same areas as Chinook and steelhead, and are known to be important predators of Chinook and steelhead (Mullan et al. 1992). Of these, bull trout and rainbow trout are probably the most important. These species occur together in most tributaries; hence, the probability for interaction is high. The presence of both fluvial and adfluvial stocks of bull trout in the region further increases the likelihood for interaction there.

Bull trout are opportunistic feeders and will eat just about anything including squirrels, birds, ducklings, snakes, mice, frogs, fish, and insects (Elliott and Peck 1980; Goetz 1989); although, adult migrant bull trout primarily eat fish. Because adult migrant bull trout occur throughout the upper basin, including the mainstem Columbia River (Stevenson et al. 2003), they likely prey on juvenile Chinook and steelhead.

In the upper Wenatchee basin, Hillman and Miller (2002) noted that juvenile Chinook and steelhead were rare in areas where adult bull trout were present. Like northern pikeminnow, adult bull trout frequent the tailrace areas of upper Columbia dams. These areas provide concentrated prey items that include juvenile Chinook and steelhead.

It is likely that adult bull trout prey heavily on migrant salmon and steelhead in these areas. Indeed, Stevenson et al. (2003) found bull trout staging near the Wells Hatchery outfall, apparently seeking opportunistic feeding opportunities. As the number of bull trout increase in the upper basin, the interaction between them and Chinook and steelhead will increase.

Rainbow/steelhead trout feed on Chinook fry in the upper basin. In the Wenatchee River, for example, Hillman et al. (1989a) observed both wild and hatchery rainbow/steelhead feeding on Chinook fry. Predation was most intense during dawn and dusk. At these times, rainbow/ steelhead occupied stations immediately adjacent to aggregations of Chinook. Hillman et al. (1989a) noted that within the prey cluster, the largest, light-colored Chinook were closest to shelter and seldom eaten. Small, darker-colored Chinook were farther from escape cover and usually eaten by predators. Hillman et al. (1989a; 1989b) suggest that predator-mediated interaction for shelter was strong and contributed to the rapid decline in Chinook numbers in May. Although this work was done in the Wenatchee River, the results probably hold for other tributaries where the two species occur together.

Although adult salmonids prey on juvenile Chinook and steelhead in the upper basin, the predation rate is unknown. Because of the abundance of both bull trout and rainbow/steelhead trout in the upper basin, it is reasonable to assume that large numbers of fry are consumed by these fish.

3.16.5 American shad

A potentially important source of exploitative competition occurring outside the geographic boundary of the ESUs may be between the exotic American shad and juvenile Chinook and steelhead. Changes in stream flow in the Columbia River system have resulted in increased plankton production that has apparently increased the success of introduced shad.

Shad prey on the most abundant foods (Walburg 1956; Levesque and Reed 1972). Shad in the Columbia River estuary consume amphipods, calanoid copepods (*Neomysis mercedis*), cladocerans (*Daphnia* spp.), and insects (Durkin et al. 1979). Juvenile salmonids eat the same foods (McCabe et al. 1983). Palmisano et al. (1993a, 1993b) concluded that increased numbers of shad likely compete with juvenile salmon and steelhead.

Predation

Fish, mammals, and birds are the primary natural predators of Chinook and steelhead in the Upper Columbia basin. Although the behavior of Chinook and steelhead precludes any single predator from focusing exclusively on them, predation by certain species can nonetheless be seasonally and locally important. Below is a discussion on the importance of specific predators on the production of Chinook and steelhead in the Upper Columbia basin.

3.16.6 Smallmouth bass

Smallmouth bass were introduced into the Columbia River before 1900 (Poe et al. 1994). Given their behavioral characteristics, it is assumed that they could significantly affect the abundance of juvenile Chinook and steelhead. In spring and early summer, they inhabit rocky shoreline areas that are also used by juvenile salmonids (Scott and Crossman 1973; Wydoski and Whitney 1979).

Studies in Columbia basin reservoirs and Lake Sammamish, Washington, showed that smallmouth bass were highly predacious on outmigrating juvenile salmonids (Gray et al. 1984; Gray and Rondorf 1986). In contrast, studies by Bennett et al. (1983) and Zimmerman (1999) found that even though salmonids were present in Snake and Columbia River reservoirs, they were less important in the diets of smallmouth bass than other fish.

Smallmouth bass commonly consumed sculpins, minnows, suckers, and troutperches in impounded and unimpounded reaches of the lower Columbia and lower Snake rivers during the outmigration of juvenile anadromous salmonids (Zimmerman 1999).

Sampling in the Upper Columbia Basin indicates that smallmouth bass are relatively rare (Dell et al. 1975; Burley and Poe 1994). Burley and Poe (1994) described studies that assessed the relative abundance of northern pikeminnow, walleye, and smallmouth bass in the Rocky Reach project area. Smallmouth bass constituted only 5% of the catch; northern pikeminnow and walleye made up 91% and 4% of the respective catch. Most (63%) smallmouth bass resided in the tailrace.

Very few (3%) were captured mid-reservoir. Mullan (1980), Mullan et al. (1986), and Bennett (1991) suggested that few smallmouth bass occur within the Upper Columbia because of low ambient water temperatures. Optimum growth temperatures for smallmouth bass range from 79-84°F (26-29°C) (Armour 1993a).

Because Upper Columbia reservoirs function as a cold-tailwater to the reservoir of Grand Coulee Dam, optimal temperatures for bass occur primarily in warm backwaters (Mullan et al. 1986; Bennett 1991). The typical low water temperatures in the project area result in late spawning times, slow fry and fingerling growth, and small body size of smallmouth bass entering the first winter. This contributes to high overwinter mortality of juvenile smallmouth bass (Bennett 1991).

One could theorize that if sustained removals of northern pikeminnow significantly reduce mortality of juvenile salmonids in the project area, predation by smallmouth bass may be enhanced because of increased availability of juvenile salmonid prey. Studies in the lower Columbia and Snake rivers found that smallmouth bass did not respond to sustained removals of northern pikeminnow (Ward and Zimmerman 1999). Smallmouth bass density, year-class strength, consumption of juvenile salmonids, survival, growth, and relative weight did not increase concurrent with removals of northern pikeminnow. Likewise, it is unlikely that smallmouth bass will respond to sustained removals of northern pikeminnow in the Upper Columbia basin.

Because smallmouth bass are not abundant in the upper Columbia, they probably have a minor influence on the survival of juvenile Chinook and steelhead. Of the anadromous fish in the project area, subyearling summer/fall Chinook may be consumed more readily because their habitats overlap seasonally with smallmouth bass, and because the subyearlings are ideal forage size for adult smallmouth bass (Poe et al. 1994).

3.16.7 Walleye

According to Li et al. (1987), walleye recently invaded the Columbia River from the reservoir of Grand Coulee Dam, where they are now very abundant. This fish is a large, schooling predator, unlike the native fauna, and its affect on juvenile Chinook and steelhead could be significant because of the potential for depensatory predatory-prey interactions.

Gray et al. (1984) found a high frequency of occurrence (42%) of juvenile salmonids in the stomachs of walleyes collected in the John Day tailrace during spring. In John Day Reservoir, however, Maule (1982) reported that walleyes ate few juvenile salmonids, and suggested that the probable reason was the spatial and temporal segregation of the species when walleyes were feeding most actively. Perhaps the reason that walleyes eat more juvenile salmonids in the tailrace is because the dam creates habitat that increases potential for spatial overlap, and, therefore, predation between the species. This is supported by the high occurrence of juvenile salmonids in walleye stomachs collected between 1800 and 2400 hours (Gray et al. 1984), when the greatest fraction of smolts move through the powerhouse at John Day Dam (Sims et al. 1981), and when walleyes feed most heavily (Maule 1982).

Work by Zimmerman (1999) in impounded and unimpounded reaches of the lower Columbia River indicated that walleyes, like smallmouth bass, more commonly consumed sculpins, suckers, minnows, and troutperches during the outmigration of juvenile salmonids. This comports with the observations of Vigg et al. (1991), who estimated that nonsalmonid consumption rates of walleye were similar to those of smallmouth bass, and exceeded those of northern pikeminnow in John Day Reservoir.

Walleyes are relatively rare in the upper Columbia (Dell et al. 1975; Burley and Poe 1994). Burley and Poe (1994) reported that walleyes made up only 4% of the catch of the major predators in the Rocky Reach project area; the other two major predators, northern pikeminnow and smallmouth bass, made up 91% and 5% of the respective catch.

Most of the walleyes were captured in the tailrace. Few were captured in the forebay or mid-reservoir. The abundance of walleye appears to be limited by poor recruitment and low turbidity (Bennett 1991). Bennett (1991) reported that the most significant factor limiting abundance of walleyes is the short reservoir retention times (5.5-0.7 days), especially at the time of larvae abundance. High mortality and low food abundance for larvae probably limit recruitment of walleyes in reservoirs. In addition, low water turbidity likely affects the temporal and spatial distribution of feeding and reproduction of walleyes.

Walleyes attain maximum population sizes in shallow, large, turbid waters (Scott and Crossman 1973). They prefer turbid water because their eyes are sensitive to bright light. In clear waters, walleyes retain contact with the substrate during the day (Ryder 1977) and increase activity as light conditions decrease in the evening. Peak periods of activity in clear waters are dusk and dawn (Kelso 1976).

Mullan et al. (1992) believed that low water temperatures may limit recruitment of walleyes in the upper Columbia. Optimal water temperatures for embryo incubation range from 9-15°C (48-59°F) (Armour 1993b). Optimal growth temperatures for juveniles and adults range from 22-28°C (72-82°F) and 20-28°C (68-82°F), respectively (Armour 1993b). These thermal requirements suggest that water temperatures in the project area may not increase sufficiently fast or high enough for successful incubation, hatching, and rearing (Mullan et al. 1986; Bennett 1991). Successful incubation, hatching, and rearing may occur in backwater areas.

Because walleyes are not abundant in the upper Columbia, they probably do not significantly reduce the abundance of juvenile Chinook or steelhead in the area. Walleye predation on juvenile salmonids is probably greatest on subyearling summer/fall Chinook. Gray et al. (1984) found that about 80% of the juveniles identified in walleye stomachs were subyearlings, probably a result of their smaller size. Subyearling Chinook spend more time in shallower water than yearling spring Chinook, also increasing the likelihood of encountering walleyes.

3.16.8 Northern pikeminnow

The northern pikeminnow is a native cyprinid widely distributed throughout the Columbia River system (Mullan et al. 1986). It is the dominant predator of juvenile salmonids in the system, and predation by this species is clearly important compared to other sources of mortality (Poe et al. 1991; Rieman et al. 1991; Vigg et al. 1991; Ward and Zimmerman 1999; Zimmerman 1999).

Petersen (1994) estimated the annual loss of juvenile salmonids to predation by northern pikeminnow in John Day Reservoir to be 1.4 million, or approximately 7.3% of all juvenile salmonids entering the reservoir. Predation varies throughout the system and is often highest near dams (Ward et al. 1995). Although the work by Gadomski and Hall-Griswold (1992) suggests that northern pikeminnow prefer dead juvenile Chinook to live ones, Petersen (1994) found that 78% of juvenile salmonids eaten by northern pikeminnow near a dam were consumed while alive.

Ward et al. (1995) estimated that 48% of predation occurs in mid-reservoir areas away from dams, where juvenile salmonids are presumably alive and uninjured when consumed. Of the estimated 200 million juvenile salmonids that emigrate annually through the Columbia River system, about 16.4 million (8%) are consumed by northern pikeminnow (Beamesderfer et al. 1996).

Northern pikeminnow are abundant in the Upper Columbia Basin (Dell et al. 1975; Mullan 1980; Mullan et al. 1986; Bennett 1991; Burley and Poe 1994), and large numbers pass through the fishways at dams. Of the three major predators in the Rocky Reach project area (northern pikeminnow, smallmouth bass, and walleye), northern pikeminnow made up 91% of the catch (Burley and Poe 1994). These fish were most abundant in the mid-reservoir (45% of the total catch of northern pikeminnow), with the remaining catch of northern pikeminnow split equally between the forebay and tailrace.

At other dams in the Upper Columbia basin, Burley and Poe (1994) found larger numbers of northern pikeminnow in the tailrace areas. Northern pikeminnow in the Rocky Reach project area averaged 296 millimetres (12 inches) fork length (range, 115-515 millimetres [4.5-20 inches]) (Burley and Poe 1994). Vigg et al. (1991) reported that juvenile salmonids are the major dietary component of northern pikeminnow larger than 250-mm (10 inches) fork length; therefore, one would assume that northern pikeminnow could significantly affect the abundance of juvenile Chinook and steelhead in the upper basin.

Burley and Poe (1994) summarize studies that assessed the significance of northern pikeminnow predation in the Upper Columbia region. They reported that northern pikeminnow in the Rocky Reach project area consumed primarily fish during the spring and summer; crustaceans, molluscs, insects, and plants were also consumed. Typically, the highest percentage of gut contents consisting of fish occurred in pikeminnows feeding in the tailrace and forebay areas. Juvenile salmonids were a significant component of northern pikeminnow diets, especially in tailrace areas.

The concern that northern pikeminnow could significantly affect the abundance of Chinook and steelhead in the upper basin, resulted in the initiation of a pikeminnow population reduction program. Since its initiation (1994), the program has removed well over 75,000 northern pikeminnow from Rocky Reach and Rock Island project areas (West 2000). At Rocky Reach, the program removed 44,743 (average, 6,400 per year; range, 2,482-9,633) pikeminnow. The number of northern pikeminnow ascending fish ladders at both dams has declined and catch rates have decreased (West 2000).

It is reasonable to assume that the reduction in numbers of northern pikeminnow has increased survival of juvenile Chinook and steelhead in the upper basin. In the lower Columbia and Snake rivers, potential predation on juvenile salmonids by northern pikeminnow decreased 25% after a pikeminnow removal program was implemented there (Friesen and Ward 1999). Friesen and

Ward (1999) estimated a reduction in potential predation of 3.8 million juvenile salmon (representing 1.9% of the total population).

Knutsen and Ward (1999) found no evidence that the surviving pikeminnow compensated for removals. That is, estimates of relative weight, growth, and fecundity of pikeminnow were similar to estimates made before pikeminnow removals. Zimmerman and Ward (1999) concluded that consumption of juvenile salmonids by surviving pikeminnow has not increased in response to pikeminnow removal. It is likely that similar results occur within the Upper Columbia basin.

Northern pikeminnow are abundant in the Upper Columbia basin, and have the potential to significantly affect the abundance of juvenile Chinook and steelhead. They consume large numbers of juvenile salmonids, primarily those concentrated in the tailrace and forebay areas during the spring outmigration. They also consume large numbers of juvenile salmonids (probably summer/fall Chinook) during summer.

Currently, the factor limiting the abundance of northern pikeminnow in the upper basin is the sustained population reduction program. The program has removed large numbers of northern pikeminnow from the project area. As a result, dam passage counts of pikeminnow have decreased. This has likely resulted in increased survival of juvenile anadromous fish in the project area.

3.16.9 Sculpins

Sculpins are native and relatively common in the upper basin (Dell et al. 1975; Mullan 1980; Burley and Poe 1994). Although sculpins are not considered a major predator of outmigrating anadromous fish, they do prey on small Chinook and steelhead (Hunter 1959; Patten 1962, 1971a, 1971b; Hillman 1989).

In the Wenatchee River, Hillman (1989) noted that large concentrations (20 fish/m$^{2)}$ of juvenile Chinook and steelhead occupied inshore, shallow, quiet-water positions on the streambed during the night. Hillman (1989) found that many sculpins moved into these areas at night and preyed heavily on Chinook and steelhead fry. Predation on fry appeared to be limited to sculpins larger than 85 millimetres (3.3 inches) and ceased when prey reached a size larger than 55 millimetres (2 inches). The number of fry eaten per night appeared to be related to sculpin size, with the largest sculpins consuming the most fry per individual.

Because sculpins are abundant in Upper Columbia River tributaries, they are likely an important agent of mortality of Chinook, and of steelhead eggs and fry. As Chinook and steelhead fry grow, they are released from this source of mortality. It is unknown what fraction of the Chinook and steelhead population is removed by sculpins.

3.16.10 White sturgeon

White sturgeon, a native species, are not abundant in the upper basin (Mullan 1980; Mullan et al. 1986; Gray and Rondorf 1986; DeVore et al. 2000). According to Mullan (1980), sturgeon were perhaps the most important predator on young and adult salmon, as well as other fishes. This is not the case now because of greatly reduced sturgeon abundance.

Using setlines and gill nets, DeVore et al. (2000) found few sturgeon in the Upper Columbia River. In Rock Island Reservoir, a total of 95 overnight setlines captured only four sturgeon. The researchers did not sample in Rocky Reach Reservoir and used only setlines in Rock Island Reservoir. Sturgeon in Rock Island Reservoir ranged in lengths from 144-192 centimetres (57-76 inches) and in weight from 31-57 kilograms (68-126 pounds). The researchers aged two fish, one at 17 years and the other at 30 years.

White sturgeon are occasionally captured during the northern pikeminnow reduction program. For example, anglers collected two sturgeon in 1998, one at Rocky Reach Dam and another at Rock Island Dam (West 1999). Angling in 1999 captured three sturgeon at Rock Island Dam (West 2000). No sturgeon were captured at Rocky Reach Dam in 1999. All sturgeon captured during the northern pikeminnow control program were 91 centimetres (36 inches) or larger (T. West, Chelan PUD, pers. comm.).

White sturgeon are opportunistic bottom feeders, as indicated by morphological adaptations that include ventral barbels and a ventral, protrusible, sucker-like mouth (Wydoski and Whitney 1979; Ford et al. 1995). Juveniles predominantly eat chironomids and to a lesser degree, zooplankton, molluscs, and immature mayflies, caddisflies, and stoneflies (Scott and Crossman 1973). In the lower Columbia River, juveniles primarily ate the tube-dwelling amphipod *Corophium salmonis* (McCabe et al. 1993).

Individuals larger than 48 centimetres (18 inches) in length eat primarily fish (Scott and Crossman 1973; Ford et al. 1995). In the Kootenai River, white sturgeon larger than 80 centimetres (32 inches) fed on fish (whitefish, suckers, and other unidentified fish), aquatic insects, snails, clams, leeches, and chironomids (Partridge 1983).

DeVore et al. (2000) concluded that the white sturgeon in the Upper Columbia region are recruitment-limited because spawning habitat appears to be absent and no juveniles were found. Spawning coincides with peak flows during spring and early summer. Mature adults typically spawn in swift water (mean water column velocity, 0.8-2.8 m/s) over large substrate (cobble, boulder, or bedrock) (Parsley et al. 1993; Ford et al. 1995). In the upper basin, these conditions likely exist just downstream from Wells Dam and Rocky Reach Dam. It is unknown if white sturgeon spawn in these areas.

Because white sturgeon are rare in the upper basin, they probably do not significantly affect the abundance of juvenile Chinook or steelhead. Small Chinook that rear in the Columbia River may be vulnerable to predation by white sturgeon. Theoretically, this would occur primarily at night when Chinook and steelhead are stationed on the streambed.

3.16.11 Birds

Predation by piscivorous birds on juvenile anadromous fish may represent a large source of mortality. Birds have high metabolic rates and require large quantities of food relative to their body size.

In the Columbia River estuary, avian predators consumed an estimated 16.7 million smolts (range, 10-28.3 million smolts), or 18% (range, 11-30%) of the smolts reaching the estuary in 1998 (Collis et al. 2000). Caspian terns consumed primarily salmonids (74% of diet mass), followed by double-crested cormorants (21% of diet mass) and gulls (8% of diet mass). The NMFS (2000) identified these species as the most important avian predators in the Columbia River basin.

Currently, there is little information on the effects of bird predation on the abundance of juvenile Chinook and steelhead in the upper basin. Fish-eating birds that occur in the region include great blue herons, gulls, osprey, common mergansers, American dippers, cormorants, Caspian terns, belted kingfishers, common loons, western grebes, black-crowned night herons, and bald eagles (T. West, Chelan PUD, pers. comm.).

According to Wood (1987a, 1987b), the common merganser limited salmon production in nursery areas in British Columbia. Wood found that during smolt migrations, mergansers foraged almost exclusively on juvenile salmonids (Wood 1987a). Maximum mortality rate declined as fish abundance increased (i.e., depensatory mortality), and did not exceed 10% for any salmonid species. Wood (1987b) also estimated that young mergansers consumed almost one-half pound of subyearling Chinook per day. A brood of ten ducklings, therefore, could consume between four and five pounds of fish daily during the summer.

The loss of juvenile Chinook and steelhead to gulls is potentially significant. Ruggerone (1986) studied the consumption of migrating juvenile salmon and steelhead below Wanapum Dam, and found that the foraging success of gulls averaged 65% during bright light conditions, and 51% during the evening. The number of salmonids consumed ranged from 50 to 562 fish/hour. Ruggerone (1986) estimated that the number of salmonids consumed by gulls foraging downstream from the turbines during 25 days of peak salmonid migration was about 111,750 to 119,250 fish, or 2% of the estimated spring migration. Ruggerone (1986) noted that gulls consumed some salmonids that had been killed when passing through the turbines.

Cormorants may take large numbers of juvenile Chinook and steelhead in the upper basin. Roby et al. (1998) estimated that cormorants in the estuary consumed from 2.6 to 5.4 million smolts in 1997, roughly 24% of their diet, most being hatchery fish. Although Caspian terns are not common in the upper basin, there is evidence that they consume fish from the area. Bickford (Douglas PUD, pers. comm.) found both PIT-tags and radio tags at a Caspian Tern nesting area near Moses Lake. Tag codes indicated that consumed fish were from the Upper Columbia region.

Although there are no estimates of the losses associated with bird predation in the Upper Columbia basin, it appears that bird predation can significantly affect the survival of juvenile Chinook and steelhead. Accordingly, the PUDs have implemented bird harassment measures, and in some cases, placed piano wire across tailraces. The degree to which these measures have reduced predation on juvenile anadromous fish is unknown at this time, but they have reduced bird predation on fish in the region (T. West, Chelan PUD, pers. comm.).

3.16.12 Mammals

No one has studied the effects of mammals on numbers of Chinook and steelhead in the upper Columbia basin. Observations by BioAnalysts (unpublished data) indicate that river otters occur throughout the region. BioAnalysts (unpublished data) found evidence of otters fishing the Wenatchee, Chiwawa, Entiat, and Methow rivers, and Icicle Creek.

Otters typically fished in pools with LWD. According to Hillman and Miller (2002), juvenile Chinook are most abundant in these habitat types; thus, the probability for an encounter is high.

Dolloff (1993) examined over 8,000 otoliths in scats of two river otters during spring 1985 and found that at least 3,300 juvenile salmonids were eaten the otters in the Kadashan River system, Alaska. He notes that the true number of fish eaten was much higher, as it is unlikely that searchers found all the scats deposited by the otters.

Other predators, such as raccoon and mink also occur in tributaries throughout the Upper Columbia basin. Their effects on numbers of Chinook and steelhead are unknown.

Black bears are relatively common in the upper Columbia basin, and frequent streams used by spawning salmon during autumn. Studies have shown that salmon are one of the most important meat sources of bears, and that the availability of salmon greatly influences habitat quality for bears at both the individual level and the population level (Hilderbrand et al. 1999; Reimchen 2000).

Observations by crews conducting Chinook spawning surveys in the upper basin indicate that bears eat Chinook, but it is unknown if the bears remove pre-spawned fish, or are simply scavenging post-spawned fish. Regardless, there is no information on the role that bears play in limiting survival and production of Chinook and steelhead in the upper basin.

Pinnipeds, including harbor seals, California sea lions, and Stellar sea lions are the primary marine mammals preying on Chinook and steelhead originating from the Upper Columbia basin (Spence et al. 1996). Pacific striped dolphin and killer whale may also prey on adult Chinook and steelhead. Seal and sea lion predation is primarily in saltwater and estuarine environments, though they are know to travel well into freshwater after migrating fish. All of these predators are opportunists, searching out locations where juveniles and adults are most vulnerable.

Although there are no estimates of the losses associated with mammal predation in the upper Columbia basin, it appears that mammals can significantly affect the survival of Chinook and steelhead, especially in the estuary and near-shore ocean environments.

3.17 Habitat Conditions and Limiting Factors to Fish Production

Both naturally occurring and human-induced habitat conditions affect fish spawning, rearing and passage within the Methow subbasin. While the Methow region has accommodated human habitation for close to 7,500 years, substantial changes to overall habitat conditions caused by human activities have taken place in the mid and lower reaches of the basin during the last century.

Three habitat factors identified as limiting to salmon, steelhead, and bull trout in the WSCC analysis, require additional research (Williams 2000). Those factors are:

- the extent to which irrigation diversion affects natural runoff patterns, water temperature, chemical enrichment, and fish production;
- the role that LWD played historically within the Methow in producing fish; and,
- the affect of man’s placement of 35 miles of riprap on fish production

Natural factors

Naturally occurring habitat conditions can cause both benefit and harm to fish species. Some tributaries within the Methow subbasin experience naturally occurring seasonal low flows and occasional instances of dewatering. Some creeks and streams throughout the subbasin, such as the mainstem Methow upstream of Weeman Bridge, are subject to naturally occurring seasonal dewatering. In the upper elevations of the watershed, avalanches, landslides, flooding and creek icing can both negatively and positively affect salmonid habitat.

Throughout the subbasin, naturally occurring influences, such as: fire, which can contribute to erosion and sediment delivery; high stream flow events, which potentially alter stream channels and structure, and; low stream flow, which can limit fish passage and strand LWD, play a role in altering and defining habitat. Although the short-term effects of naturally occurring habitat changes like fire, avalanches, and flooding tend to be detrimental to fish and wildlife, in the long run these changes are often beneficial.

Landslides and avalanches in the upper reaches of the drainage periodically alter habitat conditions, sometimes destroying, and at other times creating, rearing and spawning habitat. Harsh winter temperatures in the Methow subbasin also play a role in limiting productive fish habitat. Additionally, fire events have altered habitat in many portions of the watershed.

Harsh winter temperatures also contribute to seasonal limitations in water quantity. Water quality, primarily in terms of temperature, is to a lesser degree, also a limiting factor in the subbasin. In general, stream temperatures within the basin are conducive to fish health; although, elevated temperatures have been noted in select reaches, and in winter, freezing creeks pose a limiting factor in some reaches.

The reduction in the number of beaver historically found within the watershed has potentially detracted from overall spawning and rearing habitat by eliminating pools, LWD recruitment, and decreasing water and nutrient storage capacity, previously facilitated by beaver activity. The overall decrease in nutrients, caused by lack of large numbers of salmon carcasses throughout the watershed, has potentially contributed to reductions of both fish and wildlife abundance.

Anthropogenic Effects

Over the course of the last century, a number of human-induced physical changes have redefined the quality and quantity of aquatic and terrestrial habitat found in the mid-upper and lower reaches of the Methow subbasin. Most significant among these changes is habitat fragmentation compounded by degradation in overall habitat quality, the result of historic and current agricultural practices, timber management, mismanaged grazing, mining, and commercial and residential development activities.

Combinations of these activities have contributed to:

- alteration, reduction, and elimination of riparian habitat;
- alteration and elimination of floodplains;
- degradation of instream habitat through sediment loading, elimination of LWD, and loss of stream bank integrity;
- construction of artificial barriers to fish passage, such as push up dams, diversions, and ill-functioning fish screens and culverts;
- increased road densities and related erosion, as well as loss of canopy cover; and

- changes to overall vegetative composition and forage availability in both riparian and upland areas.

Irrigation and low flows

Irrigated agriculture took root in the Methow Valley around 1887. By the 1890s farmers were regularly diverting water from the Methow River and other tributaries to grow crops in the valley. Irrigated land has always comprised a relatively small percentage of the basin's total acreage (currently about 1.7%)(Mullan et al. 1992b).

In some areas of the Methow basin, irrigation water is still delivered via unlined open ditches. Whether irrigation ditches and diversions contribute to stream dewatering or groundwater recharge, is a matter of great concern and speculation in the Methow subbasin, but the exact nature of that relationship is not fully understood. Substantial future growth in agricultural activity within the Methow Valley is not anticipated; nevertheless, ongoing small-scale conversions of riparian habitat to residential, pasture and agricultural uses are likely to continue.

Seasonal, naturally occurring, and human-influenced low stream flows and occasional dewatering can alter fish passage to upstream spawning and rearing habitat in the Methow. Low flows also affect water quality by contributing to higher stream temperatures in summer months, particularly prevalent in the lower reaches of the Methow. In addition, low stream flows tend to concentrate any toxic materials or other contaminants entrained in the stream flow.

The effects of the myriad of small irrigation diversion and hydropower projects throughout the range of bull trout are likely of even greater significance than the large hydropower and flood control projects. Many of these are located further up in watersheds, and either physically block fish passage by means of a structure (i.e., a dam), or effectively block passage by periodically dewatering a downstream reach (e.g., diversion of flows through a penstock to a powerhouse; diversion of flows for the purposes of irrigation). Even if diversions are not so severe as to dewater downstream reaches, reduced flows can result in structural and thermal passage barriers. Other effects include water quality degradation resulting from irrigation return flows and runoff from fields and entrainment of bull trout into canals and fields (MBTSG 1998). Some irrigation diversion structures are reconstituted annually with a bulldozer as "push up" berms and not only affect passage, but also significantly degrade the stream channel. The prevalence of these structures throughout the range of bull trout has resulted in the isolation of bull trout populations in the upper watersheds in many areas.

Bull trout may enter unscreened irrigation diversions and become stranded. Diversion dams without proper passage facilities prevent bull trout from migrating, and may isolate groups of fish (Dorratcaque 1986; Light et al. 1996). Other effects on aquatic habitat include stream channelization and LWD removal (Spence et al. 1996).

Sediments

High road densities, poor road placement and land management practices have contributed to persistent sediment delivery to streams in the middle reaches of the Chewuch River subwatershed (USFS 1994). The lower reaches of the watershed host the greatest concentrations of human activity, and are the site of the much of the basin's recent habitat changes. For example, diking, channelization, and conversion of riparian areas to agricultural and residential uses have occurred throughout much of the lower reaches of the Methow mainstem, Twisp, Chewuch and Lost Rivers, and the middle and lower Methow River subwatersheds.

Migratory fish and many wildlife species depend on intact, complex, and functioning habitat extending over broad geographic ranges to support healthy populations. Resident, non-migratory populations of fish and wildlife also indirectly depend on basin-wide habitat connectivity since migratory species make essential contributions to overall ecosystem balance, such as providing essential nutrients and maintaining predator/prey balances (NPPC 1996). Overarching habitat loss, brought about as a result of human settlement activities within the Columbia River Basin since the early 1800s, and the development of hydropower facilities along the Columbia River, have irrevocably altered both terrestrial and aquatic habitat in the Methow subbasin.

Forest Practices

The middle reaches of the Methow subbasin, particularly areas within the Chewuch River and Goat Creek drainages, exhibit significant habitat degradation as a result of past logging activities. Forest management activities, including timber extraction and road construction, affect stream habitats by altering recruitment of LWD, erosion and sedimentation rates, runoff patterns, the magnitude of peak and low flows, water temperature, and annual water yield (Cacek 1989; Furniss et al. 1991; Wissmar et al. 1994; Spence et al. 1996; Spencer and Schelske 1998; Swanson et al. 1998).

Activities that promote excessive substrate movement reduce bull trout production by increasing egg and juvenile mortality and reducing or eliminating habitat (e.g., pools filled with substrate), important to later life history stages (Fraley and Shepard 1989; Brown 1992). The length and timing of bull trout egg incubation and juvenile development (typically more than 200 days during winter and spring), and the strong association of juvenile fish with stream substrate make bull trout vulnerable to changes in peak flows and timing that affect channels and substrate (Goetz 1989; Pratt 1992; McPhail and Baxter 1996; MBTSG 1998).

Roads

Roads for logging access and log skidding can, and have locally introduced fine sediments to spring Chinook and summer steelhead habitat. Riparian communities have, at times, been disrupted, reducing shade and availability of LWD. Timber removal alters hydrology of tributaries until regrowth occurs.

Roads constructed for forest management are a prevalent feature on managed forested and rangeland landscapes in the Methow. Roads have the potential to adversely affect several habitat features, (e.g., water temperature, substrate composition and stability, sediment delivery, habitat complexity, and connectivity) (Baxter et al. 1999; Trombulak and Frissell 2000). Roads may also isolate streams from riparian areas, causing a loss in floodplain and riparian function. The aquatic assessment portion of the Interior Columbia Basin Ecosystem Management Project provided a detailed analysis of the relationship between road densities and bull trout status and distribution (Quigley and Arbelbide 1997). The assessment found that bull trout are less likely to use streams in highly roaded areas for spawning and rearing, and do not typically occur where average road densities exceed 1.1 kilometres per square kilometre (1.7 miles per mile^2).

Roads degrade bull trout habitats by: creating flow constraints in ephemeral, intermittent, and perennial channels; increasing erosion and sedimentation; impacting groundwater-streamwater interactions, important to bull trout spawning and rearing habitat; creating passage barriers; channelizing stream reaches, and; reducing riparian vegetation (Furniss et al. 1991; Ketcheson and Megahan 1996; Trombulak and Frissell 2000). Effects are not limited to direct effects on occupied bull trout habitat, but can indirectly affect occupied habitat by altering natural functions in smaller upstream tributaries. For example, Wipfli and Gregovich (2002) identified small headwater tributaries not occupied by salmonids as important sources of aquatic invertebrate production for areas occupied by salmonids downstream. Roads also provide access to many activities, including undesired activities such as illegal fishing and fish stocking, and accidental discharges into streams.

Roads may affect aquatic habitats considerable distances away. For example, increases in sedimentation, debris flows, and peak flows affect streams longitudinally so that the area occupied by a road can be small compared to the entire downstream area subjected to its effects (Jones et al. 2000; Trombulak and Frissell 2000). Upstream from road crossings, large areas of suitable habitats may become inaccessible to bull trout because of fish passage barriers (e.g., culverts).

Livestock Grazing

Improperly managed livestock grazing degrades salmonid habitats, including bull trout habitat, by removing riparian vegetation, destabilizing streambanks, widening stream channels, promoting incised channels, lowering water tables, reducing pool frequency, increasing soil erosion, and altering water quality (Howell and Buchanan 1992; Mullan et al. 1992; Overton et al. 1993; Platts et al. 1993; Uberuaga 1993; Henjum et al. 1994; MBTSG 1995a,b,c; USDA and USDI 1996, 1997). These effects reduce overhead cover, increase summer water temperatures, and promote formation of anchor ice (ice attached to the bottom of an otherwise unfrozen stream, often covering stones, etc.) in winter, and increase sediment in spawning and rearing habitats.

Negative effects of livestock grazing may be minimized if grazing is managed appropriately for conditions at a specific site. Practices generally compatible with the preservation and restoration of fish habitats include fences to exclude livestock from riparian areas, rotation schemes, maintenance of fences, relocation of water, placement of salting facilities away from riparian areas, and use of herders.

Agricultural Practices

Agricultural practices, such as cultivation, irrigation diversions, and chemical application contribute to non-point source pollution in some areas within the range of bull trout (IDHW 1991; WDE 1992; MDHES 1994). Impacts resulting from these practices are as follows: release of sediment, nutrients, pesticides, and herbicides into streams; increased water temperature; reduced riparian vegetation, and; altered hydrologic regimes, typically by reducing flows in spring and summer.

Mining

Mining degrades aquatic habitats used by bull trout by altering water chemistry (e.g., pH), by altering stream morphology and flow, and by altering the substrate composition and benthic insect community composition where in-channel mining activity occurs, causing sediment, fuel, and heavy metals to enter streams (Martin and Platts 1981; Spence et al. 1996; Thomas 1985). The types of mining that occur within the range of bull trout include extraction of hard rock minerals, coal, gas, oil, and sand and gravel. Past and present mining activities have adversely affected bull trout and bull trout habitats in Washington (Johnson and Schmidt 1988; Moore et al. 1991; WDW 1992; Platts et al. 1993; MBTSG 1995a, c, 1996b, c; McNeill et al. 1997; Ramsey 1997).

Development and Urbanization

Residential and commercial development has altered habitat in the subbasin. Approximately 874 building permits were issued in the Methow watershed between 1984 and 1994 (Methow Valley Water Pilot Planning Project Planning Committee 1994). During that time, the majority of development activity occurred in the middle and lower reaches of the watershed.

Residential development has altered stream and riparian habitats through contaminant inputs, stormwater runoff, changes in flow regimes, streambank modification and destabilization, increased nutrient loads, and increased water temperatures (MBTSG 1995b). Indirectly, urbanization within floodplains alters groundwater recharge by rapidly routing water into streams through drains rather than through more gradual subsurface flow (Booth 1991).

Urbanization negatively affects the lower reaches of many of the large rivers and their associated side channels and wetlands. Activities such as: dredging; removing LWD (e.g., snags, logjams, driftwood); installing revetments, bulkheads, and dikes, and; filling side channels have led to the reduction, simplification, and degradation of habitats (Thom et al. 1994; Spence et al. 1996;). Pollutants associated with urban environments such as heavy metals, pesticides, fertilizers, bacteria, and organics (oil, grease) have contributed to the degradation of water quality in streams, lakes, and estuaries (NRC 1996; Spence et al. 1996).

3.17.1 Summary of Limiting Factors

Following is a summary of limiting factors in the Methow subbasin based primarily on the WSCC Limiting Factors Analysis (WSCC 2000) and on the RTT draft report to the UCSRB (RTT 2001).

Habitat Fragmentation compounded by degradation in overall habitat quality

- Alteration and reduction of riparian habitat (fish & wildlife)
- Habitat connectivity (fish & wildlife)
- Instream and floodplain habitat degradation (fish and wildlife)
- Artificial and natural fish passage barriers (fish)
- Land management practices (fish & wildlife)
- Noxious Weeds

Water Quantity and Quality

- Low flows and dewatering (fish & wildlife)
- Temperatures (fish)
- Sediment load (fish)

- Freezing creeks and streams (fish & wildlife)

Additional Key Factors

- Severely reduced numbers of returning naturally produced adults (fish & wildlife)
- Decrease in nutrients (i.e., salmon carcasses [fish & wildlife])
- Presence of brook trout in many Methow subbasin streams and creeks (bull trout)
- Data and knowledge gaps (fish & wildlife)

3.18 The Form and Function of Ecosystem Change

Alteration and Reduction of Riparian Habitat

Loss of riparian areas in the Methow basin because of logging, agriculture, and residential development affects streambanks, water quality, water quantity, and overall habitat complexity; the loss leads to increased erosion, which in turn, increases sedimentation. Riparian habitat losses also contribute to higher water temperatures in summer months and lower temperature in winter months.

Riparian zones play many essential roles in maintaining ecosystem health and integrity. They provide connectivity between aquatic and upland habitats, moderate stream temperature through shading, maintain water quality by performing filtering and bank stabilizing functions, and supply in-stream nutrients through insect and vegetative contributions (Platts 1991; Johnson and Carothers 1982; Mitsch and Gosselink 1986; Lee et al. 1987).

Additionally, riparian zones act to “meter” water delivery by holding water in plant root wads and soils, and gradually releasing that moisture as humidity and groundwater (Knutson and Naef 1997). Riparian zones also assist in recruitment of LWD, the loss of which reduces instream pools and channel complexity. In addition to the role riparian zones play in moderating and improving overall habitat conditions, many species of fish and wildlife depend directly on riparian zones to provide cover and forage (Federal Caucus 2000).

Instream and Floodplain Habitat Degradation

Loss of instream habitat complexity limits spawning and rearing habitat for fish, and in egregious cases, limits passage. Large woody debris plays an important role in maintaining varied and functional instream habitat. Logging and destruction of riparian habitat decrease available LWD recruitment materials, particularly in the lower Methow subbasin.

Reduced riparian cover, conversion of riparian zones to agricultural and residential uses, road construction, road failures, accelerated scour at culverts, and logging all contribute sediment materials to streams. Increased sedimentation alters stream channel characteristics and reduces spawning gravels and egg/alevin survival.

Floodplains help to moderate river flows by dissipating flow velocity and providing storage capacity for excess flows. Loss of floodplain wetland habitat in the developed reaches of the Methow and tributaries further reduces the already limited overwintering habitat for salmonids, eliminates forage and cover for wildlife, and reduces recharge potential of shallow groundwater in dry seasons.

Loss of floodplain wetland also contributes to higher stream velocities with associated bank erosion and sediment delivery.

Artificial and Naturally Occurring Barriers

Dikes and dams constructed for irrigation purposes can reduce fish passage to spawning and rearing grounds, block passage to floodplain habitat, prevent development of stream side channels, limit spawning gravel recruitment, and can confine the stream channel which in turn concentrates stream flows and facilitates scouring of stream beds.

Unscreened irrigation diversions can divert fish from the main river or creek flow, leaving them stranded when the irrigation flow is cut off. Maintenance of irrigation diversions can damage streambeds and banks. Inadequate or inappropriate screens, associated with diversion, can entrap fish or simply not function properly, allowing fish to pass into irrigation diversions.

Culverts can prevent access to spawning and rearing grounds by concentrating flow to the extent that they become impassable, and by concentrating debris. The high velocities of water moving through culverts also sometimes downcut the streambed to such an extent that upstream fish passage eventually becomes impossible.

While all of these man-made diversions play a role in reducing passage within the Methow subbasin, even before human settlement, waterfalls and high gradient steams characterized by high velocity spring run-off prevented and reduced passage to many reaches of the Methow subbasin.

Land Management Practices

Timber management activities, including extensive timber harvest in sections of the Methow subbasin and livestock grazing, have negatively impacted both fish and wildlife habitat in mid and lower reaches of the watershed, particularly in the Chewuch River and Beaver Creek drainages. Both logging and grazing contribute to fragmentation of habitat, soil erosion, sediment delivery to creeks and streams, channel simplification from loss of LWD recruitment within the riparian zone, and changes to upland and riparian vegetative communities, including displacement of native plant communities with exotic species.

Timber harvest changes upland vegetative cover and influences snow accumulation and melt rates. Road building associated with timber harvest further exacerbates erosion, habitat fragmentation, and contributes barriers to fish passage through construction of culverts. Uncontrolled livestock grazing compacts soil, contributes to stream bank destabilization, affects compositions of riparian plant communities, and slows recovery of damaged riparian habitat.

Conversion of forestland and riparian habitat to residential and agricultural uses also negatively affects habitat connectivity and composition. Human developments often constrain wildlife range and quality through construction of roads, dispersed residential developments, impediments to stream access, and changes to vegetative communities. Human activities have increased the number of fire starts, but historic fire control policies have kept the size of fires small, resulting in a buildup of fuel in the forested uplands of the subbasin. This absence of fire has resulted in changes in the composition of the forest and plant communities, and in the related capacity to store and transport water. Areas of the Methow subbasin burn periodically because of lightning and human causes, and will continue to do so.

Policy, Social, and Cultural Effects

Humans and salmon colonized and expanded their range in the Columbia River Basin after the most recent Ice Age (10,000-15,000 years BP). American Indians developed a culture that relied extensively upon anadromous fish for sustenance in some portions of the area (Craig and Hacker 1940). Their catches must have increased as their populations rose and techniques of fishing developed. Particularly at partial obstacles for passage, Indians captured large numbers of fish for both sustenance and trade.

Native Americans had access to an abundant fish resource comprised of spring, summer, and fall runs of Chinook salmon, coho and sockeye salmon, and steelhead, as well as Pacific lamprey and white sturgeon. Estimates of pre-development (late 1700s) abundance of Columbia River salmon and steelhead ranged from about 8 million (Chapman 1986) to 14 million (NPPC 1986) fish. Estimates of pre-development salmon and steelhead numbers were based on maximum catches in the latter part of the 1800s and assumed catch rates by all fishing gear. Inherent in such calculations is the assumption that fish populations in the late 1800s represented a reasonable expression of average effects of cyclic variation in freshwater and ocean habitat conditions. No one, currently, has determined validity of that assumption. It is, however, quite certain that salmon and steelhead have declined to a small fraction of their former abundance (Figure 3-2 in NRC 1996). Peak catches in the 1800s by all fishers may have included 3-4 million salmon and steelhead (Chapman 1986). Total run size for all salmon and steelhead recently has ranged from 1 to 2 million fish. About three-quarters of recent spring Chinook and summer steelhead runs have consisted of fish cultured to smolt size in hatcheries.

While actual numbers of adult spring Chinook salmon and steelhead produced by the upper Columbia River basin in the pre-development period are not available, one can attempt to estimate them, albeit roughly. From Fulton (1968, his Table 2), one can total formerly-used spring Chinook salmon habitat throughout the Columbia River basin as 10,002 kilometres (6215 miles), and upper Columbia habitat (upstream from the Yakima River) as 899 kilometres (559 miles), or about 9% of the total. Chapman (1986) estimated that about 500,000 spring Chinook returned to the Columbia River in the latter portion of the 1800s. Nine percent of that total would be about 45,000 spring Chinook salmon attributable to the upper Columbia River.

Anadromous fish of the upper Columbia area must have fluctuated because of variable environmental conditions. Certain combinations of freshwater and ocean habitat conditions appear to have caused very low salmon returns in some years, well before non-Indians degraded habitat or began fishing intensively (Mullan et al. 1986).

Numbers of spring Chinook that escaped to the Columbia River at Priest Rapids Dam in the most recent decade have averaged about 15,800 (adults plus jacks). This escapement would convert to approximately 21,000 fish downstream from Bonneville Dam (adjusting for 4% loss of adults for each dam between the estuary and counting station at Priest Rapids Dam, and a fishing rate of about 5%, mostly upstream from Bonneville Dam). Hatcheries had contributed about 75-80% of these fish. Thus naturally produced spring Chinook salmon abundance in the upper Columbia area can be estimated to have declined to about 5,000 fish, a decrease of 89% . Estimation of the percentage decline in wild summer steelhead produced in the upper Columbia River would indicate a similar major decline. Salmon and steelhead genetic diversity has also declined as a result of artificial propagation and widespread stock transfers.

Both spring Chinook and summer steelhead in the upper Columbia River have been listed under provisions of the Endangered Species Act (ESA) of 1972. Factors that depressed numbers of wild spring Chinook and steelhead sufficiently enough to lead to ESA listing include range extirpation, fishing, artificial propagation, and habitat degradation caused by dams, irrigation, channelization, overgrazing, and public policy. Lackey (2001) wrote:

> The depressed abundance of wild stocks was caused by a well known, but poorly understood combination of factors, including: unfavorable ocean or climatic conditions; excessive commercial, recreational, and subsistence fishing; various farming and ranching practices; dams built for electricity generation, flood control, and irrigation, as well as many other purposes; water diversions for agricultural, municipal, or commercial requirements; hatchery production to supplement diminished runs or produce salmon for the retail market; degraded spawning and rearing habitat; predation by marine mammals, birds, and other fish species; competition, especially with exotic fish species; diseases and parasites; and many others.

Lackey (2001) also wrote that "technocrats," who represent various organizations, have developed estimates of the proportions of wild fish declines attributable to one or more of the above-mentioned factors for decline. He pointed out that models that resulted in that work usually ended up supporting the favoured policy position of the supporting organization.

Fishing

Pre-development harvests and effects

Until 7,000 to 10,000 B.P., glacial ice blocked upper reaches of many rivers of the Pacific Northwest (Lackey 1999). Improved ecological conditions for salmon likely developed about 4,000 years ago, and aboriginal fishermen benefited. Lackey (1999) speculated that salmon populations reached their highest levels within the last few centuries.

It seems quite unlikely that aboriginal fishing was responsible for run declines in the Columbia River (Craig and Hacker 1940; Chapman 1986; Lackey 1999). Their artisanal fishing methods (Craig and Hacker 1940) were incapable of harvesting upper Columbia River spring Chinook and summer steelhead at rates that approached or exceeded optima for maximum sustained yield (probably 68% and 69% for spring Chinook and steelhead, respectively, as estimated in Chapman (1986)).

Indian populations declined sharply about 100-500 years ago, attacked by smallpox, measles, sexually-transmitted diseases, cholera, and other pathogens imported from Europe. Fishing rates likely declined in concert.

The year 1957 marked a major change in Native American fisheries. The Dalles Dam, completed in that year, and flooded the most important traditional and important Indian fishing dipnetting site in the Columbia River, at Celilo Falls. Catch rates in 1957 in Zone 6 dropped dramatically, and did not increase until the early 1960s, once Indians shifted to set gillnets.

Fisheries of the late 1800s

The population of humans in the Columbia River basin developed rapidly, beginning in the mid-1800s, with extensive immigration from the eastern U.S. Efficient fishing techniques, and preservation methods such as canning, set the stage for overexploitation of Columbia River salmon stocks. The onslaught of techniques included gillnets, traps, horse-pulled beach seines, purse seines, and fish wheels.

Intense fishing first targeted the abundant late-spring and summer components of what was a bell-shaped abundance function for Chinook salmon. Spring Chinook entered first and in relatively small numbers (Chapman 1986). The late-spring and summer runs formed the central bulk of the abundance timing function, then finally, fall Chinook arrived in lesser numbers. Thompson (1951) showed that fishing had all but extirpated the central bulk of the return distribution by 1919. As that fishery disappeared, industry shifted to sockeye, steelhead, coho, and fall Chinook. These shifts partially masked the decline of over-fished run components.

Although governmental agencies existed, with nominal responsibility, for fishery management (e.g., U.S. Bureau of Fisheries, Oregon Fish Commission), demand for fish and gear competition, chiefly among commercial fishermen, brooked little interference with seasons and fishing intensity. Washington passed its first gear restriction in 1866, some six years after commercial fishing became an important Columbia River industry. Oregon’s first restriction came in 1878. Not until 1899, did Oregon and Washington begin to jointly manage Columbia River fisheries.

There can be little doubt that the relentless fishing intensity in most of the latter half of the 1800s and early 1900s substantially exceeded optimum rates. Chapman (1986) assumed that extant rates were 80-85% on spring and summer Chinook, 88% on fall Chinook, and 85% on steelhead.

The 1900s - decades of change

In 1909, Oregon and Washington instituted joint consistent fishing seasons. From about 1910 to 1912, as reasonably dependable internal combustion engines became available, troll fishing for salmon developed, enabling offshore fishing on Columbia River stocks mixed with fish from other rivers. Some inflation of early Columbia River landing statistics likely occurred as a result of troll-caught salmon sales inside the Columbia River mouth.

Industrial fishing practices

An intense industrial fishery in the lower Columbia River, employing traps, beach seines, gillnets, and fishwheels, developed in the latter half of the 1800s. In the early 1900s, troll fisheries developed to catch salmon even before they reached the Columbia River. The late-spring and early-summer Chinook salmon returns, which constituted the heart of the Columbia River runs, were decimated by the early 1900s (Thompson 1951).

In 1917, purse seines were prohibited in the Columbia River. These regulations, as several others later, likely resulted in part from gear wars, rather than from conservation. Whip seines became illegal in 1923, and fish wheels in Oregon were prohibited in 1927. Fish wheels in Washington remained legal until 1935. Washington prohibited drag seines, traps, and set nets in 1935, while Oregon waited until 1949 to take similar steps.

Washington law prohibited commercial take or sale of steelhead from the Columbia River after 1934, while Oregon continued to permit take and sale of steelhead by non-Indians until 1975.

Meanwhile, upriver dams began to deny salmon access to habitat. Swan Falls Dam on the Snake River was the first mainstem obstacle (1910). On the Columbia River mainstem, Rock Island

Dam was completed in 1933, Bonneville Dam in 1938. These facilities provided the first consistent numerical assessments of fish passage (only harvest data were available formerly). Grand Coulee Dam denied fish access to salmon and steelhead that formerly used Canadian tributaries and the Spokane and San Poil rivers. Small irrigation dams also chipped away at fish habitat, beginning in the 1800s.

Commercial fishing, and most Native American subsistence fishing in the latter half of the 1900s, was confined to gillnets. Downstream from Bonneville Dam, in zones 1-5, only drift nets were employed. In Zone 6, set gillnets were used. Gillnets do not facilitate release of gilled fish alive; hence, the principal means for protecting weak stocks of salmon and steelhead are area and time closures. Large mesh sizes in the 1990s afforded some protection for upper Columbia A-group steelhead (most upper Columbia summer steelhead are in this group of smaller steelhead); although, some larger steelhead, that spent two years at sea, were taken during late summer during the fall Chinook season.

As upriver spring Chinook populations declined sharply in the last quarter of the 1900s, managers reduced commercial fishing seasons in zones 1-5, and tribes reduced harvest rates in Zone 6. Hatchery-produced salmon and steelhead increasingly dominated runs.

Effects of harvest on wild/natural spring Chinook and steelhead of the upper Columbia River are very difficult to control in mixed-stock fisheries of zones 1-5 (Columbia River mouth to Bonneville Dam) and Zone 6 (upstream from Bonneville Dam, concentrated in Bonneville, The Dalles, and John Day pools). Gillnets are the most utilized fishing technique, indiscriminate in selecting one stock or another, or hatchery fish over wild ones. Mixed-stock fisheries are particularly detrimental to naturally small populations or those depressed (Spence et al. 1996; NRC 1996).

Only through virtual elimination of fishing on weak stocks can managers achieve protection for them. Fisheries in zones 1-6 have been curtailed sharply to protect ESA-listed stocks, chiefly destined for the Snake and upper Columbia rivers. This has led to excess escapements of spring Chinook of hatchery origin, leading to public policy conflicts with respect to management use of the excess returns when the fish arrive at the hatchery.

Near elimination of harvest on weak stocks can be accomplished by fishery closures, restrictions on area and times of fishing, and limitations on gillnet mesh sizes, sometimes combined with net modifications (e.g., trammel nets that entangle rather than gill fish).

Sport and Native American subsistence catches have been confined largely to areas short distances downstream from hatcheries where managers expect sufficient returns (e.g., on Icicle Creek downstream from Leavenworth National Fish Hatchery).

Columbia River fishery management in the last third of the 1900s was based in large measure on the concept of maximum sustained yield (MSY) (NRC 1996). At least two important issues make that concept obsolete for future management. The first is that stock-recruit models, from which MSY was determined, are based on historical adult and progeny adult information obtained under past environmental conditions. Those conditions changed, or re-set, as successive mainstem dams came on line, especially after the early 1950s. They may also change markedly over time with cyclicity of the ocean environment. Furthermore, MSY management does not acknowledge value of “excess” escapement as: a) a means of augmenting nutrient levels by bringing marine nutrients to the infertile streams of the upper Columbia River; or b) important in fostering competition for mates and spawning sites. The MSY paradigm now does not well serve managers, especially regarding upriver anadromous stocks.

Although the long-term effects of non-native species introductions often remain unpredictable because of the intricate nature of aquatic food webs and ecosystems, experience has demonstrated the establishment of certain non-native species will usually have predictable negative effects, resulting in serious population declines of bull trout.

Current fisheries

Extremely restrictive fisheries are allowed in the lower Columbia River for spring Chinook and steelhead in order to protect listed fish (including upper Columbia River spring Chinook and steelhead). For example, a federally-established limit of 2% incidental kill of wild spring Chinook and wild steelhead was set in 2004 for non-tribal fisheries; of that allowance, a maximum kill of 1.2% was set for the recreational fishery and 0.8% for the commercial fishery in zones 1-5. These conservative impacts were emplaced in spite of an expected spring Chinook run to the Columbia River of 500,000 fish, the second largest run since 1938, when Bonneville Dam counts began. Tribal gillnet fisheries in Zone 6 are likely to harvest an additional 8 to 10%.

Current restrictions also require sport anglers, between the Rocky Point/Tongue Point line in the estuary upstream to the I-5 bridge, to maintain caught fish that have intact adipose fins in the water as they remove the hook. Commercial fishers must use a combination of tangle net (4.25 inch mesh) and large mesh sizes (9-9.75 inches), not longer than 150 fathoms. Recovery boxes on board must be used for any wild fish captured, and on-board observers determine the number of wild fish caught and released.

ESA-listed upriver stocks, including those in the upper Columbia, prevent directed fisheries, even though substantial numbers of hatchery-produced spring Chinook can be taken. Upriver summer steelhead may not be harvested in the commercial fishery of zones 1-5.

A set-gillnet fishery for spring Chinook and steelhead, classed as “ceremonial and subsistence” is prosecuted by Indians in Zone 6. Steelhead captured by Indians in Zone 6 can be sold or used as “ceremonial and subsistence” harvest. Mean catch rates in the last half of the 1990s equalled about 10%.

Fishing in the future

Schaller et al. (1999) estimated spawner numbers required for full seeding of spawning areas used by wild Columbia River spring Chinook salmon as 4,808 for the Wenatchee River, 496 for the Entiat River, and 1,379 fish for the Methow River, for a total of 6,683. Other estimates have placed the spawner requirement higher.

Mainstem multipurpose dam projects in the Columbia River kill upper Columbia River spring Chinook and steelhead smolts at cumulative rates that may approach 45-50%. Adult inter-dam loss at 4% per project accumulates to 25% (Wenatchee River fish), and more for fish destined for tributaries upstream from Rocky Reach and Wells dams. Under these pressures from dam-related mortality, wild fish cannot sustain a directed fishery prosecuted with gillnets, and their escapements, even at full seeding, are insufficient to return one progeny spawner for each parent spawner.

Four solutions are theoretically feasible. The first, the approach now employed, is to severely restrict harvest, and to supplement wild fish with hatchery programs aimed at maintaining and fostering genetic adaptiveness peculiar to each upper Columbia River spawning/rearing area. The long-term utility and appropriateness of this approach has yet to be demonstrated.

A second approach is to shift mainstem fisheries to live-catch methods that permit identification and release of wild fish unharmed (NRC 1996). Although live-catch systems would permit substantially greater harvest of hatchery fish, political resistance to this option is strong. Tribal interests regard such proposals as interference with treaty rights.

The third is to confine fisheries aimed at hatchery fish to terminal areas (e.g., Icicle Creek spring Chinook, supported by Leavenworth National Fish Hatchery and by some natural spawners not listed under the ESA, are harvestable in Icicle Creek downstream from the hatchery). Fish quality for spring Chinook destined to spawn in terminal areas of the upper Columbia River declines as fish progress upstream. Quality in the terminal areas cannot compete with quality of pen-reared, or ocean- or estuary-caught salmon. Pen-reared salmon have made up over 50% of marketed salmon in recent years.

The fourth is to stop all fishing other than terminal harvests. NRC (1996) discussed this option, but noted that it is fraught with treaty and international, political, and legal issues.

Effects of fishing on population characteristics

High fishing rates in the 1800s virtually extirpated some late-spring and summer stocks of Chinook salmon. Past effects of fishing on now-listed spring Chinook and steelhead of the upper Columbia River are unknown. Attempts to sustain fishing by use of hatchery fish influenced genetic composition of at least summer steelhead, as progeny of adults trapped at Priest Rapids and Wells dams were, for several generations, liberated as smolts in the major tributaries of the upper Columbia River without regard to fostering local adaptations. NRC (1996) noted: “The continual erosion of the locally adapted groups that are the basis of salmon reproduction constitutes the pivotal threat to salmon conservation today.”

Nelson and Soule (1987) and Thorpe (1993) reviewed effects of fishing on genetic makeup of salmon populations. Intense fishing probably altered genetics of pink salmon in the north Pacific, for example, with the result that adult size declined. Historically, intense gillnetting in the Columbia River may have increased the proportion of smaller fish in escapements, with potential increases in jack fractions and reduced fecundity of females. Three-ocean spring Chinook adults may have been selected against at earlier high fishing rates. At current low fishing rates, genetic selection against large spring Chinook and steelhead by gillnets likely does not occur (Chapman et al. 1995).

Despite the implementation of restrictive fishing regulations and strong educational efforts, both legal and illegal angling have direct impacts on bull trout populations. In streams open to general fishing, without legal harvest of bull trout, bull trout adults and juveniles are vulnerable to incidental catch, poaching, or disturbance. Incidental hooking mortality varies from less than 5% to 24% for salmonids caught on artificial lures, and between 16% and 58% for bait-caught salmonids (Taylor and White 1992; Pauley and Thomas 1993; Lee and Bergersen 1996; Schill 1996; Schill and Scarpella 1997). Although salmonid eggs in the early developmental stages are resistant to crushing (Hayes 1949), eggs and alevins in redds are vulnerable to wading-related mortality. Wading can cause mortality of up to 46% from a single wading event (Roberts and White 1992). In addition, harvest of bull trout may occur within their range because of misidentification. Schmetterling and Long (1999) found that only 44% of anglers correctly identified bull trout, and anglers frequently confused related species.

Illegal harvest is a significant common theme across the range of bull trout. Bull trout are also susceptible to incidental mortality associated with gill-net fisheries that target salmon and steelhead. Many of the life history attributes of bull trout increase their susceptibility to interception in gillnet fisheries. The highly migratory behavior of bull trout, coupled with their ability to repeat spawn, and their longevity, increase the number of possible encounters with nets located at river mouths.

Because they are a predator on other, more highly prized fish, intentional fisheries management efforts in the past have also negatively affected bull trout. Bull trout were sometimes targeted for elimination in many parts of their range through bounties, liberal daily bag limits on recreational angling, or the removal of limits entirely (Bond 1992; Brown 1992; Colpitts 1997; Stuart et al. 1997). Additionally, streams and reservoirs were sometimes treated with toxicants to remove undesirable species (usually targeting native suckers and minnows) in preparation for introduction of native and non-native sport fishes; (MBTSG 1996b).

Effects of fishing on salmonid populations

As these run components rapidly declined, fishing shifted earlier, later, and to other species, changes that, for a time, numerically masked the precipitous decline in the sought-after late-spring and early-summer fish.

By the early 1930s, mean escapement of spring Chinook into the upper Columbia River upstream from Rock Island Dam had declined to fewer than 3,000 fish. That escapement would represent perhaps 12,000 fish arriving in the lower Columbia River, inasmuch as fishing rates exceeded 75% in that period. Only Rock Island Dam (1933) lay athwart the Columbia River. Mean returns of summer steelhead to the upper Columbia River were lower than 4,000 fish in the first part of the 1930s. Harvest rates of 70%, and probably higher, were common before the 1940s. If one assumes a 70% rate, returns of upper Columbia summer steelhead to the estuary may have amounted to about 13,000 fish.

By the 1930s and 1940s, restrictions on fishing time and gear had increased. For example, purse seines were outlawed in 1917, whip seines in 1923, fish wheels in 1927 (in Oregon), seine, and traps east of Cascade Locks in Oregon in 1927, and drag seines, traps, and set nets in 1935 (Washington). Seasons were gradually shortened. Catch rates almost certainly were much higher than those appropriate for MSY or populations for several decades before then.

It is important to remember that fishing intensity, unless pursued to stock extinctions, can be relaxed by management action. If habitat remains intact, stocks can rebound. Presently, fishing rates have been reduced well below 10% for spring Chinook and below 13% for summer steelhead, yet wild and natural components of the respective runs in the upper Columbia River have not responded markedly. Currently, factors other than fishing depress these fish of the upper Columbia River.

Mainstem Columbia River Dams

Spring Chinook and steelhead production areas in the pre-development period included the Wenatchee, Entiat, Methow, Okanagan, and limited portions of the Spokane, San Poil, Colville, Kettle, Pend O'pers. comm., and Kootenay rivers . The Grand Coulee Dam project and Chief Joseph Dam eliminated access to the Columbia River upstream. The Grand Coulee Fish Maintenance Project (GCFMP), designed to transfer populations formerly produced upstream, into remaining habitat downstream from Grand Coulee, trapped fish at Rock Island from 1939 to 1943. Managers placed some adults in tributaries (e.g., Nason Creek) to spawn naturally, and artificially propagated others. Spring Chinook from outside the upper Columbia were introduced. The extreme changes in population structures permanently transfigured populations of spring Chinook and steelhead of the upper Columbia River (Chapman et al. 1995).

The era of mainstem multi-purpose dams downstream from the Grand Coulee project began with Rock Island Dam in 1933 and culminated with completion of Wells Dam. Seven mainstem dams lie between the Wenatchee River and the sea, eight downstream from the Entiat River, and nine between the Methow/Okanagan systems and the estuary. Dam-related losses are substantial. For example, adult salmon and steelhead mortality in the reaches between projects has been estimated as 4% or more in some years (Chapman et al. 1994 and 1995), and juvenile losses at each project can amount to about 10%. Some of the losses result from physical effects of adult and smolt passage. Others are derived from altered limnological conditions that increase predation by fish and birds, or that cause gas-bubble trauma. The cumulative loss rates also explain why so much mitigative effort has been allocated to project-related mortality rates.

Dams for storage, like Grand Coulee, and mainstem multipurpose dams, have had other effects on ecology of salmon and steelhead. Estuarine limnology has shifted from a basis of macrodetritus and benthos to a microdetrital, planktonic, trophic structure that favors non-salmonids. Spring freshet flows and turbidity have declined in the river and estuary, and the Columbia River plume has been reduced seasonally (Ebbesmeyer and Tangborn 1993, Chapman et al. 1994 and 1995, NRC 1996) with potential, but largely unknown effects on survival of salmon and steelhead in the estuary and nearshore ocean.

Tributary Habitat Degradation

Residential development is rapidly increasing within portions of the range of bull trout, including the Methow subbasin.

Perhaps the most important habitat influence on wild spring Chinook and steelhead in the upper Columbia River, including the Methow subbasin, involves water diversion, withdrawal, and application to crops. The Columbia Basin Project, operated by the U.S. Bureau of Reclamation, constitutes the largest single water diversion and application system in the area. In the Wenatchee, Okanagan, and Entiat River basins, water diversion for orchards is important. In the Methow River system, crops and pasturage divert tributary and mainstem water.

For wild spring Chinook and summer steelhead, diversions on tributaries of the Methow river must be considered a factor for decline. Instream flows have been depleted downstream from irrigation diversion dams, reducing instream habitat and improving predator access to rearing juvenile fish. Diversions were unscreened for many decades, permitting downstream migrants to pass into, and perish, in fields and orchards. Today some fish diversion screens are less than

100% effective. Diversion dams were built in some cases without adequate provision for adult passage.

Cattle pastures adjacent to tributaries can, and have, denuded riparian vegetation, and permitted nutrients from fecal material, and fine sediment, to enter salmon and steelhead habitat. Overgrazing by sheep and cattle has locally increased runoff of fine sediments and increased stream flow peaks (Mullan et al. 1992).

Channelization reduces instream habitat by straightening meanders, increasing water velocity, and eliminating or reducing riparian cover and input of LWD. It can, and has, occurred associated with roads and railroad grades, residential encroachment, and protection of agricultural land. Diking and channel-bank riprap prevents stream lateral movements across alluvial floodplains, particularly in the Methow and Okanagan drainages.

Note: Of the foregoing habitat factors, diversions and associated diversion dams probably constitute the most important factors for decline.

Hatcheries

NRC (1996) and Flagg et al. (2001) discussed at length the risks and problems associated with use of hatcheries to compensate for, or supplement, fish produced in the wild. NRC (1996) noted demographic risk, pointing out that large-scale releases of hatchery fish exacerbate mixed-stock harvest problems. Wild fish cannot sustain harvest rates that would be appropriate for hatchery fish. Demand is essentially unlimited for salmon and steelhead, and advocacy groups for various fisheries often clamour to have access to ever-more harvestable fish from hatcheries.

Solutions to the mixed-stock fishing problem are elusive. Gillnets, for example, have only limited potential for releasing wild spring Chinook and steelhead unharmed. Terminal fisheries, particularly for spring Chinook after they enter waters that contain only hatchery fish, are impractical for commercial fisheries because fish quality there has declined greatly. Steelhead are somewhat easier to manage in sport fisheries, where fish known to be of wild origin (identifiable by an intact adipose fin) can be released with minimal mortality, and hatchery fish (with adipose intact) kept.

Genetic and evolutionary risks for hatchery fish and interacting populations include inbreeding depression, loss of population identity and within-population diversity, and domestication selection (NRC 1996). Recognition of these possible factors has increased in recent decades. Unfortunately, measures used in the GCFMP and steelhead management in the upper Columbia (until recently) almost certainly realized some of the listed risks, and contributed to decreased genetic diversity of wild fish. Steelhead adults were collected at Priest Rapids, and later at Wells Dam, their progeny reared in hatcheries and released as smolts to the various tributaries, without regard to fostering local adaptation in tributaries.

Foraging, social behaviour, time of spawning, and predator avoidance can differ for fish reared in the hatchery and in the wild (Flagg et al. 2001). While resulting differences may primarily reduce survival of hatchery-produced salmon and steelhead, negative effects may carry into the wild population where adults of hatchery origin spawn with wild fish. Effects of disease on released hatchery fish and on wild fish are poorly understood, but likely to be negative (Flagg et al. 2001, tables 10-11 summarize these).

Also poorly understood, are ecological effects of hatchery programs. NRC (1996) noted that 5.5 billion salmon smolts of all species are released to the wild each year around the Pacific rim, with potential trophic effects that may lead to altered body size and survival of wild fish. Emphasis on hatchery fish denies marine nutrients to infertile rearing streams used by relatively few wild spring Chinook salmon and steelhead.

Intentional and unintentional introductions of non-native aquatic species have contributed to declines in bull trout abundance, local extirpations, and hybridization (Bond 1992; Howell and Buchanan 1992; Leary et al. 1993; Donald and Alger 1993; Pratt and Huston 1993; MBTSG 1995b,d, 1996g, h; Platts et al. 1995; J. Palmisano and V.Kaczynski, Northwest Forest Resource Council, in litt. 1997). The historical record documents many cases of both authorized and unauthorized introductions of non-native species by government agencies, as well as by private parties, across the range of bull trout.

Public policy

The Marine Mammals Protection Act of 1976 afforded seals and sea lions complete protection from killing by humans. These animals increased sharply in abundance thereafter (Fresh 1996). NRC (1996) discussed the potential for effects on salmon and steelhead. They concluded that such predation was “probably not a major factor in the current decline of salmon in general.” Chapman et al. (1994 and 1995) suggested a need for adaptive management, including population control through selective harvest and/or sterilization of live-captured seals on haul-out beaches. They pointed out that, although pinnipeds and salmon coexisted long before man interfered ecologically, contrary views hold that it is unrealistic for man to manage and prey upon salmon without managing one of their principal predators.

The Corps of Engineers dredges shipping channels in the lower Columbia River and has created artificial islands with the spoils. Caspian terns have exponentially increased in the Columbia River estuary after dredge spoils created near-ideal nesting sites within the boundaries of a U.S. Fish and Wildlife Service refuge. Many PIT tags have been found on artificial island sites, demonstrating that terns may be very important predators on smolts that must pass through the estuary to reach the sea.

Public policy clearly has more ubiquitous influences, both direct and indirect, than the foregoing examples (NRC 1996). Mainstem dams are a direct outgrowth of public policy, constructed by the federal government (Chief Joseph, Grand Coulee, and four mainstem Columbia River dams downstream from the Snake River) or by public utilities licensed by the Federal Energy Regulatory Commission (Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids dams).

Human population growth in the Pacific Northwest, often fostered by local government boosters, places more pressure every year on salmon and steelhead. Lackey (1999, 2001) eloquently described the ramifications for salmon of human population growth, and of public policies and decisions. He noted that the Pacific Northwest has a population increase rate that rivals many developing third-world nations. Public policies affect water diversions, instream flows, water temperature, dam operations, manufacturing, urban development, national defence, fishing, hatchery outputs, and transportation of people and goods. All of these factors, and more, some of greater influence than others, have depressed salmon and steelhead abundance and potential for restoration of depressed fish populations.

Marsh (1994) may have inadvertently captured an essence of the effects of public policy on salmon when he wrote:

> the process is seriously, significantly, flawed because it is too heavily geared towards a status quo that has allowed all forms of river activity to proceed in a deficit situation – that is, relatively small steps, minor improvements and adjustments – when the situation literally cries out for a major overhaul.

He was referring to salmon restoration and management. But the underlying question was identified by Lackey's papers: Given human population growth and perceived needs, is Pacific Northwest society prepared to make the sacrifices necessary to restore wild listed spring Chinook and steelhead in the upper Columbia River (and elsewhere in the Columbia River basin)? The answer to date appears to be "no."

3.19 Synthesis Of Previous Efforts to Determine Important Factors For Decline of Methow Subbasin and Upper River Columbia Fish Populations

A number of key documents and reports have addressed factors affecting the decline of wild bull trout, spring Chinook and steelhead in the upper Columbia. Often the assessments take the form of limiting factor analyses, and are reported as such. There is not always clear agreement regarding the importance of various factors. Here we summarize and compare some of the central findings and conclusions offered in a number of key reports.

Chapman et al. (1995) reviewed the status of the spring Chinook salmon ESU of the upper Columbia Basin, including populations in the Wenatchee, Entiat, Methow, and Okanogan rivers. Their key findings and conclusions regarding factors affecting the decline of these wild populations are:

- The extensive development of mainstem dams and upstream storage reservoirs reduced productivity by 43% from the 1950s through the 1980s.
- Spawning and rearing habitat has not suffered functional degradation in most areas. However, water withdrawal for irrigation is a serious concern in several key tributaries, particularly in the Methow River Basin.
- There is no evidence to indicate that inter-specific competition from exotic or native fish species reduced the productivity of this ESU.
- Inriver harvest rates have been minimal since 1974, but in decades before that, harvest rates ranged from 40-85%. Marine harvest impacts are low, less that 1% for the years 1978-1993.

Their report emphasized hydro-passage effects as the primary factor limiting the productivity of this ESU. Risks associated with hatchery programs, and modest degradation in tributary habitat conditions were discussed, but they were not identified as critical factors responsible for the decline in the ESU. In-river harvest pressures were substantial before 1974, but subsequent to that year, harvest rates had been minimal or negligible with the imposition of harvest restrictions.

Chapman et al. (1994) wrote a similar status report for steelhead populations comprising the listed upper Columbia ESU. In their assessment, the following factors were identified as the chief causes of the decline of wild steelhead:

- Over fishing prior to the 1950s;
- Elimination of access to productive habitat above Grand Coulee Dam with dam emplacement, and;
- Mainstem dams, that have been the major cause for the depressed runs in recent decades.
- Additionally, they suspect two other human activities probably contributed to the decline of wild steelhead:
- Hatchery practices that mixed fish from a variety of sources to seed tributaries, and;
- Mortality (direct and incidental) associated with sport fishing for hatchery-released and resident trout.

They did not identify tributary habitat conditions as being important factors in the population decline. In fact, they characterize most spawning and rearing areas as being in fair to good condition; however, they noted that irrigation withdrawals in late summer in the Methow, Wenatchee, and Okanogan rivers posed a risk.

Specific land and water management activities that depress bull trout populations and degrade habitat include dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta et al. 1987; Chamberlin et al. 1991; Furniss et al. 1991; Meehan 1991; Nehlsen et al. 1991; Sedell and Everest 1991; Craig and Wissmar 1993; Frissell 1993; Henjum et al. 1994; McIntosh et al. 1994; Wissmar et al. 1994; USDA and USDI 1995, 1996, 1997; Light et al. 1996; MBTSG 1995a e, 1996a f).

Mullan et al. (1992) focused on conditions and processes (including both hatchery influences and habitat factors) within three major watersheds: the Wenatchee, Entiat, and Methow rivers. In general, they concluded that the carrying capacity of those rivers is similar to what it was historically. On page 28, they conclude that natural production of Chinook salmon and steelhead smolts now may be similar to historical production. Overall, human activities have not badly degraded the tributary habitat, although some localized problem areas were identified. Even so, they note that coho are now extinct in this area. Furthermore, they point to mainstem dams and reservoirs as critical factors impacting stocks emanating from this basin, noting that 62-71% of smolts die while passing through the hydrosystem.

More recently a series of draft subbasin summaries have been published that address limiting factors in the subbasins of the upper Columbia. Electronic copies of these are on the NPCC website. The summaries are supported by a series of limiting factor analyses that were conducted for individual subbasins. Their characterization of tributary habitat conditions as limiting factors contrast with the portrayal by Mullan et al. (1992) and Chapman et al. (1994, 1995). In general, the limiting factors analyses describe a network of tributaries that has been degraded by assorted human activities, and where ecological processes have been compromised, the implication being that some of these areas may well be important in limiting the productivity of anadromous fish in the basin.

3.19.1 Mortalities Inside Methow subbasin

The Limiting Factors Analysis (Andonaegui 2000) points to poor salmonid productivity as a consequence of habitat fragmentation and loss of ecological function in important areas within the subbasin.

3.19.2 Mortality Outside the ESU

Mortality Assumptions

Decadal-scale, climate-driven fluctuations in marine conditions are a dominant factor influencing salmonid survival in marine waters. This factor appears to account for the greatest amount of change in survival from smolt through return as adults documented over the decades.

NOAA Fisheries (Williams et al. 2003-draft) recently characterized the importance of marine-based processes on the abundance of Columbia River salmon as follows:

Increasing evidence points to dramatic changes in the marine ecosystem of the northern Pacific Ocean resulting from shifts in climate over the past 2000 years (Finney et al. 2002, Moore et al. 2002). Throughout this region, changes in ocean-climate conditions have influenced zooplankton, benthic invertebrate, seabird, and fish populations (McGowan et al. 1998). In particular, analyses of data from the last 100 years demonstrate a strong relationship between ocean conditions and the production of Pacific salmon (*Oncorhynchus* spp.) across a range of spatial and temporal scales (Mantua et al. 1997, Beamish et al. 1999). The varied response of salmon to these past environmental changes likely reflects their complex life history and the wide diversity of freshwater and marine habitats that they occupy (Hilborn et al. 2003).

Recent evidence links Chinook salmon from the Columbia River basin to cyclic changes in ocean-climate conditions. Modeling exercises, directed at explaining the negative effects of various anthropogenic activities on the productivity of Snake River spring-summer (SRSS) Chinook salmon, identified the estuary and ocean environments as important sources of unexplained variation in stock performance (Kareiva et al. 2000, Wilson 2003). Using catch records from commercial fisheries, Botsford and Lawrence (2002) found reasonable correlations between the inferred survival of Columbia River Chinook salmon and physical attributes of the ocean, such as sea-surface temperature and coastal upwelling. Building upon these previous studies, Scheuerell and Williams (in review) found that they could actually forecast changes in the smolt-to-adult survival of SRSS Chinook from changes in coastal ocean upwelling over the past 37 years, including the rapid decline in the 1960-70s and the increase in the late 1990s.

All of these analyses highlight the important effects of the ocean in determining smolt-to-adult survival, and further support Pearcy's, {1992 #307} assertion that the primary influence of the ocean on salmon survival occurs early within the first year that juveniles occupy coastal waters.

Smolt and adult mortality associated with passage through the hydrosystem is still problematic, but efforts are underway to improve passages conditions and evaluate progress.

System survival studies conducted during the 1980s revealed that the survival of spring-migrating smolts was poor. Skalski and Giorgi (1999) summarized results from seven studies from that decade, conducted by either the Public Utility Districts or the Fish Passage Center. Four studies used yearling spring Chinook, and three used steelhead. The average annual per-project survival across all studies was 86.2% (range = 83.4 to 88.7%).

This equates to only 47.6% survival for smolts passing through five hydroelectric projects, from Wells Dam to Priest Rapids Dam. Today the HCP for Douglas and Chelan County PUDs specifies a smolt survival goal of 93% per project for all species of smolts. If this goal can be realized through passage improvements currently being implemented or explored at all five dams, then the smolt survival through that system would equate to 69.6%. If these passage survival goals can be achieved, they would provide a substantive contribution to the recovery of ESA-listed spring Chinook and steelhead ESUs in the Upper Columbia.

The existence and magnitude of delayed effects associated with passage through the hydrosystem remains unresolved, and constitutes a critical uncertainty in the context of ESU recovery.

It has been hypothesized that cumulative effects may be incurred as smolts migrate through the hydrosystem, effects that are not expressed until smolts enter saltwater. Such a scenario has proved difficult to test and verify. NOAA Fisheries established the Plan for Analyzing and Testing Hypotheses (PATH) in 1995. For five years, this issue was one of many key ones that were investigated. Consensus was never reached. Subsequent to PATH, a number of papers were published, some supporting and some contesting the hypothesis. The debate still continues today, and is a prominent topic treated in a recent draft technical memorandum published by NOAA Fisheries (Williams et al. 2003-draft).

The condition of smolts migrating from a watershed can influence survival in subsequent life stages; thus, improving habitat conditions may realize benefits beyond those reflected in egg-to-smolt survival.

Total Mortality Outside The Subbasin

The most comprehensive and instructive index of ESU survival beyond the watershed is smolt-to-adult return rate (SAR). It is a common survival index used to characterize the performance of salmonid populations throughout the Pacific Northwest. This survival index reflects all sources of mortality affecting migrating smolts through returning adults. These include effects associated with:

- Hydrosystem operations;
- Migration conditions in the mainstem, including both natural and anthropogenic causes (e.g., actions associated urbanization and industrialization);
- Fish condition that can vary annually by hatchery or rearing stream;
- Marine/estuarine conditions and processes influenced by natural and anthropogenic factors;
- Harvest in marine and riverine waters, and;
- Predation.

SARs can be calculated in different ways. Juvenile salmonids implanted with either PIT tags or CWT can be used to estimate SAR if returning adults can be sampled at strategic locations. Alternatively, the survival index can be calculated by estimating smolt abundance passing some site (a dam or the mouth of a tributary), then subsequently estimating adult returns to that location for a specific brood year. Often, SARs are expressed in terms of return rates to the mouth of the Columbia River. This calculation requires additional information such as estimates of inriver harvest and adult passage mortality.

3.20 Upper Columbia Smolt-to-Adult Survival

3.20.1 Spring Chinook

Historical estimates of SAR for naturally produced spring Chinook in the upper Columbia River have been reported by Mullan et al. (1992) and Raymond (1988). Mullan et al. estimated the smolt-to-adult return rate for the collective populations produced in the Wenatchee, Entiat, and Methow rivers for the years 1967 to 1987. Over that period, SAR ranged from 2.0 to 10.1%. They noted that the estimates reflect corrections for adult passage mortality, as well as for marine and inriver harvest.

Raymond (1988) estimated the percent of returning adults to the uppermost dam on the upper Columbia River for the years 1962 through 1984. Values for wild spring Chinook ranged from 0.7 to 4.9% over those years. One reason Raymond's values are generally lower than those reported by Mullan et al. (1992) may be that his estimates are not adjusted for adult passage mortality and marine harvest, whereas Mullan et al.'s (1992) were. Also, the reference locations for calculating SARs differed, with Raymond focusing on the upper dam, and the other investigators referencing the spawning grounds. This raises an important point; when comparing SAR values among investigators, the locations where smolts and adults are enumerated must be known.

SAR estimates for the most recent decade have not been calculated and published by any other investigators; thus, the historical estimates provide the only guidance on this matter.

3.20.2 Steelhead

Raymond (1988) estimated smolt-to-adult return percentages for the combined wild and hatchery steelhead population, 1962-1984 (**Figure 55**). Adult return rates to the upper dam ranged from a low of 0.2% for the smolt migration of 1977, to a high of 6.4% for the 1982 smolt migration. Mullan et al. (1992) reported SARs for only one stock (Well Hatchery steelhead), for the years 1982 to 1987.

The percent return to the mouth of the Columbia River averaged 6.38%, ranging from 1.32% to 14.28%. Survival back to Wells Dam averaged 3.01%,and ranged from 0.72% to 7.31%. These estimates aligned closely with Raymond's estimates for the overlapping years 1982 to 1984. Chapman et al. (1994) compiled data from three hatcheries in the upper Columbia (Chelan, Entiat, and Leavenworth) for the years 1961 to 1991. Smolt-to-adult survival averaged 1.7%, with a range from 0.16% to 7.54%.

The reference point for smolt abundance is the upper dam on the Columbia and estimated return of adults to that location. Years refer to smolt migration years

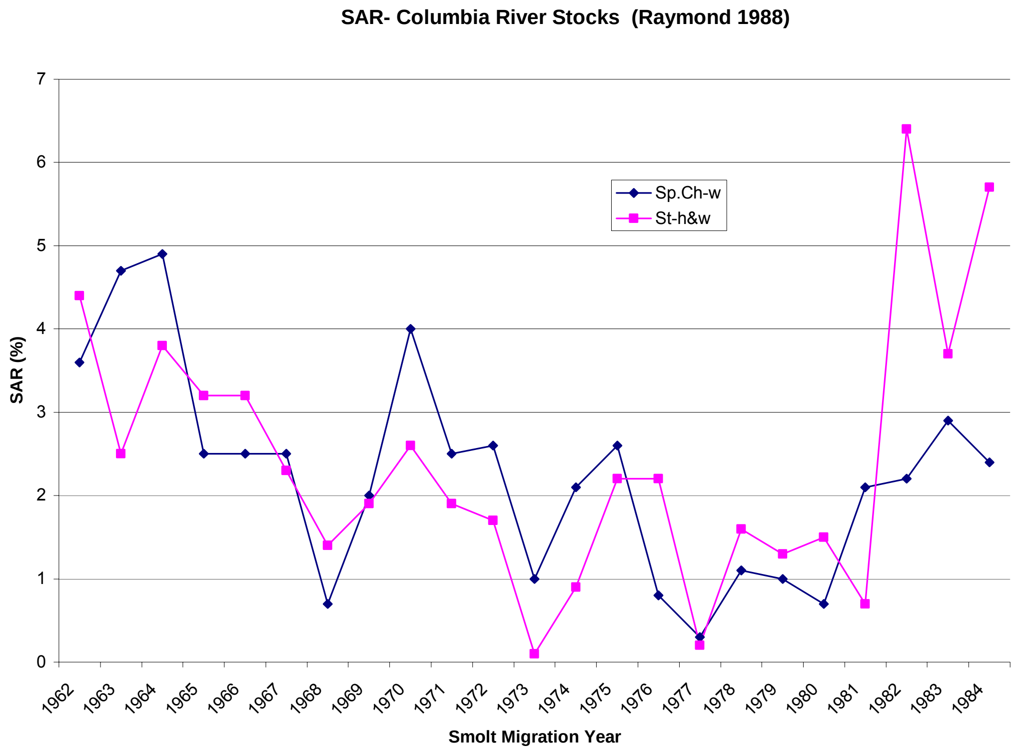


Figure 55 Survival from smolt to returning adult for upper Columbia wild spring Chinook and steelhead stocks as estimated by Raymond (1988)

Selecting Values for SAR to Use in ESU-Level Habitat Effectiveness Evaluations

Clearly SAR estimates for both spring Chinook and steelhead vary greatly across years. Over the decades, changes spanning at least an order of magnitude were commonly observed; thus, no single survival index value is satisfactory for accurately representing the performance of an ESU beyond the watershed. But accuracy may not be a central requirement for selecting a standard SAR that can be applied universally in habitat evaluations that use models like Ecosystem Diagnosis and Treatment (EDT). In years when smolt-to-returning-adult survival is low, survival from pre-spawner through parr in the tributaries carries more weight in terms of overall lifecycle survival. Conversely, when SARs are high, the contribution of survival during the subbasin residence stages contributes less proportionately to overall gravel-to-gravel survival.

What is the importance in establishing the magnitude of survival expressed outside the boundaries of a subbasin? When resource managers wish to compare the effectiveness of tributary habitat actions among subbasins, or across ESUs, then effects beyond the bounds of the subbasin or watershed become an issue. For example, if analysts in subbasin A assume a high SAR index, and they use adult abundance as a performance measure in modeling analyses, then the contribution from tributary-resident life stages is diluted. In contrast, if analysts in subbasin B assume a low SAR index, then the contribution of tributary survival is magnified in importance. One could imagine that funding agencies may prefer to invest in habitat projects where the "bang for the buck" might be greatest. This will be difficult to determine unless a standard out-of-subbasin survival index is adopted by all parties.

Is it practical to ignore effects outside the subbasin, and not incorporate them in quantitative analyses? Not if performance measures like productivity and adult abundance are of interest; these are sensitive to hydro, marine, and harvest effects. A SAR-like component, therefore, should be incorporated into whatever analytical model is employed; however, it may not be practical to run a series of model analyses over a range of SARs to reflect the sensitivity of every watershed population to variable marine or hydrosystem conditions. This is another reason why it is advantageous if a standard SAR value and approach can be selected for application when analyzing various populations emanating from different subbasins.

Out-of-subbasin Survival Effects in EDT Analyses

Ecosystem Diagnosis and Treatment (EDT) evaluates habitat across the life history of a focal fish species. For anadromous species, this evaluation addresses conditions within a subbasin, as well as outside of it, for example, in the mainstem Columbia River, estuary and ocean. Conditions outside the subbasin are often referred to as "out-of-subbasin effects" or OOSE. While EDT includes out-of-subbasin effects, the focus of an EDT evaluation is on the potential of a habitat condition within a subbasin; however, it is of interest to understand how survival conditions outside the subbasin might affect protection and restoration priorities within the subbasin.

Estimating out-of-subbasin effects in the upper Columbia will require a separate and dedicated effort under the Management Plan in years two and three. Because only general guidance for estimating the overall effects outside the subbasins exists at the time of this plan, we chose to identify the methods for this estimation protocol, and recommend that a dedicated effort be done as part of the overall Management Strategy. Estimates of SAR for each population are available at this time; however, estimates of mortality associated with specific locations or causal mechanisms in the mainstem or ocean are not.

Once the picture is complete, and under this proposed OOSE approach, a hypothetical generic situation forms the blueprint. There is one SAR reference value selected for each species. The maximum value of this SAR index value stock is realized for a generic stock of smolts entering the mainstem from tributaries downstream from Bonneville Dam. In modeling analyses, that generic stock of smolts is moved upstream to subbasins that enter the mainstem above an increasing number of dams. This effort will require additional modeling that was not made available to subbasin planners during the assessment phase.

Out-of-subbasin Effects (OOSE) Approach

Since subbasins enter the mainstem Columbia at differing distances from the point of ocean entry, each subbasin population will incur different levels of hydrosystem-related mortality. Mobrand Biometrics, in conjunction with the NPCC, has devised an approach to generically treat all populations entering the mainstem. They refer to the composite mortality through the hydrosystem and marine waters, including harvest removals, as "out-of-subbasin-effects" (OOSE). We propose adopting that approach at this time.

Under this OOSE approach, a hypothetical generic situation forms the blueprint. There is one SAR reference value selected for each species. The maximum value of this SAR index value stock is realized for a generic stock of smolts entering the mainstem from tributaries downstream from Bonneville Dam. In modeling analyses, that generic stock of smolts is moved upstream to subbasins that enter the mainstem above an increasing number of dams.

The SAR index value is then reduced by incremental amounts to reflect the number of dams the generic stock now has to pass enroute to the mouth of the Columbia River. The values initially selected as the SAR index do not need to represent the "truth," nor do values representing dam passage survival, but they should fall within an accepted range of observed values. The purpose is to prescribe a standard OOSE that can be applied to all ESUs or populations entering the mainstem at different locations.

Out-of-subbasin survival effects in EDT analyses are described in 2.6 Synthesis and Interpretation.

3.21 Synthesis and Interpretation of Assessment for Fish Ecosytems

The review of limiting factors for focal species of fish was carried out using an extensive and powerful tool called EDT (Ecosystem Diagnosis and Treatment). The major results of EDT are captured under the plan sections entitled Major Findings and Assessment Unit Summaries. In brief, they show that in the Methow Basin habitat losses have chiefly resulted from artificial and natural fish passage barriers, alteration and reduction of riparian habitat, loss of habitat connectivity, instream and floodplain habitat degradation, low flows and dewatering, and extreme water temperatures. Added to these limiting factors within the Methow are out-of-basin problems including fish passage over mainstem dams and harvest.

Thus, the ecosystem diagnosis method used was intended primarily to address the question: *Is there potential to improve anadromous salmonid population status through improvements to habitat conditions in tributary environments?*

Said in a form of a **central subbasin hypothesis** (for fish and adaptable for wildlife): *Improvements in habitat conditions will have a positive effect on habitat productivity and thus, improve fish population status through increased abundance, diversity, and spatial structure.*

Ecosystem Diagnosis and Treatment

Reach analysis tables (EDT consumer reports tables) were used to determine primary and secondary limiting factors within each Assessment Unit (AU). The Subasin Core Team factored in the results of assessments on focal species, and across all reaches in each AU. In general, a survival factor was considered a primary limiting factor if there were high or extreme impacts on key life stages.

Exceptions included some reaches where sediment load or temperature only had a high impact to spawning or egg incubation. Additionally, a survival factor was considered to be a primary limiting factor if there were small to moderate impacts across most (9-12) life stages, thereby producing a cumulative impact that could be just as severe as high and extreme impacts on fewer life stages. Secondary limiting factors, generally, had small to moderate impacts on several (5-8) life stages.

An exception occurred with the survival factor “food”; when there were small to moderate impacts on two or three juvenile life stages in most of the reaches of a particular AU, then we considered “food” to be a secondary limiting factor.

In most reaches and AUs, the break between primary and secondary limiting factors was fairly obvious. In some cases, where EDT results were not as obvious, other information, such as the Limiting Factors Reports, the RTT Biological Assessment, professional opinion, and local knowledge were factored into the decision.

Out-of-subbasin Survival Effects in EDT Analyses

Ecosystem Diagnosis and Treatment (EDT) evaluates habitat across the life history of a focal fish species. For anadromous species, this evaluation addresses conditions within a subbasin, as well as outside of it, for example, in the mainstem Columbia River, estuary and ocean. Conditions outside the subbasin are often referred to as “out-of-subbasin effects” or OOSE. While EDT includes out-of-subbasin effects, the focus of an EDT evaluation is on the potential of a habitat condition within a subbasin; however, it is of interest to understand how survival conditions outside the subbasin might affect protection and restoration priorities within the subbasin.

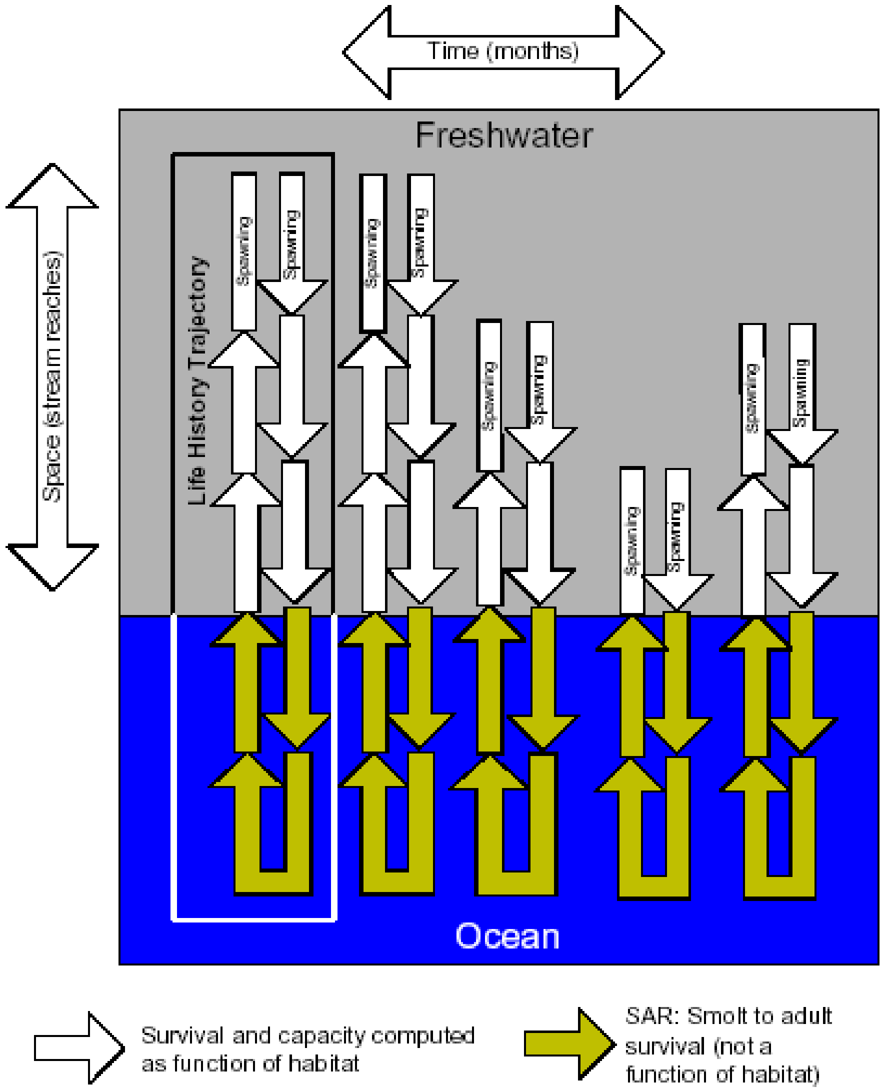
In contrast to the situation within a subbasin, in EDT, OOSE survival is not calculated from habitat information; instead, a set of survival multipliers are used to achieve reported smolt-to-adult survival rates (SAR). These multipliers result in a SAR value for the focal population, which is reported in the standard EDT output summary.

The SAR, as reported in the EDT output, represents the survival from a juvenile leaving the subbasin to an adult returning. Since EDT accounts for age at emigration and at maturation, the survival value will vary depending on the age composition of a population. However, since age-composition for a given population is stable, a single SAR value can be used for each population. For some populations in some watersheds, significant numbers of juveniles that emigrate from the subbasin are not smolts. In these cases, the SAR reported by EDT may be an underestimate.

SAR has been estimated from empirical data, for some species, in a limited number of subbasins (NOAA 2004). From these estimates, it is clear that the SAR is highly variable from year to year, and from subbasin to subbasin, and that spatial or temporal trends in SAR are difficult to discern. The variability in SAR indicates that the survival rate of smolts leaving a subbasin is highly dependent on conditions both inside and outside the subbasins.

Life History Trajectories in Ecosystem Diagnosis and Treatment

To understand how the SAR affects results in EDT, it is necessary to explain the concept of life history trajectories. A life history trajectory is the unbroken sequence of life stages and habitat segments that a fish moves through while completing its full life cycle. Trajectories start and end with spawning at a particular spot (i.e., a stream reach), and at a particular time within a year (**Figure 56**). At each trajectory segment (defined by a life stage, a location, and a time), the survival conditions are computed from habitat characteristics as they affect the life stage.

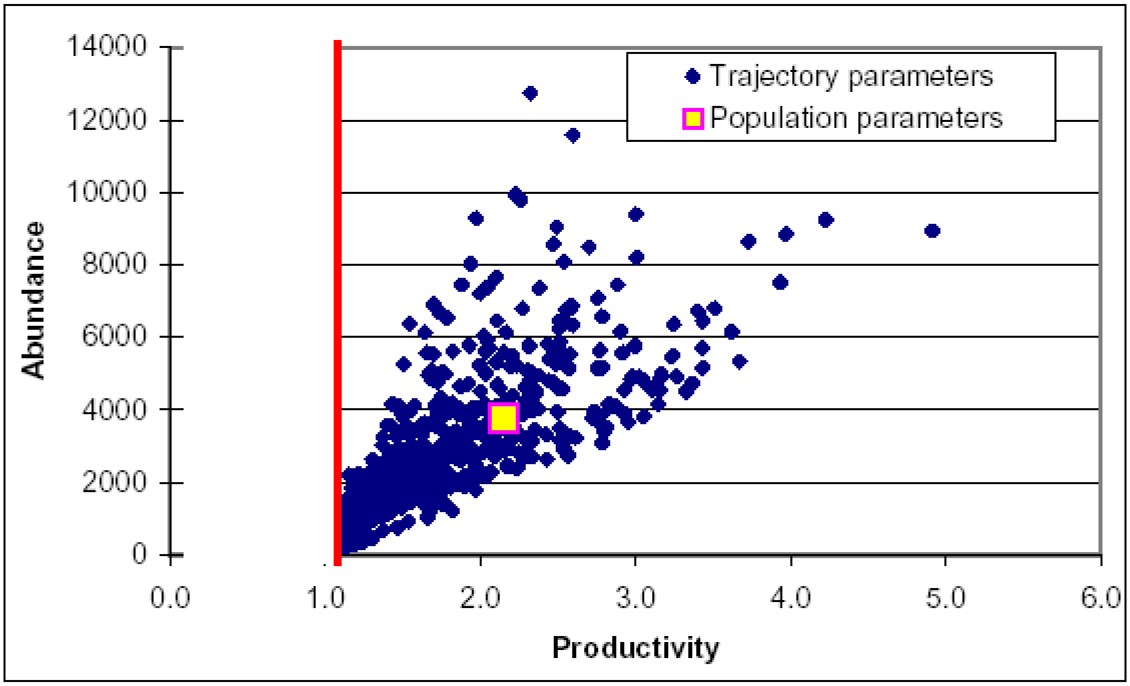


Source: Mobrand Biometrics 2004

Figure 56 Life History Trajectory Concept in EDT

Trajectory segments outside the subbasin are greatly simplified by applying constant, population-specific survival factors. EDT then computes the cumulative survival of all segments along each trajectory. EDT samples the environment by starting trajectories in a regular pattern along the stream course, and at regular time intervals during the spawning season (**Figure 56**). In a typical stream, EDT generates hundreds of life history trajectories to sample and characterize the habitat conditions within a stream. EDT finally estimates survival parameters for the focal population from this collection of trajectories (**Figure 57**); thus, the SAR computation is embedded in the trajectory calculations.

To capture the seasonal variations of hydroelectric operations and conditions in the estuary and ocean, survival conditions outside the subbasin are shaped by month within a year.

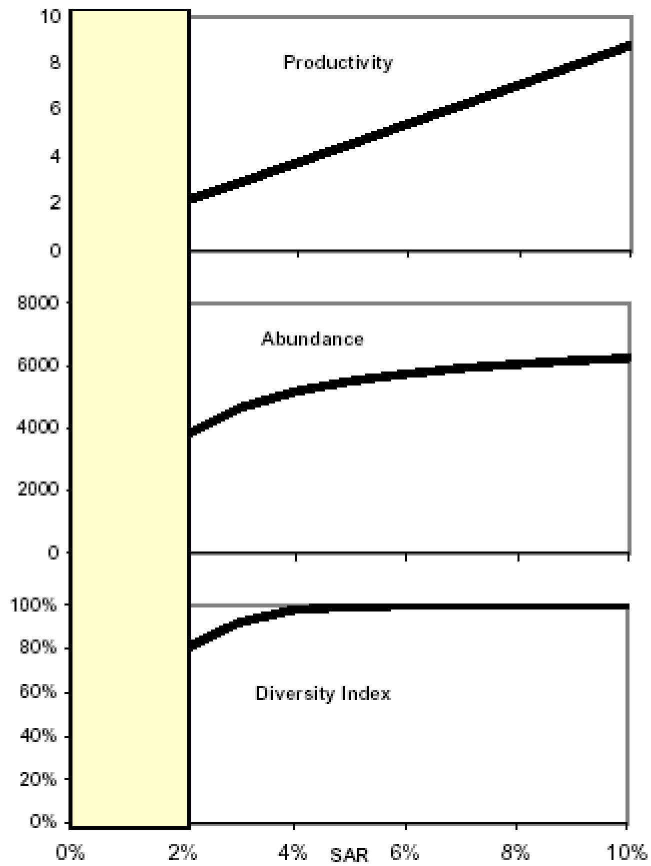


Source: Mobrand Biometrics inc., 2004

Figure 57 Hypothetical population depicting individual trajectories, population abundance and productivity parameters EDT derives from the trajectories

Effects of OOSE on Population Parameters

A hypothetical example might help illustrate how the survival outside the subbasin, the SAR, affects the EDT estimates of the population parameters of the focal population. There is a near-linear relationship between productivity and the SAR, as might be expected (**Figure 58**). The deviation from linearity is because of the fact that the SAR affects the population productivity parameter through the individual trajectories described above. For small SAR's (< 2% in the example), both equilibrium abundance and the diversity index are very sensitive to changes in SAR (**Figure 58**). One of the consequences of this is that errors in the estimate of SAR in this range will have a significant effect on the abundance and diversity estimates. Also implied is that overall improvements in productivity (e.g. through habitat restoration) will stabilize the population, making it less vulnerable to changes in SAR.



Source: Mobrand Biometrics 2004

Figure 58 Effects of SAR on EDT estimates of population productivity, abundance and diversity

Qualitative Habitat Analysis (QHA)

Qualitative Habitat Analysis (QHA), as modified from its original intent to meet the specific needs of the Methow subbasin planning process regarding bull trout and westslope cutthroat trout, has been a useful tool to organize and summarize a large amount of information into a useable format.

The QHA relies on the expert knowledge of natural resource professionals, with experience in a local area, to describe bull trout and westslope cutthroat trout use in the target stream. From this assessment, planners are able to develop hypotheses about the population and environmental relationships of the bull trout and westslope cutthroat trout. The ultimate result is an indication of the relative importance for restoration and/or protection management strategies at the sub-watershed scale addressing specific habitat attributes.

The primary strength of the QHA is its ability to conveniently store and summarize a substantial amount of information relating focal species to their habitats. Consequently, planners chose to view the assessment as a tool for examining four fundamental questions:

1. Where have significant bull trout and westslope cutthroat trout use changes occurred since the historic reference condition?

7. What changes are thought to have most significantly affected the distribution and abundance of bull trout and westslope cutthroat trout (sub-populations within the watersheds)?

8. Where are the greatest opportunities to protect and/or enhance habitat attributes that will potentially provide the greatest benefits to fish populations within the subbasin?

Current and historic focal species distribution was described by ranking focal species use for each of the stream reaches. The QHA values were compared to existing literature to ensure consistency and credibility as well as the EDT habitat analysis.

The technical sub-committee used the subbasin vision, goals and biological objectives as a backdrop for describing a desired future condition. The technical team evaluated where the most affective application of various actions might occur, and described the extent to which specific attributes may need to change in order to achieve stated goals and objectives.

Each of these reference conditions was evaluated and compared. Findings from this evaluation are found in the Assessment / Synthesis sub-chapter within this document.

The QHA was used in the Methow subbasin planning process for two fundamental reasons; a) the tool is a straight forward means to summarize a substantial amount of information, associated with bull trout and westslope cutthroat trout, in an accessible manner, and; b) rules of bull trout and westslope cutthroat trout have not been developed for the EDT model. The subbasin planners have developed various approaches to communicate the findings of the QHA to the general public and scientific community as a basis for the development of management strategy recommendations. Regardless of the shortcomings of the QHA, the methodology was successful in its intent in describing the fundamental changes in bull trout and westslope cutthroat trout use that have occurred in the Methow subbasin, and has served as a catalyst for describing future management direction.

Technologies Employed

Scaled Versus Unscaled EDT Output

We analyzed two sets of EDT model output: scaled and unscaled. The unscaled output estimated the total potential for increase or decrease (because of restoration or protection actions) within an assessment unit (AU), regardless of its length relative to other AUs.

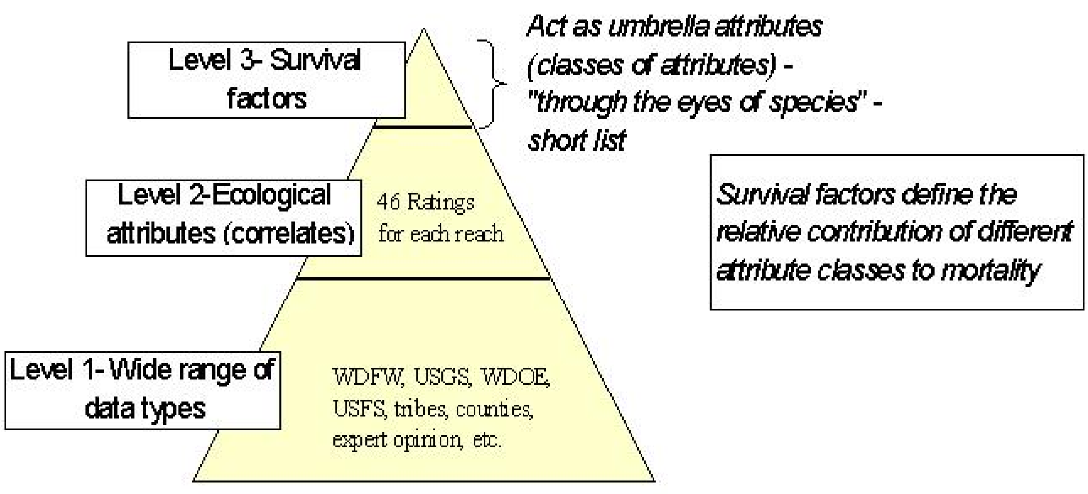
Unscaled output allowed us to evaluate in-basin versus OOSE, and showed the critical areas for restoration and protection, regardless of size or efficiency. The scaled output calculated the potential benefit on a per kilometre basis, which gave us “bang for the buck,” or the most efficient areas to work in to benefit focal species.

Scaled output can de-emphasize large, important areas, and there may be some segments within these larger AUs where it is just as efficient to perform restoration or protection actions. Therefore, it is important to consider both scaled and unscaled output, as well as site-specific nuances within the AUs when evaluating the final list of priority AUs.

Methow Subbasin Habitat Assessment Methods

The Methow subbasin habitat was assessed using the Ecosystem Diagnosis and Treatment (EDT) method; EDT is an analytical model relating habitat features and biological performance to support conservation and recovery planning for salmonids (Lichatowich et al. 1995; Lestelle et al. 1996; Mobrand et al. 1997; Mobrand et al. 1998). It acts as an analytical framework that brings together information from empirical observation, local experts, and other models and analyses.

The Information Structure and associated data categories are defined at three levels of organization. Together, these can be thought of as an information pyramid in which each level builds on information from the lower level (**Figure 59**). As we move up through the three levels, we take an increasingly organism-centered view of the ecosystem. Levels 1 and 2, together, characterize the environment, or ecosystem, as it can be described by different types of data. This provides the characterization of the environment needed to analyze biological performance for a species. The Level 3 category is a characterization of that same environment from a different perspective: “through the eyes of the focal species" (Mobrand et al. 1997). This category describes biological performance in relation to the state of the ecosystem described by the Level 2 ecological attributes.



Source: Mobrand Biometrics 2004

Figure 59 Data/information pyramid—information derived from supporting levels

The organization and flow of information begins with a wide range of environmental data (Level 1 data) that describe a watershed, including all of the various types of empirically-based data available. These data include reports and unpublished data. Level 1 data exist in a variety of forms and pedigrees. The Level 1 information is then summarized or synthesized into a standardized set of attributes (Level 2 ecological attributes) that refine the basic description of the watershed. The Level 2 attributes are descriptors that specify physical and biological characteristics about the environment relevant to the derivation of the survival and habitat capacity factors for the specific species in Level 3. Definitions for Level 2 and Level 3 attributes can be found at www.edthome.org, together with a matrix showing associations between the two levels and various life stages.

The Level 2 attributes represent conclusions that characterize conditions in the watershed at specific locations, during a particular time of year (season or month), and for an associated management scenario; hence, an attribute value is an assumed conclusion by site, time of year, and scenario. These assumptions become operating hypotheses for these attributes under specific scenarios. Where Level 1 data are sufficient, these Level 2 conclusions can be derived through simple rules; however, in many cases, experts are needed to provide knowledge about geographic areas and attributes where Level 1 data are incomplete. Regardless of the means whereby Level 2 information is obtained, the characterization it provides can be ground-truthed and monitored over time through an adaptive process.

To perform the assessment we first structured the entirety of the relevant geographic areas, including marine waters, into distinct habitat reaches. The Methow drainage was subdivided into 148 stream segments within the estimated historic range of steelhead by an assembled technical workgroup (**Table 43**). We identified reaches on the basis of similarity of habitat features, drainage connectivity, and land use patterns. Such a detailed reach structure, however, is counterproductive for displaying results and implementing a management plan. Therefore the reaches were regrouped into 13 larger geographic areas or AUs (**Table 43**). A set of standard habitat attributes and reach breaks, developed by MBI, were used for the mainstem Columbia and Snake Rivers, estuarine, nearshore, and deep water marine areas. We then assembled baseline information on habitat and human-use factors and fish life history patterns for the watersheds of interest. This task required that all reaches be completely characterized by rating the relevant environmental attributes.

Table 43 Stream reaches and assessment units (AUs) defined in the Methow River for Ecosystem Diagnosis and Treatment (EDT) modeling

Reach Codes	Location/Description	Assessment Unit
Met1-Met7	Methow River mainstem; mouth to RM 33 (1 mile below Beaver Ck)	Lower Methow
Met8-Met17	Methow River mainstem; RM 33 to Weeman Bridge (RM 60).	Middle Methow
Met18-Met23	Methow River mainstem; Weeman Bridge to Robinson Ck (RM 74)	Upper-Middle Methow
Met24-Met26a; EarlyW1-3, Cedar1; Lost1-3, Eureka1	Methow River mainstem; Robinson Ck to falls above Brush Ck.; Early Winters Ck (RM 0-8.2), Cedar Ck (RM 0-2.3), Lost R (RM 0-7.5), Eureka Ck (0-0.3)	Upper Methow
Gold1-4, GoldSF1-3, Foggy1, GoldNF1; Libby1-5, Smith1-2	Gold Creek; mouth to North Fork (RM 5.5), South Fork of Gold Creek to falls (RM 0-7.3); Foggy Dew Cr to falls (RM 0-2.7), North Fork Gold Ck to Crater Ck (RM 0-1.3); Libby Ck, mouth to confluence of N and S forks (RM 0-7.4), Smith Canyon Ck (RM 0-2.9)	Gold Ck/Libby Ck
Beav1-5, Fraz1-2;Bear1-2	Beaver Ck, mouth to South Fork Confluence (RM 0-10), Frazer Ck to Jack Ck (RM 0-4.7); Bear Ck, mouth to RM 6	Beaver Ck/Bear Ck

Reach Codes	Location/Description	Assessment Unit
Twisp1-11; LBridge1-4, Cany1-2, Butter 1-2, EF Butter1, WF Butter1	Twisp River, from mouth to Eagle Ck (RM 0-17.3); Little Bridge Creek to West Fork (RM 0-7.7), Canyon Ck to RM 2.2, Buttermilk Ck to E and W forks (0-2.8), West Fork Buttermilk Ck (RM 0-2.2), East Fork Buttermilk Ck (RM 0-2.6)	Lower Twisp
Twisp12-17a; Eagle1-2, War1-2, Reynolds1-2, South Cr1, North 1	Twisp River from Eagle Ck to falls at RM 31; Eagle Ck to falls at RM 0.5, War Ck to falls at RM 1.4, Reynolds Ck to falls at RM 0.7, South Ck to falls at 0.6, North Ck to falls at 0.5	Upper Twisp
Chew 1-6; Pearrygin Lake Ck1; Cub1; Boulder1;	Chewuch River, mouth to Eightmile Ck (RM 11.3); Pearrygin Lake Ck (RM 0-0.2), Cub Ck to falls at RM 0.41, Boulder Ck to falls at RM 1	Lower Chewuch
Chew7-16; Eight1-3, Twenty1, Dodd1, Lake1-4, Farewell1, Andrews1, Sheep1, Thirty1	Chewuch River, from Eightmile Ck to Chewack Falls (RM 11-35); Eightmile Ck (RM 0-14.2), Twentymile Ck (RM 0-0.5), Dodd Ck (RM 0-0.7), Lake Ck (RM 0-9.5), Farewell Ck (RM 0-0.4), Andrews Ck (RM 0-0.3), Sheep Ck (RM 0-0.4), Thirtymile Ck (RM 0-0.3)	Upper Chewuch
Wolf1-3; Hancock1	Wolf Creek, mouth to North Fork (RM 0-6.2); Hancock Ck, mouth to springs (RM 0-0.81)	Wolf/Hancock Ck
Goat1-6; LBoulder1-2	Goat Ck, mouth to Montana Ck (RM 0-3.2); Little Boulder Ck, mouth to Left Fork (RM 0-1.1)	Goat/L.Boulder Ck

3.22 Methow Subbasin EDT Results

Species Prioritization

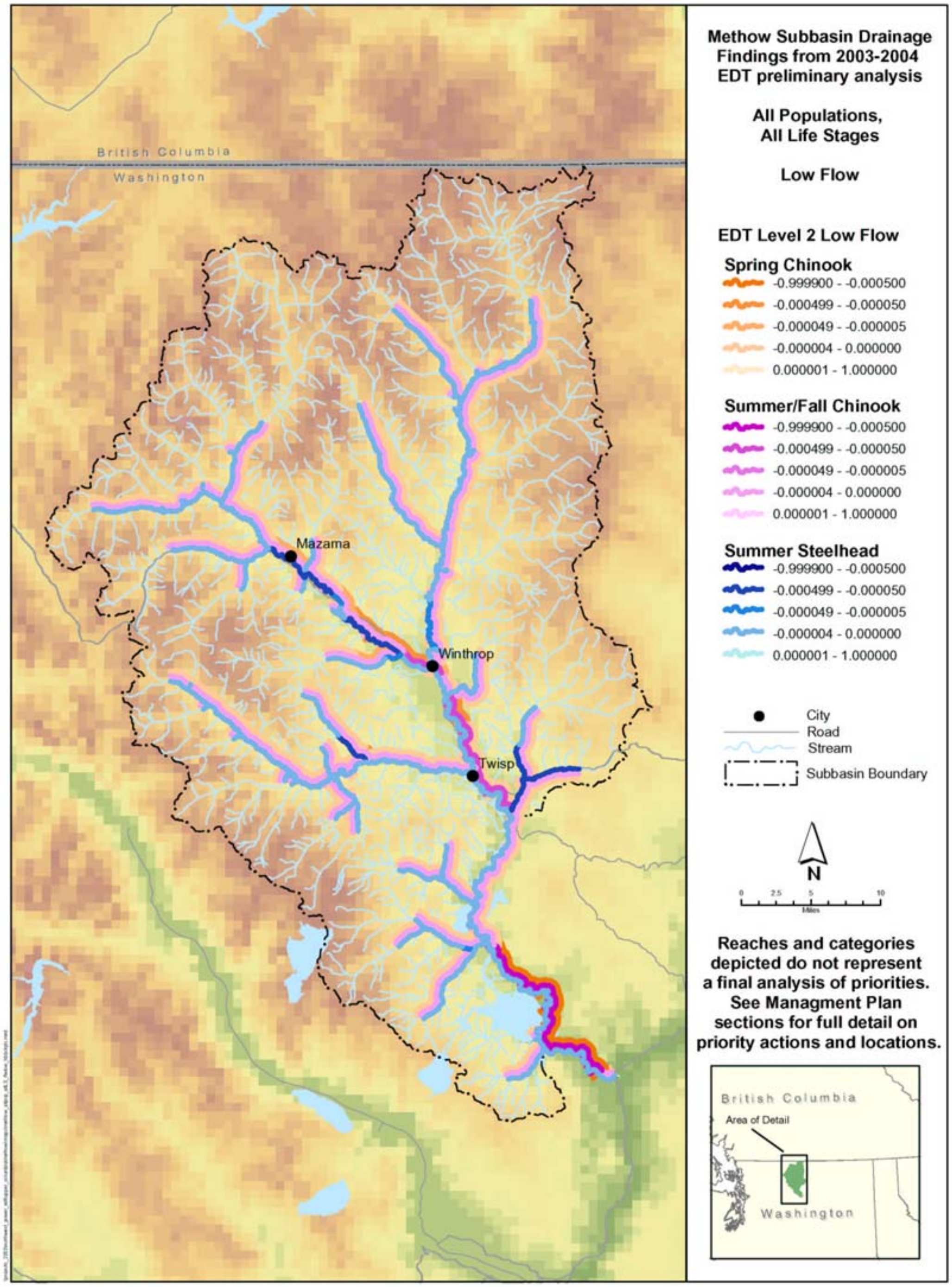
Reach analysis tables (EDT consumer reports tables) were used to determine primary and secondary limiting factors within each Assessment Unit (AU). The Subbasin Core Team factored in the results of assessments on focal species and across all reaches in each AU. In general, a survival factor was considered a primary limiting factor if there were high or extreme impacts on key life stages. Exceptions included some reaches where sediment load or temperature only had a high impact to spawning or egg incubation. Additionally, a survival factor was considered a primary limiting factor if there were small to moderate impacts across most (9-12) life stages, thereby producing a cumulative impact that could be just as severe as high and extreme impacts on fewer life stages.

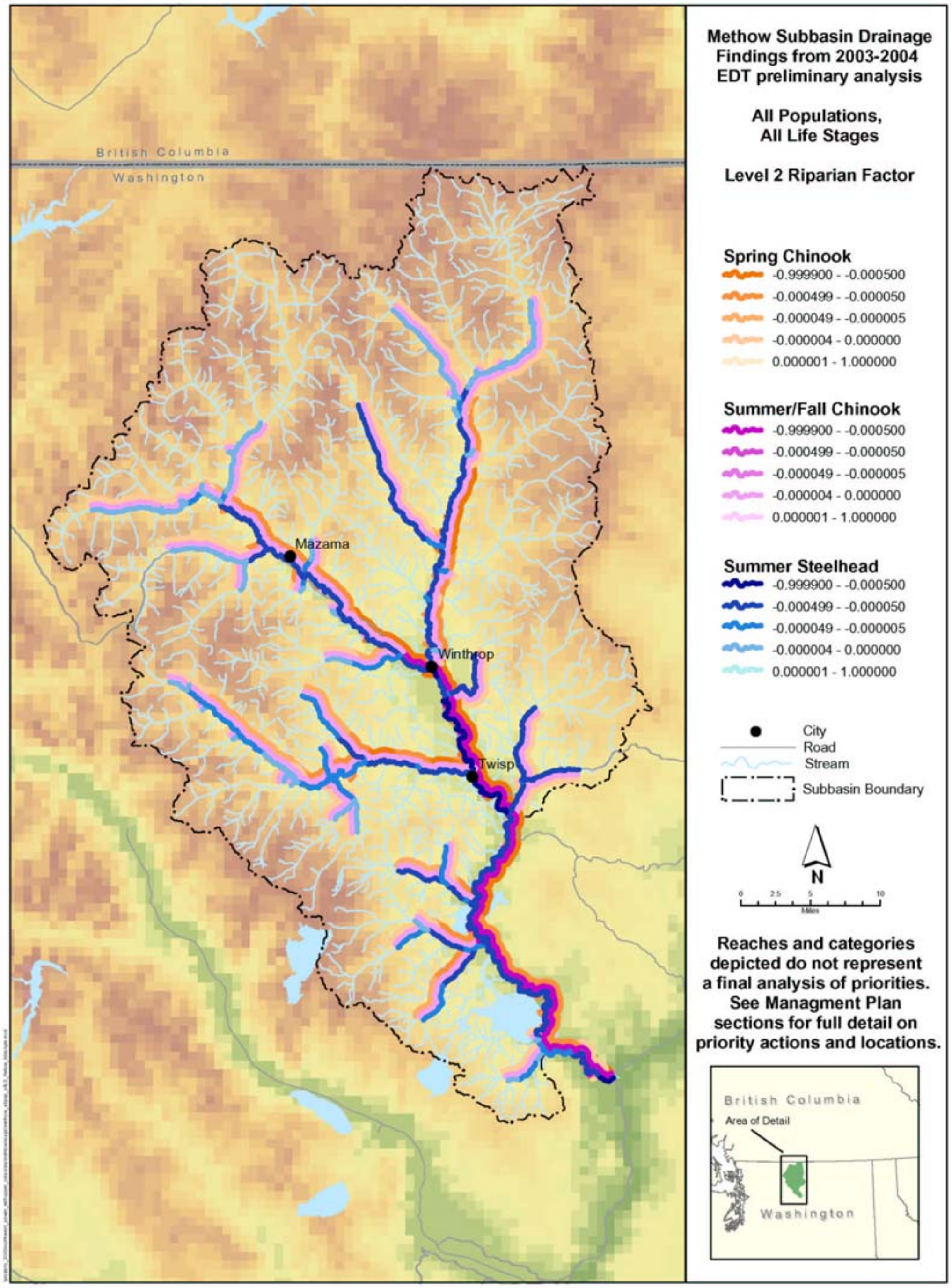
Secondary limiting factors generally had small to moderate impacts on several (5-8) life stages. An exception occurred with the survival factor “food”; when there were small to moderate impacts on two or three juvenile life stages in most of the reaches of a particular AU, then we considered it a secondary limiting factor. In most reaches and AU, the break between primary and secondary limiting factors was fairly obvious. In some cases where EDT results were not as obvious, other information, such as the Limiting Factors Reports, RTT Biological Assessment, professional opinion, and local knowledge were factored into the decision.

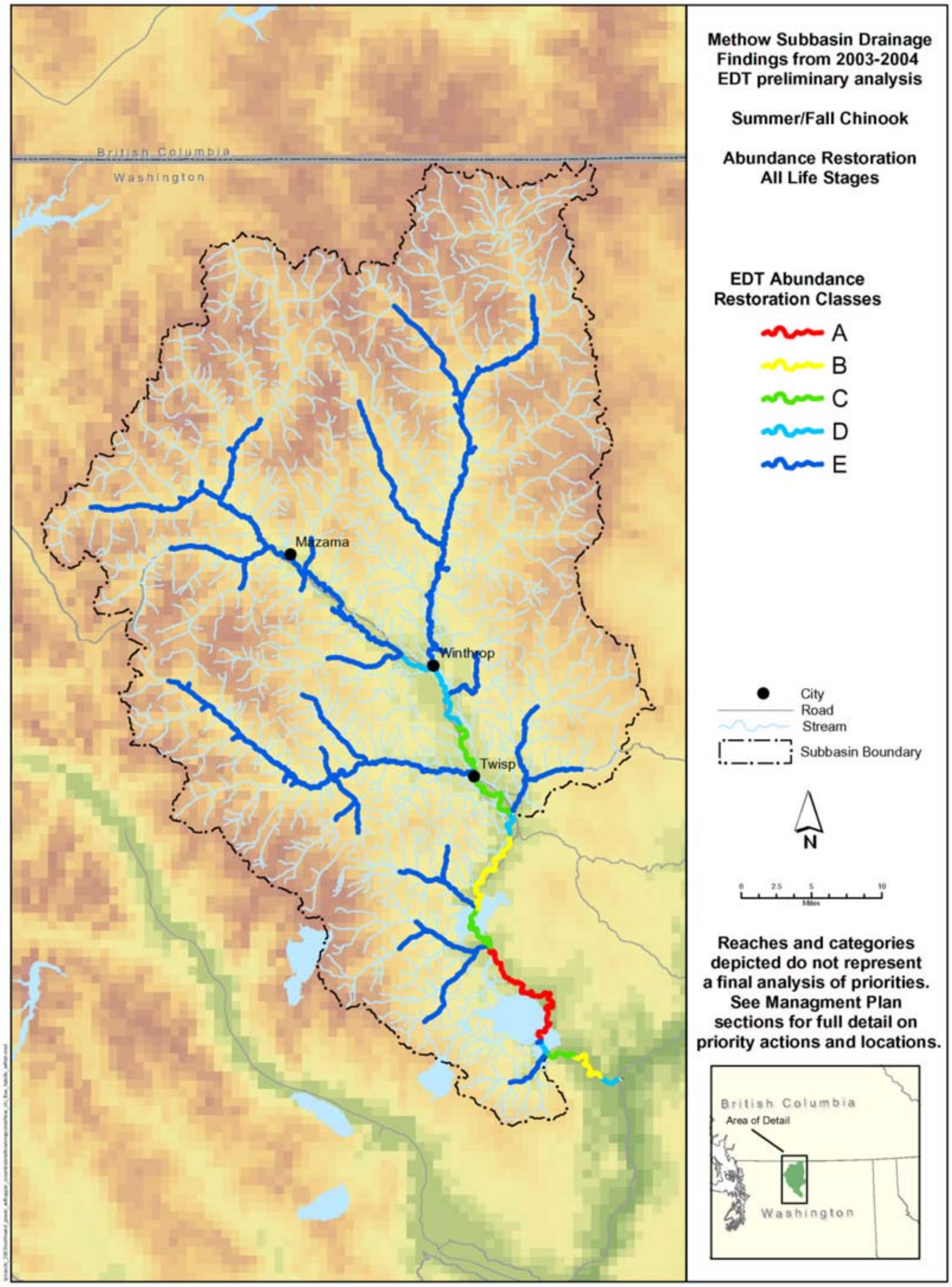
Species Findings – Ecosystem Diagnosis and Treatment (EDT)

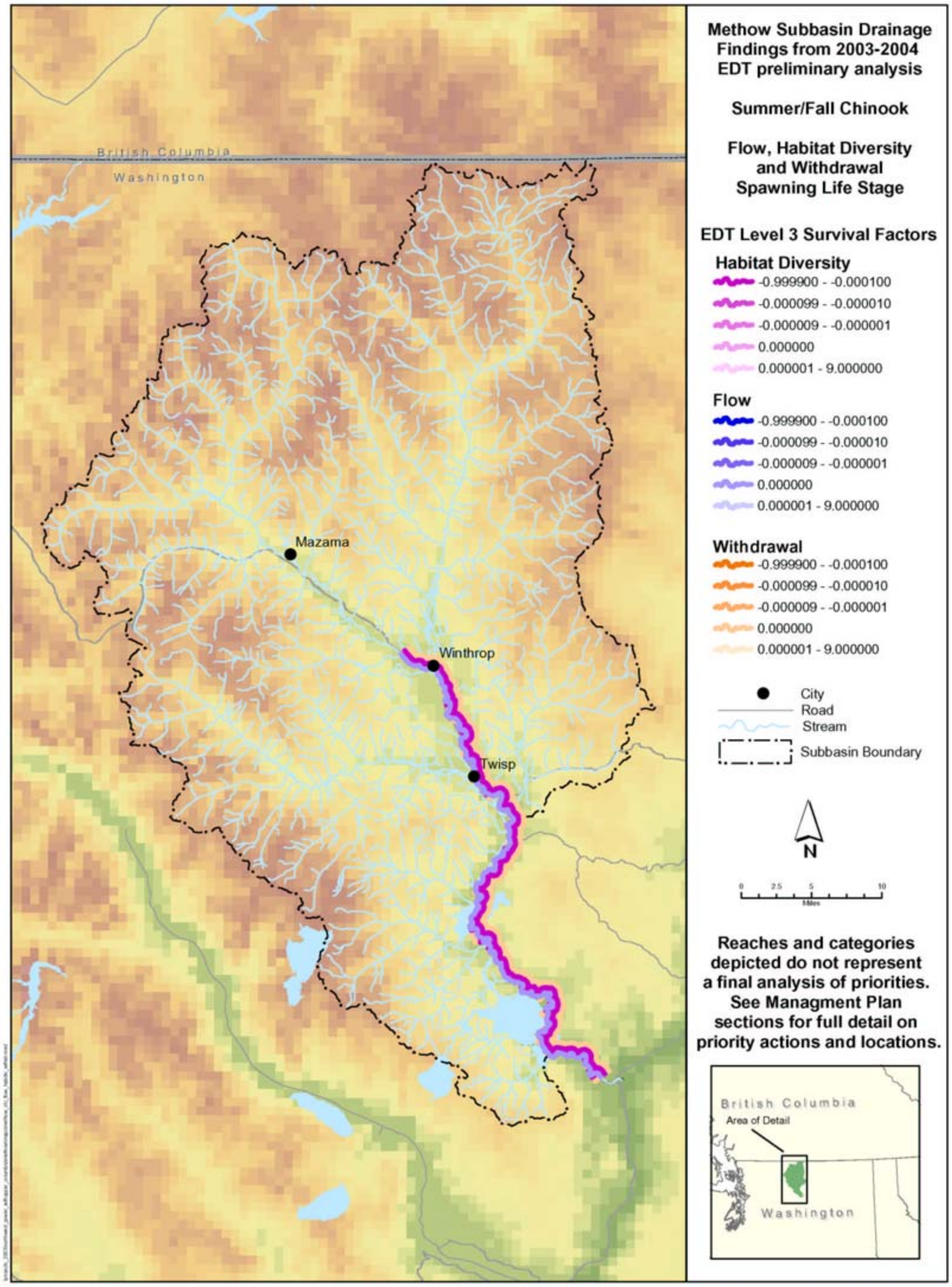
Intraspecific priorities were generated using the Ecosystem Diagnosis and Treatment (EDT) model scaled (percent potential benefit / kilometre) for anadromous fish and qualitative habitat assessment method for resident fish. Well-coordinated (integrated) priorities were generated by giving preference to Endangered fish first, then Threatened, then all focal species. Categories (A,B,C) represents groups of AUs with the highest, intermediate, and lowest potential for benefit to focal species. Throughout the Methow subbasin, habitat diversity (floodplain connection, off-channel habitat, LWD, riparian vegetation) was the greatest limiting factor to anadromous fish (**Table 45**).

Other critical limiting factors included key habitat quantity (primarily a function of fewer quality pools for rearing and holding and fewer pool tailouts for spawning), sediment load (turbidity, embeddedness, and percent fines), obstructions, and channel stability. Common secondary limiting factors included flow (reduced base flow, increased peak flow), food (reduced salmon carcasses and benthic productivity), and temperature (high summer temperatures) (**Table 45**).

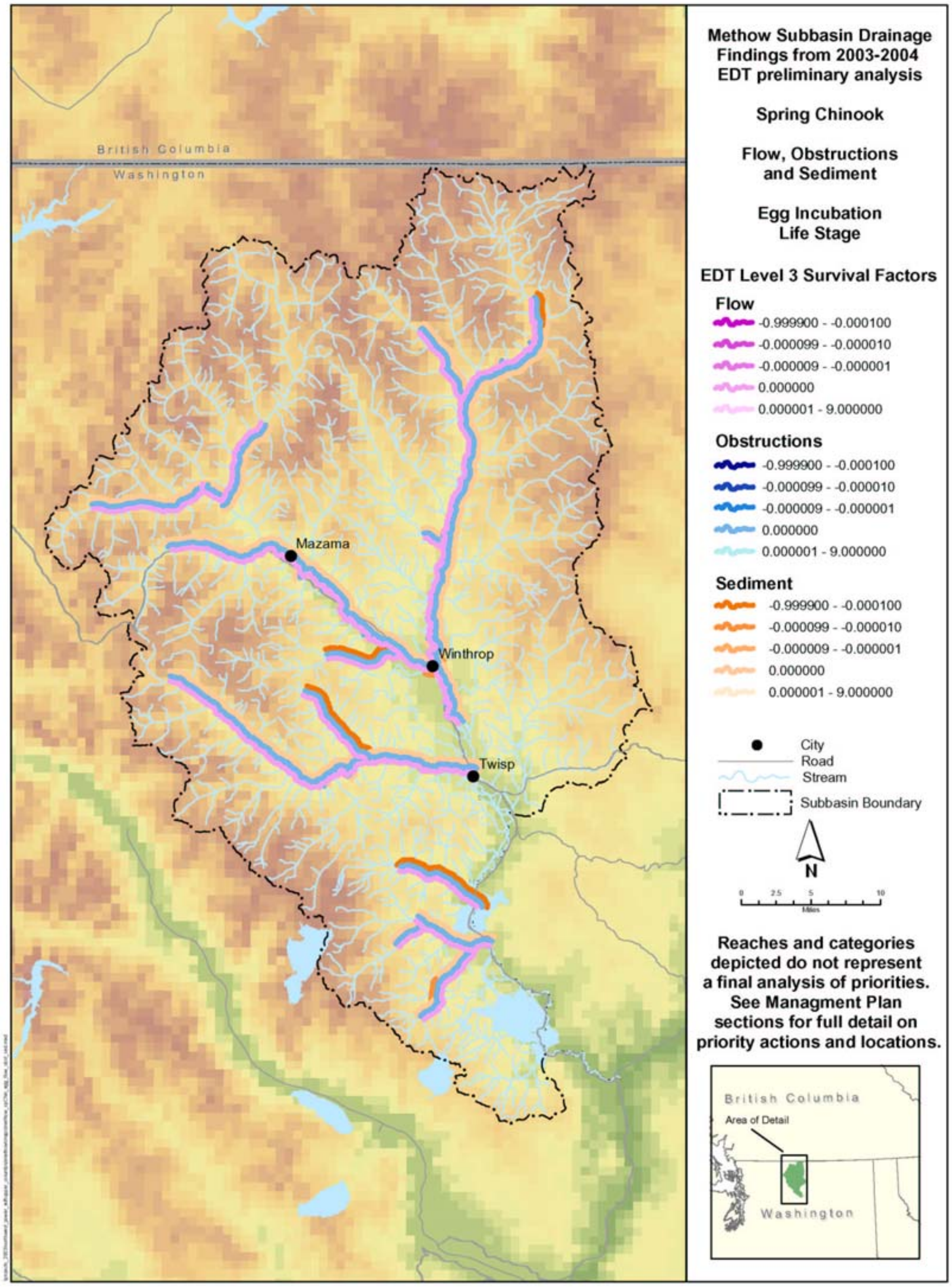

Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
All Populations,
All Life Stages
Low Flow
EDT Level 2 Low Flow
Spring Chinook
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
Summer/Fall Chinook
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
Summer Steelhead
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
City
Road
Stream
Subbasin Boundary
N
0
2.5
5
10
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
British Columbia
Area of Detail
Washington


Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
All Populations,
All Life Stages
Level 2 Riparian Factor
Spring Chinook
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
Summer/Fall Chinook
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
Summer Steelhead
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
City
Road
Stream
Subbasin Boundary
N
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail

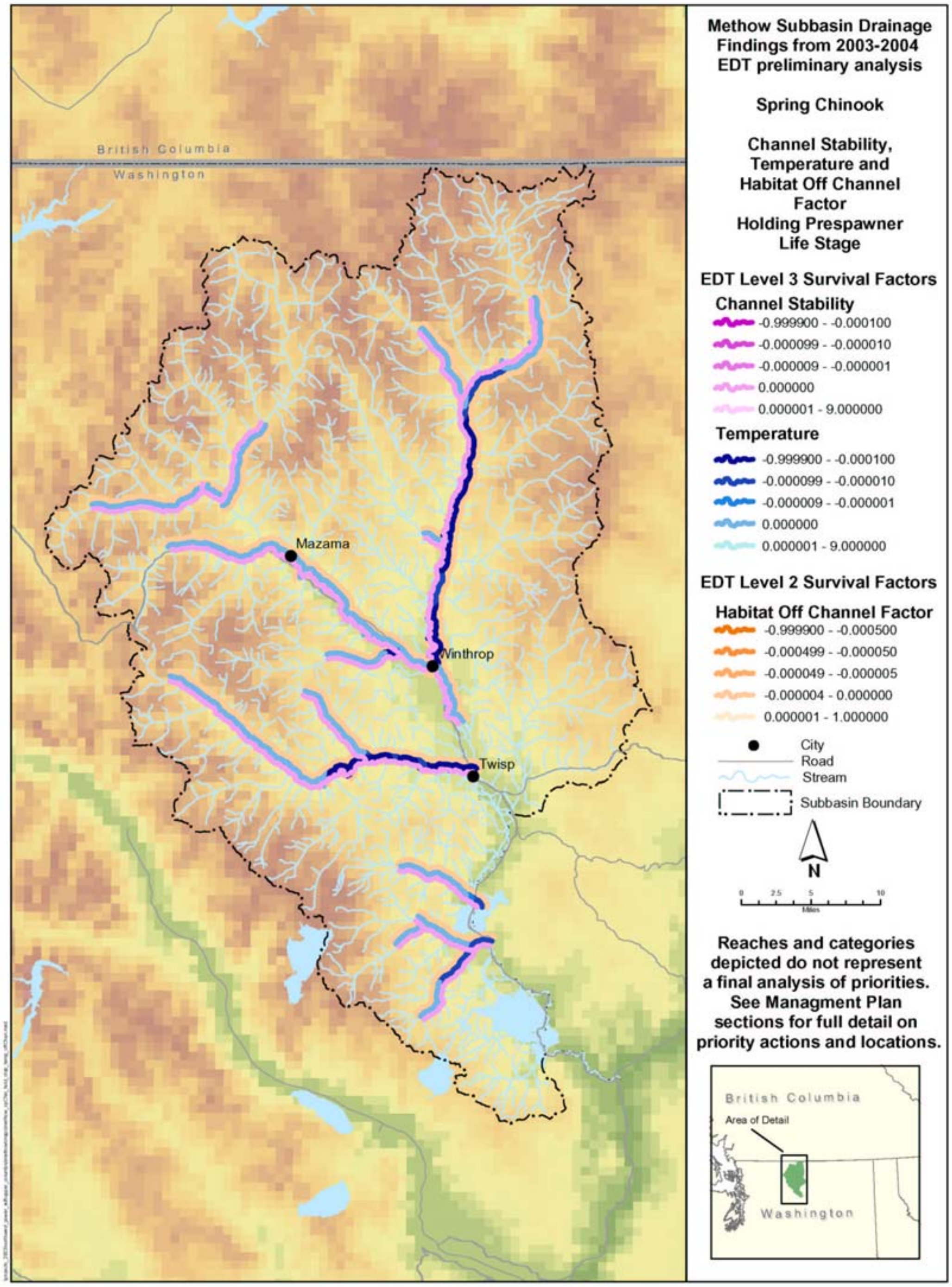

British Columbia
Washington
Mazama
Winthrop
Twisp
Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer/Fall Chinook
Abundance Restoration
All Life Stages
EDT Abundance
Restoration Classes
A
B
C
D
E
City
Road
Stream
Subbasin Boundary
N
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington



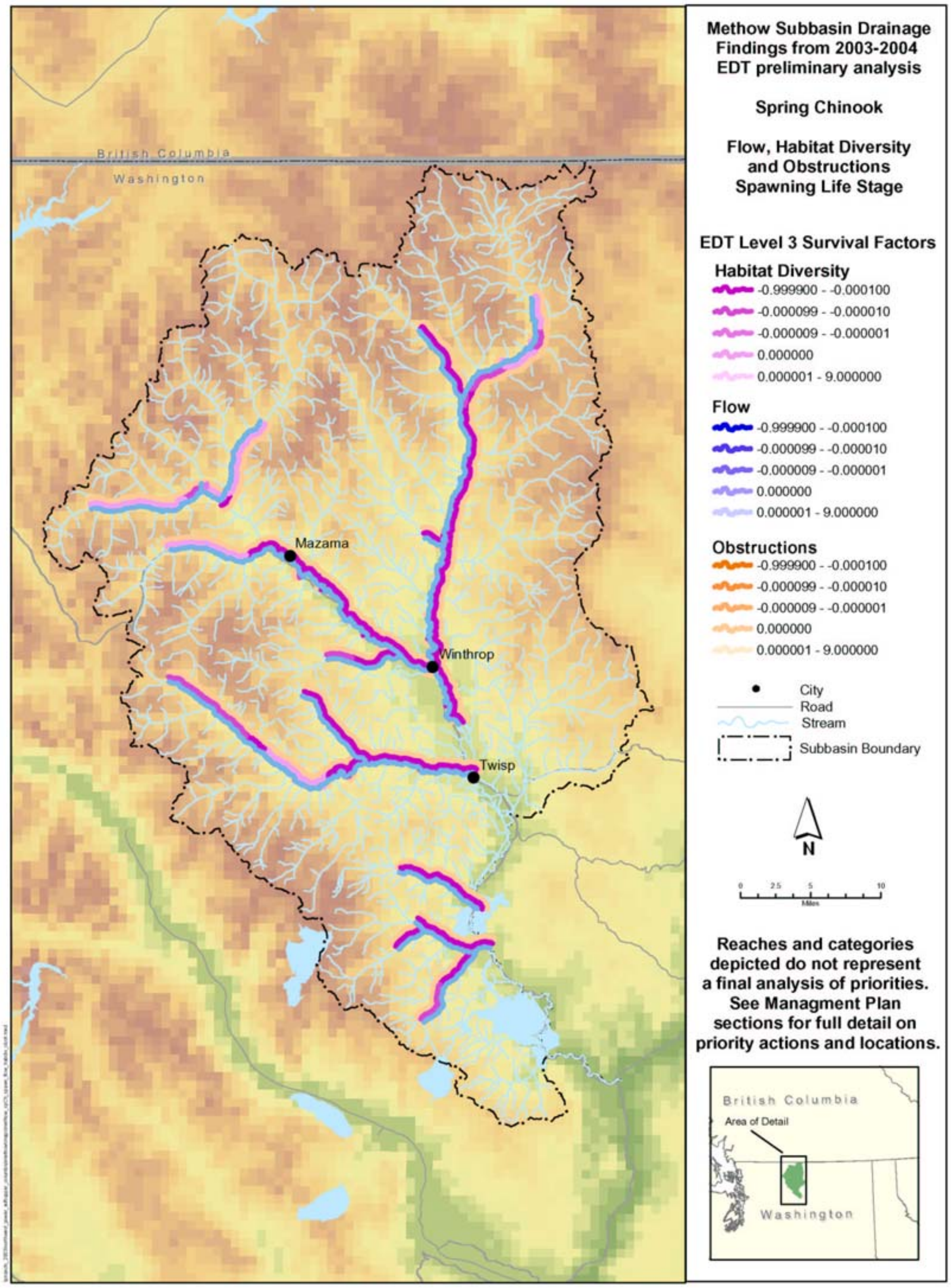
Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer/Fall Chinook
Flow, Habitat Diversity
and Withdrawal
Spawning Life Stage
EDT Level 3 Survival Factors
Habitat Diversity
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Flow
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Withdrawal
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
City
Road
Stream
Subbasin Boundary
N
0 2.5 5 10
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail



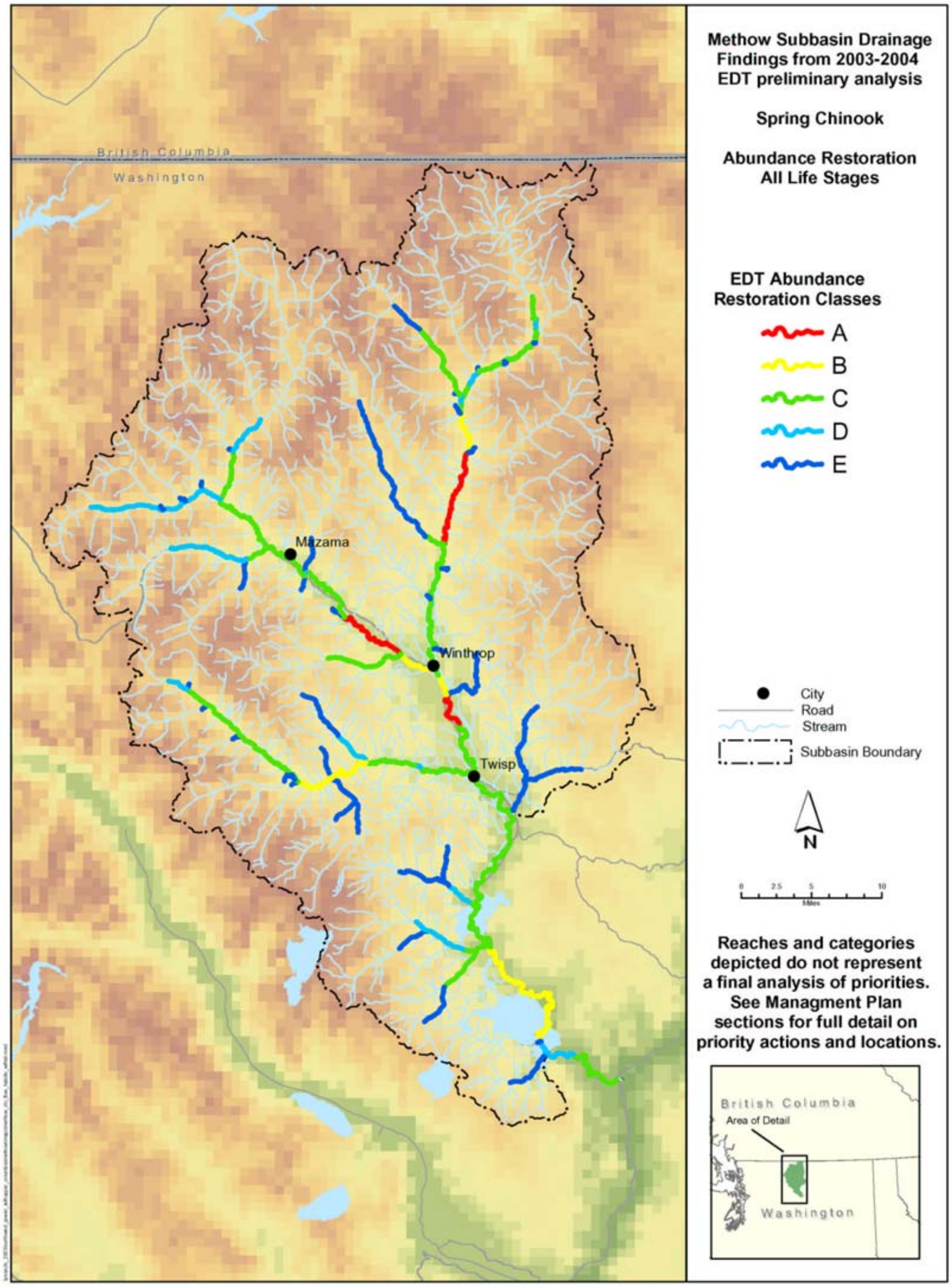
Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Spring Chinook
Flow, Obstructions
and Sediment
Egg Incubation
Life Stage
EDT Level 3 Survival Factors
Flow
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Obstructions
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Sediment
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
City
Road
Stream
Subbasin Boundary
N
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail



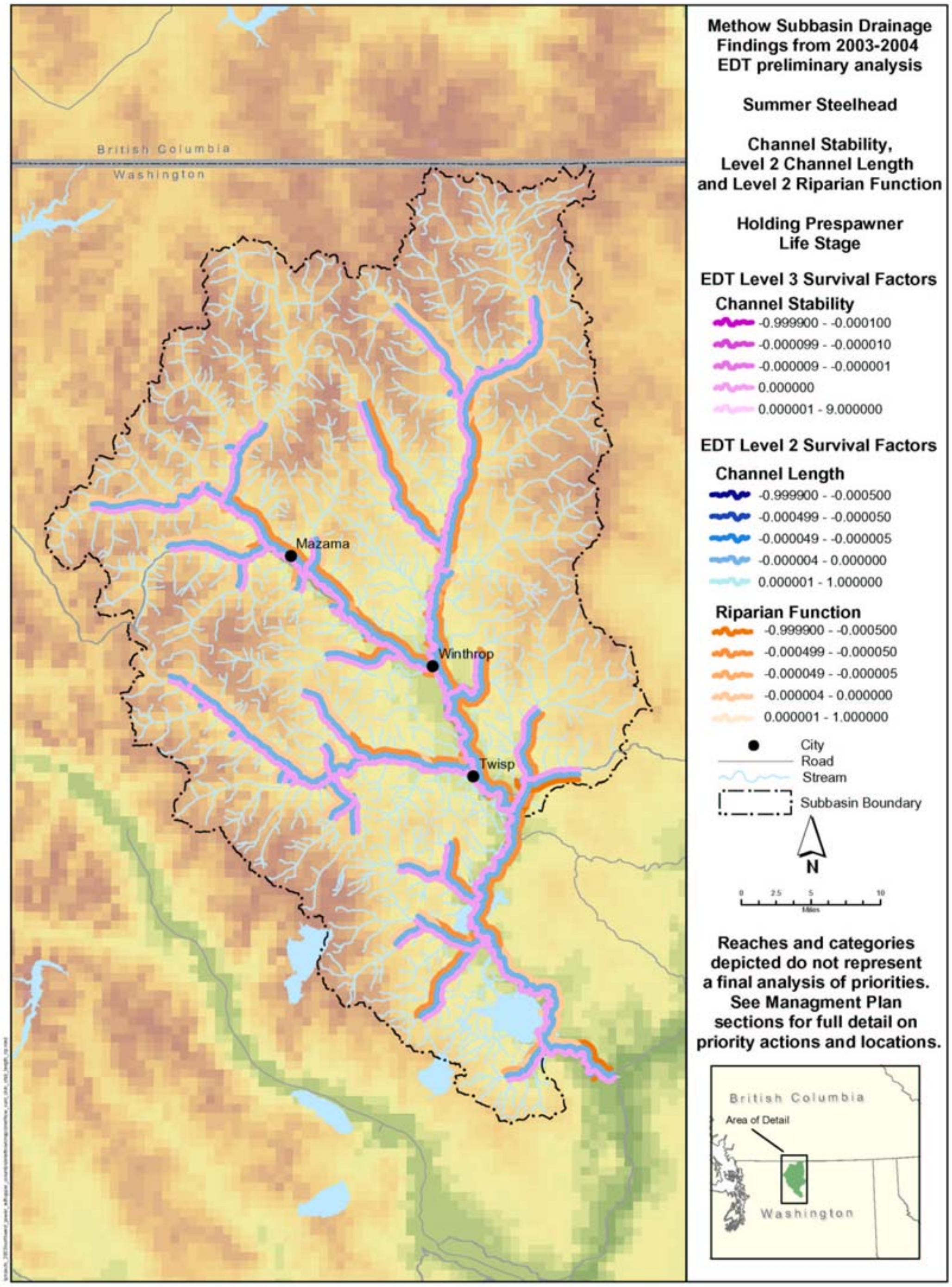
Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Spring Chinook
Channel Stability, Temperature and Habitat Off Channel Factor
Holding Prespawner Life Stage
EDT Level 3 Survival Factors
Channel Stability
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Temperature
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
EDT Level 2 Survival Factors
Habitat Off Channel Factor
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
City
Road
Stream
Subbasin Boundary
N
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail

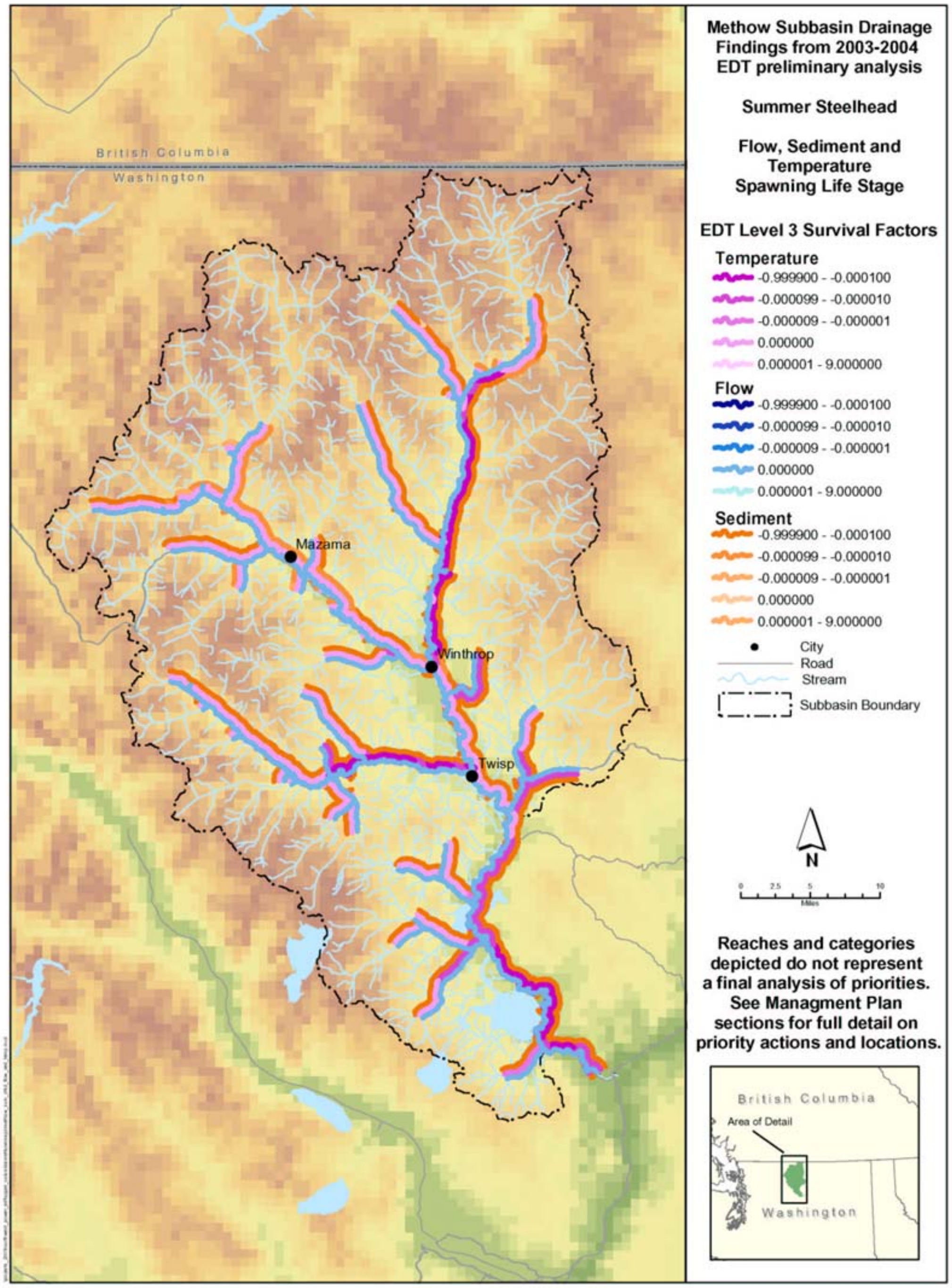


British Columbia
Washington
Mazama
Winthrop
Twisp
Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Spring Chinook
Flow, Habitat Diversity
and Obstructions
Spawning Life Stage
EDT Level 3 Survival Factors
Habitat Diversity
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Flow
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Obstructions
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
City
Road
Stream
Subbasin Boundary
N
0 2.5 5 10
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington

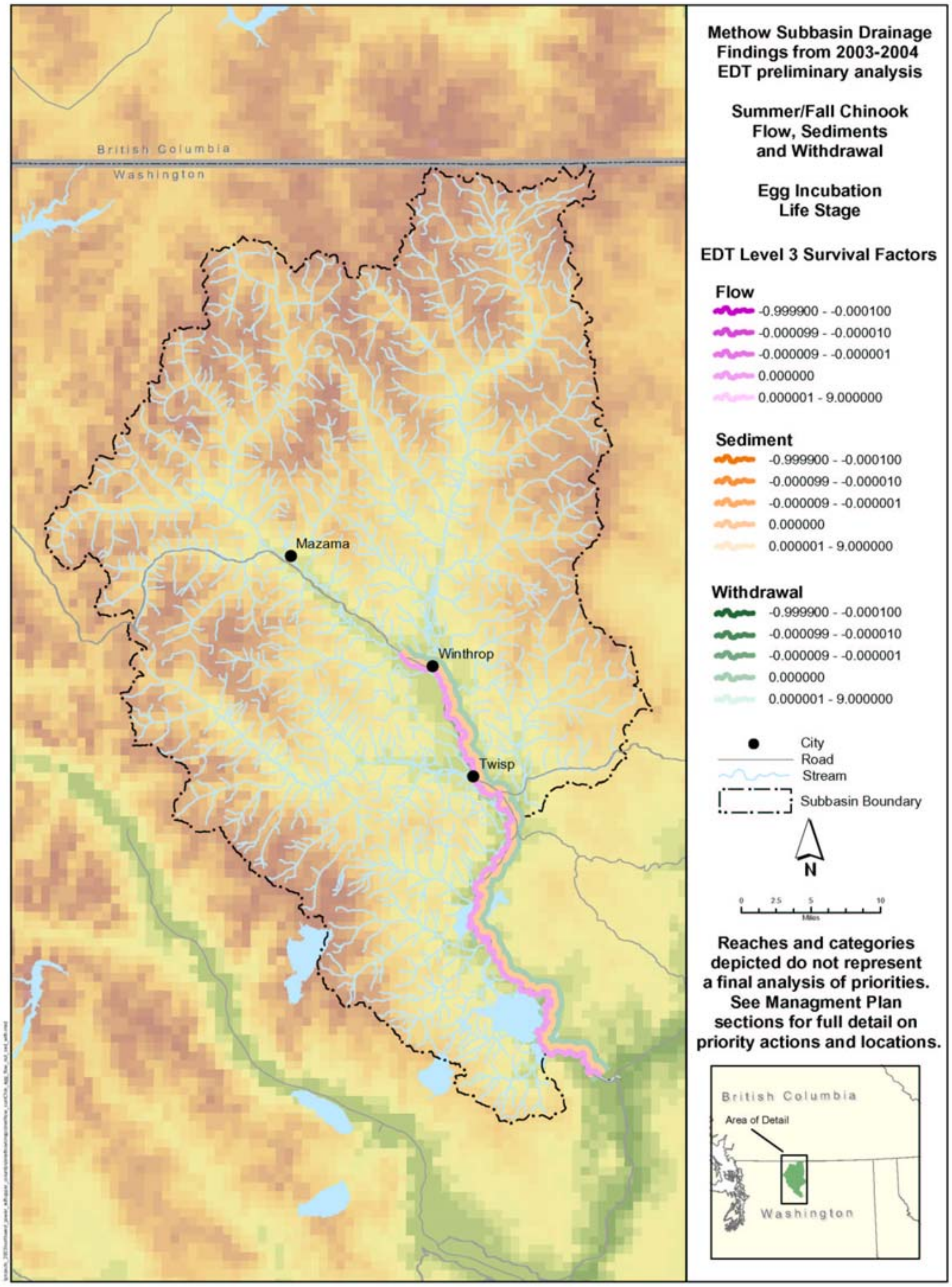


Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Spring Chinook
Abundance Restoration
All Life Stages
EDT Abundance
Restoration Classes
A
B
C
D
E
City
Road
Stream
Subbasin Boundary
N
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail

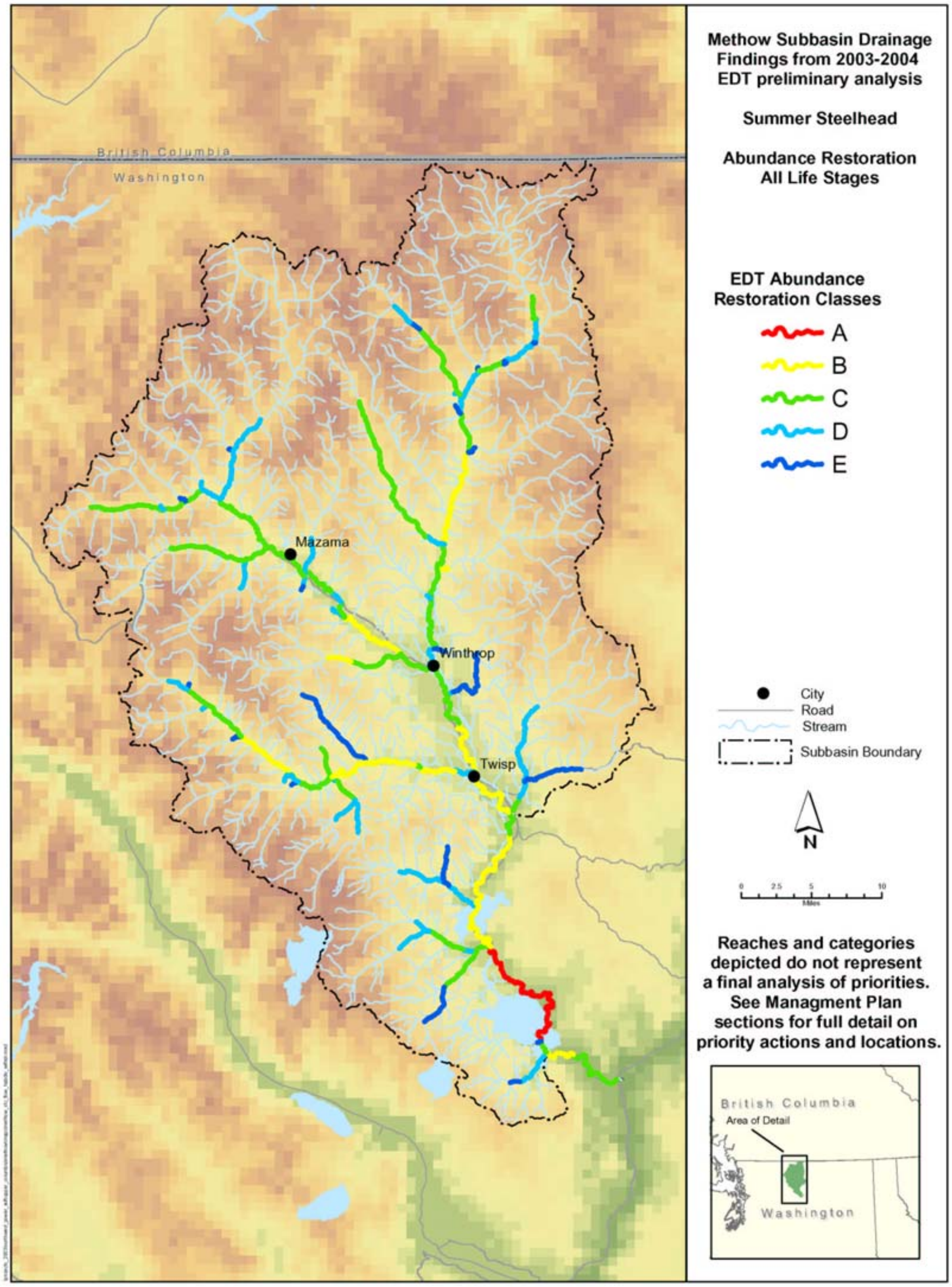

Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer Steelhead
Channel Stability,
Level 2 Channel Length
and Level 2 Riparian Function
Holding Prespawner
Life Stage
EDT Level 3 Survival Factors
Channel Stability
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
EDT Level 2 Survival Factors
Channel Length
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
Riparian Function
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
City
Road
Stream
Subbasin Boundary
N
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail



Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer Steelhead
Flow, Sediment and
Temperature
Spawning Life Stage
EDT Level 3 Survival Factors
Temperature
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Flow
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Sediment
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
City
Road
Stream
Subbasin Boundary
N
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail



Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer/Fall Chinook
Flow, Sediments
and Withdrawal
Egg Incubation
Life Stage
EDT Level 3 Survival Factors
Flow
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Sediment
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Withdrawal
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
City
Road
Stream
Subbasin Boundary
N
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail



Methow Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer Steelhead
Abundance Restoration
All Life Stages
EDT Abundance
Restoration Classes
A
B
C
D
E
City
Road
Stream
Subbasin Boundary
N
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Washington
Mazama
Winthrop
Twisp
Area of Detail

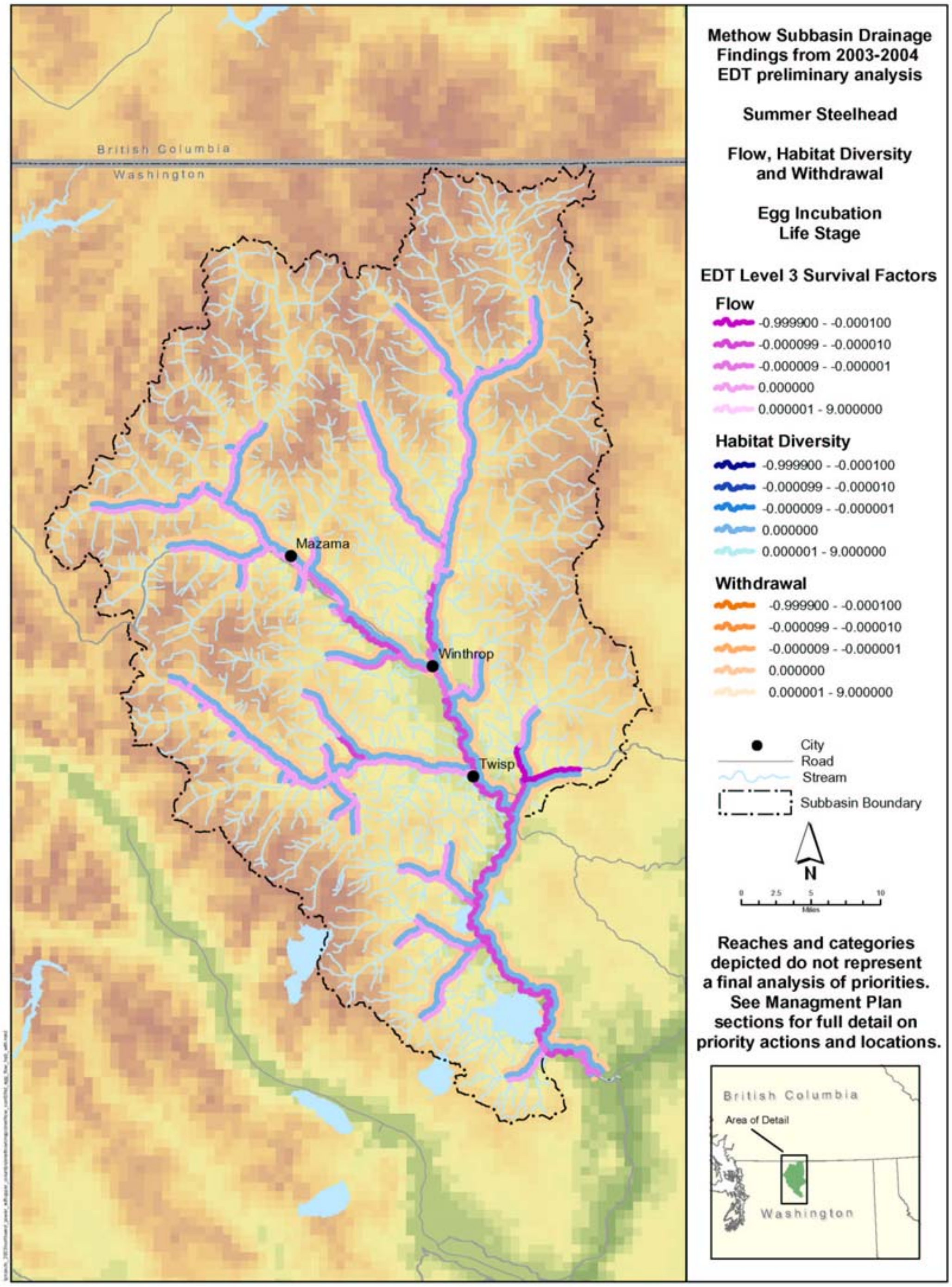


Table 44 Integrated priority geographic areas for habitat restoration for summer steelhead (Stlhd), spring Chinook (SprChk), summer/fall Chinook (S/FChk), bull trout (Bull Tr.), and westslope cutthroat trout (WSCT) in the Methow River subbasin, Washington

		Unscaled								Scaled (% / km)		
Geographic Area / Assessment Unit	**DI**	**Prod.**	**N(eq)**	**Sum**	**Total Cumu -lative**	**Within Basin Cumu-lative**	**Rank**	**Cate-gory**		**Sum**	**Rank**	**Cate-gory**
Out of Subbasin	89%	248%	723%	1060%			1	A		0.1%	14	C
Lower Twisp	21%	38%	54%	113%	7%	23%	2	A		2.0%	1	A
Lower Methow	27%	23%	44%	94%	13%	42%	3	A		1.8%	2	A
Middle Methow	17%	15%	26%	58%	17%	54%	4	B		1.4%	3	A
Beaver Ck/ Bear Ck	15%	10%	20%	46%	20%	63%	5	B		1.4%	4	A
Upper Chewuch	9%	13%	23%	45%	23%	72%	6	B		0.6%	10	C
Gold / Libby Ck	16%	9%	15%	40%	25%	80%	7	B		0.9%	7	B
Upper Methow / Early Winters Ck / Lost R.	1%	9%	16%	26%	27%	85%	8	C		0.4%	12	C
Upper Twisp	1%	9%	14%	24%	29%	90%	9	C		0.9%	8	B
Lower Chewuch	7%	6%	11%	24%	30%	95%	10	C		1.1%	6	B
Wolf / Hancock Ck	4%	3%	6%	13%	31%	97%	11	D		1.2%	5	B
Upper-Middle Methow	1%	1%	2%	5%	31%	98%	12	D		0.4%	13	C
Black Canyon/Squaw Ck	3%	1%	1%	5%	32%	99%	13	D		0.7%	9	C
Goat / Little Boulder Ck	2%	1%	1%	4%	32%	100%	14	D		0.5%	11	C

Table 45 Priority assessment units (AUs) and priority survival factors in the Methow subbasin, Washington.

Geographic Area / Assessment Unit	Integrated Priority Restoration Category	Habitat Diversity	Key habitat quantity	Sediment load	Obstructions	Channel Stability	Flow	Food	Temperature	Predation	Chemicals	Competition (hatchery fish)	Competition (other species)	Harassment/Poaching	Oxygen	Pathogens	Withdrawals
Middle Methow	A	1	2	2	1	1	2			2							
Lower Twisp	A	1	1	1	1	1	2	2	1								
Lower Chewuch	A	1	2	1	1	2	2	2	1								
Upper-Middle Methow	A	1	2			1	2	2									
Lower Methow	A	1		2					2	1							
Beaver Ck./ Bear Ck.	A	1	1	1	1	2	1	2									
Upper Twisp	B	1	1		1		2	2									
Wolf Ck / Hancock Ck	B	1	1	1	1	2	2	2	2								
Upper Chewuch	B	1	1	1	2	2		2	2								
Gold Ck/Libby Ck	B	1	1	1	1	2	2		2								
Upper Methow / Early Winters Ck / Lost R.	B	1	1			2	2	2									
Goat Ck / Little Boulder Ck	C	1	1	1		2		2									
Black Canyon/Squaw Ck	C	1		1	1		2										

Priorities were determined using the EDT model for steelhead and Chinook, and the QHA method for bull trout and cutthroat trout. For survival factors, 1=primary limiting factor, 2= secondary limiting factor, and blank cells were minor or not considered limiting factors.

3.23 EDT Species Results

3.23.1 Summer Steelhead

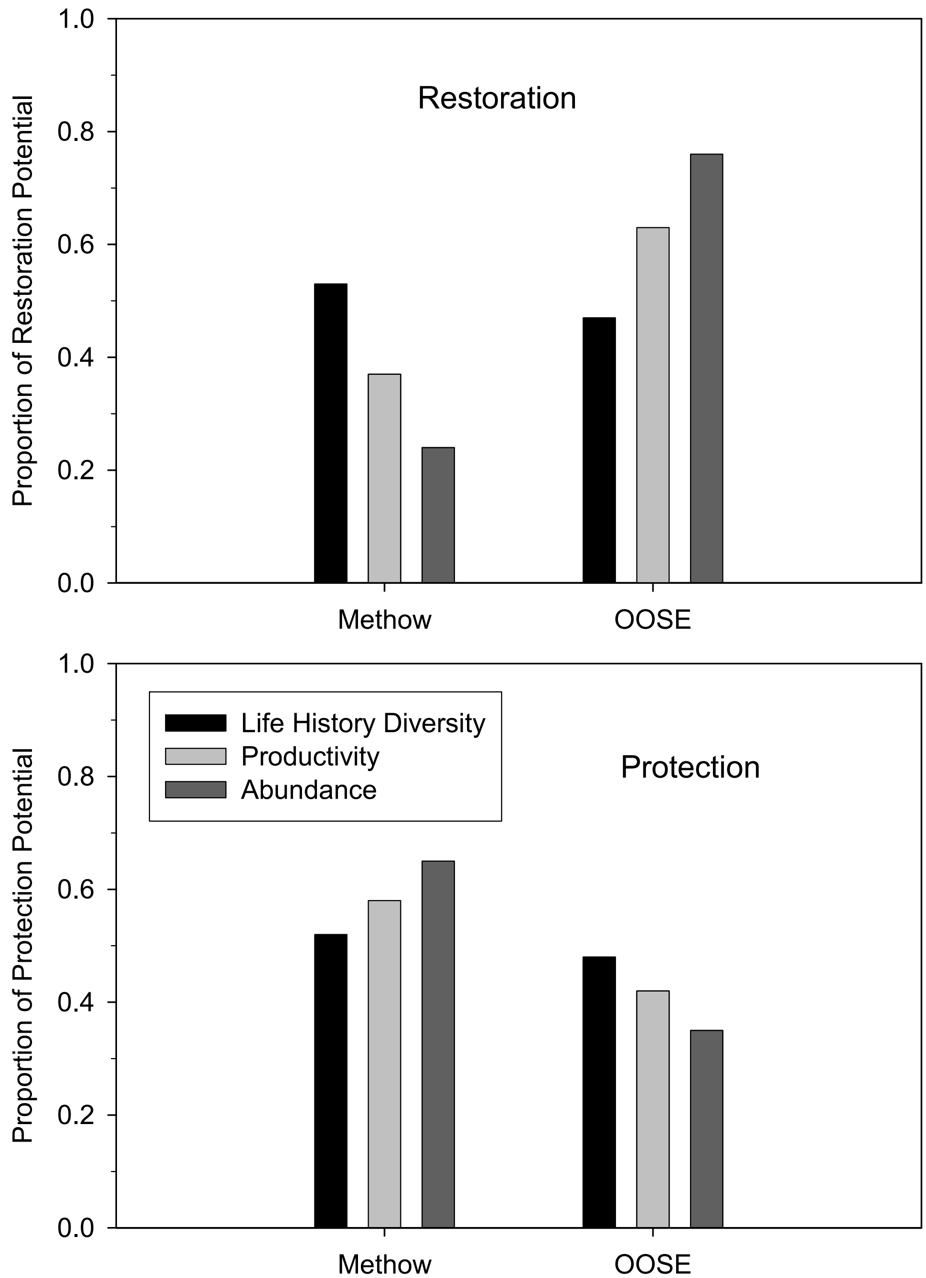
The restoration potential for summer steelhead within the Methow watershed was 59% for life history diversity, 35% for productivity, and 24% for abundance; therefore, increasing performance of summer steelhead in the Methow basin will be strongly tied to actions in the mainstem Columbia River. Additionally, when restoration actions are implemented in the Methow basin, we can expect to see the most gain in life history diversity, with smaller benefits to productivity and abundance.

Conversely, the largest potential losses to summer steelhead performance, because of degradation of habitat conditions, are within the Methow basin, with 68% for life history diversity, 74% for productivity, and 75% for abundance (**Table 46**). Therefore, it is most important to protect the pristine habitat in the Methow basin and prevent further degradation to current functional habitats.

Within the Methow basin, the Lower Twisp, Lower Methow Mainstem, Middle Methow Mainstem, and Beaver Creek/Bear Creek assessment units were the top priority for both scaled and unscaled restoration benefits (**Table 46**). These four assessment units comprised 63% (unscaled results) of the combined restoration potential for summer steelhead within the Methow basin and 20% of the overall restoration potential when including OOSE (**Figure 61**, **Table 46**).

For protection value, the Upper Twisp, Upper Methow (including Early Winters Creek and the Lost River), Lower Methow, and Upper Chewuch where the most important assessment units when considering both scaled and unscaled output. These four assessment units comprised 70% (unscaled results) of the combined protection benefit for summer steelhead within the Methow basin, and 51 % of the overall restoration potential when including OOSE The scaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometre basis. N(eq) was the equilibrium abundance of returning adult spawners (**Table 47**).

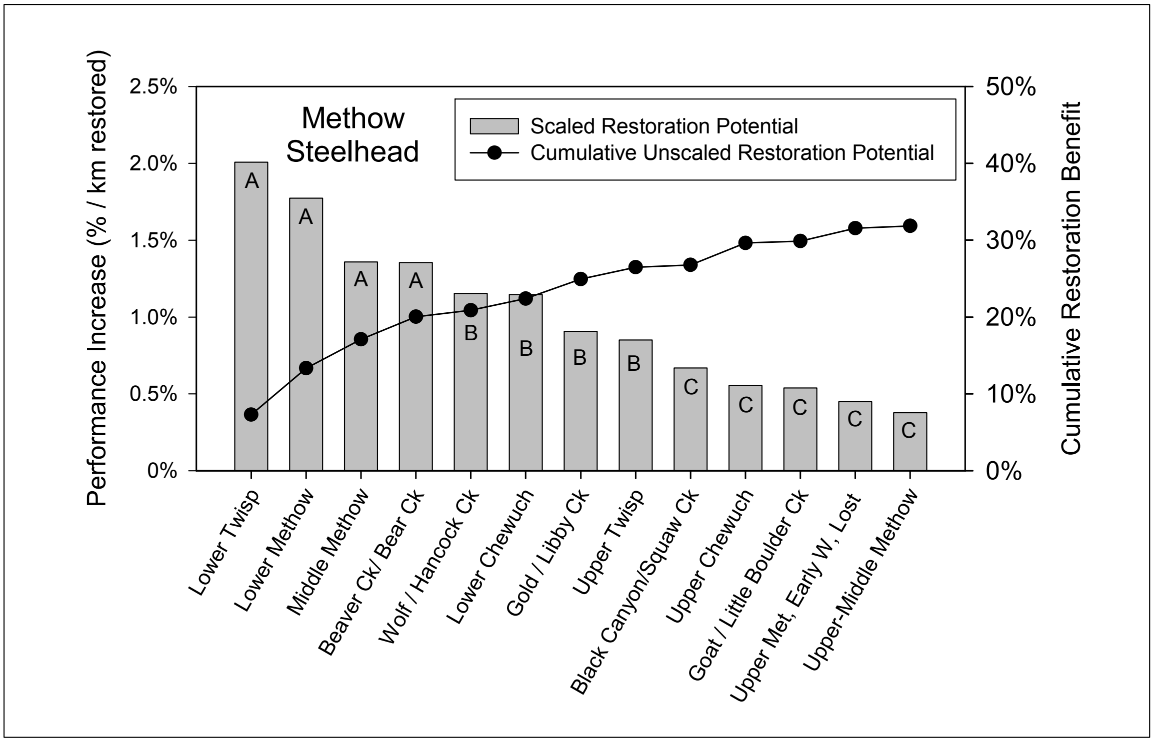
A summary of limiting habitat attributes and survival factors for each assessment unit and species specific life stage generated in the reach analysis of EDT can be found on the assessment unit summary sheets in the “synthesis of key findings” section of this report. The reach specific analysis reports that were generated in EDT and used to formulate the working hypothesis and limiting factors can be found at www.mobrand.com/edt/NWPCC/index.htm.



Source: Mobrand Biometrics Inc. 2004

Figure 60 Contribution of reaches inside and outside* the Methow River subbasin, Washington, to the total restoration and protection potential of summer steelhead

* Out-of-subbasin-effects (OOSE) include the Columbia River mainstem and estuary.



Source: Mobrand Biometrics Inc. 2004

Figure 61 Ecosystem Diagnosis and Treatment Model predictions of potential increased steelhead performance in the Methow basin, Washington, due to restoration actions in specific assessment units

Table 46 Ecosystem Diagnosis and Treatment (EDT) Model predictions of restoration potential for summer steelhead in Geographic Areas of the Methow basin, Washington

		Unscaled								Scaled (% / km)		
Geographic Area / Assessment Unit	**DI**	**Prod.**	**N(eq)**	**Sum**	**Total Cumu -lative**	**Within Basin Cumu-lative**	**Rank**	**Cate-gory**		**Sum**	**Rank**	**Cate-gory**
Out of Subbasin	89%	248%	723%	1060%			1	A		0.1%	14	C
Lower Twisp	21%	38%	54%	113%	7%	23%	2	A		2.0%	1	A
Lower Methow	27%	23%	44%	94%	13%	42%	3	A		1.8%	2	A
Middle Methow	17%	15%	26%	58%	17%	54%	4	B		1.4%	3	A
Beaver Ck/ Bear Ck	15%	10%	20%	46%	20%	63%	5	B		1.4%	4	A
Upper Chewuch	9%	13%	23%	45%	23%	72%	6	B		0.6%	10	C
Gold / Libby Ck	16%	9%	15%	40%	25%	80%	7	B		0.9%	7	B
Upper Methow / Early Winters Ck / Lost R.	1%	9%	16%	26%	27%	85%	8	C		0.4%	12	C
Upper Twisp	1%	9%	14%	24%	29%	90%	9	C		0.9%	8	B
Lower Chewuch	7%	6%	11%	24%	30%	95%	10	C		1.1%	6	B

		Unscaled								Scaled (% / km)		
Geographic Area / Assessment Unit	DI	Prod.	N(eq)	Sum	Total Cumu -lative	Within Basin Cumu-lative	Rank	Cate-gory		Sum	Rank	Cate-gory
Wolf / Hancock Ck	4%	3%	6%	13%	31%	97%	11	D		1.2%	5	B
Upper-Middle Methow	1%	1%	2%	5%	31%	98%	12	D		0.4%	13	C
Black Canyon/Squaw Ck	3%	1%	1%	5%	32%	99%	13	D		0.7%	9	C
Goat / Little Boulder Ck	2%	1%	1%	4%	32%	100%	14	D		0.5%	11	C

The scaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometre basis. N(eq) was the equilibrium abundance of returning adult spawners.

Table 47 Ecosystem Diagnosis and Treatment Model (EDT) predictions of degradation potential (protection benefit) for summer steelhead in Geographic Areas of the Methow Basin, Washington

				Unscaled						Scaled (% / km)		
Geographic Area / Assessment Unit	**DI**	**Prod.**	**N(eq)**	**Sum**	**Total Cumu -lative**	**Within Basin Cumu-lative**	**Rank**	**Cate-gory**		**Sum**	**Rank**	**Cate-gory**
Out of Subbasin	-60%	-44%	-100%	-204%			1	A		0.0%	14	D
Upper Methow / Early Winters Ck / Lost R.	-26%	-29%	-69%	-124%	16%	22%	2	A		-2.1%	2	A
Lower Methow	-21%	-24%	-63%	-108%	30%	42%	3	A		-2.0%	3	A
Upper Chewuch	-21%	-17%	-42%	-80%	41%	56%	4	A		-1.0%	6	B
Upper Twisp	-13%	-20%	-44%	-77%	51%	70%	5	A		-2.7%	1	A
Lower Twisp	-12%	-11%	-28%	-50%	58%	79%	6	B		-0.9%	8	B
Middle Methow	-10%	-9%	-22%	-41%	63%	86%	7	B		-1.0%	7	B
Gold / Libby Ck	-6%	-4%	-11%	-21%	66%	90%	8	C		-0.5%	11	C
Upper-Middle Methow	-9%	-2%	-5%	-16%	68%	92%	9	C		-1.3%	4	B
Lower Chewuch	-4%	-3%	-9%	-15%	70%	95%	10	C		-0.7%	9	C
Beaver CS[k./ Bear Ck.	-1%	-2%	-7%	-11%	71%	97%	11	C		-0.3%	12	C
Goat / Little Boulder Ck	-5%	-1%	-2%	-8%	72%	99%	12	D		-1.2%	5	B
Wolf / Hancock Ck	-1%	-2%	-4%	-7%	73%	100%	13	D		-0.7%	10	C
Black Canyon/Squaw Ck	0%	0%	0%	0%	73%	100%	14	D		-0.1%	13	D

The scaled rank adjusted the unscaled rank by dividing by the length of stream in the Geographic Area to evaluate restoration potential on a per kilometre basis. N(eq) was the equilibrium abundance of returning adult spawners.

3.23.2 Spring Chinook

The restoration potential for spring Chinook within the Methow watershed was 58% for life history diversity, 43% for productivity, and 40% for abundance (**Figure 62**). Therefore, increasing performance of spring Chinook in the Methow basin will be strongly tied to actions in the mainstem Columbia River. Additionally, when restoration actions are implemented in the Methow basin, we can expect to see the most gain in life history diversity, with smaller benefits to productivity and abundance. Conversely, the largest potential losses to spring Chinook performance because of degradation of habitat conditions were within the Methow basin, with 94% for life history diversity, 89% for productivity, and 89% for abundance. It is most important, therefore, to protect the pristine habitat in the Methow basin and prevent further degradation to current functional habitats.

Within the Methow basin, the Middle Methow mainstem, Lower Chewuch, and Lower Twisp were high priority for both scaled and unscaled restoration benefits (Table 48). Additionally, the Upper-Middle Methow (Weeman Bridge to Robinson Creek) was high priority for scaled output, and the Upper Chewuch was high priority for unscaled output (**Table 49**). These five AUs comprised 83% (sum of unscaled totals for life history diversity, productivity, and abundance) of the restoration potential for spring Chinook in the Methow basin.

For protection value, the Upper Methow (including Early Winters Creek and Lost River), Upper Twisp, Upper-Middle Methow, Middle Methow, and Upper Chewuch were the most important AUs when considering both scaled and unscaled output (**Table 49**). These five AUs comprised 81% (sum of unscaled totals for life history diversity, productivity, and abundance) of the protection benefit for spring Chinook in the Methow basin.

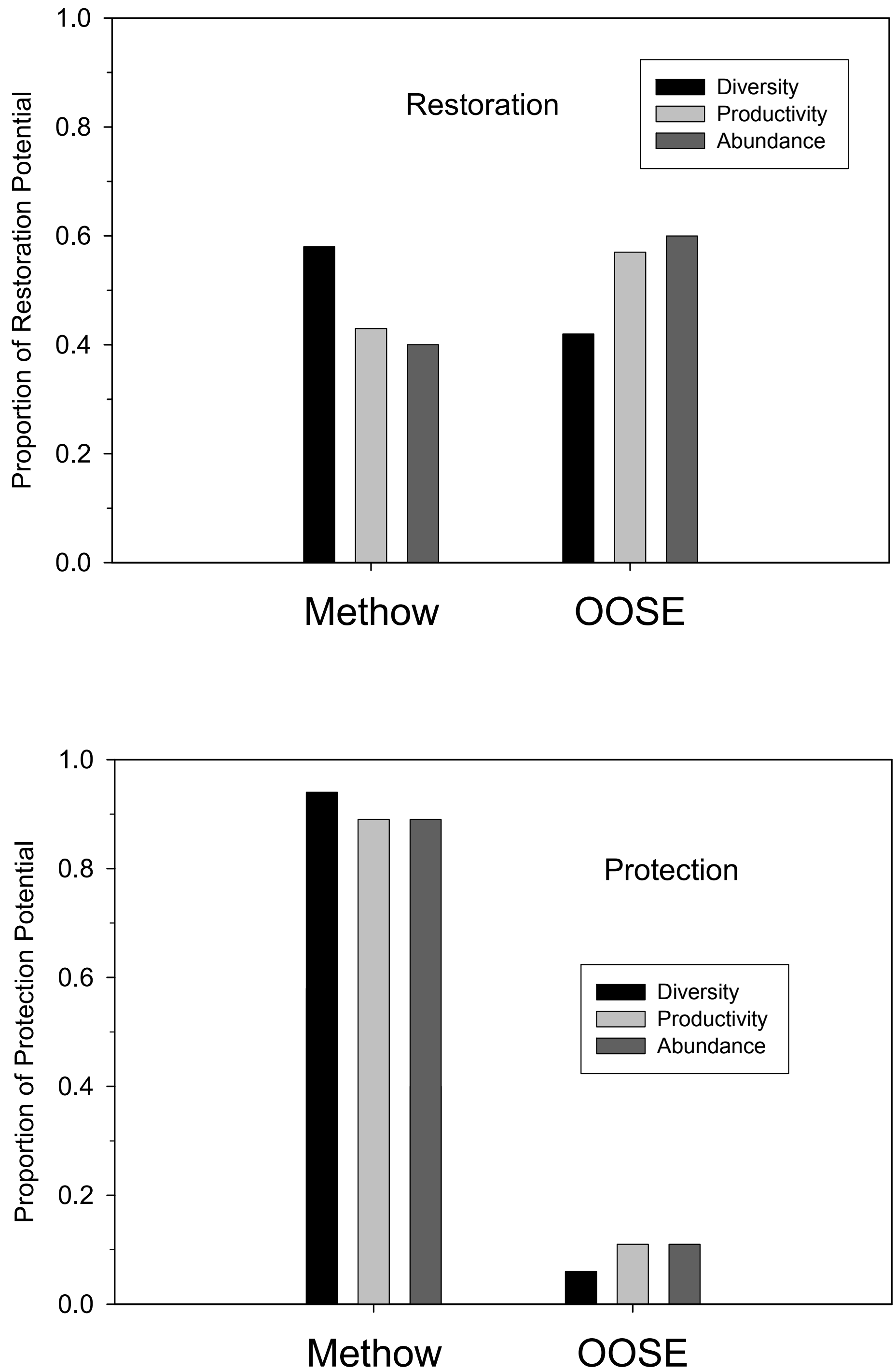


Figure 62 Contribution of reaches inside and outside* the Methow River subbasin, Washington to the total restoration and protection potential of spring Chinook

* Out-of-subbasin-effects (OOSE) include the Columbia River mainstem and estuary.

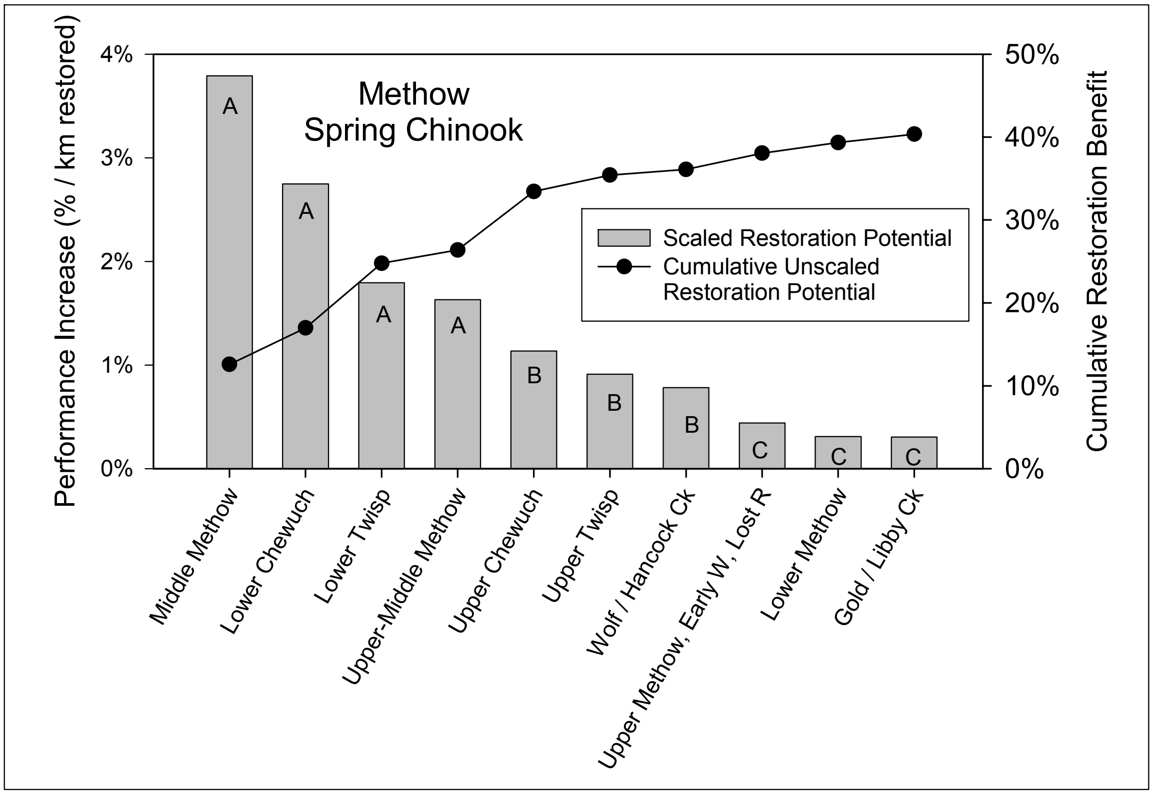


Figure 63 Ecosystem Diagnosis and Treatment Model predictions of potential increased spring chinook performance in the Methow basin, Washington, due to restoration actions in specific assessment units

Table 48 Ecosystem Diagnosis and Treatment Model (EDT) predictions of restoration potential for spring Chinook in Geographic Areas of the Methow basin, Washington

				Unscaled						Scaled (% / km)		
Geographic Area / Assessment Unit	**DI**	**Prod.**	**N(eq)**	**Sum**	**Total Cumu-lative**	**Within Basin Cumu-lative**	**Rank**	**Cate-gory**		**Sum**	**Rank**	**Cate-gory**
Out of Subbasin	31%	257%	485%	773%			1	A		0.1%	11	C
Middle Methow	10%	63%	91%	163%	13%	31%	2	A		3.8%	1	A
Lower Twisp	13%	36%	53%	101%	20%	51%	3	A		1.8%	3	A
Upper Chewuch	4%	34%	53%	92%	27%	68%	4	A		1.1%	5	B
Lower Chewuch	6%	19%	31%	57%	32%	79%	5	A		2.7%	2	A
Upper Methow / Early Winters Ck / Lost R.	0%	10%	15%	26%	34%	84%	6	B		0.4%	8	C
Upper Twisp	0%	11%	15%	26%	36%	89%	7	B		0.9%	6	B
Upper-Middle Methow	0%	10%	11%	21%	37%	93%	8	B		1.6%	4	A
Lower Methow	2%	4%	10%	16%	39%	96%	9	C		0.3%	9	C
Gold / Libby Ck	4%	3%	6%	13%	40%	98%	10	C		0.3%	10	C
Wolf / Hancock Ck	4%	2%	3%	9%	40%	100%	11	C		0.8%	7	B

The scaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometre basis. N(eq) was the equilibrium abundance of returning adult spawners.

Table 49 Ecosystem Diagnosis and Treatment (EDT) Model predictions of degradation potential (protection benefit) for spring Chinook in Geographic Areas of the Methow Basin, Washington

			Unscaled							Scaled (% / km)		
Geographic Area / Assessment Unit	DI	Prod.	N(eq)	Sum	Total Cumu -lative	Within Basin Cumu- lative	Rank	Cate- gory		Sum	Rank	Cate- gory
Upper Methow / Early Winters Ck / Lost R.	-32%	-24%	-27%	-83%	18%	20%	1	A		-1.4%	4	B
Upper Chewuch	-24%	-18%	-33%	-75%	35%	39%	2	A		-0.9%	6	B
Middle Methow	-14%	-22%	-34%	-70%	50%	56%	3	A		-1.6%	3	B
Upper Twisp	-14%	-23%	-22%	-59%	64%	70%	4	A		-2.1%	2	A
Upper-Middle Methow	-12%	-16%	-17%	-45%	73%	81%	5	B		-3.5%	1	A
Out of Subbasin	-7%	-15%	-22%	-44%			6	B		0.0%	11	C
Lower Twisp	-6%	-13%	-19%	-38%	82%	91%	7	B		-0.7%	7	B
Lower Chewuch	-8%	-5%	-14%	-27%	88%	97%	8	B		-1.3%	5	B
Lower Methow	-2%	-1%	-3%	-6%	89%	99%	9	C		-0.1%	9	C
Gold / Libby Ck	-1%	0%	-2%	-4%	90%	99%	10	C		-0.1%	10	C
Wolf / Hancock Ck	0%	0%	-2%	-2%	90%	100%	11	C		-0.2%	8	C

The scaled rank adjusted the unscaled rank by dividing by the length of stream in the Geographic Area to evaluate restoration potential on a per kilometre basis. N(eq) was the equilibrium abundance of returning adult spawners.

3.23.3 Summer Chinook

The restoration potential for summer/fall Chinook within the Methow watershed was 53% for life history diversity, 37% for productivity, and 24% for abundance (**Figure 64**); therefore, increasing performance of spring Chinook in the Methow basin will be strongly tied to actions in the mainstem Columbia River. Additionally, when restoration actions are implemented in the Methow basin, we can expect to see the most gain in life history diversity, with smaller benefits to productivity and abundance. Conversely, the largest potential losses to summer/fall Chinook performance because of degradation of habitat conditions were within the Methow basin, with 52% for life history diversity, 58% for productivity, and 65% for abundance. Therefore, it is most important to prevent further degradation to current functional habitats.

Summer/fall Chinook only occur in the lower 55 miles of the Methow River mainstem, which only spans two of the AUs delineated in our EDT model run. It does not make sense to prioritize at this course scale, so we gave primary importance to both the Lower and Middle Methow AUs. Prioritizing individual reaches within these AUs for summer/fall Chinook in a separate EDT model run was beyond the scope of this subbasin plan.

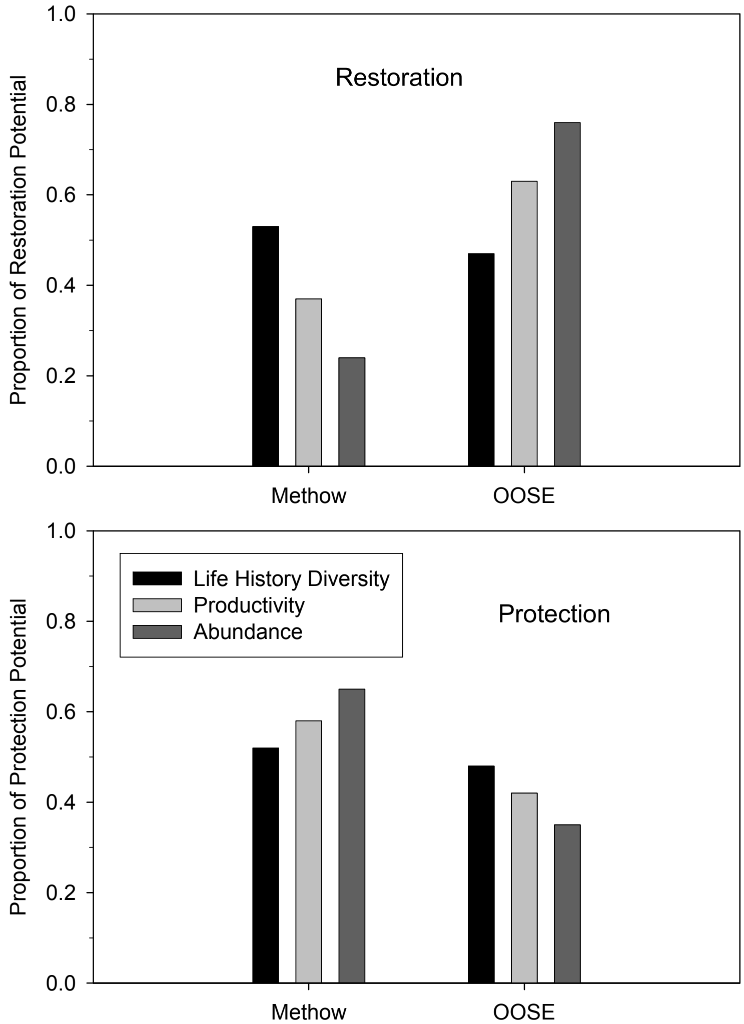


Figure 64 Contribution of reaches inside and outside* the Methow River subbasin, Washington to the total restoration and protection potential of summer/fall Chinook

* Out-of-subbasin-effects (OOSE) include the Columbia River mainstem and estuary.

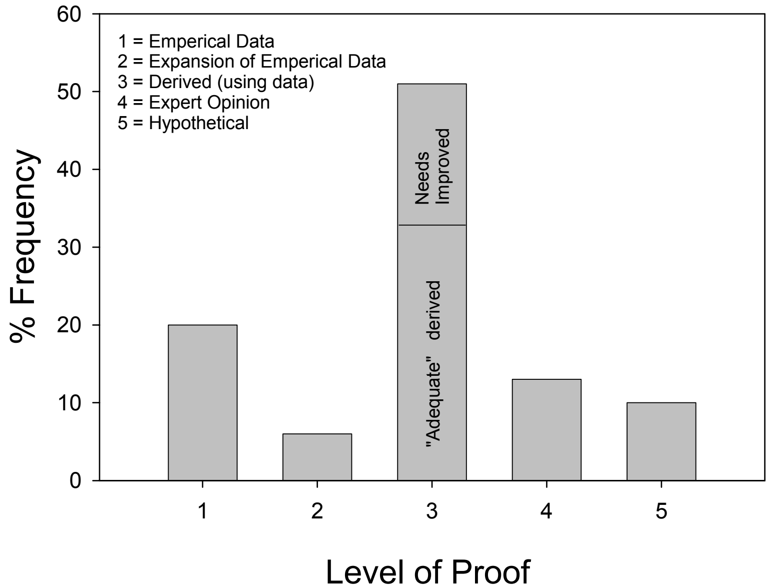


Figure 65 Summary of basin-wide level of proof used to rate EDT input data for current environmental conditions in the Methow subbasin, Washington

Table 50 Integrated priority geographic areas for habitat restoration for summer steelhead (Stlhd), spring Chinook (SprChk), summer/fall Chinook (S/FChk), bull trout (Bull Tr.), and westslope cutthroat trout (WSCT) in the Methow River subbasin, Washington

	EDT Restoration Priorities			QHA Restoration Priorities				
Geographic Area / Assessment Unit	**Steel-head**	**Spr-Chk**	**Sum-Fal-Chk**	**Bull Tr.**	**WSCT**	**Endangered Fish Sum**	**All Fish Sum**	**Cate-gory**
Middle Methow	1	1	1	1	2	2	6	A
Lower Twisp	1	1	4	2	2	2	10	A
Lower Chewuch	2	1	4	2	2	3	11	A
Upper-Middle Methow	3	1	4	1	1	4	10	A
Lower Methow	1	3	1	3	3	4	11	A
Beaver Ck / Bear Ck.	1	4	4	3	4	5	16	A
Upper Twisp	2	2	4	1	1	4	10	B
Wolf Creek / Hancock Ck	2	2	4	1	1	4	10	B
Upper Chewuch	3	2	4	1	1	5	11	B
Gold Ck / Libby Ck	2	3	4	1	2	5	12	B
Upper Methow / Early Winters Ck / Lost R.	3	3	4	1	1	6	12	B
Goat / Little Boulder Ck	3	4	4	2	2	7	15	B
Black Canyon / Squaw Ck	3	4	4	4	4	7	19	C

For each focal species-AU combination, categorical ranks (A,B,C) were converted to numerical values (1,2,3) and a value of 4 was assigned to the assessment unit if a particular species was absent. Intra-specific priorities were generated using the Ecosystem Diagnosis and Treatment model scaled (% potential benefit / km) for anadromous fish and qualitative habitat assessment method for resident fish. Inter-specific (integrated) priorities were generated by giving preference to Endangered fish first, then Threatened, then all focal species. Categories (A,B,C) represents groups of assessment units with the highest, intermediate, and lowest potential for benefit to focal species.

Table 51 Integrated priority geographic areas for habitat protection for summer steelhead, spring Chinook (Spr-Chk), summer/fall Chinook (Sum-Fal-Chk), bull trout (Bull Tr.), and westslope cutthroat trout (WSCT) in the Methow River Subbasin, Washington

	EDT Restoration Priorities				QHA Restoration Priorities					
Geographic Area / Assessment Unit	**Steel-head**	**Spr-Chk**	**Sum-Fal-Chk**		**Bull Tr.**	**WSCT**		**Endangered Fish Sum**	**All Fish Sum**	**Cate-gory**
Upper Twisp	1	1	4		1	1		2	8	A
Upper Methow / Early Winters Ck / Lost R.	1	2	4		1	1		3	9	A
Upper-Middle Methow	2	1	4		1	1		3	9	A
Lower Methow	1	3	1		3	3		4	11	A
Upper Chewuch	2	2	4		1	1		4	10	B
Wolf Ck / Hancock Ck	3	3	4		1	1		6	12	B
Gold Ck/Libby Ck	3	3	4		1	1		6	12	B
Middle Methow	2	2	1		2	2		4	9	B
Goat Ck / Little Boulder Ck	2	4	4		2	2		6	14	B
Lower Twisp	2	2	4		3	3		4	14	B
Lower Chewuch	3	2	4		3	3		5	15	B
Beaver Ck./ Bear Ck.	3	4	4		3	3		7	17	C
Black Canyon/Squaw Ck	4	4	4		3	3		8	18	C

For each focal species-AU combination, categorical ranks (A,B,C) were converted to numerical values (1,2,3) and a value of 4 was assigned to the assessment unit if a particular species was absent. Intra-specific priorities were generated using the Ecosystem Diagnosis and Treatment model scaled (% potential benefit / km) for anadromous fish and qualitative habitat assessment method for resident fish. Inter-specific (integrated) priorities were generated by giving preference to endangered fish first, then threatened, then all focal species. Categories (A,B,C) represents groups of assessment units with the highest, intermediate, and lowest potential for benefit to focal species.

Table 52 Priority assessment units and priority survival factors in the Methow subbasin, Washington

Geographic Area / Assessment Unit	Integrated Priority Restoration Category	Habitat Diversity	Key habitat quantity	Sediment load	Obstructions	Channel Stability	Flow	Food	Temperature	Predation	Chemicals	Competition (hatchery fish)	Competition (other species)	Harassment/Poaching	Oxygen	Pathogens	Withdrawals
Middle Methow	A	1	2	2	1	1	2			2							
Lower Twisp	A	1	1	1	1	1	2	2	1								
Lower Chewuch	A	1	2	1	1	2	2	2	1								
Upper-Middle Methow	A	1	2			1	2	2									
Lower Methow	A	1		2					2	1							
Beaver Ck./ Bear Ck.	A	1	1	1	1	2	1	2									
Upper Twisp	B	1	1		1		2	2									
Wolf Ck / Hancock Ck	B	1	1	1	1	2	2	2	2								
Upper Chewuch	B	1	1	1	2	2		2	2								
Gold Ck/Libby Ck	B	1	1	1	1	2	2		2								
Upper Methow / Early Winters Ck / Lost R.	B	1	1			2	2	2									
Goat Ck / Little Boulder Ck	C	1	1	1		2		2									
Black Canyon/Squaw Ck	C	1		1	1		2										

Priorities were determined using the EDT model for steelhead and Chinook, and the QHA method for bull trout and cutthroat trout. For survival factors, 1=primary limiting factor, 2= secondary limiting factor, blank cells were minor or not considered limiting factors.

Limiting Environmental Attributes

The Methow Basin is a naturally harsh environment for fish, with high peak flows, low base flows, warm summers, extremely cold winters, natural dewatering areas, and intense fire regimes. Our assessment was not designed nor intended to evaluate the conditions that naturally limit salmonid production. We determined limiting factors from EDT output that identified the survival factors that deviated the most from template conditions. If low base flow and cold winter temperatures are the natural limitations to salmonid production in the Methow Basin, then our assessment would not identify those factors, unless it was determined that current flow is lower and current temperatures are colder. This is an important distinction because the goal of this assessment was to identify the greatest opportunities for improvement within the Methow basin. The goal was not to identify the natural limits of the watershed, nor to compare and contrast cost-benefit tradeoffs of improving survival inside the Methow basin versus in the mainstem Columbia River or other area outside the basin.

Throughout the Methow Subbasin, habitat diversity was the most common limiting factor to focal fish species (Table 8). Habitat diversity was a function of gradient, natural confinement, man-made confinement, floodplain connection, off-channel habitat, LWD, and riparian vegetation. The effect of man-made confinement, riparian function, and template LWD were driving these results, but there was no way to validate our assumptions about template conditions. Losses to habitat diversity affected most life stages from moderate to high degrees, depending on the AU and species. See the working hypothesis in Appendix E for predictions of life stages most affected by losses of habitat diversity.

Other critical limiting factors included key habitat quantity (which was primarily a function of reduced quality pools for rearing and holding and reduced pool tailouts for spawning), sediment load (turbidity, embeddedness, and % fines), obstructions, and channel stability (bed scour, icing, riparian function, wood, man-made confinement, flashy flow, change in annual peak flow). We assumed that man-made confinement, recent and historic removal of LWD, increased bed scour, and degraded riparian zone vegetation had reduced the number of quality pools, pool tailouts, and LWD in most of the lower reaches of the Methow River and its tributaries. The difference between current and template values for these assumptions were driving the results that these survival factors were primary limiting factors in the Methow Basin, and there was no way to validate our assumptions about template conditions. Channel stability (bed scour) and sediment load were particularly problematic for fry colonization and incubation life stages, whereas obstructions and key habitat quantity varied by AU depending on localized conditions within the AU. See the working hypothesis in Appendix E for predictions of life stages and assessment units most affected by these habitat attributes.

Common secondary limiting factors included flow (reduced base flow, increased peak flow), food (reduced salmon carcasses and benthic invertebrate productivity), and temperature (high summer temperatures) (Table 8). Although there was a slight increase to peak flow and flashy flow because of road density, the majority of flow-related problems in the Methow basin were related to water withdrawals during summer low flows, impacting juvenile rearing life stages and pre-spawn holding and spawning spring Chinook. There are studies underway, and a draft watershed plan, that deals extensively with irrigation withdrawals, groundwater recharge, IFIM, and other flow-related issues. We did not attempt a scientifically defensible analysis of base flow in relation to salmonid performance; however, the EDT model is capable of evaluating the benefit of alteration to flow regimes. This tool could be used in the future to predict benefits and tradeoffs, once options are identified for improving flow conditions in the Methow basin. Our assessment identified flow as a secondary limiting factor to salmonid performance; therefore, opportunities to fill data gaps regarding flow or increase flow during base flow conditions should be pursued, but not at the expense of other primary limiting factors. See the working hypothesis in Appendix E for predictions of life stages and assessment units most affected by increased peak flows and reduced base flows.

Fewer salmon carcasses were the primary reason for food being identified as a secondary limiting factor. The EDT model predicted that small to moderate increases could be gained for juvenile life stages, but potential increases were very minor compared to factors such as riparian function, channel stability, and habitat diversity.

Warm summer temperatures were identified as a primary problem in the two key tributaries, the Twisp and Chewuch Rivers, at a time when migration, pre-spawn holding and spawning was critical to spring Chinook. Although temperature was identified as secondary in other tributaries, it rarely got above 18 ^{o}C (64 F)and the majority of the effect was because of multiple days over 16 ^{o}C (61 F). In the lower Twisp and Chewuch Rivers, however, the majority of daytime high temperatures were over 18 ^{o}C from mid-July to early September, based on USFS data collected in 2001 and 2002. We had access to very good temperature data for this analysis, and have high confidence that cooler temperatures in these key tributaries need to be restored.

See section 2.5 for a qualitative description of potential causal mechanisms for each of these limiting factors, relevant to each assessment unit.

Integrated Priority Assessment Units (AUs)

We incorporated EDT output for anadromous fishes, and QHA output for resident fishes and generated an integrated list of priority AUs. Categorical ranks (A,B,C) for each species were converted to numerical values (1,2,3), and a value of 4 was assigned to the AU if a particular species was absent. We then summed across all focal species and ordered the list by prioritizing Endangered fish first, Threatened fish second, and non-listed focal species last.

All AUs with a primary benefit to an Endangered species (steelhead, spring Chinook) were in the integrated category "A," and were then ordered within category "A" based on their score (lowest sum across focal species with Endangered fish first, all fish second) (**Table 42**). All remaining AUs with a primary benefit to a Threatened species (bull trout) were in the category "B," and were then ordered within category "B" based on their score (lowest sum across focal species with Endangered fish first, all fish second) (**Table 42**). Remaining AUs were considered category "C" and were ordered in the same fashion as previously described. The integrated priority list for restoration and protection can be seen in **Table 50** and **Table 51**, respectively.

We also integrated the inter-species priority list with the AU limiting habitat attribute summary analysis to provide a matrix to describe "where" and "what" needs restoration in the Methow subbasin.

Note: In the Management Plan section of this plan we outline the limitations of assigning priorities across multiple subbasin scales, programs and all "H" sectors. Readers are encouraged to use caution during qualitative prioritization exercises and to examine this plan in sum and in context before adopting or ascribing priorities based upon restricted use of independent sections.

3.24 Synthesis of Key Findings – Fish Habitat

Four course-scale filters, noted below, were used to guide us in developing strategies and to ensure that actions are balanced and rational. They were then used to gauge if the actions will be ultimately implementable. In taking this step, we found that trade-off analysis and multiple iterations of planning was reduced by focusing actions in areas and on habitat attributes that fell within the "realm of the do-able and effectual."

9. Is the strategy supported by science?
10. Is the strategy cost-effective?
11. Does the strategy have (or is it likely to win) public support?
12. Are resources available to implement the strategy and monitor the outcomes—including enforcement where relevant?

These AU Summaries are, therefore, not intended to be prescriptive; rather, they focus on a logical series of actionable measures for use and consideration in developing future programs and projects. The prioritizations are relative and qualitative in nature. The question asked was "Where and when do we focus efforts to support the subbasin plan goals, and what is the range of possible and reasonable actions?"

We took a four-step approach to answering this question: 1) estimate status of habitat processes historically and currently; 2) evaluate current and historic fish population use of these habitats; 3) characterize actions and strategies through the use of working hypothesis statements, and 4) identify a list of measurable objectives (see Monitoring and Evaluation Program), and identify strategies to guide the development of projects, programs and actions for the next 15 years.

The assessment focused on identification of limiting factors, specific habitat and ecosystem attributes relative to survival and/or mortality, and location and spatial extent of the habitats themselves. Our analytical method and tool (EDT) allowed us to do this "through the eyes of the fish."

The Goals and Species Objective sections of this plan describe the future desired condition for fish populations in terms of long-term viability, sustainability and opportunities for ceremonial, subsistence, and recreational harvest. These are tied directly to the assessment findings, with subsequent and derived guidance provided in this section.

In summary, the ecosystem diagnosis method used (the assessment) was intended primarily to address the question: "*Is there potential to improve anadromous salmonid population status through improvements to habitat conditions in tributary environments?*"

3.25 Synthesis and Interpretation of Assessment for Terrestrial / Wildlife Ecosystems

Subbasin assessment conclusions are identical to those found at the Ecoprovince level for focal habitat types and species. An assessment synthesis is included in section 6 in Ashley and Stovall (unpublished report 2004).

The process used to develop wildlife assessments and management plan objectives and strategies is based on the need for a landscape-level, holistic approach to protecting the full range of biological diversity at the Ecoregion scale, with attention to size and condition of core areas (subbasin scale), physical connections between core areas, and buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most wildlife populations extend beyond subbasin or other political boundaries, this "conservation network" must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation of wildlife resources.

In response to this need, Ecoregion planners approached subbasin planning at two scales. The landscape-level scale emphasizes focal habitats and associated species assemblages that are important to Ecoregion wildlife managers, while specific focal habitat and/or species needs are identified at the subbasin-level scale.

Ecoregion and subbasin planners agreed with Lambeck (1997) who proposed that species requirements ("umbrella species concept") could be used to guide ecosystem management. The main premise is that the requirements of a demanding species assemblage encapsulate those of many co-occurring, less demanding species. By directing management efforts towards the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met; therefore, managing habitat conditions for a species assemblage should provide life requisite needs for most other focal habitat obligate species.

Ecoregion/subbasin planners also assumed that by focusing resources primarily on riparian wetland, Ponderosa pine, and shrubsteppe habitats, the needs of most listed and managed terrestrial species, dependent on these habitats, would be addressed during this planning period. While other listed and managed species occur within the subbasin, primarily forested habitat obligates, needs of these species are addressed primarily through the existing land management frameworks of the federal agencies within whose jurisdiction the overwhelming majority of these habitats occur (Okanogan/Wenatchee National Forest and Washington Department of Natural Resources).

Ecoprovince/subbasin planners identified a focal species assemblage for each focal habitat type and combined life-requisite habitat attributes for each species assemblage to form a "recommended range of management conditions," that, when achieved, should result in functional habitats.

The rationale for using focal species assemblages is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem. The corollary is that factors that affect habitat quality and integrity within the Ecoregion and subbasins also impact wildlife species. As a result, identifying and addressing "factors that affect focal habitats" should support the needs of obligate wildlife populations as well. Planners recognize, however, that addressing factors that limit habitat does not necessarily address some anthropogenic-induced limiting factors such as affects of human presence on wildlife species.

Emphasis in this management plan is placed on the selected focal habitats and wildlife species described in the inventory and assessment. It is clear from the inventory and assessment that reliable quantification of most subbasin level impacts is lacking; however, many anthropogenic changes have occurred and clearly impact the focal habitats: riparian wetlands, shrubsteppe and Ponderosa pine forest habitats.

While all habitats are important, focal habitats were selected in part because they are disproportionately vulnerable to anthropogenic impacts, and likely to have received the greatest degree of existing impacts within the subbasin. In particular, the majority of shrubsteppe and Ponderosa pine habitats fall within the “low” or “no” protection status categories defined above. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (ie, USFS adjustments to grazing management).

It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. The context within which this plan was drafted recognizes that human uses do occur, and will continue into the future. Recommendations are made within this presumptive framework.

Subbasin assessment conclusions are identical to those found at the Ecoprovince level for focal habitat types and species. An assessment synthesis is included in section 6 in Ashley and Stovall (unpublished report 2004).

Riparian Wetlands Working Hypothesis Statement

The proximate or major factors affecting riparian wetlands are direct loss of habitat, due primarily to urban/agricultural development, reduction of habitat diversity and function resulting from exotic vegetation, livestock overgrazing, fragmentation, and recreational activities. The principal habitat diversity stressor is the spread and proliferation of invasive exotics. That stressor, coupled with poor habitat quality of existing vegetation, has resulted in extirpation and/or significant reductions in riparian habitat obligate wildlife species.

Ponderosa Pine Working Hypothesis Statement

The near-term or major factors affecting Ponderosa Pine stands are direct loss of habitat due primarily to timber harvesting, fire reduction/wildfires, mixed forest encroachment, development, recreational activities, and reduction of habitat diversity and function resulting from invasion by exotic species and vegetation and overgrazing. The principal habitat diversity stressors are the spread and proliferation of mixed-forest conifer species within Ponderosa pine communities, due primarily to fire reduction and intense, stand-replacing wildfires, and invasive exotic weeds. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation), coupled with poor habitat quality of existing vegetation (i.e., lack of old growth forest and associated large-diameter trees and snags), have resulted in significant reductions in Ponderosa pine habitat obligate wildlife species.

Shrubsteppe Working Hypothesis Statement

The near-term or major factors affecting shrubsteppe areas are direct loss of habitat, due primarily to conversion to agriculture, residential development, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and livestock grazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and knapweeds that either supplant and/or radically alter entire native bunchgrass communities, significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation), coupled with poor habitat quality of extant vegetation, have resulted in extirpation and/or significant reductions in shrubsteppe obligate wildlife species.

4 Inventory of Existing Activities

4.1 Introduction, Purpose, and Scope

The information presented in this section is specifically designed to provide context for subbasin planners and to reduce or eliminate duplication of efforts between parties. The tables attempt to categorize project types and geographic areas as well as identify project sponsors. To a degree, this information can be viewed as a snapshot of what is happening on the ground at this time for fish and wildlife protection and restoration. However, it does not depict the full range of actions that have been recommended in the Province even as "high priority actions." This situation is especially prevalent in the Columbia Cascade Province, especially when viewed within the context of population status, past losses and mitigation history, and, when compared to implementation levels in other Provinces.

To provide a regional context for this subbasin plan, Electronic Appendix L provides summarized information for the Columbia Cascade and for the Methow subbasin. This information details an accounting of what project categories and funding levels have been recommended by the basin technical teams, fish and wildlife managers, the ISRP, the CBFWA and the NPPC. The results depict what BPA has actually funded in the 2001-2003 period.

Inventory of existing activities is a key element of the subbasin plans. The following section summarizes agency program, management, and regulatory activities which represent each agency's role in the management of the subbasin. In addition, an inventory of projects follows in Appendix D. This inventory is designed to be compared with the needs of fish and wildlife identified in this plan's Assessment.

Federal and state agencies, local Counties, tribal groups, and public interest groups all manage, regulate, or otherwise are involved in land and water usage within their respective jurisdictions. For the most part, these governing bodies and stakeholders have policies and guidelines to control the demands placed upon the watershed, and their mandates include the management of natural resources for society while maintaining a level of protection of water, land, fish, and wildlife resources.

This subbasin plan's inventory of projects includes projects from the last 10 years. An extensive effort, through multiple planning processes, has occurred to develop this inventory of projects; however, the list is not all-inclusive. Furthermore, not all other planning processes have required the level of information that is required by NPCC. Given the timeframe and funding level, the subbasin planners could not provide all of the information that was suggested in the Technical Guide for Subbasin Planners (Council Document 2001-20). This included: identifying the limiting factors or ecological processes the activity is designed to address; summarizing accomplishments/failures of the activity; and identifying the relationship to other activities in the subbasin. Furthermore, subbasin planners were not able to identify gaps between actions that have already been taken or are underway and additional actions that are needed.

4.1.1 Purpose and Scope

Programs and projects in the subbasin relating to fish and wildlife are primarily directed at rebuilding or maintaining anadromous and resident fish and wildlife habitat that is vulnerable to many direct and indirect impacts within the basin; many of these impacts and their resolution have cross-border implications. Such impacts include hydroelectric facilities and their operations, water consumption, water management, urban development, infrastructure, agriculture, forestry, water quality, ground disturbances, outright habitat loss, and introduced species.

4.2 Programmatic Actions

A number of programs are available that provide project resources to address offsite mitigation for salmon entrainment in downstream dams, as well as programs to address Endangered species recovery and clean water management.

Many agencies and entities share responsibility for management and protection of fish and wildlife populations and habitats in the Methow subbasin. Roughly 80% of land within the subbasin is owned and managed by the federal government. In addition to federal management, state, county, and tribal regulations and policies guide management activities within the subbasin. Regional coordination efforts and management goals also play vital roles in guiding local management response to specific fish, wildlife and habitat issues, including species-specific recovery plans.

4.3 Projects Summary by Assessment Unit (AU)

Existing and past project efforts in the Methow subbasin span a broad range of habitat restoration work, education and awareness, improvements to irrigation systems, etc., and represent largely cooperative efforts of various combinations of local government, private organizations, private citizens, tribes and state agencies.

The greatest proportion of project effort was dedicated to fish habitat restoration and wildlife projects, followed by fish supplementation and assessment. Aside from the limited project activity directed at habitat procurement, the least project investment was dedicated to research and monitoring.

Click here for a summary of projects in Appendix D.

4.4 Current Management Activities

4.4.1 Federal Agencies and Programs

USDA Forest Service (USFS)

The Forest Service has evolved into a 30,000 employee agency that manages the national forests for a number of multiple uses, including recreation, timber, wilderness, minerals, water, grazing, fish, and wildlife. The history of the agency is long and remarkable. Over the last century, the Forest Service has initiated numerous, innovative products and procedures, as well as led the country and the world in scientific forestry matters.

The USDA Forest Service is a major landowner and land manager in the Methow subbasin, and conducts a broad range of monitoring and evaluation projects in the subbasin, as well as issuing and managing special use permits, conducting biological assessments, issuing biological opinions and participating in many planning and management efforts.

Bonneville Power Administration (BPA)

The BPA is a federal agency established to market power produced by the federal dams in the Columbia River basin. The BPA provides funding for fish and wildlife protection and enhancement to mitigate for the loss of habitat resulting from hydroelectric construction and operations.

USDA Bureau of Land Management

The Bureau of Land Management (BLM), an agency within the U.S. Department of the Interior, administers 261 million surface acres of America's public lands, located primarily in 12 western States. The BLM sustains the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

BLM manages 17,707,693 acres of public lands in Oregon and 399,950 acres of public lands in Washington. BLM also has subsurface responsibilities for an additional 23.4 million acres in Oregon and about 16.5 million acres in Washington. From the forests of western Oregon to the rangelands in eastern Oregon and Washington, BLM uses a multiple-use approach to managing public lands. BLM manages for wildlife, recreation, timber harvest, livestock grazing, mineral extraction and other public uses.

US Fish and Wildlife Service

Partner's for Fish and Wildlife Program

Partner's for Fish and Wildlife is a federal cost-share program to implement voluntary on-the-ground habitat improvement projects on private lands for the benefit of Federal trust species and the landowner. The program is run by the U.S. Fish and Wildlife Service who provides financial and technical assistance.

Fish Restoration and Irrigation Mitigation Act of 2000 (FRIMA)

FRIMA is a federal cost-share program to implement voluntary fish screening and fish passage at water withdrawal projects in Washington, Idaho, Oregon, and western Montana. The program is implemented by the U.S. Fish and Wildlife Service in cooperation with State and Tribal partners within the north western U.S.

US Army Corps of Engineers

Section 10 Permit - Work in Navigable Waters

A Corps (Army Corps of Engineers) permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States, or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharfs, dolphins, breakwaters, bulkheads, groins, jetties, mooring buoys, and boat ramps.

Not every activity, however, requires a separate, individual permit application. Certain activities and work can be authorized by letters-of-permission, nation-wide permits, or regional permits. Some activities authorized by these permits are permitted in advance. Typically, little or no paperwork is required, and consequently, permitting time is reduced. Prior to submitting an application, applicants can contact the District Engineer's office to receive current information about the type of permit required.

Activity which requires a permit: Locating a structure, excavating, or discharging dredged or fill material in waters of the United States, or transporting dredged material for the purpose of dumping it into ocean waters. Fees are variable.

For 404 permits, the Corps has developed Nation-wide permits to streamline the process for specific activities. The Corps reviews a proposed project to determine if an individual 404 permit is required, or if the project can be authorized under a Nationwide permit. The Nationwide permits also need 401 certification from Ecology. Ecology (Department of Ecology) has already approved, denied, or partially denied specific Nationwide permits.

Applicants receiving a section 404 permit from the Army Corp of Engineers, a Coast Guard permit, or a license from the Federal Energy Regulatory Commission (FERC) are required to obtain a section 401 water quality certification from the Department of Ecology. Issuance of a certification means that the Ecology anticipates that the applicant's project will comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority. The 401 certification can cover both the construction and operation of the proposed project. Conditions of the 401 certification become conditions of the federal permit or license.

Statewide Contact:

U.S. Army Corps of Engineers, Seattle District Regulatory Branch, PO Box 3755, Seattle, WA98124-2255. Telephone: (206) 764-3495 Fax: (206) 764-6602

* Permit information last updated 10/1/1998.

401 Water Quality Certification (DOE)

If approved, no further 401 certification review by Ecology is required. If partially denied without prejudice, an individual certification or Letter of Verification from Ecology is required. If denied without prejudice, an individual certification is required for all activities under that nation-wide permit.

Activity which requires the permit: Applying for a federal permit or license to conduct any activity that might result in a discharge of dredge or fill material into water or non-isolated wetlands or excavation in water or non-isolated wetlands.

Fees: No fee for certification

Online Application: The application for an individual permit, called the Joint Aquatic Resources Permit Application Form (JARPA), is online and can be downloaded at http://www.ecy.wa.gov/programs/sea/pac/jarpa.html

Application Requirements (if applicable to the project): Mitigation plans, Operation and maintenance plans, Stormwater site plans and Restoration plans.

Permit Dependencies: In most cases, State Environmental Policy Act (SEPA) compliance is needed. If you live within any of Washington's 15 coastal counties, then you may need a Coastal Zone Consistency Determination (CZM).

Permit Time Frame: Individual 401s: Minimum twenty-day public notice; up to one year to approve, condition, or deny; usually less than three months, see notes/comments. Nationwide permits that have been partially denied may take a few days or weeks after receipt of the JARPA and a letter from the Corps issuing a Letter of Verification (LOV). LOV: Usually takes 30 days, but can take up to 180 days.

Permit Review Process: Review is conducted in Shoreline and Environmental Assistance within each regional office (except dredging and WSDOT projects which are done at Ecology's Headquarters). Regional staff review the applications for completeness, and send out a letter or call if additional information is needed. Once the application is considered complete, the regional staff starts reviewing the project to recommend approval or denial. Modifications to plans submitted may be required. A site visit maybe also be required as part of the process.

Permit Duration: 401 certification becomes part of the federal permit or license. The duration of the 401 certification would be in effect for the same time period as the permit or license, however Ecology issues 401 certifications as 90.48 administrative orders, so they may have conditions that apply to the project longer than the federal permit or license.

Permit Appeal Information: Appealable to Pollution Control Hearings Board (P.C.H.B.) within thirty days of Ecology’s decision. P.C.H.B. may not hear case for six or more months.

Notes / Comments: If an applicant receives a nation-wide permit and Ecology issues a LOV, there is no public notice requirement under 401 certification for that specific project. If the applicant receives a nation-wide permit but is required to obtain an individual 401 Certification, public notice is required.

Legal Authority:

- Chapter 173-201A State Water Quality Rule WAC
- Chapter 173-225 Federal Clean Water Act, Section 401 WAC
- Chapter 90.48 State Water Quality Law RCW
- Statewide Contact: Department of Ecology, 300 Desmond Drive, Lacey, WA98503. Telephone: (360) 407-6000

* Permit information last updated 10/23/2003.

Section 404 Permit - Discharge of Dredge and Fill Material

A Corps permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharfs, dolphins, breakwaters, bulkheads, groins, jetties, mooring buoys, and boat ramps.

However, not every activity requires a separate, individual permit application. Certain activities and work can be authorized by letters-of- permission, nation-wide permits, or regional permits. Some activities authorized by these permits are permitted in advance. Typically, little or no paperwork is required, and consequently. permitting time is reduced. Prior to submitting an application, applicants can contact the District Engineer's office to receive current information about the type of permit required.

Activity which requires the permit: Locating a structure, excavating, or discharging dredged or fill material in waters of the United States, or transporting dredged material for the purpose of dumping it into ocean waters.

Fees: Variable

Statewide Contact: U.S. Army Corps of Engineers, Seattle District Regulatory Branch. PO Box 3755, Seattle, WA98124-2255. Telephone: (206) 764-3495. Fax: (206) 764-6602

* Permit information last updated 10/1/1998.

ESA Permits

Section 7

The Endangered Species Act (ESA) has a broader mandate than simply directing the FWS and NOAA Fisheries to protect listed fish, animals and plants. It directs all federal agencies to participate in Endangered species conservation. Under section 7 of the ESA, federal agencies are required to consult with FWS and NOAA Fisheries to ensure that actions they fund, authorize, permit, or otherwise carry out will not jeopardize the continued existence of any listed species, nor adversely modify designated critical habitats. For further information regarding consultation see http://endangered.fws.gov/consultation.

FWS, Central Washington Field Office 215 Melody Lane. Suite 119, Wenatchee WA 98801. Telephone: (509) 665-3508.

NOAA Fisheries, 304 S. Water Street, #201, Ellensburg, WA 98926. Telephone (509) 962-8911

Section 10 : Habitat Conservation Plans

In 1982, the U.S. congress amended Section 10 of the ESA to authorize “incidental take” through the development and implementation of Habitat Conservation Plans (HCP). An incidental take permit allows property owners, state or county entities to conduct otherwise lawful activies in the presence of listed species. A non-federal entity develops an HCP in order to apply for an incidental take permit under Section 10(a)(1)(B) of the ESA. The HCP integrates the applicant’s proposed project or activity with the needs of the species. It describes, among other things, the anticipated effect of a proposed taking on the affected species, and how that take will be minimized and mitigated. Such information must be submitted with any incidental take permit. For more information regarding HCPs, see http://endangered.fws.gov/hcp/

FWS, Central Washington Field Office 215 Melody Lane. Suite 119, Wenatchee WA 98801. Telephone: (509) 665-3508.

NOAA Fisheries, 304 S. Water Street, #201, Ellensburg, WA 98926. Telephone (509) 962-8911

Natural Resource Conservation Service (NRCS)

One of the purposes of the NRCS is to provide consistent technical assistance to private land users, tribes, communities, government agencies, and conservation districts. The NRCS assists in developing conservation plans, provides technical field-based assistance, including project design, and encourages the implementation of conservation practices to improve water quality and fisheries habitat. Programs include the CRP, River Basin Studies, Forestry Incentive Program, Wildlife Habitat Improvement Program, the Environmental Quality Incentives Program, and Wetlands Reserve Program. The USDA Farm Services Administration (FSA) and the NRCS administer and implement the federal CRP and Continuous CRP.

Conservation Reserve Program (CRP)

The enrollment of agricultural land, with a previous cropping history, into CRP has removed highly erodible land from commodity production. The land is converted into permanent herbaceous or woody vegetation to reduce soil and water erosion. Conservation Reserve Program contracts are for a maximum of 10 years per sign-up period (the contracts may be extended) and have resulted in an increase in wildlife habitat. Cover Practices (CP) that occur under CRP include planting introduced or native grasses, wildlife cover, conifers, filter strips, grassed waterways, riparian forest buffers, and field windbreaks.

Conservation Reserve Program contract approval is based, in part, on the types of vegetation landowners are willing to plant. Cover Practice planting combinations are assigned points, based on the potential value to wildlife. For example, cover types more beneficial to wildlife are awarded higher scores. Seed mixes containing diverse native species generally receive the highest scores (FSA 2003).

There are currently an estimated 4,064 acres enrolled in CRP in Okanogan County. Conservation Reserve Program and associated cover practices that emphasize wildlife habitat increase the extent of shrubsteppe habitat, provide connectivity/corridors between extant native shrubsteppe and other habitat types, reduce habitat fragmentation, contribute towards control of noxious weeds, increase landscape habitat diversity and edge effect, reduce soil erosion and stream sedimentation, and provide habitat for a myriad of wildlife species.

Continuous Conservation Reserve Program (CCRP)

The CCRP focuses on the improvement of water quality and riparian areas. Practices include shallow water areas with associated wetland and upland wildlife habitat, riparian forest buffers, filter strips, grassed waterways and field windbreaks. Enrollment for these practices is not limited to highly erodible land, as is required for the CRP, and carries a longer contract period (10-15 years), higher installation reimbursement rate, and higher annual annuity rate.

Conservation Reserve Enhancement Program (CREP)

The CREP, established in 1998, is a partnership between USDA and the State of Washington, and is administered by FSA and the WCC. The CREP provides incentives to restore and improve salmon and steelhead habitat on private land. Program participation is voluntary. Under 10- or 15-year contracts, landowners remove fields from production, remove grazing, and plant trees and shrubs to stabilize stream banks.

The program' efforts also provide wildlife habitat, reduces sedimentation, shades stream corridors, and improves riparian wetland function. Landowners receive annual rent, incentive and maintenance payments, and cost share for practice installations. Payments made by FSA and WCC, can result in no cost to the landowner for participation. Both the CRP and CREP utilize herbaceous seedings, shrubs, and trees to accomplish conservation measures that provide short-term high protection for wildlife habitats. It is unknown how many acres in the subbasin are protected by CREP.

Wildlife Habitat Incentive Program (WHIP)

The WHIP is administered and implemented by NRCS, and provides financial incentives to develop wildlife habitat on private lands; participants agree to implement a wildlife habitat development plan and NRCS agrees to provide cost-share assistance for the initial implementation of wildlife habitat development practices. The NRCS and program participants enter into a cost-share agreement for wildlife habitat development; this agreement generally lasts a minimum of 10 years. It is unknown how many acres in the subbasin are protected by WHIP.

Environmental Quality Incentives Program (EQIP)

The EQIP is administered and implemented by the NRCS and provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program assists farmers and ranchers with federal, state, and tribal environmental compliance, and encourages environmental stewardship. The program is funded through the Commodity Credit Corporation.

Program goals and objectives are achieved through the implementation of a conservation plan that incorporates structural, vegetative, and land management practices on eligible land. Eligible producers commit to 5- to 10-year contracts. Cost-share payments are paid for implementation of one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Furthermore, incentive payments are made for implementation of one or more land management practices, such as nutrient management, pest management, and grazing land management. It is unknown how many acres in the subbasin are protected by EQIP.

Wetlands Reserve Program (WRP)

The WRP is also administered and implemented by the NRCS. This voluntary program is designed to restore wetlands. Participating landowners can establish permanent or 30-year conservation easements, or they can enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land, and 100% of the restoration costs for restoring the wetlands. The 30-year easement payment is 75% of what would be provided for a permanent easement on the same site, and 75% of the restoration cost. The voluntary agreements are a minimum of 10 years in duration, and provide for 75% of the cost of restoring the involved wetlands. Easements and restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the easement or agreement. It is unknown how many acres in the subbasin are protected by WRP.

The Public Law 566 Small Watershed Program (PL 566)

The Public Law 566 Small Watershed Program can be leveraged with other federal, state, or local program funds to provide wildlife and fisheries protection. Soil and water conservation districts using other project funding sources leverage NRCS program resources in combination to concentrate conservation within watersheds of concern.

Agricultural Community

Private landowners manage the vast majority of Ponderosa pine, shrubsteppe, and riparian wetland habitats in the subbasin. Many landowners protect, enhance, and maintain privately owned/controlled steppe communities and riparian habitats through active participation in the USDA's CRP and CREP programs.

Agriculturalists apply Best Management Practices (BMPs) to croplands to reduce the amount of soil leaving these areas. The BMPs include use of: upland sediment basins designed to catch sediment; terraces to direct runoff to sediment basins or grassed waterways and filter strips; strip cropping, and; direct seeding of crops reducing summer-fallow acres and reducing erosion by 95% on those acres. Landowners also control noxious weeds, which severely affect wildlife habitats and populations.

Tribes

Colville Tribes

On the western third of the Colville Reservation, 344,146 acres of tribal land fall within the Okanogan subbasin drainage. This massive tract of land, inclusive of both tribal, ceded, and traditional areas, supports viable breeding and/or migratory populations of state and Species of concern, and Threatened or Endangered species.

The Colville Tribes is leading an effort to document what species are still, or are now, occurring in the Upper Columbia River, including the Methow subbasin, to assess after the study period concludes for this area, which species are no longer detected, which are least abundant, and thus, potentially at risk, and to manage and partially mitigate using that information.

The Chief Joseph and Grand Coulee Dam hydroelectric projects forced the Colville Confederated Tribes (CCT) to rely largely on resident fish and wildlife resources. The ensuing decline in wildlife resources and native salmonid fish stocks significantly and negatively impacted the traditional subsistence lifestyle of Colville Tribal members. The extent of that impact to historical and current native wildlife species must be measured for fair partial mitigation and adequate management of the remaining resource for subsistence, cultural, and ceremonial use. The Bonneville Power Administration has committed to protecting native fish and wildlife habitat on the Colville Indian Reservation as a means of partially mitigating the impacts of the Columbia River Hydroelectric System.

Grand Coulee and Chief Joseph hydroelectric projects destroyed, essentially forever, in excess of 88,000 acres of critical low elevation wildlife habitat. This habitat was largely comprised of riverine, island, riparian, shrubsteppe, mixed and coniferous ecosystems that, being rich in biodiversity, supported a large number and abundance of wildlife species. Existing conditions throughout the region very likely preclude management entities from ever being able to fully mitigate these losses; however, many projects throughout the region, and on this reservation, provide some partial mitigation leading toward the fulfillment of full mitigation for losses because of the dams and the subsequent and continuing habitat loss.

Yakama Nation

Yakama Nation is working towards restoring naturally spawning salmon populations in the Methow subbasin, including coho. Coho recovery programming is considered in the long-term vision for the Mid-Columbia coho ESU, and is described in the Mid-Columbia coho HGMP (Appendix K.). The Yakama Nation also conducted spawning ground surveys and smolt trapping in the Methow subbasin since approximately 1992.

Okanogan County

Lead Entity Strategy

Okanogan County and the Colville Confederated Tribes are co-leads, and thus, co-coordinators for the Okanogan County Lead Entity. Occurring since the creation of the Okanogan County Lead Entity in 1999, this co-coordination effort has proven to be mutually beneficial. A portion of the Colville Confederated Tribes reservation lands is within the boundaries of Water Resource Inventory Area 48: Methow subbasin.

The primary purpose of the Okanogan County Lead Entity Strategy is to provide specific and strategic guidance regarding the development of habitat protection and restoration projects primarily for the Salmon Recovery Funding Board's grant process, and for Okanogan County's related contractual work with the Washington State Department of Fish and Wildlife.

The lead entity strategy is a habitat protection and restoration action plan for the watershed(s) within the lead entity area. The strategy provides a step-wise approach to determining "how," "where" and "when" action is to be taken to restore and protect the habitat and watershed processes that are necessary to support salmon.

Many in the Upper Columbia region view the regional salmon recovery plan as the overall plan for salmon recovery, with the many other ongoing processes feeding directly into its appropriate sections. In the long-term, the Upper Columbia Combined Strategy will be directly derived from the applicable habitat portions of the regional recovery plan.

Consistent with the state Planning Enabling Act (RCW 35.63), each jurisdiction (the towns, the County, and the Colville Confederated Tribes) uses a Comprehensive Plan to guide future development and redevelopment, and a suite of land use regulations to implement the goals, objectives, policies, and recommendations in the land use element of its Comprehensive Plan. The following tools are being used in the Okanogan/Methow subbasin:

Zoning: Zoning is the most important tool for regulating land use. The basic purpose of zoning is to promote a jurisdiction's public health, safety, and welfare, and to assist in the implementation of the comprehensive plan. In a zoning ordinance, the jurisdiction is divided into zoning districts, with types of uses, permit requirements, and other land use regulations defined for each district. The most basic regulations pertain to: the height and bulk of buildings; the percentage of a lot which may be occupied and the size of required yards; population density; and the use of buildings and land for residential, commercial, industrial, and other purposes.

Subdivision: Subdivision regulations are intended to regulate the manner in which land may be divided and prepared for development. They apply whenever land is divided for purposes of sale, lease or transfer. State law specifies that any subdivision of land that results in the creation of a parcel of less than five acres in size must comply with state and local subdivision requirements. There are two basic forms of subdivision: long plats, which contain five or more lots, and; short plats, which contain four or fewer lots. Regulations pertaining to both types of subdivisions are adopted and enforced at the local level in accordance with provisions and statutory authority contained in state law. The regulations specify methods of subdivision procedures for the developer and the local government, minimum improvements (streets, utilities, etc.) to be provided by the developer, and design standards for streets, lots, and blocks. Subdivision regulations are intended to encourage the orderly development and redevelopment of large tracts in the planning area.

Planned Development: Planned development regulations are intended to provide an alternative method for land development that:

- Encourages flexibility in the design of land use activities so that they are conducive to a more creative approach to development, resulting in a more efficient, aesthetic, and environmentally responsive use of the land;
- Permits creativity in the design and placement of buildings, use of required open spaces, provision of on-site circulation facilities, off-street parking, and other site design elements that better utilize the potential of special features, such as geography, topography, vegetation, drainage, and property size and shape;
- Facilitates the provision of economical and adequate public improvements, such as, sewer, water, and streets. and;
- Minimizes and/or mitigates the impacts of development on valuable natural resources and unique natural features such as agricultural lands, steep slopes, and floodplain and shoreline areas.
- Planned development regulations may be incorporated into a jurisdiction's zoning ordinance, or developed as a separate ordinance. It is also possible for the City, County or tribes to use the planned development process for certain uses that, because of their nature, may be more appropriately reviewed under such regulations.

Planned developments are currently not permitted in the Methow basin because the DOE has placed a moratorium on community well permits.

Binding Site Plan: The binding site plan is a relatively new method for dividing property for commercial and industrial purposes, and in some cases for residential uses, such as manufactured home and recreational vehicle parks, where the individual parcels are not to be sold. This method for regulating development is intended to provide a flexible alternative to developers, and requires that a specific site plan be developed that shows the layout of streets and roads, and the location of utilities required to serve the property. The binding site plan is a legally enforceable document which, when required, can be amended to reflect changing conditions. The plan also must be reviewed to ensure that the cost of providing basic services, and the maintenance of those services, does not represent an unreasonable burden on residents of the planning area.

Shoreline Master Program (SMP): The SMP is, in effect, a special comprehensive plan and zoning ordinance for those areas falling under shoreline jurisdiction, as defined in the State Shoreline Management Act of 1971.

Uniform Building Code: The Uniform Building Code (UBC) is a uniform set of regulations used to regulate and enforce construction activities. The UBC may be used, in conjunction with other implementation tools, to ensure compliance and conformance with the comprehensive plan.

Flood Damage Prevention Ordinance: Flood Damage Prevention ordinances are required for jurisdictions that have areas subject to inundation by 100-year flood events. The purpose of this type of implementation tool is to ensure that new or substantially improved structures and fills are constructed in a manner that, not only will minimize flood damage to the structure, but also will minimize the potential for increasing the flood hazard on adjacent properties.

The State Environmental Policy Act (SEPA) and the Growth Management Act complement local land use regulations. While SEPA is not necessarily an implementation tool, local requirements for SEPA review provide land use administrators with useful information on potential impacts, and proposed measures to mitigate such impacts. The Growth Management Act provides significant direction for planning and regulation of land use. In accordance with RCW 36.70, by July 1, 1993, all City and County ordinances were required to be consistent with the Comprehensive Plan. Those ordinances found to be inconsistent may be held invalid.

Watershed Planning

In 1998, the Washington State legislature approved ESHB 2514 to create RCW 90.82 and subsequently amended the RCW in 2003 with HB 1336. This RCW enables local stakeholders, within their watersheds, to develop management strategies related to water quantity (required by the bill), water quality (optional), instream flow (optional), and habitat (optional).

In the Methow subbasin, a watershed plan has been completed by the local planning unit and is currently under consideration for formal adoption by the Okanogan County Board of Commissioners. Some of the recommendations in the watershed plan include (but are not limited to): the reallocation of water for a greater number of uses in the watershed; utilization of the benefits of groundwater recharge; and creation of the Methow Watershed Council, an organization which will allow for more local control regarding water management.

4.4.2 State Programs

Washington Department of Natural Resources (WDNR)

The WDNR manages 134,000 acres in the Loomis Forest. The Chopaka Natural Reserve, in the Loomis Forest, is a 3,000-acre natural preserve area. In the year 2000, two parcels totaling 25,000 acres were designated as Natural Areas, with access for recreation and grazing. The remaining area in the Loomis Forest is managed for multiple uses, including timber harvest and livestock grazing. There are 15 million board feet harvested annually from the Loomis Forest (C. Johnson 2001, pers. comm.).

Washington Department of Fish and Wildlife (WDFW)

The WDFW's mission embodies sound stewardship in fish and wildlife, and encourages partnerships with public and international entities, tribal leaders, public volunteers, and service groups to share responsibility for fish and wildlife. WDFW maintains five wildlife areas in the Okanogan Basin, and is an active participant in salmon recovery and subbasin planning.

In addition, the WDFW is responsible for the administration of state statute directed at the protection of fish and wildlife habitats. The key statutes relevant to subbasin planning are listed below:

Priority Habitat and Species Program

The Priority Habitats and Species (PHS) Program fulfills one of the most fundamental responsibilities of the Washington Department of Fish and Wildlife (WDFW): to provide comprehensive information on important fish, wildlife, and habitat resources in Washington. Initiated in 1989, the PHS Program was identified as the agency's highest priority. Today, the PHS Program serves as the backbone of WDFW's proactive approach to the conservation of fish and wildlife.

PHS is the principal means by which WDFW provides important fish, wildlife, and habitat information to local governments, state and federal agencies, private landowners and consultants, and tribal biologists for land use planning purposes. PHS is the agency's primary means of transferring fish and wildlife information from agency resource experts to those who can protect habitat. PHS information is used: a) to screen 12,000 - 15,000 Forest Practice Applications, 10,000 - 18,000 Hydraulic Project Applications, and over 3,000 SEPA reviews annually; b) by a majority of cities and counties to meet the requirements of the Growth Management Act; c) for the development of Habitat Conservation Plans on state, federal, and private lands; d) by state, federal, and tribal governments for landscape-level planning and ecosystem management, and e) for statewide oil spill prevention planning and response.

PHS provides the information necessary to incorporate the needs of fish and wildlife in land use planning. The PHS program addresses three central questions:

- Which species and habitat types are priorities for management and conservation?
- Where are these habitats and species located?
- What should be done to protect these resources when land use decisions are made?

To answer those essential questions, the PHS Program:

- identifies habitats and species determined to be priorities based on defensible criteria;
- maps the known locations of priority habitats and species using GIS technology;
- provides information on the conditions required to maintain healthy populations of priority species, and viable, functioning priority habitats, using best available science;
- provides consultation and guidance on land use issues affecting priority habitats and species, and;
- distributes this information and makes it easily accessible.

1. PHS also furnishes products which enable the agency to provide competent and efficient customer service. In this regard, PHS staff annually produce and distribute:

13. Over 4,000 copies of the Priority Habitats and Species List. The PHS List identifies and defines which species and habitats are priorities, and outlines criteria used for their selection.
14. Over 3,500 copies of Management Recommendations for Washington's Priority Habitats and Species. These detailed documents identify the needs of fish and wildlife based on the best available science. Guidelines for their incorporation in management decisions are provided.
15. Nearly 2,000 state-of-the-art Geographic Information System (GIS) maps which display locations and extent of priority species and habitats on 29 million acres in Washington State.
16. Upland Restoration Program Outstanding text needed for agencies that are involved in protection of fish and wildlife habitats within the subbasin, including:

- Washington Priority Habitat and Species Program
- Washington State Conservation Commission
- Washington Department of Ecology

Upland Restoration Program

The WDFW has worked with private landowners to restore habitat within the subbasin. The Habitat Development Program established small (0.5 to 3 acres) habitat plots primarily for upland game birds on unfarmed areas, usually on poor or rocky soils. In the 1980s, partnerships between WDFW, NRCS, conservation districts, and private landowners made possible habitat restoration projects at the watershed scale. Today, this multi-agency/private landowner partnership continues to enhance, protect, maintain, and increase wildlife habitat throughout the subbasin.

Through cooperative agreements with private landowners, Upland Restoration Program biologists improve and restore riparian, upland, and shrubsteppe habitats used by both resident and migratory wildlife species within the subbasin. Projects typically include establishing riparian grass buffers, planting shrubs and trees (for thermal and escapement cover), seeding wildlife food plots, developing water sources (e.g., guzzlers, ponds, spring developments), and maintaining winter game bird feeders.

The CRP has provided WDFW with another opportunity to work with local conservation agencies and landowners to improve wildlife habitat throughout the subbasin. WDFW biologists assist landowners with selecting and/or planting herbaceous seed mixes, trees, and shrubs.

While habitat restoration is WDFW’s main priority within the subbasin, the Upland Restoration Program requires all cooperators to sign public access agreements in conjunction with habitat projects. Landowners voluntarily open their land to hunting, fishing, and/or wildlife viewing in return for habitat enhancements. The Upland Restoration Program, in conjunction with CREP and CRP, has increased the extent and/or protection and enhancement of riparian wetlands and shrubsteppe habitats within the subbasin.

Programmatic description of Shoreline Management Act:

Reference: http://www.ecy.wa.gov/programs/sea/SMA/index.html

Washington's Shoreline Management Act (SMA) was passed by the state Legislature in 1971 and adopted by the public in a 1972 referendum. It is codified within RCW 90.58. The Shoreline Master Program (SMP) is essentially a shoreline comprehensive plan and zoning ordinance, with an environmental orientation customized to local circumstances. The SMA emphasizes accommodation of reasonable and appropriate shoreline uses, protection of shoreline environmental resources, and protection of the public's rights to access and use shorelines. All allowed uses are required to mitigate for any adverse environmental impacts and preserve the natural character and aesthetics of the shoreline.

The SMA seeks to provide for a balance of authority between local and state government. Cities and counties are the primary regulators. The SMA applies to all 39 counties and more than 200 cities with "shorelines of the state" or "shorelines of state-wide significance" within their jurisdictional boundaries. The Department of Ecology (Ecology) is the lead state agency, and it provides technical assistance and reviews local programs and permit decisions. The SMA places a strong emphasis on public involvement in developing local shoreline programs, and provides opportunities for public involvement in individual permits.

In December 2003, new SMP guidelines were adopted by the state. These guidelines state rules for use by cities and counties as they update plans that regulate development and the use of shorelines of marine waters, rivers and larger streams, lakes and reservoirs over 20 acres, associated wetlands, and portions of flood plains. In addition, the 2003 legislature adopted amendments to the SMA addressing integration with the Growth Management Act.

Fish and Wildlife and the Growth Management Act

The Growth Management Act (GMA) (RCW 36.70A) is intended to avoid the possibility of uncoordinated and unplanned growth inherent in anticipated population increases. It requires county and city governments to adopt locally derived plans and regulations around a basic framework of natural resources issues defined by the state legislature. One of the primary intents of the GMA is to prevent unwise use of natural resources and critical areas in accommodating urban growth.

Each jurisdiction must classify and designate their resource lands and critical areas, and each must adopt development regulations for their critical areas. In addition, some jurisdictions must adopt planning policies and comprehensive plans that address many aspects of urban growth and development that are expected to occur in the county, including land use, housing, utilities, transportation, and others. Subsequent amendments to the GMA require that counties and cities include the best available science in developing policies and development regulations to protect the functions and values of critical areas. In addition, counties and cities must give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries.

The Washington Department of Fish and Wildlife (WDFW) has biologists in five of its six regions that provide technical assistance to local jurisdictions regarding compliance with the requirements of the GMA regarding fish and wildlife resources. One of the primary goals of WDFW is to integrate its Priority Habitats and Species (PHS) program into the local jurisdictions' GMA planning activities.

Washington Conservation Commission

The Washington State Conservation Commission (WCC) supports conservation districts in Washington by promoting conservation stewardship through funding natural resource projects. The WCC provides basic funding to conservation districts as well as implementation funds, professional engineering grants, and Dairy Program grants and loans to prevent the degradation of surface and ground waters. The Agriculture Fish and Wildlife Program (AFWP) is a collaborative process aimed at voluntary compliance. The AFWP involves negotiating changes to the existing NRCS Field Office Technical Guide, as well as to the guidelines being developed for irrigation districts to enhance, restore, and protect habitat for Endangered fish and wildlife species and address state water quality needs. This two-pronged approach has developed into two processes, one involving agricultural interests, and the second concerning irrigation districts across the state.

Wildlife Areas

The Methow Wildlife Area is approximately 14,500 acres and is located to the east of the Methow River in the foothills of the Methow Valley. The Town of Twisp is located approximately five miles west of the southern boundary, and Winthrop is located five miles west of the Headquarters. The area consists of moderate to steep south and west facing slopes. Vegetation includes bunchgrasses and bitterbrush, occasionally interspersed with small stands of Douglas fir and Ponderosa pine. Most water sources and wetter areas have deciduous type riparian vegetation. The Methow Wildlife Area is managed primarily for mule deer winter and spring range and blue grouse spring and summer range. Canyon areas have a number of golden eagle nest sites along with some very interesting geological formations. Over l00 bird species use the Methow at various times of the year. Primary recreational uses include hunting, fishing, sightseeing, cross-country skiing, mountain biking, and camping. Fishing opportunities for either trout or limited spiney-ray fish exist on Cougar and Campbell Lakes, Sullivan Pond, portions of Bear, Beaver, and Ramsey Creeks, and the Chewuch River.

The Big Buck Wildlife Area is 5,600 acres, and is located west of the Methow River and north of the Twisp River. The area is just west of the town of Twisp. The unit consists of moderate to steep east and south facing slopes. Vegetation includes bunchgrasses, bitterbrush and sage, occasionally interspersed with stands of Ponderosa pine and Douglas fir. Water sources and wetter areas support deciduous riparian type vegetation. The Big Buck area is managed primarily for mule deer, blue grouse and non-game species. It is also an integral part of the mule deer migratory corridor in and out of the Twisp River drainage. Primary recreational uses include hunting, cross country skiing, and birding. There are three small lakes on the area, but only Aspen Lake holds fish.

The 847-acre Big Valley Wildlife Area is located three and a half miles northwest of Winthrop, and is bounded on the east by state Highway 20, and on the west by the Methow River. Approximately 300 acres are irrigated, with 200 acres in dryland pasture, and the rest in riparian river bottom. The unit is used by mule deer, white-tailed deer and numerous other game and non-game species. Recreational uses include hunting, fishing, hiking, and sightseeing. Fishing opportunities exist on the Methow River.

The Rendezvous Wildlife Area consists of 3,180 acres of land. These lands lie north of the confluence of the Methow and Chewuch Rivers, about two miles northwest of Winthrop.

Vegetation includes bunchgrasses and bitterbrush, occasionally interspersed with small stands of Douglas-fir and Ponderosa pine. The unit is moderately used as winter range, but is key to the migration of mule deer moving to and from summer and winter ranges. Other game and non-game species use the area. Primary recreational uses include hunting, birdwatching, and sightseeing.

The Golden Doe Wildlife Area consists of 1,389 acres of land. This unit is located approximately five miles south of Twisp on the west side of the Methow River in the Alder Creek drainage. Vegetation includes bunchgrasses and bitterbrush, occasionally interspersed with small stands of Douglas-fir and Ponderosa pine. The unit is heavily used as winter range and is also key to the mule deer migration east and west across the Methow Valley. Other game and non-game species use the area. Primary recreational uses include hunting, birdwatching, and sightseeing.

Road Maintenance/Transportation

RCW 77.55.060 requires that "a dam or other obstruction across or in a stream shall be provided with a durable and efficient fishway approved by the director." Culverts and other stream-crossing structures often create obstructions to upstream or downstream fish passage. Water diversions can result in significant mortality to juvenile fishes.

WDFW has developed the Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual (contact Dave Caudill, Habitat Technical Applications Division, 360-902-2486), which includes protocols for assessing fish passage barrier status at culverts and other instream structures, and juvenile fish screening and bypass status at water diversions. WDFW conducts fish passage barrier assessments and provides protocol training to other agencies and grant groups interested in conducting fish passage barrier assessments. WDFW also maintains a statewide Fish Passage and Diversion Screening Inventory database (contact Brian Benson, Habitat Science Division, 360-902-2570), which includes information on barrier status of inventoried culverts and other stream crossing structures, as well as known diversion screening information.

The WDFW Habitat Program Technical Applications Division (TAPPS) also provides technical assistance to fish passage, screening, and habitat restoration project sponsors, to help them develop habitat-related projects. In addition, WDFW in cooperation with other state and federal agencies have developed Aquatic Habitat Guidelines (technical guidance documents) for certain types of habitat projects. The two guidance documents currently available include the Fish Passage Design at Road Culverts and Integrated Streambank Protection Guidelines (ISPG); soon to be available will be Salmon Habitat Restoration Guidelines (SHRG). Information on technical assistance opportunities and contacts are available on the WDFW website at http://wdfw.wa.gov/hab/tapps.index.htm

The Hydraulic Code and Hydraulic Code Rules

The Hydraulic Code (Chapter 77.55 RCW), and the associated Hydraulic Code Rules, provide WDFW with a regulatory mechanism to protect fish life and their habitat from the impacts of most hydraulic projects. The Hydraulic Code requires that "in the event that any person or government agency desires to construct any form of hydraulic project or perform other work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state, such person or government agency shall, before commencing construction or work thereon and to ensure the proper protection of fish life, secure the approval of the department as to the adequacy of the means proposed for the protection of fish life."

WDFW's authority extends only to the protection of fish life. Fish life is broadly defined to be "all fish species, including but not limited to food fish, shellfish, game fish, and other nonclassified fish species and all stages of development of those species." Furthermore, "protection of fish life" is defined to mean "prevention of loss or injury to fish or shellfish, and protection of the habitat that supports fish and shellfish populations." Even though other animals, such as amphibians, reptiles or birds may be impacted by hydraulic projects, the Hydraulic Code is specific to fish life, and HPAs may not be conditioned to protect species other than fish. Measures to protect fish life imposed in HPAs often have multi-species benefits, however, because many species share the same habitat.

Hydraulic project proponents must apply to WDFW for authorization to conduct their projects. With the exception of emergency projects and pamphlet HPAs, which may be applied for verbally, applications must be submitted in writing. Processing time for complete applications is mandated by statute to be no greater than 15 days for expedited projects and 45 days for standard projects. Projects declared to be emergencies by county legislative authorities or WDFW must be granted approval immediately upon request.

Procedures administering the Hydraulic Code, including mitigation requirements and appeal rights, are specified in Chapter 220-110 WAC. Site-specific requirements and mitigation for unavoidable impacts on fish life are written into the HPA by the local Area Habitat Biologist.

Washington Priority Habitats and Species (PHS)

The Washington PHS Program is a guide to management of fish and wildlife "critical areas" on all state and private lands as they relate to the Growth Management Act of 1990. The recommendations address upland as well as riparian habitat, and place emphasis on managing for the most critical species and their habitats.

4.4.3 Non-Governmental Organizations

Methow Conservancy

The Methow Conservancy is an independent land trust and conservation organization dedicated to voluntary protection of the natural and scenic resources in the Methow Valley. As of August 2004, the group has over 450 members and holds 40 conservation easements on 3,774 acres of private land. The Methow Conservancy has received four State grants for riparian conservation easement purchases totaling $4.27 million in the past 5 years. The Methow Conservancy has also received a grant for one agricultural conservation easement to date.

In addition to conservation easements, the Methow Conservancy writes stewardship plans for private landowners, and each conservation easement requires a management plan that is updated annually. The Methow Conservancy published the Good Neighbor Handbook in 2001, a 33-page guide to land conservation for new landowners. The Conservancy sends these to all new landowners in the Valley, and has distributed over 3,500 Handbooks to date. The Conservancy also hosts a monthly natural history lecture series and maintains a conservation resource library.

The Methow Conservancy contracts with WDFW to monitor all WDFW conservation easements in the Methow Valley, and has conducted two landscape-level habitat surveys (the Songbird and Shrub-steppe surveys) for prioritization and outreach to landowners.

The Upper Columbia Salmon Recovery Board (UCSRB)

Our proposal to cooperatively provide the analytic foundation complements the high level of policy and technical coordination already occurring. Policy coordination is facilitated by the Upper Columbia Salmon Recovery Board (UCSRB), a partnership among Chelan, Douglas, and Okanogan counties, the Yakama Nation, and the Colville Confederated Tribes in cooperation with local, state, and federal partners.

One clear objective is to provide an all-inclusive analytic foundation for the aquatic component of subbasin plans on a timely basis, consistent with the NPPC guide, to maximize the likelihood that defensible subbasin plans are completed on schedule.

Additionally, technical coordination is occurring with the Upper Columbia Regional Technical Team and the Regional Assessment Advisory Committee, as well as with individual members of BPA, the NPPC and the CBFWA.

Upper Columbia River Regional Fisheries Enhancement Group (UCRFEG)

The UCRFEG was created to facilitate community stewardship of fish and fish habitats in the Upper Columbia Region, including the Okanogan watershed. The group coordinates delivery of state salmon recovery funding for local community projects, and has facilitated some cross-border U.S./Canada community demonstration projects in the Okanogan in partnership with the OSBFP.

North Central Washington Audubon Society (NCWAS)

North Central Washington Audubon Society, a local chapter of the National Audubon Society, is dedicated to furthering the knowledge and the conservation of the environment of North Central Washington, our Nation, and the World. The status of the yellow-breasted chat population in the Okanagan Valley of B.C. is of significance to the society in the Okanogan as an indicator of riparian ecosystem health. This is of concern in the Okanogan where much riparian habitat has been replaced by other land uses. The Washington population of yellow-breasted chat plays an important role in the persistence of the species in B.C. where current breeding populations of yellow-breasted chats are down to about 40 pairs. The chapter also sponsors regular field trips, publishes a local newsletter, and plays an active role in education events and land conservation issues throughout the Chelan, Douglas, Okanogan and Ferry County region.

4.5 Artificial Production

4.5.1 History of Hatchery Fish production in the Methow and the Upper Columbia ESU

The first hatcheries that released salmonids in the mid-Columbia Basin began operation in 1899 near the confluence of the Twisp River on the Methow River (WDFG 1899). This hatchery was built to replenish the salmon (primarily Chinook, and coho) runs, which had virtually been eliminated by the 1890s (Gilbert and Evermann 1895; WDFG 1898).

The biggest problems encountered in the early years of the hatcheries were a lack of fish for broodstock, the entrainment of a large numbers of juveniles (both naturally- and artificially produced; WDFG 1904) because of irrigation diversions.

Most of the fish planted from the Methow facility in the first few years of production were probably coho (WDFG 1904-1920; Craig and Suomela 1941). For the first few years, species were not differentiated, with up to 3 million eggs per year collected from the Methow.

Very few Chinook were released from the first Methow River hatchery (Craig and Suomela 1941). Egg take between the years 1908 and 1912 ranged from 5,000 - 68,000 (average 24,100). In 1915, the hatchery was moved downstream near the mouth of the river at Pateros for two main reasons: it lacked brood stocks other than coho, and the new location lay downstream from the irrigation intakes (WDFG 1917).

Two years of operation of the new hatchery have demonstrated the wisdom of the change. Not only are more silverside salmon spawn secured at the new location than at the old, but the new location has developed to be the best hatchery in the state for the taking of Steelhead salmon eggs. Spring Chinook salmon eggs have also been able to be secured at this location, though, from Craig and Suomela (1941),

> . . ., Chinooks were never obtained in any quantity. . . some eggs were transferred to Methow from other locations. Even chum salmon eggs were shipped there in 1916 and 1917. . . In many cases there is no indication as to where the transferred Chinook eggs were taken, but some were obtained from the U. S. Bureau of Fisheries hatcheries on the lower Columbia, and probably some of the Washington hatcheries from that section also contributed late run stock to the Methow River. It is very questionable whether any of these fish were able to return to the Methow River, since the distance they would have (had) to migrate is much greater than that to which the original stock was accustomed. However, these records indicate that the Washington State Fisheries authorities made attempts to introduce strange runs of salmon to the Methow as well as to the Wenatchee.

In 1917, 1.5 million eggs were received at the Methow Hatchery from unknown origin. In the late 1920s, eggs were received from exotic hatcheries, but appear to be mostly late-run Chinook (Craig and Suomela 1941).

The release of fry from the early hatcheries on the Wenatchee and Methow rivers probably contributed little to adult returns.

4.5.2 The Effects of Fish Production on the Methow Salmon Ecosystem

Genetic and Ecological Effects on Natural Populations

The genetic risks to naturally produced populations from artificial propagation include reduction in the genetic variability (diversity) among and within populations, genetic drift, selection, and domestication, which can contribute to a loss of fitness for the natural populations (Hard et al.1992; Cuenco et al. 1993; NRC 1996; and Waples 1996).

Disease interactions between hatchery fish and listed fish in the natural environment may be a source of pathogen transmission. Because the pathogens responsible for diseases are present in both hatchery and natural-origin populations, there is some uncertainty associated with determining the extent of disease transmission from hatchery fish (Williams and Amend 1976; Håstein and Lindstad 1991).

It is acknowledged that among-population diversity for a portion of the ESU (Methow River Basin populations) may be negatively affected by the WDFW and FWS programs if escapements remain low. Specifically, this effect may result from the consolidation of Methow Basin populations into a single Methow population through collection and mating of upriver-origin spawners arriving at Wells Dam. This strategy, however, will provide unique information on how best to increase the abundance of fish and the population's recovery.

FWS and the fisheries co-managers have implemented the phasing out of the non-endemic Carson stock spring Chinook hatchery program to address the potential for genetic introgression and out-breeding depression. Efforts are being made to minimize the effects of these fish on the natural spawning population. By phasing out the Carson stock spring Chinook and changing to Methow Composite stock, the potential adverse genetic effects from natural spawning hatchery fish will be greatly reduced.

Direct competition for food and space between hatchery and listed fish may occur in spawning and/or rearing areas, the migration corridor, and ocean habitat. These impacts are assumed to be greatest in the spawning and nursery areas, and at points of highest fish density (release areas), and assumed to diminish as hatchery smolts disperse (FWS 1994).

Competition for space and cover in the Methow River probably occurs between hatchery and natural fish shortly after release and during downstream migration, but based on the smolt travel times, the duration of interaction is minimal in the river (WDFW 1998a). Rearing and release strategies at all WDFW salmon and steelhead hatcheries are designed to limit adverse ecological interactions through minimizing the duration of interaction between newly liberated hatchery salmon and steelhead and naturally produced fish.

Hatchery fish may prey upon listed fish. Because of their location, size, and time of emergence, newly emerged Chinook salmon fry are likely to be most vulnerable to predation by hatchery-released fish. Their vulnerability is believed to be greatest as they emerge, decreasing somewhat as they move into shallow, shoreline areas (FWS 1994). Emigration out of hatchery-release areas and foraging inefficiency of newly released hatchery smolts may minimize the degree of predation on Chinook salmon fry (FWS 1994).

Hatchery salmonids that do not emigrate after release are said to have residualized. These fish that residualize can adversely affect naturally produced fish through competition and predation. Chinook salmon do not tend to residualize (Groot and Margolis 1991); thus, no effects are expected on natural UCR spring Chinook salmon or steelhead in the Methow River. If residualization is substantial, significant interaction may occur. The residual rate for steelhead smolts in the Methow River is unknown, but is currently being investigated. WDFW facilities attempt to release steelhead and Chinook that are active migrants, thereby reducing the potential residual component; however, the direct stream release strategy employed for the majority of the releases may result in residual rates greater than those resulting from volitional releases. WDFW is assessing the efficacy of volitional versus direct releases.

Harvest Management

Fish harvest in the Columbia River basin affects the listed species by incidentally taking them in fisheries that target non-listed species. The largest potential impacts on UCR spring Chinook and steelhead come from treaty Indian and non-tribal fisheries in the Columbia River mainstem and tributaries (Myers et al. 1998).

A sport fishery for steelhead in the UCR has been authorized under Section 10 Permit 1395. In years when the escapement of hatchery-origin steelhead is greater than expected (i.e., over-escapement) the fishery was specifically designed to remove excess hatchery fish from the spawning grounds with minimal impacts on the natural origin steelhead.

Domestication of Hatchery Fish

Another concern of the artificial propagation of salmon is domestication, which is the change in quantity, variety, and combination of alleles, within a captive population or between a captive population and its source population in the wild, that are the result of selection in an artificial environment (Busack and Currens 1995). Domestication may occur when fish are placed into an artificial environment for all or part of their lives, imposing different selection pressures on them than does the natural environment. The concern is that domestication effects will decrease the performance of hatchery fish and their descendants in the wild. The concern is that hatchery fish, selected to perform well in a hatchery environment, tend to not perform well when released into the wild because of the difference between the hatchery and the wild environments.

Potential risks to the natural population occur when the hatchery fish spawns in the wild and the resulting performance of the natural population is reduced because of outbreeding depression (Busack and Currens 1995). The selection of broodstock is a common source of biased sampling. In general, broodstock selection should be random, but bias occurs when selection is based on particular traits. Genetic changes because of unintentional selection can be caused by the hatchery environment that allows more fish to survive compared to the natural environment. The elimination of all risks because of genetic diversity loss and domestication is not possible, but NOAA Fisheries believes that these risks can be minimized through the following measures proposed for the adult supplementation program:

- Address genetic concerns regarding selectivity; the collection of adult broodstock at traps for the supplementation program shall be representative of the run-at-large with respect to natural and hatchery parentage, migration timing, age class, morphology, and sex ratio;
- Provide that a proportion of each population, that will not be subjected to artificial propagation and the associated potential risk of negative genetic effects (upper Columbia River spring Chinook upstream escapement goal of approximately 80 adults per population), will be maintained as a minimum level for natural spawning when escapement to Wells Dam is greater than 668 adults;
- An effective population size (Ne) of 500 fish per population per generation should be the long-term program production objective to maintain an adequate genetic base, even thought an Ne of at least 50 adults per generation is required to reduce the risk of inbreeding depression and genetic drift in the short-term (fewer than five salmon generations) (BAMP 1998). If fewer adults are available, production can be scaled to ensure that hatchery-origin progeny do not overwhelm the population as a whole;

- Rear fish at minimum pond-loading densities to reduce the risk of domestication effects and;
- Eliminate Carson stock spring Chinook (a highly domesticated stock) that will further reduce potential genetic effects.

4.5.3 Current fish production programs in the Methow subbasin

For a detailed description of facilities and production/return summaries, see Appendix E. Artificial production of anadromous fish in the Methow subbasin includes spring Chinook, summer Chinook, summer steelhead, and reintroduction of coho salmon. A Hatchery and Genetics Management Plan for reintroduction of coho salmon is included in Appendix K.Spring Chinook and summer steelhead are currently ESA-listed as Endangered through the Endangered Species Act of 1973. Summer Chinook are considered a Depressed population. Once extirpated from the Methow subbasin, small numbers of coho salmon have been reintroduced, and plans are currently in the feasibility stage for a larger-scale reintroduction. Hatchery intervention in the Methow subbasin is guided by a two-pronged approach that encourages local adaptation, preservation and enhancement of specific populations, while simultaneously spreading the risk through selection of several artificial production alternatives.

Spring Chinook

Considerable controversy regarding the effects of the GCFMP, non-indigenous introductions, recent fishery management actions (variable broodstock collection and hatchery mating) on population structure, and regarding interpretation of available genetic data has prompted variable interpretations of spring Chinook population structuring in the Methow Basin.

In response to uncertainty about population structure, poor adult returns, and a desire to spread the risk of hatchery intervention strategies, a conceptual approach was developed during the creation of the Biological Assessment and Management Plan (BAMP) for mid-Columbia River Hatchery Programs. The approach consisted of enlarging the effective hatchery supplementation spawning population of Methow River and the Chewuch River populations, during periods of low adult returns, by managing them as a single gene pool. During years of sufficient adult returns, tributary trapping locations would be utilized to obtain the broodstock components of each tributary population, and within-population mating would be a priority in an attempt to preserve and enhance discrete population attributes that exist in the Methow Basin.

Management decisions regarding the Twisp River population varied from those developed for the Methow and Chewuch populations. The Twisp River population was deemed the most divergent of the indigenous populations in the subbasin, and the least tolerant of genetic introgression (Wells Project Coordinating Committee 1995). The Twisp River population is managed more as a distinct population, using adult supplementation and captive broodstock programs. The Joint Fisheries Party (JFP, composed of federal and state agencies and tribes) opted to phase out the Twisp Captive brood program beginning in 2000, leaving 1999 as the last brood year remaining in the program.

Various processes are underway within the Columbia Basin that direct hatchery program implementation. The listing of certain populations of fish under the ESA has also dictated hatchery program modifications and reform.

Current spring Chinook artificial production in the Methow subbasin is provided through the Winthop NFH (FWS) and through the Methow State Fish Hatchery. Production level objectives are 600,000 and 550,000 yearling spring Chinook smolts, respectively. Actual release levels have been variable, and have been influenced by run size, origin composition, genetic concerns, and disease management.

Since the Endangered listing of upper Columbia River spring Chinook in 1998, both facilities have implemented measures to decrease and minimize the influence of the non-endemic Carson spring Chinook stock in the hatchery production component. Both facilities target ESA-listed upper Columbia River spring Chinook. The Methow State Fish Hatchery also targets wild-origin Chinook for the supplementation program through tributary trap operations; however, relative success has been poor because of extremely low natural-origin escapement and poor trapping efficiencies.

Summer steelhead

Steelhead in the upper Columbia River (including the Methow River population) were listed as Endangered on August 18, 1997. The Methow population is likely an admixture of native upper Columbia River steelhead stocks resulting from the GCFMP. The Wells Hatchery steelhead stock (stock utilized for supplementation activities in the Methow subbasin) was derived from this admixture population and, because it was genetically indistinguishable from the naturalized population and was deemed necessary for recovery, was included in the ESA Endangered listing in 1997.

Steelhead population abundance in the Methow River has increased in recent years; however, much of the increase can be attributable to adults returning from supplementation program releases in the subbasin, with hatchery-origin fish comprising 60-85% of the escapement in the Methow Basin (Busby et al. 1996). The most recent five-year geometric mean of natural returns over Wells Dam (includes Methow and Okanogan River subbasins) is 358 fish, representing an increasing trend of 5.9% per year (NOAA fisheries 2002). The 2001 return provide an estimated 1,380 natural-origin steelhead past Wells Dam, the greatest in the 25-year data series; however, natural-origin proportion within the returns has decreased from 19%, for the period prior to the status review, to a range of 5-11% for the period 1997 to 2001. NMFS concluded in their 1996 status review, and again in the Biological Opinion issued in 2002 for ESA Section 10 Permit 1395, that because of poor natural recruitment, this ESU might not exist today if it were not for hatchery production based on indigenous stocks (NMFS 1996 and NOAA Fisheries 2002).

Smolt production for the Methow subbasin has been variable; current steelhead artificial production within the Methow subbasin includes smolt production from the Wells Hatchery facility (approximately 280,000 - 320,000) and Winthrop NFH (approximately 100,000). Historically, smolt production, contributing to the enhancement of the Methow population, has been a product of hatchery-origin crosses. More recently (past five years), spawning has sought to maximize the proportion HxW parentage in the production. The 2004 brood year incorporated 30% of the broodstock as wild, resulting in 100% of the projected smolt production as HxW parentage. The direction toward selective broodstocking and spawning protocol to enhance the proportion of HxW parentage will continue in efforts to enhance the performance of hatchery fish spawning in the wild, and subsequently to improve the Natural Cohort Replacement Rate.

Summer Chinook

Artificial production of summer Chinook in the Methow subbasin is provided through Rock Island Settlement Agreement and pending FERC approval, will be included as a Rock Island Dam HCP obligation.

Current and future (HCP) summer Chinook production for the Methow Basin is 400,000 yearling smolts. Adult collected are a mixture of upper Columbia River summer and fall races resulting from the GCFMP. The current brood collection terminates at the end of August, reducing the probability of incorporation of fall Chinook into the summer Chinook program. Additionally, summer/fall Chinook spawning ground survey in the Methow River have yet to identify known fall Chinook spawning populations (Andrew Murdoch 2004, pers comm.). While the GCFMP may have combined races initially in early years of hatchery production, the lack of demonstrated fall Chinook spawning populations indicates that historical and current hatchery practices have had minimal, if any, impact on the Chinook race delineation in the Methow River subbasin. Incorporation of non-indigenous stocks into the program has been minimal, and does not appear to have had a significant impact on the genetic integrity of the ESU (Chapman et al. 1994a; Myers et al. 1998).

Coho

The current coho reintroduction plan still in the feasibility stage through 2004 relies on existing or temporary facilities. Currently, coho smolts are acclimated and released in the Methow River from the WNFH for the sole purpose of broodstock development, although some natural production does occur. This phase of the program is expected to last through 2004 or 2005, after which the reintroduction program will expand to included acclimated releases in natural production areas of the basin in order to reach the tribal natural production goal.

Coho salmon are collected as volunteers into the Winthrop National Fish hatchery and from the run-at-large at Wells Dam west bank and/or east bank fish traps to support a 250,000 smolt program (YN et al. 2002). Methow basin coho broodstock may be supplement with eyed-eggs transferred from Wenatchee Basin incubation facilities or from hatcheries on the lower Columbia River (Cascade FH, Eagle Creek NFH, or Willard NFH) in years where broodstock collection falls short of production goals. Coho reared at Winthrop NFH are volitionally released into the Methow River or transferred to the Wenatchee River for acclimation and release. Under the current feasibility program, coho releases from the Winthrop National Fish Hatchery are design to contribute to the broodstock development process. Details on mating protocols, rearing and acclimation strategies, size at release and monitoring and evaluation can be found in the Yakama Nation's Mid-Columbia Coho HGMP (YN et al.2002).

4.5.4 Principal Policy Processes Managing Hatchery Fish Production

Federal

Hatchery and Genetic Management Plans

The Hatchery and Genetic Management Plan (HGMP) process was initiated to identify off-site mitigation opportunities associated with operation of the federal Columbia River Power System. The HGMP process is designed to describe existing propagation programs, identify necessary or recommended modifications of those programs, and help achieve consistency of those programs with the Endangered Species Act. The HGMP process only addresses anadromous salmon and steelhead programs.

Hatchery and Genetic Management Plans are described in the final salmon and steelhead 4(d) rule (July 10, 2000; 65 FR 42422) as a mechanism for addressing the take of certain listed species that may occur as a result of artificial propagation activities. NOAA Fisheries will use the information provided by HGMPs in evaluating impacts on anadromous salmon and steelhead listed under the ESA. In certain situations, the HGMPs will apply to the evaluation and issuance of Section 10 take permits. Completed HGMPs may also be used for regional fish production and management planning by federal, state, and tribal resource managers.

The primary goal of the HGMP process is to devise biologically based artificial propagation management strategies that ensure the conservation and recovery of listed Evolutionarily Significant Units (ESUs). The HGMP process also seeks to document and implement hatchery reform in the Columbia Basin. Much of the initial work on the HGMP process was coordinated and combined with efforts to complete the Artificial Production Review and Evaluation (APRE) analysis, which looked at the same sorts of information.

Artificial Production Review and Evaluation (APRE)

The APRE process seeks to document progress toward hatchery reform in the Columbia Basin. The NPCC used consultants and representatives of the Columbia Basin fishery managers to analyze existing programs and recommend reforms; a draft report that will go to the Council and the region has been prepared. The APRE process includes both anadromous and nonanadromous fish in its analysis.

Pacific Coastal Salmon Recovery Fund

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established in FY2000 to provide grants to the states and tribes to assist state, tribal and local salmon conservation and recovery efforts. The PCSRF was requested by the governors of the states of Washington, Oregon, California and Alaska in response to Endangered Species Act (ESA) listings of West Coast salmon and steelhead populations. The PCSRF supplements existing state, tribal and federal programs to foster development of federal-state-tribal-local partnerships in salmon recovery and conservation, promoting efficiencies and effectiveness in recovery efforts through enhanced sharing and pooling of capabilities, expertise and information. The goal of the Pacific Coastal Salmon Recovery Fund is to make significant contributions to the conservation, restoration, and sustainability of Pacific salmon and their habitats.

The PCSRF's enhancement objective is: To conduct activities that enhance depressed stocks of wild anadromous salmonids through hatchery supplementation, reduction in fishing effort on depressed wild stocks, or enhancement of Pacific salmon fisheries on healthy stocks in Alaska. This includes supplementation, salmon fishery enhancements, and the Yakama Nation spring chinook pedigree study.

ESA

Current ESA Section 10 permits for listed summer steelhead (Permit #1395), listed spring Chinook (Permit #1196), and non-listed anadromous fish (Permit # 1347) also direct artificial production activities associated with the habitat conservation plans. Douglas PUD, Chelan PUD and WDFW are co-permittees; therefore, provisions within the permits and associated Biological Opinions are incorporated into the hatchery programs undertaken in the HCPs.

State

The state and federal government have various forums in which they are active. All have some role in determining or balancing artificial production programs, as well as the ones that follow under "other." Essentially no specific action would occur until the action is determined to be warranted in the already established processes.

Other

FERC processes

Under current settlement agreements and stipulations, the three mid-Columbia PUDs pay for the operation of hatchery programs within the Columbia Cascade Province. These programs determine the levels of hatchery production needed to mitigate for the construction and continued operation of the PUD dams.

Habitat Conservation Plans

In 2002, habitat conservation plans (HCPs) were signed by Douglas and Chelan PUDs, WDFW, FWS, NOAA Fisheries, and the Colville Confederated Tribes. The overriding goal of the HCPs are to achieve No Net Impact (NNI) on anadromous salmonids as they pass Wells (Douglas PUD), Rocky Reach, and Rock Island (Chelan PUD) dams. One of the main objectives of the hatchery component of NNI is to provide species-specific hatchery programs that may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Biological Assessment and Management Plan (BAMP)

The biological assessment and management plan was developed by parties negotiating the HCPs in the late 1990s. The BAMP was developed to document guidelines and recommendations on methods to determine hatchery production levels and evaluation programs. It is used within the HCP as a guiding document for the hatchery programs.

All of these processes affect the hatchery programs within the Methow River Basin in one way or another.

Federal programs

Grand Coulee Fish Maintenance Project (GCFMP)

The FWS operates the Leavenworth NFH Complex in the UCR region constructed by the U.S. Bureau of Reclamation (BOR) to mitigate for fish losses that resulted from construction of Grand Coulee Dam. These programs were authorized as part of the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and re-authorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. The complex consists of three hatchery facilities (Leavenworth, Entiat, and Winthrop NFHs), and has the following mission:

To produce high quality spring Chinook salmon and summer steelhead smolts commensurate with the production goals established by the Columbia River Fisheries Management Plan (FWS 2002a)

Historically, these facilities have reared and released spring Chinook salmon eggs transferred from the Carson NFH on the lower Columbia River. Carson stock spring Chinook salmon are not included in the ESA-listed UCR spring Chinook salmon ESU. The FWS has discontinued transferring eggs from Carson NFH in favor of utilizing hatchery-origin adult spring Chinook salmon, returning to each facility, as the primary egg source.

The hatcheries built as part of the GCFMP began operation in the early 1940s at Leavenworth (Icicle Creek, a tributary of the Wenatchee River), Entiat, and Winthrop (Methow River). The Leavenworth facility was built as the main hatchery site, and the Entiat and Winthrop hatcheries, as substations. These hatcheries were built as part of the program to relocate populations of salmon and steelhead that formerly ascended the Columbia River upstream from the Grand Coulee Dam site.

Winthrop National Fish Hatchery (NFH)

Located on the Methow River, this substation of the Leavenworth NFH complex began operation in 1941. The Winthrop Hatchery released stream-type Chinook every year from 1941 through 1962. Releases of spring Chinook ceased until 1976, when the current program began, and have since been ongoing. Releases of sockeye have taken place at Winthrop from 1943 to 1957. Spring Chinook, steelhead and coho are all currently cultured at the facility.

Broodstock origin for fish released from Winthrop NFH has varied over the years. The first four years of releases were from broodstock collected at Rock Island Dam as part of the GCFMP (see above). Eggs from the Cowlitz, Little White, Carson, Klickitat, and Leavenworth (all Carson-stock) hatcheries have been raised and released from Winthrop since the current program began in 1976, although since 1992, all brood used for the program has come from adults returning to the Methow River.

Since brood year 1999, which is the same year spring Chinook were listed under the ESA, no releases of the “pure” unlisted Carson-stock has occurred. The listed Methow Composite stock has been utilized in an effort to aid in the recovery of that population.

Facility description: Located on the Methow River, at RM 50.4, this facility has two 40 by 80 foot adult holding ponds (construction was never completed), sixteen 17 x 76 foot Foster-Lucas ponds, sixteen 12 x 102 foot, and thirty 8 x 80 foot raceways. Inside the hatchery building, there are 42 (eight-tray) incubators, thirty-five 3 x 16 foot fiberglass tanks, and four 16.5 x 16 concrete starting troughs (FWS 1986c).

The primary water source for the hatchery is the Methow River. The water right allows for withdrawals up to 50 cfs. Spring Branch Springs provides up to 10 cfs, and two groundwater infiltration galleries and wells provide 1,500 gpm each, with a maximum of 2,400 acre foot per year each. The springs and infiltration galleries provide warmer water during the winter months. A third infiltration gallery, capable of pumping 4,500 gpm, is currently under construction.

Evaluation: The Mid-Columbia River Fishery Resource Office (MCRFRO) provides monitoring, evaluation, and coordination services concerning Winthrop NFH production.

MCRFRO staff monitors hatchery returns, biological characteristics of the hatchery stock, fish marking, tag recovery, and other aspects of the hatchery program, as well as maintain the database that stores this information. MCRFRO also cooperates with the hatchery, fish health and technology centres, and co-managers to evaluate fish culture practices, assess impacts on native species, and coordinate hatchery programs both locally and regionally.

The Leavenworth NFH Complex (which includes Winthrop NFH) has a team comprised of staff from the hatcheries, Fish Health, and the MCRFRO (Hatchery Evaluation Team). Current evaluation practices/studies include, among others: bio-sampling of returning adults, 100% marking of released juveniles, application of PIT tags, assessment of stray rates, travel-time of released juveniles through the Columbia River corridor, assessment of potential of hatchery fish to transfer diseases to wild stocks, success/failure of hatchery-produced adults to reproduce naturally, use of NATURE's type rearing, raceway density studies, genetic comparisons of hatchery and wild stocks, and feed (fish food) evaluations.

State Programs

Methow Fish Hatchery Complex

The Methow Fish Hatchery Complex (MFHC) was built to compensate for losses of smolts caused by the operation of Wells Dam (Erho and Bugert 1995). The facility was constructed by, and operates, under funding from Douglas PUD. Eggs are collected at weirs on the Methow, Twisp, and Chewuch Rivers and incubated discretely at the central facility near the town of Winthrop. Smolts (246,000 for each facility) are released from acclimation ponds on the Twisp, Chewuch, and Methow (central facility) Rivers (Peck 1993; Bartlett and Bugert 1994).

The overall goal of the Methow Fish Hatchery Complex is to mitigate for No Net Impact on upper Columbia River spring Chinook as they pass Wells (Douglas PUD), Rocky Reach, and Rock Island (Chelan PUD) dams, and contribute to the rebuilding and recovery of naturally-reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Facility description: The MFHC consists of a central facility on the Methow River, near the town of Winthrop, and two satellite facilities on the Chewuch and Twisp Rivers. The main facility is located on the Methow River, approximately 45 miles upstream of the confluence with the Columbia River. This facility has three canopy-covered 8 x 78 x 4 foot adult holding ponds, 12 canopy-covered juvenile raceways of the same dimensions as the adult ponds, and twenty-four indoor 3 x 59 x 4.5 foot start tanks. In addition, there are three separate incubation rooms with 15 single-stack (eight trays per stack) vertical incubators and one 107 x 59 x 4.5 foot acclimation pond, which releases into the mainstem Methow River (Bartlett and Bugert 1994).

The main water source for the Methow facility is from four wells that provide almost 10 cfs. An additional water right of 18 cfs of Methow River water is provided, with 11 cfs guaranteed (the additional 7 cfs is shared with Winthrop NFH in the spring; Bartlett and Bugert 1994).

Almost eight miles upstream of the confluence of the Methow River is the Chewuch River acclimation site. The site has one large acclimation pond, which measures 107 x 70 x 4.5 feet. The water source of the acclimation pond is the Chewuch River, which is supplied by gravity feed from the Chewuch Canal Company's irrigation ditch. The maximum flow to the pond is six cfs (Bartlett and Bugert 1994). Adult trapping for the Chewuch fish occurs at Fulton Dam, approximately 4.5 miles downstream of the acclimation pond (1.5 miles upstream of the confluence with the Methow River).

The Twisp River acclimation site is approximately 5 miles upstream of the confluence with the Methow River. The facility has one acclimation pond, which measures 107 x 59 x 4.5 ft. The water source of the pond is the Twisp River from the Valley Power irrigation canal, with a maximum flow of six cfs. The adult collection weir and trap is located adjacent to the acclimation pond (Bartlett and Bugert 1994).

Wells Hatchery

The Wells Hatchery goal includes both operational and construction mitigation aspects. The mitigation goal of the Wells Fish Hatchery Complex is to mitigate for No Net Impact on upper Columbia River summer steelhead as they pass Wells Dam (Douglas PUD) and to mitigate for fisheries losses because of the original construction (inundation). One of the main hatchery goal components is to achieve NNI for summer steelhead (Methow and Okanogan River subbasins), and contribute to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Hatchery Objectives

- minimize interactions with other fish populations through rearing and release strategies; maintain stock integrity and genetic diversity of each population or unique stock through proper management of genetic resources;
- maximize survival at all life stages using disease control and disease prevention techniques; prevent introduction, spread or amplification of fish pathogens;
- conduct environmental monitoring to ensure that the hatchery operations comply with water quality standards and to assist in managing fish health;
- communicate effectively with other salmon producers and managers in the Columbia River basin, and with implementers of local and regional flow and spill programs;
- increase the number of naturally produced upper Columbia River summer steelhead on the spawning grounds, and;
- develop a Conservation Plan and conduct a comprehensive monitoring/evaluation program to determine that the program meets mitigation obligations, estimate survival-to-adult, evaluate effects of the program on local naturally producing populations, and evaluate downstream migration rates in regards to size and timing of fish released.

Eastbank Fish Hatchery

Artificial production of summer Chinook for the Methow subbasin is provided through the Rock Island Project Settlement Agreement (and will be superseded by the HCP), via the Eastbank Hatchery.

The overall goal of the Methow River subbasin summer Chinook production is to mitigate for No Net Impact on upper Columbia River summer Chinook as they pass Wells (Douglas PUD), Rocky Reach, and Rock Island (Chelan PUD), and contribute to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Hatchery Objectives

- minimize interactions with other fish populations through rearing and release strategies; maintain stock integrity and genetic diversity of each population or unique stock through proper management of genetic resources;
- maximize survival at all life stages using disease control and disease prevention techniques; prevent introduction, spread or amplification of fish pathogens;
- conduct environmental monitoring to ensure that the hatchery operations comply with water quality standards and to assist in managing fish health;
- communicate effectively with other salmon producers and managers in the Columbia River basin, and with implementers of local and regional flow and spill programs;
- increase the number of naturally produced upper Columbia River summer steelhead on the spawning grounds, and;
- develop a Conservation Plan and conduct a comprehensive monitoring/evaluation program to determine that the program meets mitigation obligations, estimate survival-to-adult, evaluate effects of the program on local naturally producing populations, and evaluate downstream migration rates in regards to size and timing of fish released.

United States v. Oregon

United States v. Oregon, originally a combination of two cases, Sohappy v. Smith and U.S. v. Oregon, legally upheld the Columbia River treaty tribes' reserved fishing rights. Specifically, the decision acknowledged the treaty tribes reserved rights to fish at "all usual and accustomed" places, whether on or off the reservation, and were, furthermore, entitled to a "fair and equitable share" of the resource. Although the Sohappy case was closed in 1978, U.S. v. Oregon remains under the federal court's continuing jurisdiction, serving to protect the tribes treaty-reserved fishing rights. This case is tied closely to U.S. v. Washington, which among other things defined "fair and equitable share" as 50% of all the harvestable fish destined for the tribes' traditional fishing places, and established the tribes as co-managers of the resource.

In 1988, under the authority of U.S. v. Oregon, the states of Washington, Oregon and Idaho, federal fishery agencies, and the treaty tribes agreed to the Columbia River Fish Management Plan (CRFMP), which was a detailed harvest and fish production process. There are no financial encumbrances tied to the process. Rather, the fish production section reflects current production levels for harvest management and recovery purposes, since up to 90% of the Columbia River harvest occurs on artificially produced fish. This Plan expired in 1998, and has had subsequent annual rollover of portions in which agreement has been reached; however, a newly negotiated CRFMP is forthcoming.

Hatchery production programs in the upper Columbia sub-basins are included in the management plans created by the fishery co-managers identified in the treaty fishing rights case U.S. v. Oregon. The parties to U.S. v. Oregon include the four Columbia River Treaty Tribes (Yakama Nation, Warm Springs, Umatilla, and Nez Perce tribes), NOAA-Fisheries, U.S. Fish and Wildlife

Service, and the states of Oregon, Washington, and Idaho. The Shoshone-Bannock Tribe is admitted as a party for purposes of production and harvest in the upper Snake River only. These parties jointly develop harvest sharing and hatchery management plans; these are then entered as orders of the court and are binding on the parties. The "relevant co-managers" described in the U.S. v. Oregon management plans are, for the mid-Columbia sub-basins, the federal parties, Yakama Nation, and Washington Department of Fish and Wildlife.

Hatchery programs are viewed by the Yakama Nation as partial compensation for voluntary restrictions to treaty fisheries to assist in rebuilding upriver populations of naturally spawning salmonids. Because treaty and non-treaty fisheries are restricted on the basis of natural stock abundance, the tribal priority is to use hatcheries in a manner that supplements natural spawning and increases average population productivity. Perspectives on the appropriate use of hatchery-origin fish for supplementation vary among federal, state, and tribal fish co-managers. Federal and, to a lesser degree, state co-managers place a higher priority on managing the genetic risks of hatchery supplementation of natural populations, while the tribe sees the demographic threats of habitat loss and degradation as the greater risk to natural populations. In general, however, all parties agree that hatcheries can and should be operated as integral components of natural populations, where the survival benefits of the hatchery can result in a significant increase in net population productivity.

4.5.5 Current Fish Production Program Goals and Objectives

Federal Programs

Grand Coulee Fish Maintenance Project (GCFMP)

The FWS's mission for the Leavenworth complex is:

> To produce high quality spring Chinook salmon and summer steelhead smolts commensurate with the production goals established by the Columbia River Fisheries Management Plan (FWS 2002a)

Winthrop National Fish Hatchery (NFH)

Objectives originally established for the Leavenworth Hatchery Complex, as part of the GCFMP were (from Calkins et al. 1939):

- to bring, by stream rehabilitation and supplemental planting, the fish populations in the 677 miles of tributary streams between Grand Coulee Dam and Rock Island Dam, up to figures commensurate with the earlier undisturbed conditions and with the natural food supply in the streams, and;
- to produce in addition, by the combination of artificial spawning, feeding, rearing and planting in these streams, a supplemental downstream migration equivalent to that normally produced by the 1,245 miles of streams and tributaries above Grand Coulee Dam.

Current objectives of the FWS hatcheries are outlined in FWS (1986a, b). In the FWS Statement of Roles and Responsibilities, the broad role of the hatcheries is:

> …to seek and provide for mitigation of fishery resource impairment because of Federal water-related developments . . . the Fishery Resource Program

> goal, in fulfilling its mitigative responsibilities, is to ensure that established and future fishery resource mitigation requirements are fully and effectively discharged. Implicit in this goal is the replacement of fishery resource losses caused by specific Federal projects . . . and another responsibility of the Leavenworth Hatchery . . . is to restore depleted Pacific salmon and steelhead stocks of national significance in accord with statutory mandates such as the Pacific Northwest Electric Power Planning and Conservation Act, Mitchell Act, Salmon and Steelhead Conservation Act, Pacific Salmon Treaty Act of 1985, and Indian Treaties and related Court decisions.

Shelldrake (1993) updated the objectives of the mid-Columbia NFHs:

- Hatchery production [specific to each facility].
- Minimize interaction with other fish populations through proper rearing and release strategies.
- Maintain stock integrity and genetic diversity of each unique stock through proper management of genetic resources.
- Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens.
- Conduct environmental monitoring to ensure that hatchery operations comply with water quality standards and to assist in managing fish health.
- Communicate effectively with other salmon producers and managers in the Columbia River Basin.

State programs

Methow Fish Hatchery Complex

One of the guiding principles of the Methow Basin Spring Chinook Salmon Supplementation Plan (MBSCSP) is to increase natural production of the three principal stocks from the mainstem Methow, Chewuch, and Twisp Rivers. With this in mind, the general supplementation plan has established separate strategies for each of the three streams. Each stock will have specific escapement goals, designed to provide a basis for evaluating the progress of achieving the original intent of the program

Methow River: Collaboration between Winthrop FH and Methow FH is of paramount importance for the MBSCSP. Gene flow between the two hatcheries will inevitably occur. To be consistent with this situation, all spring Chinook salmon that spawn in the mainstem Methow River upstream of the Chewuch River confluence will be managed as one genome. To be successful, this management strategy requires three conditions: 1) no spring Chinook salmon from outside this reach will be imported to either hatchery for propagation and release into the Methow River (exogenous salmon may be reared at the hatcheries if they are acclimated and released into their natal stream); 2) all salmon released from either hatchery into the Methow Basin will be externally marked, and; 3) salmon that spawn in the Lost River will be included in this population.

Chewuch River: The Fishery Parties recognize the opportunity to implement innovative fish cultural practices at Methow FH, yet also are acutely aware of the need to ensure high survival of the supplemented populations. The Chewuch River population will, therefore, be the designated stock used for innovative hatchery management. In general terms, the Chewuch stock may be considered an experimental "treatment" stream, compared to the Twisp River population, which will serve as the "reference." Alternative fish culture may include such practices as life skills training (Olla and Davis 1989, Suboski and Templeton 1989), side-channel rearing (Budhabhatti and Maughan 1994), autumn presmolt releases (Bjornn 1978, Bilby and Bisson 1987), or other prototypical hatchery strategies.

Twisp River: The Twisp River stock will be managed in a manner that ensures the highest survival of both natural and hatchery salmon in that river. Low risk production strategies will be implemented in all stages of the program. The Evaluation Plan will place an emphasis on long-term genetic and demographic monitoring of the Twisp population in order to evaluate the stability of a small semelparous population. An estimate of minimum viable population (MVP; Shaffer 1981, 1990; Lacava and Hughes 1984) size will be derived, either through empirical or heuristic analysis (Kapuscinski and Lannan 1986). The escapement goal for the Twisp River will then be based upon the estimated MVP.

The overall goal of the state hatcheries is to use artificial production to replace adult production lost because of smolt mortality at mainstem hydroelectric projects, while not reducing the natural production or long-term fitness of salmonid stocks in the area (WDF 1993). Specific goals of the WDFW hatcheries (WDF 1993) are:

- Hatchery production [in terms of number of fish released from each site];
- Minimize interactions with other fish populations through rearing and release strategies; maintain stock integrity and genetic diversity of each population or unique stock through proper management of genetic resources;
- Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens;
- Conduct environmental monitoring to ensure that the hatchery operations comply with water quality standards and to assist in managing fish health;
- Communicate effectively with other salmon producers and managers in the Columbia River basin, and with implementers of local and regional flow and spill programs, and;
- Develop a Conservation Plan and conduct a comprehensive monitoring/evaluation program to determine that the program meets mitigation obligations, estimate survival to adult, evaluate effects of the program on local naturally producing populations, and evaluate downstream migration rates in regards to size and timing of fish released.

4.5.6 Fish Production Program Operations

Federal Program

Winthrop NFH

FWS operates the Winthrop National Fish Hatchery (WNFH) located only a few miles downstream from the Methow FH. Broodstock are typically collected from the volunteer trap located in the hatchery outfall. Approximately 600,000 smolts are released annually directly into the Methow River from the WNFH.

Adult spring Chinook salmon return to the hatchery beginning in early- to mid-May. The escapement goal for this hatchery is 350 adults, for a subsequent release of 600,000 smolts annually. Spawning begins in mid-August and can continue to mid-September. The stock of spring Chinook propagated at WNFH is listed as “Endangered” under the Endangered Species Act (ESA). Brood year 1999 was the first year propagating this stock. Prior to the switch in stocks, a Carson NFH (lower Columbia River) stock was utilized (not ESA-listed).

In most years, all broodstock used for production are volunteers to the hatchery. Adults swim up the collection ladder and into a holding area. The capacity of this pond can only support about 400 adults. The current program calls for adults in excess of brood needs to spawn naturally; therefore, hatchery staff must limit the number of adults entering the ladder. A weir is placed in the channel leading to the ladder and is selectively opened and closed.

During years of extremely low adult returns, as in 1996 and 1998, all spring Chinook ascending Wells Dam are captured and transferred to WNFH and the Methow Fish Hatchery. Adult brood for the Winthrop program has, in some years, been captured at the MFH and transferred to WNFH.

For years 1984 to 2001, an average of 685 adults of WNFH origin have returned to the Methow River Basin. Although the original objective of this mitigation program was to provide fish for harvest, it is also trying to aid in the recovery of ESA-listed populations.

All juveniles released from WNFH have a coded-wire tag (CWT) inserted in their snout. During the spawning of adults, CWTs from all adults are removed and decoded prior to the mixing of gametes. This way, FWS has the ability to manage particular crosses (matings); some are more desirable than others.

Juveniles are annually released as yearlings in mid-April. The smolts are forced from the raceways into the ¼ mile long spring-fed channel (where the ladder is located), which flows to the Methow River. Currently, all juveniles carry a CWT, and a portion may also have an adipose-fin clip (depending on lineage).

Throughout the years, the spring Chinook release goal at WNFH has varied. The current goal is 600,000 smolts at 15 to18 fish/pound. During the years 1980 to 2001, an average of 642,682 have been released annually.

Winthrop NFH also has a small summer steelhead program. This stock is listed as “Endangered” under the ESA. The annual release goal is currently 100,000 smolts. Brood for this program is secured at Wells Dam by WDFW; none of the steelhead are collected as volunteers to WNFH. Eyed eggs are transferred to WNFH from Wells Hatchery in January or February each year.

Approximately 14 months later, the smolts are volitionally released over a two-to-four week period starting in early April. Juveniles are 100% fin-clipped, and returning adults may be harvested in the sport fishery above Rocky Reach Dam.

State Program

Spring Chinook

The Methow Fish Hatchery operates as an adult-based supplementation program using multiple adult broodstock collection locations including the Chewuch, Twisp, and upper Methow Rivers. Additional supplementation includes volunteer returns to Methow Fish Hatchery and Winthrop NFH. The long-term production objective for the Methow Fish Hatchery was set at 738,000 yearling spring Chinook smolts in the Wells Dam Settlement Agreement (1990); however, the maximum capacity of the facility was modified during the development of the Mid-Columbia Habitat Conservation Plan (MCHCP) to 550,000 yearlings at 15 fish/pound (BAMP 1998). Three acclimation facilities are components of the spring Chinook supplementation program and include the Twisp acclimation, Chewuch acclimation, and on-site acclimation at the Methow State Fish Hatchery.

Poor returns of wild fish and limited broodstock collection capabilities, coupled with historically poor spring Chinook replacement rates of 0.7 recruits per spawner (1985-1990; L. LaVoy, WDFW, unpublished data), prompted the development of a three-tiered broodstock collection protocol for the spring Chinook supplementation program in the Methow subbasin. Under a revised approach adopted in 1996, the location and extent of broodstock collections is based on projected escapement at Wells Dam (**Table 53**). Broodstock collection protocols are now developed annually and are determined by adult escapement above Wells Dam, expected escapement to tributary and hatchery locations, estimated wild/hatchery proportion, and production objectives and stock origin (endemic/non-endemic).

Table 53 Broodstock collection guidelines of the Methow Basin spring Chinook supplementation plan

Wells Escapement Projection	Broodstock Collection Objective
< 668	100% collection of Wells Dam escapement; place all fish into the adult-based supplementation program.
>668 <964	Pass a minimum of 296 adults upstream of Wells Dam for natural spawning.
> 964	Collection at levels to meet interim production level of 550,000 and 600,000 smolts at Methow Fish Hatchery and Winthrop NFH, respectively.

(ESA Section 7 Draft Biological Opinion, Section 10 Permit 1196)

The hatchery and acclimation ponds are operated in a manner that is consistent with accepted aquaculture standards and those identified in the Wells Dam Settlement Agreement. Broodstock handling, spawning, fertilization, incubation, rearing, fish transport, and release activities are detailed in annual summary reports of specific brood years for the Methow Basin Spring Chinook Salmon Hatchery Program (Bartlett et al. 1994; Bartlett 1996, 1997, 1998, 1999; and Jateff 2001).

Since adult returns were so low in the beginning years of the program, WDFW used some Carson stock fish in their program. WDFW is now actively avoiding fish of Carson ancestry in their broodstock; the WNFH is also moving away from using these fish.

WDFW spawns both listed hatchery x natural and natural x natural crosses to the extent possible. When possible, naturally produced fish retained for broodstock shall represent the natural-origin population in terms of age composition, sex ratio, and run timing. To the greatest extent possible, WDFW shall maintain known Twisp River spring Chinook salmon as a separate broodstock within the hatchery. The progeny of known Twisp River spring Chinook salmon shall be distinctly marked for identification purposes.

To reduce and control fish disease incidences, WDFW will use the disease control procedures identified in the operations plans, and adhere to the Washington co-manager, Pacific Northwest Fish Health Protection Committee and IHOT (Integrated Hatcheries Operation Team) fish disease control policies.

Summer Chinook

Artificial production of summer Chinook for the Methow subbasin is provided through the Rock Island Project Settlement Agreement (and will be superseded by the HCP), via the Eastbank Hatchery. The hatchery was constructed in 1989, and is located adjacent to Rocky Reach Dam on the Columbia River. The program is funded by Chelan County PUD and operated by WDFW. Summer Chinook production at Eastbank Hatchery is intended to mitigate for summer Chinook losses at Rock Island Dam. The production objective for the Methow River is a total of 400,000 yearling summer Chinook at 10 fish/pound (BAMP 1998).

Broodstock (556 adults) are collected at the Wells Dam east ladder trapping facility and transported to the Eastbank Hatchery. These fish originate from Okanogan/Methow (Wells Dam East ladder trap) summer Chinook populations of natural- or hatchery-origin, and are indigenous to the Methow/Okanogan system. Returning salmon from the Carlton (Methow River) program also volunteer into Wells Fish Hatchery, yet they are identified by Code Wire Tags (CWT) and can be placed into their program of origin if desired (Eltrich et al. 1995; BAMP 1998). Incubation, spawning, and initial rearing of Methow summer Chinook take place at the Eastbank facility. The fish are then transferred to the Carlton Acclimation Pond towards the end of their second winter, where they are volitionally released at smolt size (10fish/lb.) into the Methow River during April and May (these fish are currently raised for Wells mitigation under a “species trade” between Chelan and Douglas PUD; once the HCPs are finalized, the 400,000 fish will be split 50:50 between the two PUDs (until 2013, when Chelan’s obligation may go down)).

Broodstock collection protocols are developed annually and determined by annual escapement at Rocky Reach Dam, subject to in-season adjustments. Facility operation description, biological attributes and aquaculture practices and standards are detailed in the HGMP for summer Chinook as developed for the Biological Opinion for ESA-Section 10 Permit #1347 (Incidental Take of Listed Salmon and Steelhead from federal and Non-federal Hatchery Programs that Collect, Rear and Release Unlisted Fish Species; WDFW 2000) and as developed for the Rocky Reach and Rock Island Anadromous Fish Agreement and Habitat Conservation Plan.

Summer Steelhead

Steelhead are collected from the run-at-large at the west ladder trap at Wells Dam. Beginning in 2003, wild-origin fish were also collected from the east ladder trap to incorporate a greater number of wild fish into the broodstock (33%). Adult steelhead are spawned and reared at Wells FH.

Approximately 125,000 eyed eggs are shipped to Winthrop National Fish Hatchery to support a 100,000 smolt program that releases directly from the hatchery into the Methow River. Wells FH annually transports and releases an additional 350,000 smolts into the Twisp, Chewuch, and Methow Rivers, and an additional 130,000 steelhead smolts for release into the Okanogan and Similkameen rivers.

Broodstock collection protocols are developed annually and subject to in-season adjustments. Facility operation description, biological attributes and aquaculture practices and standards are detailed in the Draft HGMP for summer steelhead and in the Biological Opinion for ESA-Section 10 Permit #1395, #1396 and #1412, and as developed for the Wells Dam, Rocky Reach and Rock Island Anadromous Fish Agreement and Habitat Conservation Plan(s).

Coho

Coho are collected as volunteers into the Winthrop National Fish hatchery and from the run-at-large at Wells Dam west bank and/or east bank fish traps to support a 250,000 smolt program. Methow basin coho broodstock may be supplemented with eyed eggs transferred from Wenatchee Basin incubation facilities or from hatcheries on the lower Columbia River (Cascade FH, Eagle Creek NFH, or Willard NFH) in years where broodstock collection falls short of production goals. Coho reared at Winthrop NFH are volitionally released into the Methow River or transferred to the Wenatchee River for acclimation and release. Under the current feasibility program, coho releases from the Winthrop National Fish Hatchery are designed to contribute to the broodstock development process. Details on mating protocols, rearing and acclimation strategies, size at release, and monitoring and evaluation can be found in the Yakama Nation's mid-Columbia coho HGMP (YN 2002).

Non-anadromous fish releases

Non-anadromous fish have been planted within the Methow Basin since the early 1900s. Rainbow trout, cutthroat trout, brook trout, and a few brown trout have all been planted at various times through multiple hatchery programs.

Following micro-habitat work in the 1980s that showed negative effects on presmolt steelhead from "catchable" releases of rainbow trout, all releases of rainbow were shifted from streams to various lakes within the basin that did not have connectivity to anadromous areas.

Conservation of the Species: The capture of Endangered UCR spring Chinook salmon and summer steelhead by WDFW for artificial propagation efforts are designed to benefit the species. The primary objectives of these efforts are to preserve extant spring Chinook and steelhead populations in the region, and to boost the abundance of remaining stocks. There are risks of ecological and genetic impacts on the ESA-listed juvenile and adult spring Chinook salmon and steelhead resulting from the proposed programs; however, the risk of extinction to natural populations is high enough that aggressive intervention is required.

Monitoring and Evaluation

The Wells Settlement Agreement (by which MFHC and Wells Fish Hatchery were authorized, and which will be superseded by the HCP) includes provision for evaluation of the MFHC and Wells Fish Hatchery, both able to meet their production requirements under Phase I of the HCP, and its effects on natural production. This evaluation plan includes genetic monitoring of hatchery and naturally produced fish, migration timing, survival studies of hatchery releases, and studies to evaluate interaction between hatchery- and naturally produced fish. Monitoring and evaluation of the hatchery programs in the Methow River is ongoing. The plan for the adult-based supplementation program addresses three critical uncertainties associated with the program:

- whether the hatchery facilities can safely meet their production objectives;
- the effect of the programs on the long-term reproductive success of the population in the natural environment, and;
- the identification of ways to operate the facilities to reduce the short-term ecological impacts on the naturally produced fish (WDFW 1998a).

In addition, the Yakama Nation is monitoring summer chinook stock status in the Methow River using visual observations and video recordings taken near Pateros. This work is funded by Alaska through the Columbia River Inter-Tribal Fish Commission.

4.5.7 Program Results

Federal Program

Winthrop NFH was constructed to mitigate for lost habitat because of the construction of Grand Coulee Dam. The original objective of this facility was to provide adults for harvest. This role has changed in recent years. While in some years a sport fishery is open for adult steelhead returning to WNFH, it is desired that adult spring Chinook salmon (in excess of brood needs) are allowed to spawn naturally in the Methow River. This program change was driven by the ESA, and now focuses primarily on recovery.

State Program

Spring Chinook

Record escapements of spring Chinook in the Methow Basin in recent years have been positively influenced, in part, by the hatchery program at Methow Fish Hatchery. In recent years, the number of hatchery fish on the spawning grounds has greatly exceeded the number of wild fish (>90%). The number of spring Chinook (hatchery and wild) returning to the Methow Basin has also greatly exceeded escapement levels. While an increase in wild fish abundance has been observed, future adult returns should provide more information to the efficacy of the hatchery program in increasing the abundance of naturally produced populations.

Summer Chinook

Record escapements of summer Chinook in the Methow Basin in recent years have been positively influenced in part by the hatchery program at Carlton Pond. A goal of a supplementation program is to increase the number of spawners by allowing hatchery fish to spawn naturally. Subsequent increases in the number of naturally produced fish on the spawning grounds would support the hypothesis that hatchery fish contributed to future adult returns.

Steelhead

Hatchery fish have been a dominant part of the spawning population for many years; however, the objective of the hatchery program has only recently changed to a recovery role versus a harvest augmentation role. Wild or naturally produced fish comprise approximately 10% of the run over Wells Dam. If the hatchery program is successful, the proportion of wild fish should increase in subsequent years. An increase in the number of wild fish incorporated into the broodstock may reduce potential genetic impacts on the wild fish. In the Methow Basin, a high abundance of hatchery fish, because of above-average SARs, has lead to escapement levels far above the carrying capacity of the basin. In response, the WDFW developed a methodology using a sport fishery to reduce the number of hatchery fish on the spawning grounds with acceptable risks to the natural origin component (approved action on ESA Section 10 Permit #1395), reducing not only density-dependent effects but also genetic impacts.

Contribution of Adults to Recovery or Harvest

Returning adults from these programs are intended to increase naturally spawning populations. The hatchery programs have successfully contributed adults to the naturally spawning populations; however, harvest does occur in years of high abundance on summer Chinook. Harvest of steelhead has recently been authorized under Section 10 Permit 1395 as a method to reduce hatchery fish on the spawning grounds.

Summer/fall Chinook smolts released from the Carlton acclimation pond have averaged 0.19 return rate to adults, ranging from 0.02 to 0.81 for brood years 1989 through 1997.

Effects on Wild and Native Populations and Environment

Effects on the wild populations (target and non-target) will be assessed at the juvenile stage using smolt traps and when fish return as adults. The relative productivity of the spawning population will be monitored over time using smolt traps located within the Basin. Relationships between smolt production and spawner abundance (percent hatchery fish on the spawning grounds) will provide information related to reproductive potential of the stocks and habitat. Relationships in productivity between stocks would also provide some information regarding competition in the freshwater environment. Smolt traps also provide information regarding trends in other species not directly associated with hatchery programs (i.e., non-target taxa of concern).

Spawning ground surveys will not only be used to develop smolt-to-adult return rates (SARs) for hatchery and wild fish, but provide information on spawn timing and distribution. Biological data collected from carcasses will also provide data concerning age and size at maturity.

The reproductive rate of hatchery and wild steelhead will be assessed through a reproductive success study. Results will provide insights to the relative contribution of various parental crossed spawning in the natural environment (HxH, HxW and WxW). These data will be instrumental in directing the supplementation program broodstock collection, spawning protocols, release levels, parental origin of steelhead released, and adult management on the spawning grounds.

Comparisons of any of these parameters (juvenile or adult) between hatchery and wild fish would provide insight on the effects hatchery fish may have on wild populations. Any effects that are detected (greater than acceptable levels) would be addressed in subsequent changes in the respective hatchery program.

4.5.8 Restoration and Conservation Projects

Existing and past project efforts in the Methow subbasin span a broad range of habitat restoration work, education and awareness, improvements to irrigation systems, etc. These represent largely cooperative efforts of various combinations of local government, private organizations, private citizens, tribes and state agencies (See Appendix D).

5 Management Plan

The management plan described in this section is a culmination of extraordinary efforts by the subbasin planners, the public and stakeholder input. Its development came as a laborious result of carrying out the assessment and inventory work and formation of the vision, goals and principles sections of the subbasin plan. Additional guidance and direction was derived from the conscientious integration of socio-economics, harvest, hydropower and artificial production information and synthesis into the final construct.

As a result, this management plan depends upon an assimilation of this information and careful review and full use of all sections of the subbasin plan and its key findings.

Management Plan

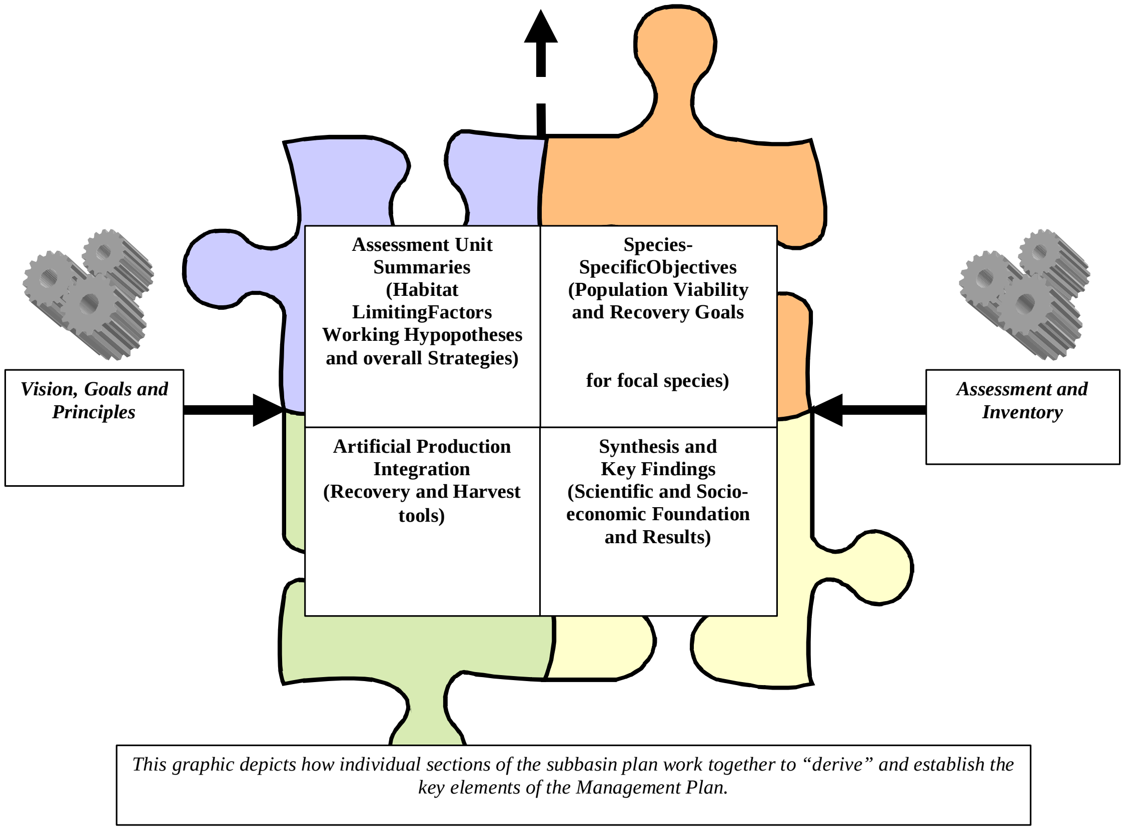


Figure 66 Logic path for translating management guidance into science

5.1 Management and Our Vision for the Methow subbasin

The management plan to follow is designed to be consistent with, and guided by, our Vision. The Vision for the Methow subbasin is consistent with the 2000 Columbia Basin Fish and Wildlife Program's Vision, yet tailored specifically to the geographic region of the Methow subbasin and its citizenry. Within 15 years, it is envisioned that:

The Methow subbasin supports self-sustaining, harvestable, and diverse populations of fish and wildlife and their habitats, and supports the economies, customs, cultures, subsistence, and recreational opportunities within the basin. Decisions to improve and protect fish and wildlife populations, their habitats, and ecological functions are made using open and cooperative processes that respect different points of view and statutory responsibilities, and that are made for the benefit of current and future generations.

Specific planning assumptions and principles are provided at the beginning of this subbasin plan.

Decisions as to which management strategies will be implemented should be a part of a public process that takes into account economics, public policy, community values and tradeoffs of several different kinds. Strategies may be rejected during the public review process because they are too expensive, conflict with policy, or are inconsistent with community values. When this occurs, it will be necessary to look for appropriate alternative strategies or re-examine the goals, and to assess the effect on the plan goals. (NPPC 1997).

Figure 67 Framework for Project Proposal

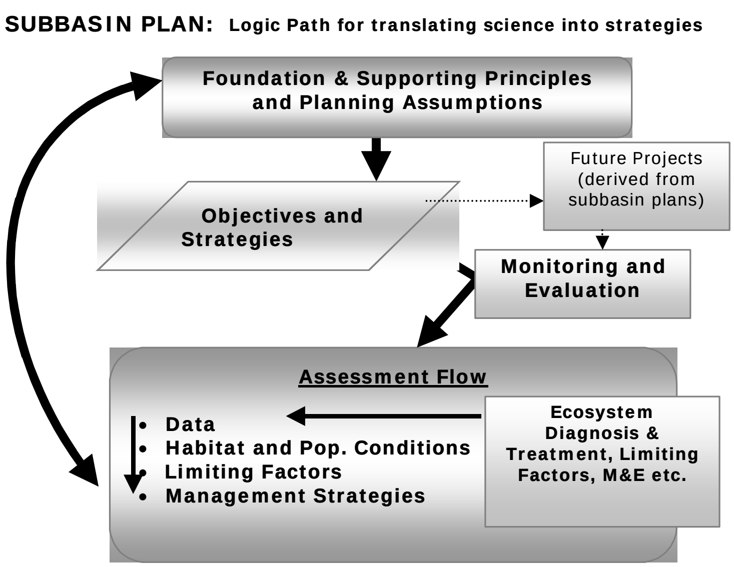


Figure 68 Logic path for translating science into strategies

5.2 Desired Future Condition

5.2.1 Fish

Major portions of the Methow watershed have relatively intact, and high quality fish and wildlife habitat because of inaccessibility and a related lack of human development. This, combined with extensive Wilderness and National Forest designations in the basin's upper reaches, point to a protection emphasis in these areas. Restoration of those habitats impacted in the middle and lower reaches of the subbasin then become the predominant strategy.

The viability of habitat types including riparian zones and floodplains, shrubbesteppe, and dry forest depends on protection of existing stands, linkages, and natural process. In addition, control of exotic species and restoration of native species diversity is critical to maintaining habitat function for fish.

5.2.2 Wildlife

Natural habitats exist with sufficient quantity, quality, and linkages to perpetuate existing native wildlife populations into the foreseeable future. Where sufficient habitat exists, through a combination of protection and restoration, extirpated wildlife species are restored within the subbasin.

5.3 Description of Values and Priorities

We developed strategies that: 1) Operate directly upon the limiting factors, including out-of-basin effects in the case of artificial production, 2) Are rationale, implementable and cost-effective, 3) Support the biological objectives, and, 4) Sustain the goals and vision of the subbasin plan. Use of testable hypotheses statements and measurable objectives, coupled with the M&E framework and current baseline efforts for the subbasin, will allow planners to more credibly and accurately assess the effects of the strategies and the overall progress towards reaching the goals of the subbasin plan over the life of the management plan.

5.3.1 Prioritization Framework for the Methow and Okanogan subbasins

The Council removed the material in this subsection because it is not consistent with the provisions in the 2000 Columbia Basin Fish and Wildlife Program and/or the Northwest Power Act that relate to program implementation. During the public comment period that runs through January 31, 2005, the Council and Washington State Subbasin Planning Coordinator will work with those involved in subbasin planning for the Methow subbasin to develop a prioritization framework for this plan.

The Council understands that much of the material that was removed here draws upon Washington state and local land use law and permitting procedures. State and local legal requirements have, and always will, apply to the implementation of the fish and wildlife program. However, those requirements cannot be relied upon exclusively given the requirements of the Northwest Power Act.

~~This framework describes the process and criteria that will be used to prioritize projects for implementation when project selection processes are initiated. It addresses the Subbasin Plan Foundation Principles, Upper Columbia Biological Strategy, Salmon Recovery Plan provisions,~~

and project costs by ranking projects according to 1.) technical, 2.) economic, and 3.) political criteria, while ensuring consistency with local policies. This prioritization framework is subject to adaptive management and will be improved upon as it is tested through time.

The Subbasin Plan objectives and strategies are also subject to adaptive management. As such, projects may be proposed to address objectives and strategies that have not been listed in the Subbasin Plans, provided the project proposals: a) show how the project will mitigate for fish and wildlife impacts of the FCRPS in the context of the vision and foundation principles presented in the subbasin plan, and b) provide adequate justification for employing alternatives.

To streamline the project application process, Okanogan County suggests development of a standardized funding application. All project applications submitted to Okanogan County for review will be ranked using an eight-step prioritization framework. The diagram below outlines the framework. A detailed description follows.

[omitted]

Figure 69 Prioritization Framework.

Prioritization Framework

I.**Criteria Definition.**

Define the criteria for "complete" applications; determine scoring system and criteria; and establish application deadlines.

II.**NPCC solicits project applications.**

III.**NPCC checks all on-time submittals for completeness.**

The checklist for complete applications may include, but will not be limited to, the following items:

All projects: For all of the projects proposed for implementation in Okanogan County, the following items must also be addressed in a "Supplemental Application."

Explanatory Statement

- The situation as it presently exists. Include how the current situation creates or exacerbates limiting factors for fish and/or wildlife.
- The effect of the proposed project if it is implemented. Include how the project would minimize or eliminate limiting factors (causes, not just the symptoms) for fish and/or wildlife. Explain the individual and cumulative benefits to fish and/or wildlife related to this project.
- Provide specific information, with literature citations as appropriate, regarding methodology that will be used to implement the project.

Impact Statement

- Estimated Cost
- Estimated Benefit to fish and/or wildlife
- Summary of Impact:
  - > Actual Cost to the tribes, county, cities, or landowners
  - > Actual Benefit to the tribes, county, cities, or landowners
- Assumptions for Analysis:

- In the project application, indicate who is responsible for implementing each action or set of actions in a project. How will actions be sequenced? What is the overall timeframe for the project?
- Where appropriate, ensure that Canadian agencies and organizations are cooperating and have assisted in prioritizing projects

Restoration projects: For restoration projects proposed for implementation in Okanogan County, the following items must also be addressed in a "Supplemental Application."

- Does the application include a JARPA and an "Application for Streamlined Process for Fish Habitat Enhancement Projects Addition to the Joint Aquatic Permit Application Form (JARPA)" (projects in U.S.) or the appropriate Canadian paperwork (projects in Canada)?

- Does the application include a Monitoring Plan (including monitoring and assessment before, during, and after completion of the project), provisions for funding implementation of the monitoring plan, and a signed contract for implementation of the land management plan?

- When required, does the application contain a completed environmental checklist and related documents to fulfill NEPA/SEPA requirements?

IV. Local technical review and rating.

Local technical review should be completed by a team appointed by the Upper Columbia Salmon Recovery Board. The team may include, but is not limited to, representatives of the CCT, WDFW, USFWS, NOAA Fisheries, YN, PUDs, and U.S. Forest Service.

All projects will be rated by the technical team using criteria that assess the following factors:

- If appropriate, has the project sponsor fulfilled obligations (such as implementing the project, implementing the land use management plan, controlled noxious weeds, etc.) on previous projects?

- Does the project address limiting factors or data gaps *or* does the application include sufficient justification to include the project in the ranking process?

- How will the project impact self-sustaining populations of fish and wildlife (productivity)?

- How will the project impact fish or wildlife abundance?

- How will the project impact fish or wildlife diversity?

- How will the project impact fish or wildlife spatial structure?

Restoration projects will be rated by the technical team using criteria that assess the following factors:

- For projects that involve structural manipulation of the stream channel, is the project designed at the reach level or context?

- Is the proposed monitoring plan comprehensive, and will it be effective in a assessing the outcomes of the project relative to the NPCC's fish and wildlife mitigation responsibilities?

Research, Monitoring and Evaluation projects will be rated by the technical team using criteria that assess the following factors:

- Is the Research, Monitoring, and Evaluation Plan designed to be consistent with other monitoring efforts in the Columbia Basin?

- Does the Research, Monitoring, and Evaluation Plan analyze recovery potential and address the recovery goals of regulatory agencies?

- Does the Research, Monitoring, and Evaluation Plan provide data for management actions, project implementation, and planning within the subbasin?

~~Additional technical ranking questions may include, but are not limited to, the following:~~

1. ~~All: Are the projects ranked by UCRTT Category?~~
2. ~~All: Are the projects ranked to have the highest priority if they are in a UCRTT watershed with the highest number of significant subwatersheds?~~
3. ~~All: Are the projects ranked to have highest priority if they are within a UCRTT significant subwatershed?~~
4. ~~All: Are the projects ranked according to the UCRTT Biological Strategy for the entire subbasin?~~
5. ~~All: Are the projects ranked by the UCRTT Biological Strategy for the watershed?~~
6. ~~All: Does the project address limiting factors or data gaps?~~
7. ~~All: Does it support self-sustaining populations of fish and wildlife (productivity)?~~
8. ~~All: Does it support harvestable populations of fish and wildlife (abundance)?~~
9. ~~All: Does it support diverse populations of fish and wildlife (diversity)?~~
10. ~~All: Does it expand the spatial distribution (spatial structure)?~~
11. ~~All: Does the project help to achieve multiple priorities (e.g., benefit both fish and wildlife, restoration of ecosystems rather than single species)?~~
12. ~~All: Will implementation of the objective or strategy result in long-term biological benefits over short-term gains?~~
13. ~~All: Does it promote fish habitat diversity?~~
14. ~~All: Does it promote wildlife habitat diversity?~~
15. ~~All: Does it benefit ecological function?~~
16. ~~All: Does it benefit habitat connectivity?~~
17. ~~All: Does the project help to protect, mitigate, or restore habitat while avoiding or minimizing impacts to native fish and/or wildlife species?~~
18. ~~All: Does the project emphasize restoration of, or provide benefits to, native over non-native species?~~
19. ~~All: Does it promote water quantity/instream flows?~~
20. ~~All: Does it promote water quality?~~
21. ~~All: Does the project benefit current and future generations?~~
22. ~~All: Does the project support recreational opportunities?~~
23. ~~All: Have the projects been reviewed and ranked based on their economic impact?~~
24. ~~Restoration: For Barriers, will removal of the barrier be beneficial to the ecosystem over the long term?~~

25.Restoration: Does it restore the complexity of the stream channel?

26.Restoration: Does it restore the complexity of the floodplain?

27.Restoration: Does it place emphasis on using proper land management practices rather than promoting structural manipulation of the stream channel?

28.Educational: Is the project designed to help fish or wildlife?

29.Educational: Has a "Lesson Plan" been developed?

30.Educational: Does the project include an effective means of distributing information (TV, newspaper, radio, email, letters, signs, personal contacts)?

31.Educational: Can the project be expected to be cost effective based on the number of people who will be exposed to this information?

32.Educational: Can the project be expected to be beneficial based on the length of time over which people will be exposed to the information? Emphasis will be placed on long-term education projects (signage, etc.).

33.Educational: Will the project decrease negative impacts on fish and/or wildlife?

V. Policy review and ranking; Citizen comments.

Okanogan County will develop a policy review committee to check the consistency of proposed projects with local policies and stipulations. The County will offer a public comment forum to address the proposed projects at an open public meeting.

Policy review and ranking questions may include, but are not limited to, the following:

1.All: If appropriate, has the project sponsor fulfilled obligations (such as implementing the project, implementing the land use management plan, controlled noxious weeds, etc.) on their previous projects?

2.All: Is the proposed project consistent with local policies?

3.All: Does the project benefit current and future generations?

4.All: Does the project support recreational opportunities?

5.All: Have the projects been reviewed and ranked based on their economic impact?

6.Protection: Does the application include a statement of support for the granting of an easement or acquisition of property, signed by the owner of the subject property?

7.Protection: Is money allotted to mitigate for long-term economic impacts (i.e., PILT)?

8.Protection: Does the application include a land use management plan that is consistent with local plans and regulations?

9.Protection: Does the plan effectively address noxious weed control?

10.Protection: Does the plan effectively address fire hazards?

11.Protection: Does the project incorporate the cost to implement the land management plan?

12.Protection: Does the application include a signed contract for implementing the land management plan?

13.Protection: Does the project modify existing rights/privileges of a landowner (land use/water rights)? If yes, has a full written disclosure been provided to the landowner? Has a signed document been obtained from the landowner to infringe on his rights? Has the landowner waived compensation or been compensated appropriately for the loss of rights/privileges?

Citizen Comments

The County will offer a public comment forum to address the proposed projects at an open public meeting.

VI. Partners develop a committee to rank projects.

For the Okanogan sub basin, Okanogan County and CCT will develop a committee to rank projects that balances the technical, policy and economical views and considers them appropriately; For the Methow sub basin, Okanogan County and WDFW will develop a committee to rank projects that balances the technical, policy and economical views and considers them appropriately.

VII. Submit project applications with tiered rankings.

VIII. Adaptive Management.

Adaptive Management will be used to improve upon the Prioritization Framework as well as to update Objectives, Strategies and proposed Projects with research, monitoring, and evaluation results.

5.4 EDT Report on Habitat Limiting Factors

The EDT reports (subbasin, assessment unit, and reach level) are intended to provide an integrated and step-wise description of findings for use by subbasin planners.

provides a subbasin *summary list* of the Methow subbasin's key factors limiting fish habitat productivity—and by extension, characterizes viability concerns associated with low abundance, limited diversity and insufficient spatial structure.

A set of EDT report maps provide an overview by Assessment Unit to aid in spatial understanding.

The Assessment Unit (AU) Summary tables provide more exhaustive and detailed information about geographic location, priority factors, working hypotheses, data gaps, and objectives. Reach-level habitat attributes information and analysis can be found in Appendix G, EDT Output Tables.

Table 54 List of Key Limiting Factors for the Methow Subbasin condensed and derived from the Assessment Unit Summaries

Key Limiting Factor or Problem	Management Strategies	Applicable AU's
Barriers (including flow) to Chinook, steelhead migration/spawning/rearing	Plan and implement fish passage; inventory barriers. Assess passage conditions. Address thermal blocks and low flow barriers.	2, 4 (Early Winters), 5, 6, 7 (secondary in upper reaches), 8, 10, 13
Fish losses in unscreened irrigation canals	Prepare and implement screening plan. Complete survey where lacking information. Assess entrainment.	
Water Temperature & Dissolved Oxygen	Investigate extent of problem. Prepare plan for remedies (e.g. flushing flows, hypolimnetic aeration, etc.)	1
Predation	Investigate extent of losses. Prepare plan for control	1,2
Habitat Diversity	Increase LWD. Reconnect to floodplain areas. Increase side channel habitat. Install habitat boulders and artificial logjams. Improve riparian habitats with the potential to contribute to future LWD recruitment. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas. Many additional strategies in AU summary.	1, 2, 3, 4, 5, 6, 7, 8, 9 (mostly natural harsh conditions in Twisp), 10, 11, 12 (mostly on alluvial fan and near Vander pool), 13
Sediment and Channel Stability	Establish baseline for residual pool depths. Monitor residual pool depths annually and evaluate trends. Conduct sediment reduction strategies throughout the Okanogan subbasin, especially in the upper portions of the watershed.	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13
Salmon Carcasses (low abundance of salmon/steelhead and their nutrients contribution to stream ecology including benthic marco invertebrates and fish growth)	Increase or maintain artificial production capacity at levels necessary to meet management needs, maintain new and existing acclimation sites, and support existing and new scatter plantings. Program is intended to support conservation, reestablishment of natural broodstock and interim harvest opportunities.	3, 4, 7,
Loss of Floodplain Connectivity and Habitat Quantity	Reestablish back channels, re-slope vertical banks, and (re)establish wetland habitats that allow floodplain inundation to occur approximately every two years. Conduct a channel migration corridor study and monitor trends and identify opportunities. Protect and re-establish groundwater sources. Numerous others strategies are found in summaries.	4, 5, 6, 7, 8 (for spck), 10 (primary for steelhead and bull trout), 11, 12 (for spawning and incubation), 13
Mining and Other Water and Habitat Quality Issues besides temperature	BMP, enforcement, clean-up of existing land-fill and pesticide dumps, etc.	2

5.5 Assessment Unit Summaries

The following Assessment Unit Summary Sheets are intended to be used as a *guide* for developing future strategies, projects and direct actions as they relate to salmon habitat. They support and form the basis for the Management Plan, and are in turn supported by the subbasin plan sections: Goals and Vision, Species Objectives, Hatchery Integration and the Monitoring and Evaluation Framework. Taken together, these form our scientific and socio-economic foundation, and ultimately, the core of the Management Plan itself.

Four course-scale filters were used to guide us in developing the specific strategies found in the AU summary sheets. These were used ensure that actions are balanced and rationale. Ultimately them were used to gauge if the actions would be (will be) implementable. In taking this step, we found that trade-off analysis and multiple iterations of planning was reduced by focusing actions in areas and on habitat attributes that fell within the "realm of the doable and effectual."

1. Is the strategy supported by science?

17. Is the strategy cost effective?

18. Does the strategy have (or is it likely to win) public support?

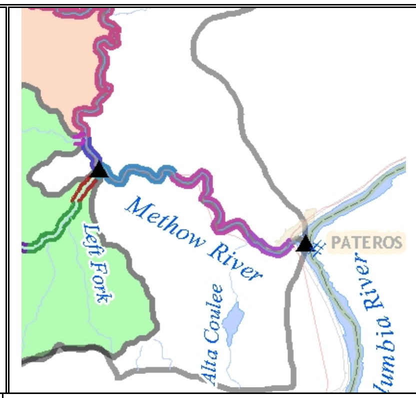
19. Are resources available to implement the strategy and monitor the outcomes—including enforcement where relevant?

The working hypotheses in these summaries are the "testable" part of the management plan equation. The strategies themselves provide the metrics for testing and form the most appropriate foundation for the monitoring and evaluation program priorities.

Assessment Unit (AU): M1—Lower Methow

Reaches: 7

1	**2**	**3**	**10**	**14**	**27**	**39**



FOCAL species: Spring, summer/fall Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 235,553 acres

SUBWATERSHEDS:

Black Canyon Creek, Squaw Creek, McFarland Creek, French Creek, Texas Creek

ASSESSMENT UNIT DESCRIPTION:

The Lower Methow River subwatershed encompasses the mainstem Methow River and its tributaries from just upstream of the town of Carlton (RM 33) downstream to the mouth of the Methow River. Running in a northwesterly to southwesterly direction, the river carves a gorge as the valley narrows; it narrows considerably in this part of the watershed in comparison to the broader floodplains and terraces from above Winthrop down to Carlton (USFS 1999a). Valley widths vary from about a mile at the upper end to less than ½ mile at the lower end (USFS 1999a). Tributaries to the Lower Methow River include Texas Creek, Libby Creek, Gold Creek, McFarland Creek, French Creek, Squaw Creek and Black Canyon Creek. The subwatershed also includes the towns of Carlton and Methow.

LEVEL OF CERTAINTY:

Use EDT level of proof Table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat diversity (Loss of connection to the floodplain via roads and riprap, loss of riparian vegetation, lack of large woody debris [LWD])

P-Predation (Exotic species and warm temperatures in the inundated zone)

S-Sediment load (high turbidity during high flows, high % fines in depositional areas)

S-Temperature (warm summer temperatures)

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer Chinook in the following life stages: a) fry colonization, and; b) pre-spawn holding. Summer steelhead survival will increase in all juvenile life stages. Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add LWD and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Predation may be a limiting factor; decreasing predation, particularly in the inundated zone, will increase survival of all juvenile salmonid life stages.

Objective 1 - Determine predation rates and quantify impacts on salmonids by exotic and native piscivores. Note: No data specific to the Methow estuary exists; the model predicted "a high predation risk" and was derived from high species richness, high numbers of exotics, and increased temperatures.

Objective 2 - Reduce unacceptable predation impact based upon results from Objective 1.

Strategy 1 - Determine predator abundance and consumption rates.

Strategy 2 - Reduce predation impact by managing aquatic predator abundance.

Strategy 3 - Monitor predator abundance annually and evaluate trends.

Hypothesis 3 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer/fall Chinook in the fry colonization life stage, and steelhead in the egg incubation life stage.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification)

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement best management practices (BMPs) for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies*:*

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2 - Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts, and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 4 - Decreasing summer maximum temperatures will increase survival of summer Chinook spawning and egg incubation life stages.

Objective 1 - No maximum daily temperatures over 64^{o} F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (<57 °F) are not realistic for the lower Methow River mainstem, and probably represent a condition that could not exist, even under pristine historical conditions.

Protection strategies:

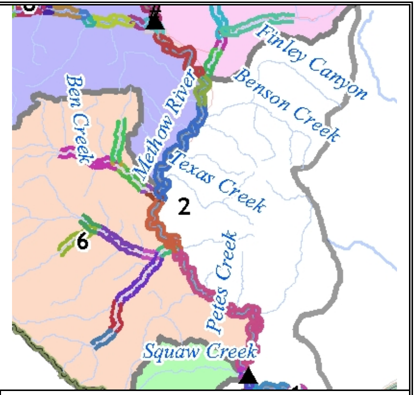
Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations. Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature. Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPs. Strategy 5 - Implement education and enforcement programs. Restoration strategies: Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow. Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes. Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams. Strategy 4 - Manage stormwater runoff from existing and new development and from roads, using detention, treatment, and infiltration measures. Hypothesis 5 - Artificial production (supplementation) will: increase fish population numbers to partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members, and; aid in salmon and steelhead recovery efforts. Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.
DATA GAPS AND M&E NEEDS: Aquatic habitat surveys Fish habitat use (species- and life stage-specific) Hatchery-Wild fish interactions (predation, competition, pathogens, productivity) Piscivory in the inundated zone Benthic invertebrate productivity Winter temperature and icing studies Monitoring and evaluation programs Bull Trout: Population, distribution and abundance Exotic interaction Fish use activity and life stage Genetics Westslope cutthroat trout: Fish use - activity and life stage Population, distribution and abundance

Assessment Unit (AU): M2—Middle Methow

Reaches: 19

40	**52**	**53**	**98**	**99**	**100**	**104**	**105**	**143**	
144	**149**	**151**	**152**	**153**	**160**	**163**	**164**	**169**	**174**



FOCAL species: Spring, summer/fall Chinook salmon, coho, bull trout, weststlope cutthroat trout, and steelhead

Drainage area: 162,834 acres

SUBWATERSHEDS:

Alder Creek, Bear Creek, Beaver Creek and Benson Creek

ASSESSMENT UNIT DESCRIPTION:

The Middle Methow River subwatershed contains 15,600 acres, encompassing the mainstem Methow River from the Weeman Bridge (RM 59.7) downstream to RM 33. It includes Wolf Creek, Hancock Creek, Alder Creek, Bear Creek, Beaver Creek, and Benson Creek drainages, and the towns of Winthrop and Twisp. The upstream end of this AU is where natural dewatering sections start to occur, and the downstream end was selected based on changes in gradient and natural confinement.

LEVEL OF CERTAINTY:

See EDT level of proof document in Level of Proof Table, Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; loss of riparian vegetation; lack of LWD)

P-Obstructions (MVID East **-**Foghorn and Barkley were modeled as having no impact, but Barkley has some impacts due to channel alteration)

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows)

S-Key Habitat Quantity (only a couple of reaches for summer/fall Chinook; the largest problem was in the upstream reach (RM 50-53) where they do not spawn every year; fewer pools and pool tailouts and more large substrate riffles seemed to be the problem, but we need better habitat data to confirm)

S-Sediment Load (high turbidity during high flows; high % fines in depositional areas; high embeddedness in spawning habitat)

S-Flow (increased peak flows [from fire activity in headwaters]; reduced low flow [water use, increased peak flow, loss of riparian function]; hydroconfinement [channelization and accelerated erosion])

S-Predation (various wild and hatchery salmonid predators primarily impacting fry (model prediction), no foraging studies available to confirm.

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer Chinook in the following life stages: a) spawning, b) prespawn holding, and; c) fry colonization. Summer steelhead survival will increase in the following life stages: a) spawning; b) fry colonization, and; c) age 0-2 juvenile rearing. Spring Chinook survival will increase for: a) fry colonization; b) age-0 rearing; c) prespawn holding, and; d) spawning. Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12” diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and

estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Improving passage at diversion dams will increase survival for all juvenile life stages of all salmonids.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 3 - Increasing channel stability will increase survival of summer steelhead in the following life stages: a) egg incubation, and; b) fry colonization.

Objective 1 - See objectives 1 and 2 of Hypothesis 1.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 3).

Note: re current assumption: major survival implications in EDT when greater than 5.5 inches [EDT score =2]).

Protection and Restoration options: See strategies for Hypotheses 1, 5, and 6.

Hypothesis 4 - Increasing key habitat quantity will increase survival for summer/fall Chinook in the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-0 active rearing (particularly in reaches Met 14-15). Steelhead survival will increase for: a) prespawn holding; b) spawning, and; c) egg incubation (particularly in reach Met 14). Spring Chinook survival will increase for: a) prespawn holding; b) spawning; c) egg incubation; d) fry colonization , and; e) age-0 summer rearing (particularly in reaches Met 14-17). Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Fill data gap by conducting formal habitat surveys in the Methow River mainstem.

Note: A preliminary survey was conducted for this assessment; however, it was not complete and did not conform to standard protocols.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Objective 3 - See Objectives 1 and 2 of Hypothesis 1, Objectives 1 and 2 of Hypothesis 5, and Hypotheses 6a and 6b.

Note: The majority of benefit was estimated to occur in reaches Met 14-15 where the upper rangeof summer/fall Chinook are represented; habitat improvements may not be as beneficial elsewhere.

Protection and Restoration options: See Strategies for Hypotheses 1, 5, and 6.

Strategy 1. Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer/fall Chinook in the fry colonization life stage, and steelhead in the: a) spawning; b) egg incubation, and; c) fry colonization life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 6a - Increasing summer base flows will increase survival of spring Chinook for prespawn holding, and of summer/fall Chinook for: a) prespawn migrants; b) prespawn holding, and; c) age-0 active rearing. Summer steelhead survival will increase for all juvenile summer and winter rearing life stages. Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout survival will increase for migration and overwintering.

Hypothesis 6b - Decreasing spring peak flows (to natural hydrograph levels) will increase survival for steelhead and Chinook in the following life stages: a) fry colonization, and; b) juvenile active rearing.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objective 3 of Hypothesis 3 (Road Density).

Objective 3 - Minimize negative impacts of irrigation and municipal water withdrawals.

Objective 4 - See Objectives 1-5 of Hypothesis 5 (Sediment Load).

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 of Hypothesis 1.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

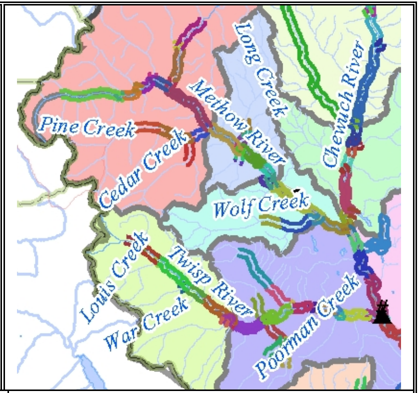
Hypothesis 7 - Predation may be a limiting factor, and decreasing predation would increase survival of all juvenile salmonid life stages.

Objective 1 - Determine predation rates, and quantify impacts on salmonids by exotic and native piscivores. Note: No data specific to the Middle Methow mainstem exists; the model predicted “a high predation risk” and was derived from high species richness, high numbers of exotics, and increased temperatures). Objective 2 - Reduce unacceptable predation impact, based upon results from Objective 1 of Hypothesis 6. Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts. Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.
DATA GAPS AND M&E NEEDS Aquatic habitat surveys (including measurements of bed scour) Fish habitat use (species- and life stage-specific) Hatchery-Wild fish interactions (predation, competition, pathogens, productivity) Benthic invertebrate productivity Winter temperature and icing studies Implement monitoring and evaluation programs Bull Trout: Population, distribution and abundance Exotic interaction Fish use-activity and life stage Genetics Westslope cutthroat trout: Population, distribution and abundance Fish use - activity and life stage Genetics.

Assessment Unit (AU): M3—Upper-Middle Methow

Reaches: 17

81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
91	**92**	**93**	**94**	**95**	**96**	**97**			



FOCAL species: Spring Chinook, bull trout, steelhead, coho, westslope cutthroat trout, and cutthroat trout

Drainage area: 162,834 acres

SUBWATERSHEDS:

Goat Creek, Little Boulder Creek, Fawn Creek, Gate Creek, Early Winters Creek, and Lost River

ASSESSMENT UNIT DESCRIPTION:

The Upper-Middle Methow River subwatershed encompasses the mainstem of Methow River from the Weeman Bridge (RM 59.7) to Robinson Creek (RM 74.5). This stretch of the Methow River was segregated from the Upper and Middle Methow AUs because it commonly has reaches that naturally dewater during baseflow.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; loss of riparian vegetation; lack of LWD)

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows (from fire activity in headwaters); increased flashy flows (from fire activity in headwaters)

S-Flow - impacts above and beyond natural condition (increased peak flows [from fire activity in headwaters]; reduced low flow [water use, increased peak flow, loss of riparian function]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Key Habitat Quantity (reduction in quality pool, LWD; loss of riparian vegetation)

S-Sediment Load (high turbidity during high flows; high % fines in depositional areas; high embeddedness in spawning habitat

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENTS:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook, steelhead, and bull trout in the following life stages: a) spawning (spring Chinook, and steelhead), b) fry colonization (spring Chinook and steelhead) and c) rearing (spring Chinook, steelhead, and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12” diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Increasing channel stability will increase survival for spring Chinook, steelhead, and bull trout in the following life stages: a) fry colonization (spring Chinook, and steelhead); and rearing (spring Chinook, steelhead, and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - See Objective 1 and 2 of Hypothesis 1.

Objective 2 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and possess good cover (NMFS 1996). (don't understand this)

Objective 3 - Achieve less than 10% eroding slopes.

Objective 4 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Objective 5 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 6: Reduce bed scour to appropriate PFC (based on Objective 5)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See Strategies for Hypotheses 1, 3, and 6.

Hypothesis 3 - Improving flow condition within the AU will increase the survival of spring Chinook, steelhead and bull trout in the following life stages: a) fry colonization (Spring Chinook, and steelhead), and; d) rearing (spring Chinook, steelhead and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - See Objectives 1and 2 of Hypothesis 1.

Objective 2 - Restore burned areas in the headwaters to a natural condition.

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 and 2 of Hypothesis 1.

Strategy 2 - Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 4 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, and bull trout in the following life stages: a) fry colonization (spring Chinook, steelhead, and bull trout), and; b) rearing (spring Chinook, steelhead, and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - See Objective 1and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 6 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 4. Achieve 125 salmon carcasses / mile as an interim target (based on estimates of historic run size (Mullen et al. 1992 distributed in areas of current spawning and rearing (WDFW unpublished data).

Protection and Restoration options: See strategies for Hypotheses 1and 6.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 5 - Increasing key habitat quantity (increased number of quality pools and improved riparian vegetation) will increase the survival of spring Chinook, steelhead and bull trout in the following life stages: a) spawning (spring Chinook, and steelhead); b) egg incubation (spring Chinook, and steelhead); c) rearing (spring Chinook, steelhead and bull trout), and; d) holding (spring Chinook and steelhead). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation, large woody debris, and connectivity to the floodplain, and off-channel habitat).

Objective 2: Reach or exceed 20 pieces/mile (12” diameter and 35 inches long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjorn and Reiser 1995).

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and possess good cover (NMFS 1996).

Protection and Restoration options: See strategies for Hypotheses 1, 3, and 6.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 6 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer/fall Chinook in the fry colonization life stage, and steelhead in the a) spawning; b) egg incubation, and; c) fry colonization life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2 - Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations.

Strategy 4 - Upgrade stream crossing, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 7 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

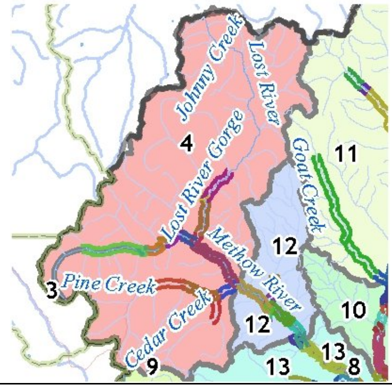
Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS: Winter temperature and icing studies Channel migration zone study Aquatic habitat survey Fish habitat use (species- and life stage-specific) Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics) Benthic invertebrate productivity Others from EDT Groundwater-surface water interactions Bull Trout: Population, distribution and abundance Exotic interaction Fish use-activity and life stage Genetics Westslope Cutthroat Trout: Population, distribution and abundance Exotic interaction Fish use-activity and life stage Genetics

Assessment Unit (AU): M4—Upper Methow/Early Winters/Lost River

Reaches: 17

81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
91	**92**	**93**	**94**	**95**	**96**	**97**			



FOCAL species: Steelhead, spring Chinook, coho, bull trout, and westslope cutthroat

Drainage area: 322,385 acres

SUBWATERSHEDS:

Brush Creek, Trout Creek, Rattlesnake Creek and Robinson Creek.

ASSESSMENT UNIT DESCRIPTION:

The Upper Methow River subwatershed contains approximately 322,385 acres, encompassing the upper Methow River from its headwaters (RM 86.8) downstream to the Robinson Creek confluence (RM 74). These HUC watersheds were grouped due to similarities of pristine conditions and lack of dewatering reaches.

LEVEL OF CERTAINTY:

Use EDT level of proof Table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity -1st reach of Early Winters and Lost River (loss of connection to the floodplain via roads, riprap, and dikes; loss of riparian vegetation; lack of LWD)

P-Key Habitat Quantity (reduction in quality pool, LWD; loss of riparian vegetation)

S-Flow - Early Winters Creek is particularly important for watering spawning habitat in the Methow mainstem, 500-1000' (increased peak flows [from fire activity in headwaters (excluding Early Winters Creek]; reduced low flow [water use, increased peak flow, loss of riparian function]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Channel Stability (loss of connection to the floodplain via roads and riprap [lower reaches only]; loss of riparian vegetation [unnaturally intense fire regime]; lack of LWD; increased peak flows [from fire activity in headwaters]; increased flashy flows [from fire activity in headwaters])

Sediment Load - Not identified as a limiting factor in this AU, but due to unnaturally intense fire regime, AU is a critical area for generating sediment that causes downstream problems (high turbidity during high flows; high % fines in depositional areas; high embeddedness in spawning habitat

Refer to Electronic Appendix B for reference and specific detail by reach and species

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1: Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of bull trout, westslope cutthroat trout, spring Chinook and summer steelhead in all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels, and disconnect habitat in floodplains and

estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add LWD and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Increasing "key habitat quantity" will increase the survival of bull trout, westslope cutthroat trout, and spring Chinook in the following life stages: a) fry colonization; b) 0-age active rearing; c) 0-age inactive rearing; d) 1-age active rearing; e) spawning; f) egg incubation, and; g) prespawn holding, and of steelhead during: a) spawning, and; b) egg incubation.

Objective 1 - See Objective 1, 3, and 6

Objective 2 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Protection and Restoration options: See strategies for Hypotheses 1, 3, and 6.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 3 - Increasing summer base flows and decreasing spring peak flows will increase survival of bull trout, westslope cutthroat trout, and spring Chinook in the following life stages: a) prespawn holding; b) fry colonization; c) 0-age active rearing, and; d) 0-age inactive rearing, and for steelhead during: a) fry colonization; b) 1–age inactive rearing, and; c)1-age active rearing.

Objective 1 - See Objective 1 and 2 of Hypothesis 1.

Objective 2 - Minimize negative impacts of irrigation water withdrawals.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Objective 4 - Minimize negative impacts of land use in riparian and upland areas (BMPss).

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objectives 1 and 2 of Hypothesis 1.

Strategy 2 - Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 4 - Increase in forage will increase the survival of bull trout, westslope cutthroat trout, and spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing, and; c) 0-age inactive rearing; and of steelhead during: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing, and; d) 1-age active rearing.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 6 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 4. Achieve 125 salmon carcasses / mile as an interim target (based on estimates of historic run size (Mullen et al. 1992 distributed in areas of current spawning and rearing (WDFW unpublished data).

Protection and Restoration options: See strategies for Hypotheses 1and 6.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 5 - Increasing channel stability will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) fry colonization (spring Chinook, and steelhead), and; b) rearing (Spring Chinook, steelhead, and bull trout).

Objective 1: See Objectives 1 and 2 of Hypothesis 1.

Objective 2 - See Objectives 1-5 of Hypothesis 3.

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Objective 4 - Achieve less than 10% eroding slopes.

Objective 5 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 6 - Reduce bed scour to appropriate PFC (based on Objective 5 of Hypothesis 5)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Objective 7 - See Objectives 1-4 of Hypothesis 6.

Protection and Restoration options: See strategies for Hypotheses 1, 3, and 6.

Hypothesis 6 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for all focal species in the fry colonization life stage and for steelhead in the a) egg incubation, and; b) fry colonization life stages, particularly in downstream reaches.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 7: Artificial production (supplementation) will increase fish population numbers to partially mitigate for habitat deficiencies and provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members, and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Channel migration zone study

Aquatic habitat surveys (mainstem reaches only)

Fish habitat use (species- and life stage-specific)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)
Benthic invertebrate productivity
Others from EDT
Groundwater-surface water interactions (lower reaches only)
Winter temperature and icing studies
Implement monitoring and evaluation programs
Bull Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Presence/absence studies in tributaries
Population, distribution and abundance
Exotic interaction
Fish use-activity and life stage
Genetics

Assessment Unit (AU): M5—Black Canyon/Squaw Ck.

Reaches: 8

4	**5**	**6**	**7**	**8**	**9**	**11**	**12**

FOCAL species: Steelhead and coho

Drainage area:

SUBWATERSHEDS:

None

ASSESSMENT UNIT DESCRIPTION:

Little information on habitat conditions is available for these drainages. Squaw Creek joins the Methow River at RM 9.0 and has a drainage of about 16 square miles (USFS 1999a). It is considered to have very little influence on anadromous habitat in the Methow River (USFS 1999a), and no stream survey has been conducted in this drainage. Black Canyon Creek joins the Methow River at RM 8.1, has a drainage of about 25 square miles (15,940 acres; USFS 1999a), and is 7.2 miles in length. Summer steelhead spawn in the lower 0.4 miles of Black Canyon Creek (USFS 1999a), and resident rainbow trout are known to occur further upstream to about F.S. Road 100 (TAG 2000). The State Highway 153 culvert crossing at the mouth of Squaw Creek blocks anadromous fish passage into Squaw Creek (USFS 1999a). Rainbow trout were noted in Squaw Creek up to and just above the FS Road 125 crossing (about RM 3.0; November 1998 field notes, D. Hopkins, USFS fish technician).

LEVEL OF CERTAINTY:

Use EDT level of proof Table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Sediment Load - limiting across all life stages (extremely high % fines and embeddedness; high turbidity during high flows

high road density, agriculture, logging, extreme fire regime)

P-Obstructions (2 culverts in lower 3.5 miles)

P-Habitat Diversity (loss of connection to the floodplain; reduced beaver activity)

S-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals)

S-Flow - problem for summer rearing (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters]; hydroconfinement [channelization in lower 2 miles])

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer steelhead in the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-0,1 winter rearing.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies and estimate appropriate target for PFC in these subwatersheds based on naturally elevated ambient sediment budget.

Objective 3 - Reduce embeddedness to an average of 20% or less (or appropriate target based on Objective 2 of Hypothesis 1) throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less (or appropriate target based on Objective 2 of Hypothesis 1) throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 2 - Improving passage at culverts will increase survival for summer steelhead in the following life stages: a) spawning, and; b) age-0,1,2 rearing.

Objective 1 - Obtain no impact to upstream or downstream movement by all fish species at all life stages.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 3 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead in the following life stages: a) spawning; b) age-0,1, 2 rearing, and; c) age-1, 2 migrants.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 4 - Increasing key habitat quantity will increase survival for summer steelhead in the following life stages: a) prespawn holding; b) spawning, and; c) egg incubation.

Objective 1 - Fill data gap by conducting formal habitat surveys in Black Canyon and Squaw Creeks.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996) with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Objective 3 - See Objectives 1 and 2 of Hypothesis 3. (Habitat Diversity)

Hypothesis 5 - Increasing base flows will increase survival of summer steelhead in the age-0,1 summer/winter rearing life stage. Decreasing spring peak flows (to natural hydrograph levels) will increase survival for steelhead in the fry colonization life stage.

Objective 1 - Minimize negative impacts of water withdrawals.

Objective 2 - Obtain/maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with "functioning at risk"(NMFS 1996); however, the properly functioning objectives (including "no valley bottom roads") are not feasible.

Objective 3: See Objectives 1 and 2 of Hypothesis 3. (Habitat Diversity)

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 and 2 of Hypothesis 3.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

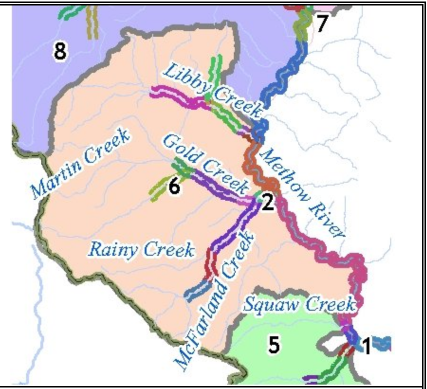
Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS
Aquatic habitat surveys
Fish habitat use (species- and life stage- specific, e.g. bull trout)
Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)
Benthic invertebrate productivity
Others from EDT
Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)
Determine impact of land use practices on riparian zone
Streamflow
Winter temperature and icing studies
Assessment of current versus historical beaver abundance and distribution
Implementation of monitoring and evaluation programs
Westslope Cutthroat Trout:
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage

Assessment Unit (AU): M6—Gold/Libby

Reaches: 12

15	16	17	18	19	20	21	22	23	24	25	26



FOCAL species: Spring Chinook, coho, bull trout, westslope cutthroat trout, and steelhead.

Drainage area: 83,800

SUBWATERSHEDS:

Gold Creek: South Fork Gold Creek, Foggy Dew Creek, Crater Creek, North Fork Gold Creek, Libby Creek, Smith Canyon Creek, Mission Creek, North Fork Libby Creek, South Fork Libby Creek

ASSESSMENT UNIT DESCRIPTION:

The Libby Creek drainage runs east to west and contains approximately 25,000 acres. Libby Creek is approximately 14 miles in length, and drains into the Methow River at RM 26.4 about 0.5 mile downstream of the town of Carlton (RM 27.0). Tributaries include Smith Canyon, Chickamun Canyon, Ben Canyon, Mission, South Fork Libby and North Fork Libby Creeks.

The Gold Creek drainage runs east to west and encompasses approximately 58,800 acres. It drains into the Methow River from the east at RM 21.8, about 6 miles downstream of the town of Carlton (RM 27.0). Gold Creek is 10.2 miles in length. Its tributaries include South Fork Gold Creek, North Fork Gold Creek, Foggy Dew Creek, and Crater Creek.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Obstructions (flow diversions; culverts)

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes, reduced beaver activity; loss of riparian vegetation; lack of LWD

P-Sediment Load (high % fines and embeddedness; high turbidity during high flows; high road density, agriculture, and logging)

P-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals

P/S-Flow - may be a bigger problem than EDT indicated; there are low natural flows, so in certain years, spring Chinook and bull trout may be impacted significantly (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters])

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows)

Temperature -for spawning and incubation of spring Chinook (high summer temperatures in lowest reach [do not know if they extend past the South Fork])

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Improving passage at diversion dams and culverts will increase survival for summer steelhead, spring Chinook, bull trout, and westslope cutthroat trout at all life stages.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring, and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook, westslope cutthroat trout, and bull trout in the following life stages: a) fry colonization; b) age-0 winter rearing, and; c) prespawn holding. Summer steelhead and westslope cutthroat trout survival will increase in the following life stages: a) spawning; b) fry colonization, and; c) age 0-2 juvenile rearing.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer steelhead and westslope cutthroat trout in the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-1 migrants (steelhead).

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices

Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 4 - Increasing key habitat quantity will increase survival for bull trout, westslope cutthroat trout, summer steelhead (lower Gold South Fork, Lower Libby Creek) in the following life stages: a) spawning, and; b) egg incubation. Spring Chinook survival will increase for the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-0 summer rearing, particularly in reach Gold 4.

Objective 1 - Fill data gap by conducting formal habitat surveys in the lower reaches on private land that have not been surveyed.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options: See strategies for Hypotheses 2, 3, and 5.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5a - Increasing base flows will increase survival of spring Chinook and bull trout for the following life stages: a) prespawn holding, and; b) age-0 winter rearing. Summer steelhead survival will increase for all juvenile summer and winter rearing life stages.

Hypothesis 5b - Decreasing spring peak flows (to natural hydrograph levels) will increase survival for steelhead, spring Chinook, bull trout, and westslope cutthroat trout in the following life stages: a) fry colonization, and; b) juvenile active rearing.

Objective 1 - See objectives 1 and 2 of Hypothesis 2.

Objective 2 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 3 - Minimize negative impacts of irrigation water withdrawals.

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 of Hypothesis 1.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Increasing channel stability will increase survival of westslope cutthroat trout and summer steelhead in the following life stages: a) egg incubation, and; b) fry colonization.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options*:* See strategies for Hypotheses 2, 3, and 5.

Hypothesis 7 - Decreasing summer high temperatures will increase survival for spring Chinook and bull trout in the following life stages: a) spawning, and; b) egg incubation, particularly in lower Gold Creek.

Objective 1 - Reduce summer temperatures so that there are no days over 61^{o} F.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and roads using detention, treatment, and infiltration measures.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

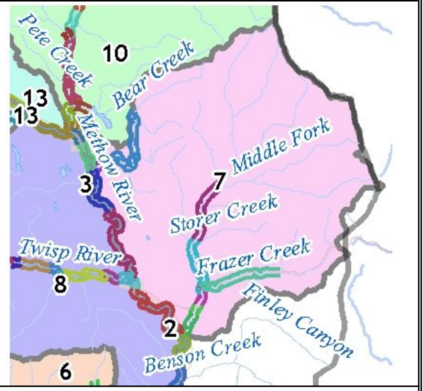
Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS
Winter temperature and icing studies
Survey diversions and culverts
Benthic invertebrate productivity
Fish habitat use (species- and life stage-specific, e.g. bull trout)
Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)
Impact of land use practices on riparian zone
Others from EDT
Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)
Spatial and temporal thermal regime
Aquatic habitat surveys (including measurements of bed scour)
Assessment of current versus historical beaver abundance and distribution
Ongoing water quality monitoring
Implementation of monitoring and evaluation programs
Bull Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics

Assessment Unit: M7—Beaver/Bear Creek

Reaches: 11

41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**



FOCAL species: Spring Chinook, coho, bull trout, and steelhead.

Drainage area: 71,400 acres (Beaver Creek)

SUBWATERSHEDS:

Frazer Creek, South Fork Beaver Creek, Middle Fork Beaver Creek, Lightning Creek, and Blue Buck Creek.

ASSESSMENT UNIT DESCRIPTION:

The Beaver Creek drainage runs northeast to southwest, encompassing about 71,400 acres. It drains into the Methow River east at RM 35.2 about 5 miles downstream of the town of Twisp (RM 40.0). Beaver Creek is 22.3 miles in length and includes the following tributaries: Frazer Creek, South Fork Beaver Creek, Middle Fork Beaver Creek Lightning Creek, and Blue Buck Creek. Water uses in the Beaver Creek drainage have been adjudicated, with water use exceeding water availability most years during late irrigation season (USFS 1997). In a 1998 fish passage barrier and screen safety inventory (Gower and Espie 1999), a total of 78 partial and full fish passage barriers, including both culverts and dams, were identified in the Beaver Creek drainage (Map Appendix C - inventory included Beaver Creek and all its tributaries). Of the 36 water diversions located, 20 gravity diversions and 6 pump diversions were unscreened.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Obstructions (flow diversions; culverts)

P-Sediment Load (high % fines and embeddedness on public lands [need to incorporate information from private property]; high turbidity during high flows; high road density, agriculture, and logging)

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD)

P-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals

P/S- Flow - secondary in upper reaches (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters (excluding Early Winters Creek)]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Survival for all life stages of Chinook, steelhead, and bull trout will increase by restoring proper passage conditions at human-made barriers.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for steelhead in the: a) spawning; b) egg incubation, and; c) fry colonization life stages.

Objective 1 - Minimize and/or avoid land use activities in areas susceptible to surface erosion and in riparian zones, to prevent accelerating the naturally occurring rate and delivery of sediment.

Objective 2 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 3 - Determine % fines and embeddedness through empirical studies.

Objective 4 - Reduce embeddedness to an average of 20% or less throughout the AU (or appropriate target based on Objective 3 of Hypothesis 2 throughout the AU).

Objective 5 - Reduce % fines to an average of 12% or less throughout the AU (or appropriate target based on Objective 3 of Hypothesis 2 throughout the AU).

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 3 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead and bull trout at all juvenile life stages.

Objective 1 - Protect key habitat and channel conditions by restoring and maintaining habitat processes directly affecting channels in the watershed.

Objective 2 - Protect healthy areas and restore degraded riparian zones to a more natural condition. Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat). Riparian corridor provides adequate shade, LWD recruitment, habitat protection and connectivity.

Objective 3 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 4 - Increasing key habitat quantity will increase survival for steelhead and bull trout during the following life stages: a) prespawn holding; b) spawning, and; c) egg incubation.

Objective 1 - Fill data gap by conducting formal habitat surveys on private lands in lower Beaver Creek/Bear Creek drainages.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options: See Strategies for Hypotheses 2, 3, and 5.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5 - Increasing summer base flows will increase the survival of summer steelhead and bull trout at all juvenile summer and winter rearing life stages.

Objective 1 - Ensure that base flows sufficiently support resident and anadromous fishes similar to an undisturbed watershed of similar size, geology and geography. Use common and professionally accepted methodologies and/or analytical tools to determine appropriate flow needs (timing, order and magnitude) and implementation strategies.

Objective 2 - See Objectives 1 and 2 of Hypothesis 3 (Habitat Diversity).

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies*:*

Strategy 1. See strategies for Objectives 1 and 2 of Hypothesis 3.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, and bull trout in the following life stages: a) fry colonization (spring Chinook, steelhead, and bull trout), and; b) rearing (spring Chinook, steelhead, and bull trout).

Objective 1 - See Objectives 1 and 2 of Hypothesis 3 (Habitat Diversity).

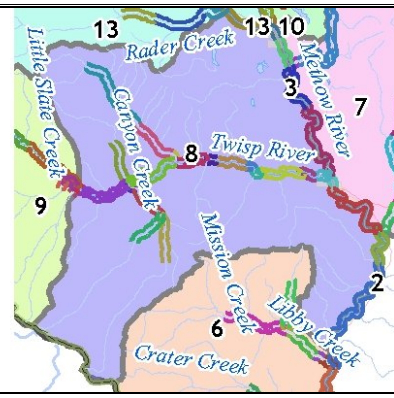
Objective 2 - See Objectives 1-4 of Hypothesis 2 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program. Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 6. Protection and Restoration options: See strategies for Hypotheses 2 and 3. Strategy 1 - Restore nutrients through salmon carcass or analog distribution. Hypothesis 7 - Increasing channel stability will increase survival of summer steelhead and bull trout in the following life stages: a) egg incubation, and; b) fry colonization. Objective 1 - See Objectives 1-5 of Hypothesis 2, Objectives 1-2 of Hypothesis 3, and Objective 1 of Hypothesis 5. Objective 2 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU. Objective 3 - Reduce bed scour to appropriate PFC (based on Objective 2 of Hypothesis 7)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)]. Protection and Restoration options: See strategies for Hypotheses 2, 3, and 5. Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts. Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.
DATA GAPS AND M&E NEEDS Aquatic habitat surveys (including bed scour) Fish habitat use (species- and life stage-specific, e.g. bull trout) Benthic invertebrate productivity Others from EDT Groundwater-surface water interactions Include sediment information from OCD, implement in other areas Sediment budget and delivery study (understand background levels and impacts of past and current land use practices) Impact of land use practices on riparian zone Survey diversions and culverts (some unknowns in Bear Creek; effectiveness monitoring for previous projects) Winter temperature and icing studies Assessment of current versus historical beaver abundance and distribution Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics) Implementation of monitoring and evaluation programs Bull Trout: Presence/absence studies in tributaries Population, distribution and abundance Exotic interaction Fish use-activity and life stage Genetics Westslope Cutthroat Trout: Presence/absence studies in tributaries Population, distribution and abundance Exotic interaction Fish use-activity and life stage Genetics

Assessment Unit (AU): M8—Lower Twisp

Reaches: 27

54	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**
69	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**			



FOCAL species: Spring Chinook salmon, coho, bull trout, steelhead, westslope cutthroat trout, and cutthroat trout.

Drainage area: 157,114 acres (entire Twisp)

SUBWATERSHEDS:

Poorman, Newby, Little Bridge, Canyon, and Buttermilk

ASSESSMENT UNIT DESCRIPTION:

The capability of the lower 15 miles of the Twisp River to provide productive salmonid habitat has been substantially reduced (TAG 2000). This is the result of reduced LWD levels, road placement, dike placement, bank hardening, and conversion of riparian areas to agriculture and residential uses. In addition, from RM 4.0 to the mouth, the reduction of instream flows resulting from water diversions further reduces the quantity of rearing habitat and access to rearing habitat.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD

P-Temperature (warm temperatures limiting spawning and incubation [spring Chinook] in 3 lowest reaches (RM 0-4)

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD

P-Obstructions (MVID West canal diversion; culverts)

P-Sediment - below Buttermilk Ck., primarily for steelhead (high road densities in Little Bridge Creek, Poorman Creek, and Buttermilk Creek; fire regime

P-Key Habitat Quantity - primarily for spring Chinook (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals

S-Flow - impacts above and beyond natural condition (reduced low flow [water use, loss of riparian function]; hydroconfinement [channelization])

S-Food (reduced salmon carcasses)

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead at all juvenile life stages and spring Chinook at the following life stages: a) spawning; b)fry colonization; c) age-1 summer rearing, and; d) prespawn holding. Bull trout and westlope cutthroat trout survival will increase in all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Decreasing summer maximum temperatures will increase survival of spring Chinook during the following life stages: a) pre-spawn holding; b) spawning, and; c) egg incubation, and increase survival of summer steelhead during the following life stages: a) age-0,1, and; b) 2 active rearing. Bull trout survival will increase for rearing, spawning and migration. Westslope cutthroat trout survival will increase for rearing.

Objective 1 - No maximum daily temperatures over 64^{o}F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (< 57oF) are not realistic for the lower Twisp River mainstem and probably represent a condition that could not exist, even under pristine historical conditions.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Reserve Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and from roads, using detention, treatment, and infiltration measures.

Hypothesis 3 - Increasing channel stability will increase survival of summer steelhead and westslope cutthroat trout in the following life stages: a) egg incubation, and; b) fry colonization.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with "functioning at risk" (NMFS 1996); however, the properly functioning objectives (including "no valley bottom roads") are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 3)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 1, 2, and 5.

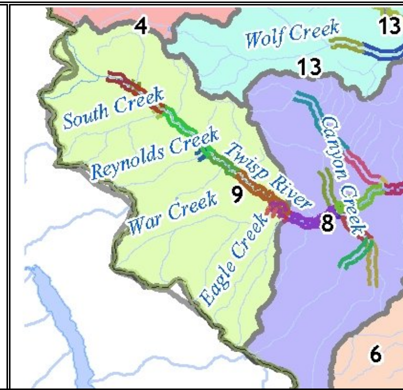
Hypothesis 4 - Survival for all life stages of Chinook, steelhead, westslope cutthroat trout, and bull trout will increase by restoring proper

DATA GAPS AND M&E NEEDS:
Winter temperature and icing studies
Fish habitat use (species- and life stage-specific, e.g. bull trout)
Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)
Benthic invertebrate productivity
Others from EDT
Groundwater-surface water interactions
Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)
Impact of land use practices on riparian zone
Survey diversions and culverts (some unknowns in Bear Creek; effectiveness monitoring for previous projects)
Long term temperature and flow monitoring throughout (including tributaries)
Channel migration zone study
Aquatic habitat surveys (periodic and ongoing)
Implementation of monitoring and evaluation programs
Bull Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics

Assessment Unit (AU): M9—Upper Twisp

Reaches: 27

54	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**
69	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**			



FOCAL species: Spring, summer/fall Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 157,114 acres (entire Twisp)

SUBWATERSHEDS:

Poorman, Newby, Little Bridge, Canyon, Buttermilk, Eagle, War, Reynolds, South, and North Creeks.

ASSESSMENT UNIT DESCRIPTION:

This is a relatively pristine area that extends from the headwaters down to the Eagle Creek confluence. There is a stretch between Reynolds Creek and South Creek that naturally goes dry during below-average water years.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Obstructions (culverts in tributaries [generally only block small stretches before a natural barrier])

P-Habitat Diversity - mostly limited by naturally harsh conditions (reduced LWD [from historic logging]; reconnection of off-channel habitat [1 spot on War Creek only])

P-Key Habitat Quantity (reduction in quality pools; LWD)

Flow (natural low flow conditions)

Food (reduced salmon carcasses)

P-Sediment (steelhead)

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1: Survival for all life stages of steelhead, westslope cutthroat trout, and bull trout will increase by restoring proper passage conditions at culverts.

Objective 1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Increasing (maintaining) habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead at all juvenile life stages. Bull trout and westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Protect key habitat and channel conditions by restoring and maintaining habitat processes directly affecting channels in the watershed.

Objective 1 - Protect healthy areas and restore degraded riparian zones to a more natural condition (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat). Riparian corridor provides adequate shade, LWD recruitment, habitat protection and connectivity.

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3: Increasing key habitat quantity will increase survival for steelhead during the following life stages: a) prespawn holding; b) spawning, and; c) egg incubation. Spring Chinook and bull trout survival will increase during the following life stages: a) prespawn holding; b) spawning; c) egg incubation; d) fry colonization, and; e) age-0 summer rearing. Westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options**:** See strategies for Hypotheses 2, 4, and 5.

Hypothesis 4: Increasing summer base flows will increase the survival of summer steelhead, bull trout, and spring Chinook at all juvenile summer and winter rearing life stages. Westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Ensure that base flows sufficiently support resident and anadromous fishes similar to an undisturbed watershed of similar size, geology and geography. Use common and professionally accepted methodologies and/or analytical tools to determine appropriate flow needs (timing, order and magnitude) and implementation strategies.

Objective 2 - See Objectives 1 and 2 of Hypothesis 1.

Protection strategies:

Strategy 1 - Maintain natural fire regime in this AU and upstream.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Restoration strategies:

Strategy 1 - Restore natural fire regime in this AU and upstream and actively recover intensely burned areas.

Strategy 2 - See strategies for Objective 1 of Hypothesis 1.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6. -Conserve and reuse water.

Hypothesis 5: Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for steelhead in the following life stages: a) spawning; b) egg incubation, and; c) fry colonization life stages. Westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Minimize and/or avoid land use activities in areas susceptible to surface erosion and in riparian zones, to prevent accelerating the naturally occurring rate and delivery of sediment.

Objective 2 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 3 - Determine % fines and embeddedness through empirical studies.

Objective 4 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 5 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Strategy 2 - Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 7 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Hypothesis 6 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) fry colonization, and; b) rearing.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 5 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 6.

Protection and Restoration options: See strategies for Hypotheses 2 and 5.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 7 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

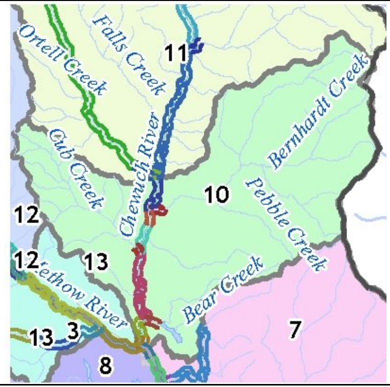
Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS
Winter temperature and icing studies
Benthic invertebrate productivity
Others from EDT
Aquatic habitat surveys (periodic and ongoing, include bed scour)
Fish habitat use (species- and life-stage specific, e.g. long term monitoring of species assemblage)
Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)
Long term monitoring of temperatures and flow
Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)
Bull Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics

Assessment Unit (AU): M10—Lower Chewuch

Reaches: 11

106	**107**	**108**	**109**	**110**	**111**	**112**
113	**114**	**115**	**116**			



FOCAL species: Spring Chinook salmon, coho, bull trout, steelhead, westslope cutthroat trout, and cutthroat.

Drainage area: 340,000 acres (entire Chewuch)

SUBWATERSHEDS:

Pearrygin Lake Creek, Cub Creek, Boulder Creek

ASSESSMENT UNIT DESCRIPTION:

The Chewuch River subwatershed contains approximately 340,000 acres (USFS 2000c), is oriented north-to-south, and drains into the Methow River at the town of Winthrop (RM 50.0). The Chewuch River is 44.8 miles in length from its headwaters to the mouth.

Tributaries include Cub Creek, Boulder Creek, Eightmile Creek, Falls Creek, Lake Creek, Andrews Creek, Twentymile Creek, Thirtymile Creek, and Dog Creek. Upper natural falls barriers have been mapped on all these tributaries. All other tributaries to the Chewuch River also have natural upstream migration barriers (either falls or steep gradients) reflecting the geological formation of the mainstem Chewuch valley, a U-shaped trough with side slopes often in excess of 60-70%.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD

P-Sediment Load - limiting across all life stages (high % fines and embeddedness; high turbidity during high flows)

P-Temperature - spring Chinook spawning (high summer temperatures)

P-Obstructions (flow diversions [Chewuch]; culverts [in bull trout reaches of Cub and Little Boulder])

S/P-Key Habitat Quantity - for steelhead and bull trout in Cub Creek (reduction in quality pools, LWD; loss of riparian vegetation

reduced stream width because of water withdrawals)

S-Flow (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters, road density]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook and summer steelhead in almost all life stages. Bull trout and westslope cutthroat trout survival will be increased in all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for spring Chinook during the following life stages: a) prespawn migration; b) adult holding; c) spawning; d) incubation, and; e) 0-age active rearing, and for summer steelhead, bull trout, and westslope cutthroat trout in almost all life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 3a - Decreasing summer maximum temperatures will increase survival of summer steelhead, bull trout, and westslope cutthroat trout during the following life stages: a) age-0 active rearing, and; b) age-1 active rearing, and for spring Chinook during the following life stages: a) pre-spawn holding; b) spawning; c) incubation, and d) age-0 active rearing.

Objective 1 - No maximum daily temperatures over 61°F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (< 57oF) are not realistic for the lower Chewuch River and may represent a condition that could not exist, even under pristine historical conditions.

Hypothesis 3b - Restoring hyporheic function will decrease negative effects of winter low temperatures for steelhead, bull trout, and westslope cutthroat trout spawning and rearing, and for spring Chinook rearing.

Objective 1 - No anchor ice and less than 15 days per month under 34°F.

Objective 2 - See Objective 1 of Hypothesis 1.

Protection Strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 4 - Survival for all life stages of Chinook, steelhead, westslope cutthroat trout, and bull trout will increase by restoring proper passage conditions at human-made barriers.

Objective 1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 5 - Increasing “key habitat quantity” will increase the survival of spring Chinook during the following life stages: a) prespawn holding; b) spawning; c) egg incubation; d) fry colonization; e) 0-age active rearing; f) 0-age inactive rearing; and; g) 1-age active rearing, and during the following life stages for steelhead: a) prespawn holding; b) spawning, and c) egg incubation. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options: See strategies for Hypotheses 1, 2, and 7.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 6 - Improved channel stability will increase survival of spring chinook egg incubation, fry colonization, and 0-age active rearing, and 0-age inactive rearing; and summer steelhead egg incubation, fry colonization, 0-age active rearing, 0,1-age inactive rearing and 1-age active rearing. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 2 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 1, 5, and 7.

Hypothesis 7: Increasing summer base flows and decrease in spring peak flows will increase survival of summer steelhead during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing; d) 1-age active rearing, and; e) 2+ age active rearing, and for spring Chinook during the following life stages: a) prespawn holding; b) fry colonization; c) 0-age active rearing, and; d) 0-age inactive rearing. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objective 3 of Hypothesis 6 (Minimum Road Density).

Objective 3 - Minimize negative impact of water withdrawals.

Protection Strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objectives 1 and 2 of Hypothesis 1, and Objective 3 of Hypothesis 6.

Strategy 2 - Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 8 - Increasing forage will increase the survival of spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing, and c) 0-age inactive rearing, and for steelhead during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing, and; d) age-1 active rearing. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objectives 1-5 of Hypothesis 2 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 8.

Protection and Restoration options: See strategies for Hypotheses 1 and 2.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 9 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Winter temperature and icing studies

Channel migration zone study

Aquatic habitat surveys (Including bed scour)

Fish habitat use (species- and life-stage specific, e.g. bull trout)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Others from EDT

Groundwater-surface water interactions

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Continue summer and implement winter temperature/icing monitoring

Impact of land use practices on riparian zone

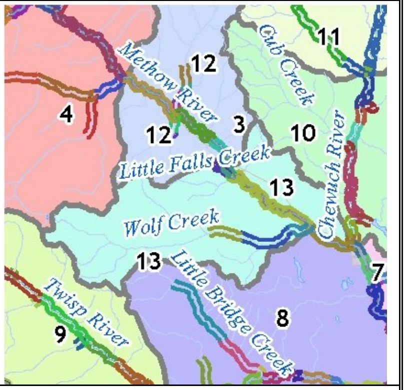
Survey culverts (in Cub and Little Boulder)

Assessment of current versus historical beaver abundance and distribution
Implementation of monitoring and evaluation programs
Bull Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics

Assessment Unit (AU): M13—Wolf/Hancock Cr.

Reaches: 5

145	146	147	148	150



FOCAL species: Spring Chinook salmon, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 25,800 acres -Wolf Creek

SUBWATERSHEDS:

Little Wolf Creek, North Fork Wolf Creek, South Fork Wolf Creek, and Hubbard Creek

ASSESSMENT UNIT DESCRIPTION:

The Wolf Creek drainage runs east to west, encompasses about 25,800 acres, and ranges in elevation from 8,897 feet (Gardner Mountain is the highest point in Okanogan County) in its headwaters to near 2,000 feet at its mouth. It drains into the Methow River from the south at RM 52.8, about 3 miles upstream of the Town of Winthrop (RM 50.0). Wolf Creek is 14 miles in length. Its named tributaries are Little Wolf Creek, North Fork Wolf Creek, South Fork Wolf Creek, and Hubbard Creek. The upper portion of the drainage is confined in a steep valley until it opens up on to an alluvial fan 1.5 miles upstream from the confluence with the Methow river. The portion of Wolf Creek that runs through the alluvial fan has been channelized.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (IN PRIORITY FROM EDT ANALYSIS):

P-Obstructions (WCRD diversion dam)

P-Habitat Diversity (loss of riparian vegetation; lack of LWD)

P-Sediment (mostly natural in Wolf Creek, very low road density; land use practices [Hancock Creek[)

P-Key Habitat Quantity - lower 4 miles Wolf Creek and Hancock Creek (reduction in quality pools, LWD; loss of riparian vegetation [lower mile])

S-Flow - only an issue on Wolf Creek from the mouth to the diversion at RM 0-4.3 (low flow problem made worse by natural losing reach on the alluvial fan; loss of riparian function; hydroconfinement [channelization])

S-Channel Stability (loss of connection to the floodplain via roads and riprap [lower 800 feet]; loss of riparian vegetation; lack of LWD)

S-Food (reduced salmon carcasses)

S-Temperature (EDT identified moderate impacts to spring Chinook in lower reach but it did not exceed 61° F in 1999.

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Improving adult and juvenile passage over Wolf Creek Irrigation Diversion at RM 4.0 will increase survival of steelhead, westslope cutthroat trout, and bull trout for the following life stages: a) spawning (steelhead and bull trout); b) rearing (steelhead and bull trout); c) holding (steelhead and bull trout), and d) migration (westslope cutthroat trout).

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring, and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Increasing habitat diversity (riparian function, LWD, man-made confinement will increase survival of spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) spawning (spring Chinook); b) egg incubation (spring Chinook); c) fry colonization (spring Chinook), and; d) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3: Decreasing sediment load (turbidity, % fines, and embeddedness) will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout during the following life stages: a) spawning (spring Chinook, westslope cutthroat trout, steelhead and bull trout); b) egg incubation (Spring Chinook, westslope cutthroat trout, steelhead and bull trout); c) fry colonization (spring Chinook, westslope cutthroat trout, steelhead, and bull trout); d) rearing (spring Chinook, westslope cutthroat trout, steelhead, and bull trout), and; e) migration (spring Chinook, westslope cutthroat trout, steelhead, and bull trout).

Objective 1 - Reduce turbidity to a SEV index <7.5, (sub-lethal impacts, minimal behavior modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 15% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 11% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 4 - Increasing key habitat quantity (number of quality pools and improved riparian vegetation) will increase the survival of steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) spawning (spring Chinook, westslope cutthroat trout, steelhead and bull trout); b) egg incubation (spring Chinook, westslope cutthroat trout, steelhead and bull trout), and; c) rearing (spring Chinook, westslope cutthroat trout, steelhead and bull trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Protection and Restoration options: See Strategies for Hypotheses 2, 3, and 5.

Strategy 1. Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5 - Improving flow conditions in the lower 4 miles of Wolf Creek will increase the survival of spring Chinook, steelhead and bull trout in the following life stages: a) spawning (bull trout); b) egg incubation (bull trout); c) fry colonization (Spring Chinook, steelhead and bull trout),; d) rearing (spring Chinook, steelhead and bull trout); and e) migration.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reduce hydroconfinement in the lower 800 feet of Wolf Creek by 50%, and provide connectivity to the floodplain.

Objective 3 - Decrease negative impacts of water withdrawals.

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objectives 1 and 2 of Hypothesis 2.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Implement BMPs for water use.

Strategy 5 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Increasing channel stability will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) egg incubation (spring Chinook, westslope cutthroat trout, steelhead, and bull trout); b) fry colonization (spring Chinook, westslope cutthroat trout, steelhead, and bull trout), and c) rearing (Spring Chinook, westslope cutthroat trout, steelhead, and bull trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 2, 3, and 5.

Hypothesis 7: Increasing food availability within the AU will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) fry colonization (steelhead, bull trout and westslope cutthroat trout), and; b) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - See Objectives 1 and 2 of Hypothesis 2 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 3 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 7.

Protection and Restoration options: See strategies for Hypotheses 1 and 3.

Strategy 1. Restore nutrients through salmon carcass or analog distribution.

Hypothesis 8 - Decreasing instream summer temperature in the lower 1 mile of Wolf Creek will increase survival for spring Chinook in the following life stages: a) spawning; b) egg incubation, and; c) rearing. This will increase survival for bull trout in the following life stages: a) migration, and b) holding.

Objective 1 - Reduce summer temperatures so that there are no days over 61^{o} F.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and roads using detention, treatment, and infiltration measures.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Aquatic habitat surveys (Including bed scour)

Fish habitat use (species- and life stage-specific)

Channel migration zone study

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Winter temperature and icing studies

Others from EDT

Assessment of current versus historical beaver abundance and distribution

Implementation of monitoring and evaluation programs

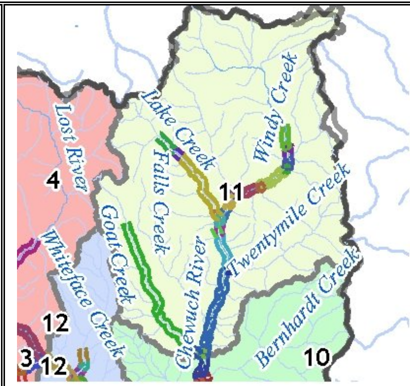
Bull Trout:

Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage

Assessment Unit (AU): M 11—Upper Chewuch

Reaches: 26

117	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**
130	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**



FOCAL species: Spring Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead.

Drainage area: 340,000acres (entire Chewuch)

SUBWATERSHEDS:

Eightmile Creek, Falls Creek, Lake Creek, Andrews Creek, Twentymile Creek, Thirtymile Creek, Dog Creek, and Dodd Creek

ASSESSMENT UNIT DESCRIPTION:

The Upper Chewuch AU begins at the headwaters and ends at Eightmile Creek (RM12). The Chewuch River subwatershed contains approximately 340,000 acres (USFS 2000c), is oriented north to south, and drains into the Methow River at the town of Winthrop (RM 50.0). The Chewuch River is 44.8 miles in length from its headwaters to the mouth. All other tributaries to the Chewuch River have natural upstream migration barriers (either falls or steep gradients) reflecting the geological formation of the mainstem Chewuch valley, a U-shaped trough with side slopes often in excess of 60-70%.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (IN PRIORITY FROM EDT ANALYSIS):

P-Sediment Load - limiting across all life stages (high % fines and embeddedness on public lands; high turbidity during high flows)

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD)

P-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals)

S-Obstructions (flow diversions; road confinement velocity barrier in Eightmile Creek; culverts [in bull trout reaches of tributaries])

S-Temperature - only from Eightmile to Twentymile Creek; spring Chinook spawning and incubation

S-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows)

S-Food (reduced benthic productivity; reduced salmon carcasses)

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for spring Chinook during the following life stages: a) prespawn holding; b) prespawn migration; c) spawning; d) fry colonization, and; 0-age active rearing, and for summer steelhead during the following life stages: a) prespawn migrant; b) spawning; c) fry colonization; d) 0-age active rearing; e) 1-age migrant, and; f) 1-age active rearing. Bull trout and westslope cutthroat trout survival will increase at all life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 7 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Hypothesis 2 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook during the following life stages: a) prespawn holding; b) prespawn migrant; c) spawning; d) fry colonization; e) 0-age active rearing; f) 0-age migrant; g) 0-age inactive; h) 1-age active rearing, and; i) 1-age migrant, and for summer steelhead during the following life stages: a) spawning; b) fry colonization; c) 0-age active rearing; d) 0,1-age inactive rearing; e) 1-age migrant; f) 1-age active rearing; g) 2+-age active rearing, and h)2+-age migrant. Bull trout and westslope cutthroat trout survival will increase at all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential (applicable in area from Eightmile Creek to Andrews Creek). This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3 - Increasing "key habitat quantity" will increase the survival of spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0-age inactive rearing; d) 1-age active rearing; e) spawning; f) egg incubation, and; prespawn holding. Bull trout and westslope cutthroat trout survival will increase at all life stages.

Objective 1 - Achieve a pool frequency of 18/mile. (NMFS 1996) with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options**:** See strategies for Hypotheses 1 and 2.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 4: Survival for all life stages of Chinook, westslope cutthroat trout, steelhead, and bull trout will increase by restoring proper passage conditions at human-made barriers.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring, and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 5 - Decreasing summer maximum temperatures will increase survival of summer steelhead during the following life stages: a) spawning; b) egg incubation; c) fry colonization; d) age-0 active rearing, and; e) age-1active rearing, and for spring Chinook during the following life stages: a) pre-spawn holding; b) spawning; c) incubation, and; d) age-0 active rearing. Bull trout survival will increase for migration and rearing.

Objective 5-1: No maximum daily temperatures over 61^{o}F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (< 57^{o}F) are not realistic for the lower Chewuch River, and may represent a condition that could not exist, even under pristine historical conditions.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and roads using detention, treatment, and infiltration measures.

Hypothesis 6 - Improved channel stability will increase survival of spring Chinook during the following life stages: a) egg incubation; b) fry colonization; c) age-0,1; d) age-0; e) 1 inactive rearing, and for summer steelhead during the following life stages: a) egg incubation; b) fry colonization; c) 0-age active rearing; d) 0,1-age inactive rearing, and; e) 1-age active rearing. Bull trout survival will increase at all life stages.

Objective 1 - See Objectives 1-4 of Hypothesis 1, and Objectives 1 and 2 of Hypothesis 2.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 1 and 2.

Hypothesis 7: Increasing forage will increase the survival of spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing, and; c) 0-age inactive rearing, and for steelhead during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing, and; d) age-1 active rearing. Bull trout will increase at all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2 (Habitat Diversity).

Objective 2 - See Objectives 1-5 of Hypothesis 1 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 7.

Protection and Restoration options: See strategies for Hypotheses 1 and 2.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

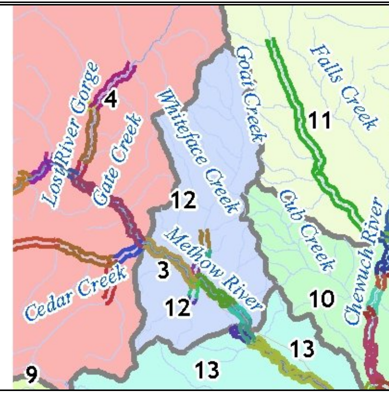
Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation

and species-specific biological objectives.
DATA GAPS AND M&E NEEDS: Winter temperature and icing studies Aquatic habitat surveys (including bed scour) Fish habitat use (species- and life-stage specific, e.g. bull trout) Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics) Benthic invertebrate productivity Others from EDT Sediment budget and delivery study (understand background levels and impacts of past and current land use practices) Continue summer and implement winter temperature/icing monitoring Impact of land use practices on riparian zone Survey culverts (tributaries) Evaluation of past habitat improvement projects (PWI engineered log jams) Assessment of current versus historical beaver abundance and distribution Implementation of monitoring and evaluation programs Bull Trout: Presence/absence studies in tributaries Population, distribution, and abundance Exotic interaction Fish use-activity and life stage Genetics Westslope Cutthroat Trout: Presence/absence studies in tributaries Population, distribution, and abundance Exotic interaction Fish use-activity and life stage

Assessment Unit: M 12—Goat Creek/Little Boulder

Reaches: 8

154	**155**	**156**	**157**	**158**	**159**	**161**	**162**



FOCAL species: Spring Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 22,200 acres -Goat Creek

SUBWATERSHEDS:

Montana Creek, Whiteface Creek, Long Creek, Short Creek, Roundup Creek and Cougar Creek

ASSESSMENT UNIT DESCRIPTION:

The Goat Creek drainage runs north to south, contains about 22,200 acres, and ranges in elevation from 8,000 feet in its headwaters to 2,100 feet at its mouth. Goat Creek drains into the Methow River from the north at RM 64, about one mile downstream of the Town of Mazama. Goat Creek is 12.5 miles in length with nine named tributaries that include Montana Creek, Whiteface Creek, Long Creek, Short Creek, Roundup Creek and Cougar Creek. The upper third of the stream course has a moderate gradient and flows through a U-shaped valley that begins in alpine meadows and avalanche paths. The middle six miles flow through a high gradient inner gorge before the valley opens up into an alluvial fan in which the stream drops large amounts of bedload. In the 1970s, the lower 1.5 miles of Goat Creek were channelized. The maximum average annual precipitation is 35-40 inches in the northern part of the watershed, and lessens to a low of 15-20 inches at the mouth of Goat Creek.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (IN PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity - mostly on the alluvial fan and near Vander pool (loss of riparian vegetation; lack of LWD; loss of connection to the floodplain)

P-Sediment (road density, grazing, historic mining [near Montana Creek], bank erosion)

P-Key Habitat Quantity - for spawning and incubation of steelhead in Little Boulder and in the gorge in Goat Creek (reduction in quality pools, LWD; loss of riparian vegetation [lower mile])

S-Channel Stability (loss of connection to the floodplain; loss of riparian vegetation; lack of LWD)

S-Food - consistent low to moderate impact to age-0 and age-1 steelhead (reduced salmon carcasses)

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) spawning (steelhead, bull trout and westslope cutthroat trout); b) egg incubation (bull trout); c) fry colonization (steelhead, and bull trout), and; d) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12” diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and

estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Decreasing sediment load (turbidity, % fines, and embeddedness) will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) spawning (steelhead, bull trout and westslope cutthroat trout); b) egg incubation (bull trout); c) fry colonization (steelhead, and bull trout); d) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout), and; e) migration (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 15% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 11% or less throughout the AU.

Objective 5 - Decrease road density levels to less than 2 miles/mile^2, and eliminate roads within the valley bottom.

Protection strategies:

Strategy 1. Implement BMPs for development, road construction, logging and intensive farming in riparian areas and upland areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2. Minimize total road density within the watershed and provide adequate drainage control for new roads.

Strategy 3. Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4. Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5. Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 3 - Increasing key habitat quantity (increase number of quality pools and improve riparian vegetation) will increase the survival of steelhead and bull trout in the following life stages: a) spawning (steelhead and bull trout); b) egg incubation (steelhead and bull trout), and; c) rearing (spring Chinook and bull trout).

Objective 1 - Achieve a pool frequency of 18/mile (NMFS 1996, with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Objective 2 - See Objectives 1 and 2 of Hypothesis 1.

Objective 3 - See Objectives 1-5 of Hypothesis 2.

Protection and Restoration options: See Strategies for Hypotheses 1 and 2.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 4 - Increasing channel stability will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat

trout in the following life stages: a) egg incubation (steelhead, bull trout and westslope cutthroat trout); b) fry colonization (steelhead, bull trout and westslope cutthroat trout), and; c) rearing (Spring Chinook, steelhead, bull trout and westslope cutthroat trout). Objective 1 - See Objectives 1 and 2 of Hypothesis 1. Objective 2 - Achieve less than 10% eroding slopes. Objective 2 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with "functioning at risk" (NMFS 1996); however, the properly functioning objectives (including "no valley bottom roads") are not feasible. Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU. Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)]. Protection and Restoration options: See strategies for Hypotheses 1 and 2. Hypothesis 5 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) fry colonization (steelhead, bull trout and westslope cutthroat trout), and; b) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout). Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat). Objective 2 - Achieve properly functioning pool frequency of 70 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and possess good cover (NMFS 1996). Objective 3 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995). Objective 4 - Reduce embeddedness to an average of 15% or less throughout the AU. Objective 5 - Reduce % fines to an average of 11% or less throughout the AU.
DATA GAPS AND M&E NEEDS (not necessarily in priority order): Aquatic habitat surveys (Little Boulder) Determine bed scour Fish habitat use (species- and life stage-specific; e.g. abundance and distribution of bull trout, temporal use by juvenile spring Chinook) Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics) Benthic invertebrate productivity Sediment budget and delivery study (understand background levels and impacts of past and current land use practices) Winter temperature and icing studies Others from EDT Implementation of monitoring and evaluation programs Assessment of current versus historical beaver abundance and distribution Bull Trout: Presence/absence studies Population, distribution, and abundance Exotic interaction Fish use-activity and life stage Genetics Westslope Cutthroat Trout Presence/absence studies Population, distribution, and abundance Exotic interaction Fish use-activity and life stage Genetics

5.6 Biological Objectives

The following summary of biological objectives, by species of fish and wildlife, is provided to guide development of recovery and management plans that will involve listed species, as well as other species and habitats of management importance.

5.7 Fish Species Objectives and Strategies

5.7.1 Spring Chinook

Goal: Run size and spawning escapement level that provides for the recovery of ESA-listed upper Columbia spring Chinook salmon in the Methow subbasin, effectively mitigates for hydrosystem losses and supports a harvestable surplus.

Objective 1: Determine natural smolt production capabilities within the Methow subbasin by 2013.

Strategy 1. Determine adult-to-adult and smolt-to-adult return rates, and quantify spawner success rates for naturally produced and hatchery-produced fish.

Strategy 2. Operate a smolt trap in the lower Methow River, and at least one tributary to the Methow River, to monitor migration pattern, timing, as well as to determine smolt production.

Strategy 3. Design and implement an overwinter ecology study to examine use and survival of stream-type fish through the winter.

Strategy 4. Locate or create a genetic mark on fish within the hatchery that can be located in progeny after adult return and spawning in order to quantify productivity.

Strategy 5. Design and implement shared monitoring and evaluation goals and objectives specific to upper Columbia River spring Chinook natural and artificial production elements.

Strategy 6. Determine egg-smolt survival for naturally spawning fish.

Objective 2: Determine and quantify natural and artificial limitations to natural production by 2013.

Strategy 1. Design and implement a study to quantify use and survival of stream-type fish through the summer and winter months of their first year.

Strategy 2. Conduct annual spawning ground surveys.

Strategy 3. Determine fry production, parr production, and spring smolt production, and correlate to spawner abundance and human and natural changes over time.

Strategy 4. Characterize the habitat utilization through a series of years and abundance trends.

Strategy 5. Develop and implement shared monitoring and evaluation goals and objectives specific to upper Columbia River spring Chinook natural and artificial production elements.

Objective 3: Achieve a natural cohort replacement rate of one or greater and a minimum of 2,000 naturally produced spawners for at least eight consecutive years (NOAA Fisheries interim recovery abundance and productivity targets).

Strategy 1. Maintain artificial production programs identified in ESA Section 10 Permits #1196 and 1300.

Strategy 2. Use locally adapted stocks in supplementation programs.

Strategy 3. Eliminate exogenous stocks from the artificial production programs.

Strategy 4. Manage consumptive fisheries consistent with adult escapement objectives.

Strategy 5. Increase and require spring flow augmentation.

Strategy 6. Reduce predatory consumption of smolts during seaward migration.

Strategy 7. Enlarge existing hatchery facilities, and construct additional facilities to increase effectiveness, not through quantity, but through quality of the hatchery programs to supplement the natural production.

Strategy 8. Improve smolt bypass systems at mainstem hydropower facilities.

Strategy 9. Design and implement shared monitoring and evaluation goals and objectives specific to upper Columbia River spring Chinook natural and artificial production elements.

Strategy 10. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 11. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 4: Maintain artificial production programs to supplement naturally spawning populations using locally adapted brood fish to meet recovery, conservation and harvest needs, while mitigating for fish losses from the Columbia River hydropower system.

Strategy 1. Use locally adapted stocks only.

Strategy 2. Implement supplementation programs identified in the mid-Columbia River HCPs and ESA Section 10 Permits #1196 and #1300.

Strategy 3. Use natural rear to determine if a better smolt (smolt-to-adult survival) can be produced from competition, predator avoidance, temperature, flow, and cover than from a traditional production facility.

Strategy 4. Quantify naturally produced spawners with CWT marked spawners.

Strategy 5. Maintain distinct population attributes of the Methow subbasin.

Strategy 6. Develop or improve tributary adult collection facilities so all brood stock requirements are met from these locations.

Strategy 7. Eliminate exogenous stocks from Methow subbasin.

Strategy 8. Increase and require spring flow augmentation.

Strategy 9. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 10. Develop, implement, manage and monitor consumptive fisheries consistent with adult escapement objectives (i.e, limit proportion of hatchery fish on the spawning grounds in years of excess spawn escapement).

Strategy 11. Perform annual spawning ground surveys.

Strategy 12. Collect DNA or genetic tissue from adult spawners within the hatchery and on the spawning ground to ensure artificial production is not altering the genetic composition of the populations.

Strategy 13. Design and implement shared monitoring and evaluation goals objectives and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

Strategy 14. Develop new and modify existing acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (Upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost rivers).

Strategy 15. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 5: Maintain the genetic diversity/ integrity and population structure of the locally adapted stocks (natural and artificially propagated stocks), consistent with VSP criteria developed through the TRT for recovery planning.

Strategy 1. Eliminate exogenous stocks.

Strategy 2. Improve existing, or create, adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 3. Collect DNA or genetic tissue to monitor and evaluate artificial production program effects upon genetic divergence from founding stocks.

Strategy 4. Quantify naturally produced and hatchery spawners on the spawning grounds to assess the relative BY production relative to proportion hatchery fish on the spawning grounds.

Strategy 5. Design and implement shared monitoring and evaluation goals objectives, and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

Strategy 6. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 7. Achieve habitat objectives identified in the AU summaries in the Methow subbasin Plan.

Strategy 8. Conduct smolt monitoring to assess BY production of tributary-specific populations.

Objective 6: Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through genetic and fish health monitoring, juvenile rearing and release strategies, and brood collection.

Strategy 1. Modify current acclimation ponds on the Chewuch and Twisp Rivers to allow overwintering of juveniles on natal water.

Strategy 2. Improve existing, or create additional, adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 3. Eliminate exogenous spring Chinook stocks.

Strategy 4. Collect DNA or genetic tissue to monitor and evaluate artificial production programs impacts relating to genetic divergence from founding stocks.

Strategy 5. Monitor smolt migration development using external visual observation within the hatchery, and coincide release with peak smoltification.

Strategy 6. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

Strategy 7. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 8. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 7: Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 1. Increase and require spring flow augmentation.

Strategy 2. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 3. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 4. Improve juvenile bypass systems within the Columbia River hydrosystem.

Objective 8: Provide species status report every five years.

Strategy 1. Collect life history information data; produce spawner-recruit analysis, monitor trends in abundance, correlate them with external influences, and assess how well artificial production is meeting goals and objectives.

Strategy 2. Develop and implement shared monitoring and evaluation goals and objectives and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

5.7.2 Summer Chinook

Goal: Run size and spawning escapement levels that provide for viable self-sustaining, naturalized population of upper Columbia summer Chinook salmon in the Methow subbasin; management effectively mitigates for hydrosystem losses and supports a harvestable surplus.

Objective 1: Increase the natural spawning escapement to pre-1980 numbers in the Methow subbasin by 2013, consistent with at least 3,500 adults past Wells Dam.

Strategy 1. Identify and evaluate most successful rearing strategy for artificial production to ensure demographic success.

Strategy 2. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Strategy 3. Increase and require spring/summer flow augmentation.

Strategy 4. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 5. Manage consumptive fisheries consistent with adult escapement objectives (i.e., limit proportion of hatchery fish on the spawning grounds in years of excess spawn escapement).

Strategy 6. Achieve habitat objectives identified in the AU Summaries in the Methow subbasin Plan.

Objective 2: Annually, provide a sport and tribal fisheries, consistent with the protection of endemic naturally produced stocks.

Strategy 1. Improve juvenile bypass facilities at Columbia River hydropower facilities.

Strategy 2. Identify and evaluate most successful rearing strategy for artificial production to ensure demographic success.

Strategy 3. Increase and require spring/summer flow augmentation.

Strategy 4. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 5. Identify, conserve and monitor natural production demographics.

Strategy 6. Develop, implement, manage, and monitor consumptive fisheries consistent with adult escapement objectives (i.e., limit proportion of hatchery fish on the spawning grounds in years of excess spawn escapement).

Strategy 7. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Strategy 8. Implement supplementation programs associated with the Mid-Columbia River HCPs, ESA Section 10 Permit # 1347, and those identified in pending HGMPs.

Objective 3:Maintain/implement artificial production programs that supplement natural production using locally adapted stocks.

Strategy 1. Identify and evaluate most successful rearing strategy for artificial production to ensure demographic success.

Strategy 2. Quantify naturally produced spawners with CWT marked spawners.

Strategy 3. Implement supplementation programs consistent with Mid Columbia HCPs, ESA Section 10 Permit 1347, and pending HGMPs.

Strategy 4. Provide adult collection facilities on Columbia River tributaries for management of locally adapted stock(s).

Strategy 5. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Objective 4: Determine natural production smolt capabilities within the Methow subbasin by 2013.

Strategy 1. Determine egg-to-smolt survival of natural spawning fish.

Strategy 2. Operate a smolt trap in the lower Methow River to monitor migration pattern and timing, as well as to determine natural production capabilities.

Strategy 3. Identify, conserve, and monitor natural production demographics.

Strategy 4. Conduct annual spawning ground surveys.

Strategy 5. Design and implement shared monitoring and evaluation, and goals and objectives specific to upper Columbia River summer Chinook natural and artificial production elements.

Strategy 6. Characterize the habitat utilization through a series of years and abundance trends.

Strategy 7. Determine adult-to-adult and smolt-to-adult return rates, and quantify spawner success rates for naturally produced and hatchery-produced fish.

Objective 5: Determine and quantify natural and artificial limitations to natural production.

Strategy 1. Design and implement microhabitat study.

Strategy 2. Evaluate long-term production trends with human and natural events.

Strategy 3. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

Strategy 4. Characterize the habitat utilization through a series of years and abundance trends.

Objective 6: Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through juvenile rearing and release strategies, brood collection and genetic monitoring.

Strategy 1. Rear and release high quality smolts determined through size, fish health, smoltification, and imprinting.

Strategy 2. Create tributary traps to collect only locally adapted fish for supplementation programs.

Strategy 3. Collect DNA or genetic tissue from natural spawners and hatchery spawners every three years to ensure consistency between the two, and with the baseline.

Strategy 4. Determine early life history strategy most successful to adult return for natural production and hatchery production. Ensure artificial production does not change demographics.

Strategy 5. Monitor fish health monthly, and ensure disease occurrence mirrors natural production.

Strategy 6. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

Strategy 7. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Objective 7: Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 1. Increase and require spring/summer flow augmentation.

Strategy 2. Improve juvenile bypass facilities at Columbia River hydropower facilities.

Strategy 3. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 4. Identify, conserve and monitor natural production demographics.

Objective 8: Provide species status report every five years to evaluate effectiveness of attaining/direction toward the goal, with adoption of changes as necessary.

Strategy 1. Collect life history information data, producing spawner-recruit analysis, monitoring trends in abundance and correlating them with external influences, and assessing how well artificial production is meeting goals and objectives.

Strategy 2. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

Objective 9: Identify, conserve, and monitor life history characteristics of summer Chinook salmon, as they relate to juvenile migration pattern and timing.

Strategy 1. Operate smolt trap in the lower Methow River.

Strategy 2. PIT tag naturally produced and artificially-produced smolts to determine if migration patterns are similar.

Objective 10: Maintain and expand evaluation of the artificial production program.

Strategy 1. Operate a smolt trap in the lower Methow River to assess natural production and smolt migration timing and pattern.

Strategy 2. Design complete life history study to monitor survival through Columbia River hydropower system, estuary and marine environment.

Strategy 3. Provide query of PSMFC database for CWT recoveries to determine escapement, fishery contributions, and general marine survival.

Strategy 4. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

5.7.3 Steelhead

Goal: Run size and spawning escapement levels that provide for the recovery of ESA-listed upper Columbia River steelhead in the Methow subbasin; management effectively mitigates for hydrosystem losses and supports a harvestable surplus.

Objective 1: Determine natural smolt production capabilities within the Methow subbasin by 2013.

Strategy 1. Determine adult-to-adult and smolt-to-adult return rates, and quantify spawner success rates for naturally produced and hatchery-produced fish (including implementation of a reproductive success study).

Strategy 2. Operate a smolt trap in the lower Methow River, and at least one tributary to the Methow River, to monitor migration pattern, timing, as well as to determine smolt production.

Strategy 3. Design and implement an overwinter ecology study to examine use and survival of stream-type fish through the winter.

Strategy 4. Locate or create a genetic mark on fish within the hatchery that can be located in progeny after adult return and spawning, in order to quantify productivity.

Strategy 5. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 6. Determine egg-smolt survival for naturally spawning fish.

Objective 2: Determine and quantify natural and artificial limitations to natural production.

Strategy 1. Design and implement a study to quantify use and survival through the summer and winter months of the first and second year.

Strategy 2. Conduct annual spawning ground surveys.

Strategy 3. Determine fry production, parr production, and spring smolt production, and correlate to spawner abundance and human and natural changes over time.

Strategy 4. Characterize the habitat utilization through a series of years and abundance trends.

Strategy 5. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Objective 3: Achieve a natural cohort replacement rate of one or greater and a minimum of 2,500 naturally produced spawners for at least eight consecutive years (NOAA Fisheries interim recovery abundance and productivity targets).

Strategy 1. Maintain artificial production programs identified in ESA Section 10 Permit 1395, 1396 and 1412.

Strategy 2. Use locally adapted stocks in supplementation programs.

Strategy 3. Manage consumptive fisheries consistent with adult escapement objectives (i.e., implement recreational fishery strategy detailed in ESA Section 10 Permit 1395 when warranted).

Strategy 4. Increase and require spring flow augmentation.

Strategy 5. Reduce predatory consumption of smolts during seaward migration.

Strategy 6. Enlarge existing hatchery facilities, and construct additional facilities, to increase effectiveness, not through quantity but through quality, of the hatchery programs to supplement the natural production (i.e., feasibility of "natures rearing" strategies).

Strategy 7. Reduce predatory consumption in mainstem migration corridor.

Strategy 8. Increase and require spring flow augmentation on the Columbia mainstem.

Strategy 9. Improve smolt bypass systems at mainstem hydropower facilities.

Strategy 10. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 11. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 12. Achieve habitat objectives identified in the AU summaries in the Methow subbasin Plan.

Objective 4: Maintain/implement artificial production programs using locally adapted brood fish to meet recovery, conservation and harvest needs, while mitigating for fish losses from the Columbia River hydropower system.

Strategy 1. Use locally adapted stocks only.

Strategy 2. Implement supplementation programs identified in ESA Section 10 Permit 1395, 1396 and 1412.

Strategy 3. Use "natures rearing" to determine if a better smolt (smolt-to-adult survival) can be produced from competition, predator avoidance, temperature, flow, and cover than from a traditional production facility.

Strategy 4. Radio-tag adult steelhead migrants in upper Columbia River to monitor location of winter holding, spawning, kelting, and wild origin apportioning to subbasins above Wells Dam.

Strategy 5. Maintain/develop distinct population attributes of the Methow subbasin.

Strategy 6. Develop tributary adult collection facilities so all brood stock requirements are met from these locations.

Strategy 7. Increase and require spring flow augmentation.

Strategy 8. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 9. Manage and monitor consumptive fisheries consistent with adult escapement objectives (i.e. implement Permit #1395 recreational fishery plan when warranted).

Strategy 10. Perform annual spawning ground surveys.

Strategy 11. Collect DNA or genetic tissue from adult spawners within the hatchery and on the spawning ground to ensure artificial production is not altering the genetic composition of the populations.

Strategy 12. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 13. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 14. Achieve habitat objectives identified in the AU summaries in the Methow subbasin Plan.

Objective 5: Maintain the genetic diversity/ integrity and population structure of the locally adapted stocks (natural and artificially propagated stocks), consistent with VSP criteria developed through the TRT for recovery planning.

Strategy 1. Improve existing, or create, adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 2. Collect DNA or genetic tissue to monitor and evaluate artificial production programs effects on genetic divergence from founding stocks.

Strategy 3. Quantify naturally produced and hatchery spawners on the spawning grounds to assess the relative BY productivity related to proportion of hatchery fish on the spawning ground.

Strategy 4. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 5. Develop new and modify existing acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 6. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Strategy 7. Conduct smolt monitoring to assess BY production of tributary specific populations.

Objective 6: Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through genetic and fish health monitoring, juvenile rearing and release strategies, and brood collection.

Strategy 1. Modify current acclimation ponds on the Chewuch and Twisp rivers to allow overwintering of juveniles on natal water.

Strategy 2. Create adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 3. Collect DNA or genetic tissue to monitor and evaluate artificial production programs effects upon genetic divergence from founding stocks.

Strategy 4. Monitor smolt migration development using external visual observation within the hatchery, and coincide release with peak smoltification.

Strategy 5. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 6. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 7. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 7: Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 1. Increase and require spring flow augmentation.

Strategy 2. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 3. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 4. Improve juvenile bypass systems within the Columbia River hydrosystem.

Objective 8: Provide species status report every five years to evaluate effectiveness of objective attaining/direction toward goal, with adoption of changes as necessary.

Strategy 1. Collect life history information data, producing spawner-recruit analysis, monitoring trends in abundance and correlating them with external influences, and assessing how well artificial production is meeting goals and objectives.

Strategy 2. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer steelhead natural and artificial production components.

5.7.4 Bull trout

Objective 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of bull trout distribution across the species' native range, so that the species can eventually be delisted.

Strategy 1. Maintain current distribution of bull trout, and restore distribution in previously occupied areas within the Methow Core Area.

Strategy 2. Maintain stable or increasing trends in abundance of bull trout.

Strategy 3. Restore and maintain suitable habitat conditions for all bull trout life stages and strategies.

Strategy 4. Conserve genetic diversity and provide opportunity for genetic exchange.

Objective 2: Reduce threats to the long-term persistence of bull trout populations and their habitat, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms.

Strategy 1. Restore passage of specific man-made migrational barriers within the Methow Watershed, providing the barriers are not providing protection from invasive species such as brook trout.

Strategy 2. Reduce impacts on stream corridor through improved road management throughout the Methow Watershed.

Strategy 3. Reduce impacts on the stream corridor through improved land use practices, such as increased riparian buffer widths, decreased livestock grazing and improved irrigation efficiencies.

Strategy 4. Reduce or eliminate impacts from past, present, and future mining activities.

Strategy 5. Reduce impacts from residential and recreational development.

Strategy 6. Reduce or eliminate effect from non-native species. This includes brook trout eradication and discontinuation of stocking non-native species.

Strategy 7. Maintain and expand fishing prohibitions on bull trout throughout the Methow watershed.

Strategy 8. Maintain and restore floodplain connectivity throughout the watershed.

Objective 3: Improve current knowledge base on bull trout throughout the Methow watershed.

Strategy 1. Complete genetic study on fluvial and resident bull trout.

Strategy 2. Investigate the resident/fluvial interaction.

Strategy 3. Complete a population distribution and abundance study throughout the watershed.

Strategy 4. Complete a life history study throughout the watershed.

Strategy 5. Investigate the effects of natural dewatering areas on bull trout habitat and life histories.

5.7.5 Westslope cutthroat trout

Goal: Manage native stocks for viability, sustainability, and opportunity.

Objective 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of westslope cutthroat trout distribution across the species' native range.

Strategy 1. Maintain current distribution of westslope cutthroat trout, and restore distribution in previously occupied areas within the Methow Core Area.

Strategy 2. Maintain stable or increasing trends in abundance of westslope cutthroat trout.

Strategy 3. Restore and maintain suitable habitat conditions for all westslope cutthroat trout life stages and strategies.

Strategy 4. Conserve genetic diversity and provide opportunity for genetic exchange.

Objective 2: Reduce threats to the long-term persistence of westslope cutthroat trout populations and their habitat, ensuring the security of multiple interacting groups of westslope cutthroat trout, and providing habitat and access to conditions that allow for the expression of various life history forms.

Strategy 1. Restore passage of specific man-made migrational barriers within the Methow Watershed, providing the barriers are not providing protection from invasive non-native species.

Strategy 2. Reduce impacts on stream corridor through improved road management throughout the Methow watershed.

Strategy 3. Reduce impacts on the stream corridor through improved land use practices, such as increased riparian buffer widths, decreased livestock grazing, and improved irrigation efficiencies.

Strategy 4. Reduce or eliminate impacts from past, present, and future mining activities.

Strategy 5. Reduce impacts from residential and recreational development.

Strategy 6. Reduce or eliminate effect from non-native species.

Strategy 7. Maintain and restore floodplain connectivity throughout the watershed.

Objective 3: Improve current knowledge base on westslope cutthroat trout throughout the Methow Watershed.

Strategy 1. Complete genetic study on migratory and resident westslope cutthroat trout.

Strategy 2. Complete a population distribution and abundance study throughout the watershed.

Strategy 3. Complete a life history study throughout the watershed.

Strategy 4. Investigate the effects of natural dewatering areas on westslope cutthroat trout habitat and life histories.

5.8 Wildlife Habitat Biological Objectives and Strategies

The following summary of biological objectives for wildlife and fish is provided to guide development of BPA-funded recovery and management plans that will involve listed species, as well as other species and habitats of management importance.

Emphasis in this subbasin plan is placed on the selected focal habitats and wildlife species described in the Assessment (“Synthesis and Interpretation for Wildlife/Terrestrial Ecosystems,” Section 2.6).

It is clear from the Assessment that reliable quantification of most subbasin-level impacts is lacking; however, many anthropogenic changes have occurred and clearly impact the focal habitats: riparian wetlands, shrubsteppe, and Ponderosa pine forest habitats. While all habitats are important, focal habitats were selected, in part, because they are disproportionately vulnerable to anthropogenic impacts, and likely have received the highest level of impacts within the subbasin.

In particular, the majority of shrubsteppe and Ponderosa pine habitats fall within the "low" or "no" protection status categories defined above. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (e.g., USFS adjustments to grazing management).

It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. The context within which this plan was drafted recognizes that human uses do occur, and will continue into the future. Recommendations are made within this presumptive framework. The Okanogan Subbasin Management Plan directs conservation efforts towards three focal habitats: Ponderosa pine, Shrubsteppe, and Eastside (Interior) Riparian Wetlands.

Focal species selected to represent the three Focal Habitats include: a) Ponderosa pine: white-headed woodpecker, Pygmy nuthatch, gray flycatcher, and flammulated owl; b) Shrubsteppe: sharp-tailed grouse, mule deer, Brewer's Sparrow, and grasshopper sparrow; and c) Eastside Riparian Wetlands: red-eyed Vireo, yellow-breasted chat, and beaver.

The table below lists the working hypotheses, goals, objectives, and management strategies for the three focal habitat types in the Okanogan subbasin.

A working hypothesis is a statement that summarizes the subbasin planners' understanding of the subbasin at the time of development of this plan based on assessment data and analysis. Working hypotheses provide the rationale for the objectives and management strategies.

Subbasin planners have developed a goal for each of the three focal habitat types. Achieving the goal for each focal habitat type should result in functional habitats for the focal species assemblage selected to represent that habitat type, and hence, for other species dependent on the habitat type.

The planners have identified both habitat and biological objectives that will advance the goals for each habitat type. Objectives describe the types of changes within the subbasin needed to achieve the goals and, ultimately, the vision for the subbasin. When insufficient data are available, objectives describe the research that will need to be done to identify physical and biological changes needed to achieve goals.

Strategies are sets of actions to accomplish objectives. The strategies in the table below are intended to serve as guidance for development of projects to accomplish the objectives listed above. Each of the strategies is intended to further one of the objectives; the number in the left-hand column shows which one.

Table 55 Summary of Wildlife Biological Goals, Objectives and Strategies

Working Hypotheses and Goals	Objectives	Strategies
Ponderosa Pine		
Working Hypothesis: The near-term or major factors affecting Ponderosa Pine stands are direct loss of habitat due primarily to timber harvesting, fire reduction/wildfires, mixed forest encroachment, development, recreational activities, reduction of habitat diversity and function resulting from invasion by exotic species and vegetation and overgrazing. The principal habitat diversity stressors are the spread and proliferation of mixed forest conifer species within Ponderosa pine communities due primarily to fire reduction, intense, stand-replacing wildfires, and invasive exotic weeds. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation), coupled with poor habitat quality of existing vegetation (i.e., lack of old growth forest and associated large-diameter trees and snags) have resulted in significant reductions in Ponderosa pine habitat obligate wildlife species. **Goal**: Provide sufficient quantity and quality Ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing Ponderosa pine toward conditions 1a, 1b, 2 and 3 identified in 3.1.7.1.3	**Habitat Objective 1**: Determine the necessary amount, quality, and juxtaposition of Ponderosa pine habitat to sustain focal species populations.	Identify and distinguish ecologically functioning and non-functioning Ponderosa pine habitats, corridors, and linkages.
		Identify sites that are currently not in Ponderosa pine habitat that have the potential to be of high ecological value, if restored.
	Habitat Objective 2: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.	Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
		Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).
		Emphasize conservation of large blocks and connectivity of functional, high quality Ponderosa pine habitat.
		Uphold existing land use and environmental regulations that protect habitats.
		Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.
	Habitat objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture practices, fire management, weed control, livestock grazing practices, and road management on existing and restored Ponderosa pine habitats.	Provide information, outreach, and coordination with public and private land managers to improve the use of prescribed fire, fire protection, and silviculture practices to restore and conserve habitat functionality.
		Implement habitat stewardship projects with private landowners.

Working Hypotheses and Goals	Objectives	Strategies
		Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
		Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
		Develop and implement a coordinated, cross-jurisdictional road management plan.
	Biological Objective 1: Show an increase in distribution and population status of white-headed woodpecker, flammulated owl, gray flycatcher, and Pygmy nuthatch.	Select survey protocol and determine current distribution and population status of each Ponderosa pine focal species
		Identify current and potential areas of high quality habitat for each of the Ponderosa pine focal species
		Work with state, federal, tribal, county, and private entities to maintain and improve structural stand conditions of Ponderosa pine habitat
	Biological Objective 2: Within the framework of the focal species' population status determinations, inventory other Ponderosa pine obligate populations to test assumption of the "umbrella species concept" for conservation of other Ponderosa pine obligates.	Implement federal, state, tribal management and recovery plans
Shrubsteppe		
Working Hypothesis: The near-term or major factors affecting shrubsteppe areas are direct loss of habitat due primarily to conversion to agriculture, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and livestock grazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and knapweeds that either supplant and/or radically	**Habitat Objective 1**: Determine the necessary amount, quality, and juxtaposition of shrubsteppe habitat to sustain focal species populations.	Identify and distinguish ecologically functioning and non-functioning Shrubsteppe habitats, corridors, and linkages.
		Identify sites that are currently not in Shrubsteppe habitat that have the potential to be of high ecological value, if restored.

Working Hypotheses and Goals	Objectives	Strategies
alter entire native bunchgrass communities significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation), coupled with poor habitat quality of extant vegetation have resulted in extirpation and/or significant reductions in shrubsteppe obligate wildlife species. **Goal**: Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing sagebrush-dominated shrubsteppe toward conditions 1, 2 and 3 identified in 3.1.7.2.3	**Habitat Objective 2**: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.	Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
		Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short-term)
		Emphasize conservation of large blocks and connectivity of functional, high-quality shrubsteppe habitat.
		Uphold existing land use and environmental regulations that protect habitats.
		Identify inadequate land use regulations. Work to strengthen existing regulations, or pass new regulations to improve protection of habitats.
	Habitat objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing and restored shrubsteppe.	Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to restore and conserve habitat functionality.
		Implement habitat stewardship projects with private landowners.
		Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
		Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
		Develop and implement a coordinated, cross-jurisdictional road management plan.

Working Hypotheses and Goals	Objectives	Strategies
	Biological Objective 1: Determine population status of the grasshopper sparrow, Brewer's sparrow, sharp-tailed grouse, and mule deer by 2008.	Select survey protocol and measure populations status of focal species.
		Complete a more detailed assessment of focal species, focal species assemblages, and obligate species needs to determine their habitat requirements (quantity and quality).
	Biological Objective 2: Re-introduce sharp-tailed grouse to at least desired minimum viable population levels by 2024.	Implement state and tribal management recovery plans for sharp-tailed grouse.
		Re-introduce sharp-tailed grouse into the subbasin.
		Ensure sharp-tailed grouse habitat needs are met on federal, state, and tribal managed lands during land use planning.
	Biological Objective 3: Maintain and enhance mule deer populations consistent with state/tribal herd management objectives.	Implement state and tribal management plans for mule deer.
		Ensure mule deer habitat needs are met on federal, state, and tribal managed lands during land use planning.
		Maintain mule deer populations within landowner tolerances..
		Protect and enhance important winter range and areas of sensitive habitat.
		Work with state, federal, tribal, and private entities to improve habitat quality within Ponderosa pine habitat (road closures, weed management, improved forage, etc.).
Riparian wetlands		
Working Hypothesis: The proximate or major factors affecting riparian wetlands are direct loss of habitat due primarily to urban/agricultural development, reduction of habitat diversity and function resulting from exotic vegetation, livestock overgrazing, fragmentation, and recreational activities. The principal habitat diversity stressor is the spread and proliferation of invasive exotics. That stressor, coupled with poor habitat quality of existing vegetation, has resulted in extirpation and/or significant	**Habitat Objective 1**: Determine the necessary amount, quality, and juxtaposition of riparian wetland habitat to sustain focal species' populations.	Identify and distinguish ecologically functioning and non-functioning riparian wetland habitats, corridors, and linkages.
		Identify sites that are currently not in riparian wetland habitat that have the potential to be of high ecological value, if restored.

Working Hypotheses and Goals	Objectives	Strategies
reductions in riparian habitat obligate wildlife species. **Goal**: Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing riparian wetland habitats toward conditions 1a, 1b, and 2 identified in 3.1.7.3.3	**Habitat Objective 2**: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species' populations and habitats by 2010.	Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
		Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short-term).
		Emphasize conservation of large blocks and connectivity of functional, high quality riparian wetland habitat.
		Uphold existing land use and environmental regulations that protect habitats.
		Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.
	Habitat objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands.	Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to produce desired riparian wetland habitat conditions.
		Implement habitat stewardship projects with private landowners.
		Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
		Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
		Develop and implement a coordinated, cross-jurisdictional road management plan.

Working Hypotheses and Goals	Objectives	Strategies
	Biological Objective 1: Determine population status of beaver, red-eyed vireo, and yellow-breasted chat by 2008.	Select survey protocol and measure populations status of focal species.
		Complete a more detailed assessment of focal species, focal species assemblages, and obligate species' needs to determine their habitat requirements (quantity and quality).
	Biological Objective 2: Within the framework of the focal species' population status determinations, inventory other riparian wetlands obligate populations to test assumption of the "umbrella species concept" for conservation of other riparian wetlands obligates.	Implement federal, state, tribal management and recovery plans.
	Biological Objective 3: Based on findings of Biological Objective 1, maintain and enhance beaver populations where appropriate and consistent with state/tribal management objectives.	Protect, and where necessary, restore habitat to support beaver.
		Reintroduce beaver into suitable habitat where natural re-colonization may not occur.
		Through state harvest restrictions, protect beaver populations at a level sufficient to allow natural and reintroduced beaver populations to perpetuate at levels that will meet Habitat Objective 2.

5.9 Consistency with ESA/CWA Requirements

The Technical Guide for subbasin planners says that "the management plan should describe how the objectives and strategies are reflective of, and integrated with, the recovery goals for listed species within the subbasin and the water quality management plan within that particular state. Coordination with NMFS's Technical Review Teams, the federal and state agency charged with implementing the CWA, will be an important step in ensuring consistency with ESA and CWA requirements."

In the Methow subbasin, there are potentially three federally-listed fish species. Spring Chinook and summer steelhead are considered Endangered, and bull trout are considered part of the Threatened Columbia River population. Objectives and strategies outlined in this plan are likely to benefit these species through improved habitat involving local irrigation districts, land owners and agency partners, as well as through hatchery augmentation and adult minipulation (harvest and direct removal) where appropriate. The objectives outlined in this plan will be addressed in concert with the Regional Technical Teams and state agencies, ensuring that ESA and CWA priorities are applied in concert with the detailed objectives outlined in this subbasin plan.

NMFS and FWS Biological Opinions include actions related to basic habitat needs of listed species. In tributary habitat, two objectives are relevant to this project: a) Increase tributary water flow to improve fish spawning, rearing, and migration, and; b) comply with water quality standards, first in spawning and rearing areas, then in migratory corridors. Biological Opinion Section 9.6.2.1. Action 151 states that “BPA shall, in coordination with NMFS, experiment with innovative ways to increase tributary flows.”

The discussion of this action notes that, while tributary flow problems are widespread, it is unclear whether and how solutions can be implemented through existing laws and processes. New approaches must be tested, especially where there are significant non-federal diversions and ancillary water quality benefits. This action will also develop a competitive process to increase flows and water quality at the lowest cost.

When developing the Methow Subbasin Plan, planners took into consideration the FWS Draft Bull Trout Recovery Plan (BTRP). The planners developed management plans, including biological goals, objectives, actions, and research needs, that were consistent with the BTRP. In addition, federally-listed wildlife species are recognized in the management plans with objectives that call for protection of these species and their habitats; therefore, the management plan is consistent with ESA requirements. Additional species-specific detail considered throughout the development of this plan is included for each ESA-listed species.

Columbia River bull trout DPS

The Columbia Distinct Population Segment (DPS) for bull trout, which includes the entire Columbia River and its tributaries, was listed as Threatened on June 10, 1999. Bull trout once filled almost every cold-water niche in the Methow subbasin; however, within the Methow subbasin, the presence of natural barriers such as waterfalls or small stream size blocked their access to many headwater streams. Today, changes in stream morphology because of the development of irrigation diversions, alterations to the natural hydrograph, and changes to temperature regimes has affected the population distribution and abundance of these bull trout population.

Factors for decline of the bull trout populations in the Methow include: hydroelectric dams, forest management practices, livestock grazing, agricultural practices, mining, residential development and urbanization, recreational development , harvest, loss of forage base, introduction of non-native species, and habitat fragmentation (FWS, 2002)

Upper Columbia River Recovery Unit

Major tributaries entering the mid-Columbia River include the Wenatchee, Entiat, Methow, and Okanogan Rivers. The Upper Columbia River Recovery Unit includes the Methow, Entiat, and Wenatchee Rivers to their confluences with the Columbia River. There are 16 identified migratory local populations currently distributed within the Wenatchee (six), Entiat (two) and Methow (eight) Rivers. Radiotelemetry study results to date have shown that bull trout are migrating between the Columbia River and core area streams inhabited by local populations. These include the Chiwawa River (Chiwawa River and Rock Creek), Nason River (Nason River and Mill Creek), Icicle Creek, Entiat River (Entiat and Mad Rivers), and Twisp River (Twisp River and Buttermilk Creek) local populations.

There is considerable evidence that bull trout use the Columbia River in this reach for foraging, overwintering, and migration (BioAnalysts 2002, 2003). During the past five years, a large number of migratory adults have been observed moving through the fish ladders at Rock Island, Rocky Reach, and Wells dams. Current radiotelemetry studies show patterns of long distance migrations (> 100 miles one way; 140 miles round trip), and extended overwintering use (>6 months) in the mainstem Columbia River by bull trout (FWS 2001, 2002; BioAnalysts 2002, 2003). Migration of bull trout between the Columbia River and the Wenatchee, Entiat, and Methow Rivers has been documented.(FWS 2004).

The Upper Columbia Recovery Team believes that it is essential to continue to monitor bull trout use in the mainstem Columbia River as well as to determine the migration patterns within its tributaries. This Team recommended that a comprehensive study on the migratory behavior of bull trout within the Upper Columbia Recovery Unit be conducted. Increased knowledge of the use of the mainstem Columbia River may revise core area descriptions and could have management implications.

Biological Opinions, Bull Trout and Hydro-power

On December 20, 2000, the FWS issued a biological opinion to the Army Corps of Engineers, Bonneville Power Administration, and Bureau of Reclamation (Action Agencies) on the effects of the Federal Columbia River Power System (FCRPS) on Threatened and Endangered species and their critical habitat.

The four federal lower Columbia River dams are presently operating under this opinion. The FWS' biological opinion includes four reasonable and prudent measures (RPM) to reduce the take of bull trout associated with operation of these projects. The RPMs are directed at determining the presence, and extent, of bull trout use of the lower Columbia River within the FCRPS area, ensuring that bull trout passage is not impeded at FCPRS dams, preventing adverse impacts caused by FCPRS operations such as fish stranding, and reducing total dissolved gas caused by spilling at FCRPS dams to state standards. Terms and conditions to implement the reasonable and prudent measures required the Action Agencies to do the following:

1. Count and record bull trout observed at the FCRPS lower Columbia River dams.

20. Record bull trout captured in field studies funded by the Action Agencies.

21. Cooperate in studies to determine the movements of bull trout from the Hood River and other tributaries into Bonneville Reservoir.

22. Cooperate in studies to evaluate potential habitat use in the White Salmon River following removal of Condit Dam.

23. Cooperate in studies to evaluate fluvial bull trout in the Klickitat River.

24. Begin studies of the effect of flow fluctuations caused by FCRPS operations on bull trout or their prey.

25. Initiate studies to determine the use and suitability of bull trout habitat in the lower Columbia River.

26. Investigate and implement, if appropriate, ways to reduce total dissolved gas production at FCRPS dams.

These terms and conditions are directed to impacts on bull trout at the lower Columbia River dams, and do not specifically address habitat needs of bull trout in the mainstem Columbia River.

The National Marine Fisheries Service issued a December 20, 2000 biological opinion on the effects of operation of the FCRPS on listed salmon and steelhead. That opinion addresses listed anadromous salmon and steelhead, and includes reasonable and prudent alternatives to reduce the take of those fish, but does not specifically list measures to protect bull trout.

Habitat Conservation Plans

Mid-Columbia HCP

Three of the mid-Columbia River hydroelectric projects (Wells, Rocky Reach, and Rock Island), have requested FERC to include in their licenses Habitat Conservation Plans under Section 10 of the ESA. Parties to these HCPs include the Public Utility Districts of Chelan and Douglas Counties, the National Marine Fisheries Service, FWS, Washington Department of Fish and Wildlife, and the Colville Tribes.

This HCP includes operations and measures to address all anadromous fish that occur upstream of Rock Island Dam (not just ESA-listed species). Bull trout will likely benefit from these HCPs, even though dam protection measures and habitat improvements are directed toward anadromous fish.

HCPs within the Methow

Currently, there are two HCPs under development in the Methow Subasin. Both are associated with effects of irrigation withdrawals on listed spring Chinook, steelhead, and bull trout. These HCPs are being designed to minimize and mitigate for the “take” of these species.

Upper Columbia River spring-run ESU

Myers et al. (1998) defined the Upper Columbia River spring-run ESU as stream-type Chinook that spawn in the Wenatchee, Entiat, and Methow Rivers. They explain that the biological review team (BRT) felt that, in spite of the tremendous amount of hatchery influence on these fish, they still represented an important genetic resource, partially because it was presumed it still contained the last remnants of the gene pools for populations from the headwaters of the Columbia River.

Ford et al. (2001) concluded that there were currently three independent populations of spring Chinook within the Upper Columbia spring Chinook ESU: Wenatchee, Entiat, and Methow basins. The Okanogan spring Chinook are believed to be extinct, possibly since the 1930s (see below).

Brannon et al. (2002) separated the Methow spring Chinook first-order metapopulation from the Wenatchee and Entiat populations, which were linked together.

Within these populations there are other sub-populations that Ford et al. (2001) suggested should be considered when reviewing management actions within these geographic areas to maintain potential adaptive advantages of these sub-populations.

The Interior Columbia Basin Technical Recovery Team (TRT), in its draft report (TRT 2003) agree with the initial designation of independent populations by Ford et al. (2001).

In conclusion, for the purposes of sub-basin planning, we assume that there are three independent populations (Wenatchee, Entiat, and Methow) within the large groups of populations that spawn naturally upstream from Rock Island Dam. Within these independent populations, there are sub-populations that should be considered during management processes, but overall, the spring Chinook from one of the three drainages is considered as a whole.

Upper Columbia summer steelhead ESU

Buby et al. (1996) determined that the ESU for Upper Columbia summer steelhead comprised the populations that currently spawn in the Wenatchee, Entiat, Methow, and possibly Okanogan Rivers. The BRT felt that because of past hatchery practices (see below) there have been substantial homogenization of the gene pool; however, there is likely remnant genetic material from ancestral populations that could have been “stored” in resident populations (Mullan et al. 1992CPa). Ford et al. (2001) agreed with the delineation described by Busby et al. (1996), but described each subbasin, with the possible exception of the Okanogan, as an independent population (see definition above).

Brannon et al. (2002) combined all of the first-order metapopulations of summer steelhead upstream of the Yakima River into one metapopulation.

In conclusion, for the purposes of sub-basin planning, we assume that there are four independent populations (Wenatchee, Entiat, Methow, and Okanogan) within the large groups of populations that spawn naturally upstream from Rock Island Dam. Implementation of strategies and attainment of habitat through hatchery objectives identified in this plan will aid in the recovery of listed upper Columbia River spring Chinook and summer steelhead ESUs, and is, therefore, consistent with ESA.

The Methow subbasin Core Team developed objectives and strategies that will lead to improvements in water quality. This is particularly emphasized where water quality does not currently meet water quality standards. In some cases, the subbasin plan specifically acknowledges the work being done by other entities to improve water quality, and recommends consistency with other management plans, such as total maximum daily load (TMDL). Therefore, the subbasin management plan is consistent with CWA requirements.

Relationship to Other Planning Efforts

In the Methow, an open dialogue existed throughout this process to included state, federal, tribal, and other stakeholder interest, and to coordinate with other planning efforts through the Habitat Working Group, and subbasin Core Group. Both groups included members who were working on watershed planning, State Salmon Recovery Planning, the Federal BIOP, Bull Trout Recovery Planning, Mid-Columbia Habitat Conservation Planning, TMDL, water quality planning, Growth Management Planning, Land Use Planning and FERC hydropower re-licensing. Participation of these members assures that the subbasin plan is compatible with other planning efforts.

A primary strategy was to coordinate with, and have the plan reviewed, by the Technical Recovery Teams developed by the Upper Columbia Salmon Recovery Board. The Upper

Columbia Salmon Recovery Board has established technical, policy and stakeholder groups that meet regularly to coordinate, evaluate, and implement mitigation measures within this subbasin.

Many documents were utilized to develop the subbasin plan including but not limited to:

- Habitat Conservation Plans
- Hatchery Genetic Management Plans
- ESA Section 10 permits 1196, 1347, 1395, 1396 and 1412
- The Clean Water Act
- The Powers Act
- The Northwest Power and Conservation Council's 2000 Fish and Wildlife Program (and the Technical Guide to subbasin planning)
- Assorted Watershed Management Plans
- The 2001 Federal BIOP
- Pacific Salmon Treaty
- Colville Tribes' Integrated Resource Management Plan
- Washington State Wild Salmonid Policy
- The Columbia River DPS Draft Bull Trout Recovery Plan
- The Endangered Species Act
- USFWS Draft Bull Trout Recovery Plan
- Critical Habitat Designation for Bull Trout

5.10 Monitoring Plan for the Methow subbasin

5.10.1 Monitoring and Evaluation Program for the Methow subbasin

Note: The first sections of this plan address fish exclusively and are derived from a variety of sources including the PNAMP guidance. Following fish, we provide a general framework for terrestrial (wildlife) monitoring. The wildlife section is adapted from Paquet, Marcot, and Powell 2004.

Introduction

To allow the subbasin plan authors to track the progress of specific objectives and goals over time, a disciplined and well-coordinated monitoring and evaluation (M&E) program is proposed. This program is designed to help confirm our scientific assumptions, resolve key scientific uncertainties, and provide the basis for performance tracking and adaptive management. The goals for this coordinated program are to maximize efficiencies, avoid duplication, and improve experiments to minimize confounding factors or actions.

This effort will begin to provide essential information on habitat conditions and fish populations beginning in 2004. This will also allow state, federal and tribal programs to operate in a manner consistent with efforts to detect the trends and effectiveness between and among other subbasins, ESUs, programs and planning efforts.

The monitoring plan described in this document is not another regional monitoring strategy. Rather, this plan draws from the existing strategies and outlines an approach specific to the Methow subbasin and the Upper Columbia region.

The plan described here addresses the following five basic questions:

1. What are the current habitat conditions and abundance, distribution, life-stage survival, and age composition of anadromous fish in the Methow subbasin (status monitoring)?

27. How do these factors change over time (trend monitoring)?

28. What effects do tributary habitat actions have on fish populations and habitat conditions (effectiveness monitoring)?

29. What effects do fishery management actions have on fish populations (effectiveness monitoring)?

30. Are the goals, vision and objectives of the subbasin plan being met?

Assumptions

Monitoring and evaluation coordination and implementation will be an ongoing activity at the reach, subbasin, and regional levels. The subbasin planners assume these iterative, concurrent processes at different scales will be coordinated to optimize when and where implementation occurs to increase learning from broader-scale monitoring both within and across subbasins.

Monitoring that is proposed will be more effective if it fits within a broader programmatic network of status monitoring programs and intensively monitored watersheds. The subbasin planners assume that M&E efforts will be able to rely on broader monitoring frameworks and programmatic activities (where they exist) to meet some of their needs.

The subbasin planners assume that local, bottom-up approaches developed within subbasins will have a higher likelihood for successful funding and meaningful results if they reflect the approaches being developed within the comprehensive state, tribal initiatives, and federal pilot projects (Wenatchee, John Day, and Upper Salmon), and the top-down framework and considerations being developed by PNAMP.

Approach

A coordinated and comprehensive approach to the monitoring and evaluation of status and trends in anadromous and resident salmonid populations and their habitats is needed to support restoration efforts in the Columbia Cascade Province, and in the Methow subbasin in particular. Currently, independent research projects, and some monitoring activities, are conducted by various state and federal agencies, tribes, and, to some extent, by watershed councils or landowners; however, to date there has been no overall framework for coordination of efforts, or for interpretation and synthesis of results.

Guidance for this M&E Program

Three primary documents make up this framework plan for the Methow. They are:

31. The Upper Columbia Monitoring Strategy (Hillman, et al. 2004)

32. Considerations for Monitoring in Subbasin Plan (PNAMP 2004)

33. Considerations for Monitoring Wildlife in Subbasin Plan (NPCC 2004)

The authors also used a variety of programs and plans to help construct the Methow Monitoring Framework. Examples used include:

- The Pacific Northwest Aquatic Monitoring Partnership (PNAMP)—Draft Guidance to the State, Federal Governments, and Tribes for Monitoring (2004)
- The Coordinated System Wide Monitoring and Evaluation Project (CSMEP) Work Plan
- 2001 ISRP (review of the Methow Baseline Program, 2001)
- 2003 ISAB Review of Supplementation
- Federal Research Evaluation and Monitoring (RME) Plan
- The Pacific Coastal Salmon Recovery Fund (PCSRF) Performance Standards
- The Pacific Coastal Salmon Recovery Fund Data Definitions
- A Data Management Protocol (Wolf, Jordan, Toshach et al.—in press)
- BPA Pilot Studies in Wenatchee and John Day (data dictionary and geospatial database structure)
- The Washington Coordinated Monitoring Strategy
- The Oregon Monitoring Plan
- The subbasin authors/planners also suggest use of the following resources in implementing the M&E plan:
- The Yakima Klickitat Fisheries Project: http://www.ykfp.org
- The Northeast Oregon Hatchery: http://www.cbfwa.org/2001/projects/198805301.htm.
- The Columbia Basin Fish and Wildlife Authority (M&E): http://www.cbfwa.org/rme.htm
- The State of Washington: Outline for Salmon Regional Recovery Plans. http://www.wdfw.wa.gov/recovery/recovery_model.htm
- Coordinated Management Strategy. http://www.iac.wa.gov/srfb/monitoring.htm

Principles, Goals and Objectives

The following principles will guide M&E in the Methow subbasin:

- Resource Policy and Management: The purpose of monitoring efforts is to provide the most important scientific information needed to inform public policy and resource management decisions.

- Acknowledge each party's mandates, objectives, and management milestones.
- Construct a monitoring program that meets each party's milestones and objectives through coordinating and sharing monitoring resources.
- Develop a monitoring program that is sufficiently robust to meet public policy needs; demonstrate the links between public policy needs and monitoring efforts.
- Develop a monitoring program that demonstrates compliance.
- Commit to resolving, scientifically, the most important policy and management questions using an adaptive management approach.
- Efficiency and Effectiveness: Cooperative monitoring will enhance efficiencies and effectiveness of our respective and collective efforts.
- Participate fully in the PNAMP, including the identification of contact(s) for monitoring issues.
- Identify and coordinate goals, objectives, and budgets, and demonstrate resource savings over short and longer time frames.
- Cooperatively adapt programs and budgets to address monitoring gaps.
- State and federal agencies and the tribes commit to long term inter- and intra-agency monitoring programs.
- Encourage staff exchanges and shared training to learn what each other are doing (e.g., new innovations), and ensure consistency across programs.
- Develop common monitoring approaches, including: quality control/quality assurance programs; shared evaluation tools; integrated status and trend monitoring efforts; land use, land cover, and riparian vegetation categorization, and; core data for representative subset of watersheds in all represented states.
- Perform all monitoring activities in a timely manner.
- Scientifically Based: Environmental monitoring must be scientifically sound.
- Develop an integrated monitoring program (e.g., issues, disciplines, and values).
- Monitoring program is based on shared goals and objectives (e.g., census level, regional status and trends, cause-and-effect questions, effectiveness of regional efforts, identification of trouble spots).
- Address multiple spatial and temporal scales.
- Develop and use compatible data collection and analysis protocols.
- Recognize inherent diversity and variability, and dynamic inter-relationships or resource conditions, in monitoring design, analysis and interpretation.
- All environmental data should have a known level of precision.

- All baseline data on ecosystems are known and compiled between agencies.
- Shared Information: Monitoring data should be accessible to all on a timely basis.
- Make strategic investments in information systems needed to make data useful.
- Monitoring databases would integrate a number of issues, disciplines and values.
- Data management systems and protocols provide a linkage for sharing data between agencies.
- Adopt and use common data sharing protocols.
- Adopt and use common database/s of core metadata, data, and electronically connected distribution systems.

The primary goal of this M&E framework is:

To combine, coordinate, and standardize the activities of multiple agencies working on fisheries-related issues in the Methow basin, and establish a measure of success or failure of habitat and hatchery practices directed towards rehabilitation of fish and wildlife populations.

Specific goals of the Methow subbasin M&E plan include:

- Assess status and trends of watershed conditions and salmon populations, regionally.
- Monitor habitat, water quality, biotic health, and salmon in select watersheds.
- Analyze habitat, water quality and population trends at the landscape scale.
- Document conservation and restoration projects, activities, and programs.
- Evaluate effectiveness of restoration and management efforts locally.
- Evaluate the combined effectiveness of restoration and conservation efforts in select watersheds.
- Standardize monitoring, collection, management, and analysis efforts.
- Coordinate and support public-private monitoring partnerships.
- Integrate information and product data products and reports.

Specific Questions (Long List of possible questions):

1. How are the annual abundance and productivity of salmon by species, ESU, and life stage changing over time?

34. What improvements are occurring regarding the restoration of the geographic distribution of salmon by ESU, species, and life stage in their historic range?

35. Are the unique life history characteristics of salmon within a Salmon Recovery Region changing over time because of human activities?

36. What are the trends in the climate of the Pacific Northwest that will allow the state to anticipate and account for such conditions when initiating and monitoring management actions for watershed health and salmon recovery? What trends in climate may mask or expose the status of freshwater habitat and its role in salmon recovery?
37. What are the trends in effects of hatchery production on the survival and productivity of wild salmon populations within each ESU?
38. How are surface water quality conditions changing over time?
39. How effective are clean water programs at meeting water quality criteria?
40. What are the trends in water quantity and flow characteristics?
41. What are the status and trends in habitat-forming landscape processes in riverine ecosystems as they relate to watershed health and salmon recovery?
42. Are habitat improvement projects effective?
43. What is the condition of salmon populations at the ESU, subbasin, and watershed scale?
44. What is the status, and what are the trends, in aquatic habitats, water quality, and stream flow?
45. What are the critical factors that limit watershed function and salmon productivity?
46. What constitutes detectable and meaningful change in habitat condition and populations?
47. What changes are occurring in watersheds that improve stream habitat quality?
48. What are the management practices and programs that enhance or restore watershed functions and salmon populations?
49. What habitat changes and biotic responses result from these projects, practices, and programs?
50. What are the abundances, productivity, and distributions of Columbia River basin (CRB) fish populations relative to performance standards or objectives?
51. What is the biological, chemical, and physical status of CRB fish habitat relative to performance standards or objectives?
52. What are the relationships between fish populations and freshwater and estuary/ocean habitat conditions that determine population-limiting factors?
53. What is the effect of a specific mitigation or management action on the habitat and/or population performance of CRB fish?
54. What is the combined effect of multiple watershed-level mitigation on management actions on the habitat and/or population performance of CRB fish?
55. Are federal and state mitigation actions achieving the necessary survival changes identified in the All Federal Caucus Programs and the FCRPS BO for each ESU?

1. Measurable Objectives [10] (Short List of Questions that the Methow Basin M&E plan will address:

56. Determine if there is a statistically significant difference in the abundance, survival, and timing and life history characteristics of summer/fall, spring Chinook, sockeye, and steelhead (7-20+ year time frame).

57. Determine if there is a statistically significant difference in selected physical habitat parameters and characteristics for summer/fall, spring Chinook, sockeye, and steelhead in the Methow basin resulting from the cumulative benefits of habitat actions (7-20+ year time frame).

58. Estimate in-basin and out-of-basin harvest and stock-specific harvest of hatchery and wild anadromous salmonids within the Methow subbasin (ongoing).

59. Conduct a baseline Methow Basin inventory & analysis: a) Collect data, to raise physical habitat data to an empirical level for use in EDT and other analytical models or methods; b) Collect data on historical and current fish population distributions, and; c) Collect passage conditions throughout the basin for use in EDT modeling runs to assist in future enhancement planning processes (1-20+ year time frame).

For artificial production objectives, the following performance standards will be monitored:

- Legal Standards
- Conservation Standards
- Life History Characteristics
- Genetic Characteristics
- Research Activities
- Operation of Artificial Production facilities
- Socio-economic effectiveness
- Harvest Standards
- Non-target population impacts
- Target population production
- Target population long-term fitness

The plan is designed to address these questions, and at the same time, eliminate duplication of work, reduce costs, and increase monitoring efficiency. The implementation of valid statistical

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10 Please also refer to the individual Assessment Unit summaries for a long list of detailed habitat objectives by geographic area. The M&E plan is developed to capture the variables and indicators necessary to determine whether progress is being made to achieve this list of habitat and artificial production objectives.

designs, probabilistic sampling designs, standardized data collection protocols, consistent data reporting methods, and selection of sensitive indicators will increase monitoring efficiency?[11]

For this plan to be successful, all organizations involved must be willing to cooperate and freely share information. Cooperation includes sharing monitoring responsibilities, adjusting or changing sampling methods to comport with standardized protocols, and adhering to statistical design criteria. In those cases where the standardized method for measuring an indicator is different from what was used in the past, it may be necessary to measure the indicator with both methods for a few years so that a relationship can be developed between the two methods. Scores generated with a former method could then be adjusted to correct for any bias.

Specific Elements of the Plan

Program Setup

In order to set up a monitoring program, it will be important to follow a logical sequence of steps. By proceeding through each step, the planner will better understand the goals of monitoring and its strengths and limitations. These steps will aid the implementation of a valid monitoring program that reduces duplication of sampling efforts, and thus, overall costs, but still meets the needs of the different entities. The plan assumes that all entities involved with implementing the plan will cooperate and freely share information. The setup steps are:

1. Identify the populations and/or subpopulations of interest (e.g., spring Chinook steelhead, summer/fall Chinook).

60. Identify the geographic boundaries (areas) of the populations or subpopulations of interest.

61. Describe the purpose for selecting these populations or subpopulations (i.e., What are the concerns?).

62. Identify the objectives for monitoring.

63. Select the appropriate monitoring approach (status/trend or effectiveness monitoring or both) for addressing the objectives.

64. Identify and review existing monitoring and research programs in the area of interest.

65. Determine if those programs satisfy the objectives of the proposed program.

66. If monitoring and evaluation data gaps exist, implement the appropriate monitoring approach by following the criteria outlined in 9-13.

67. Classify the landscape and streams in the area of interest.

68. Complete a data management needs assessment. Describe how data collection and management needs will be met and shared among the different entities.

69. Identify an existing database for storing biological and physical/environmental data.

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11 An efficient monitoring plan reduces “error” to the maximum extent possible. One can think of error as unexplained variability, which can reduce monitoring efficiency through the use of invalid statistical designs, biased sampling designs, poorly selected indicators, biased measurement protocols, and non-standardized reporting methods.

70. Estimate costs of implementing the program.

71. Identify cost-sharing opportunities.

The Methow Baseline Program currently employs these setup steps.

Suggested Table of Contents (for any entity implementing an M&E element)

1. Statement of Need and Program Outline

72. Summary of Indicators and Program Elements

73. Summary of Monitoring and Evaluation Priorities

74. Program Setup Statistical Design

75. Sampling Design

76. Sample Size

77. Measurement Error

78. Fish Population Monitoring Overview

79. Habitat Monitoring Overview

80. Biological Variables

81. Physical/Environmental Variables

82. Spatial Scales

83. Performance Standards

84. Classification

85. Indicators to be used

86. Measuring Protocols to be used

87. Status Trend Monitoring

88. Effectiveness Monitoring

89. Data Management Needs Assessment and Data Management Plan

90. Peer Review and Annual Reporting

91. Adaptive Management

92. References

93. Appendices as needed

Basic Statistical Considerations

This document defines “statistical design” as the logical structure of a monitoring study. It does not necessarily mean that all studies require rigorous statistical analysis. Rather, it implies that all studies, regardless of the objectives, be designed with a logical structure that reduces bias and the likelihood that rival hypotheses are correct. The purpose of this section is two-fold. First, it identifies the minimum requirements of valid statistical designs, and second, it identifies the appropriate designs for status/trend and effectiveness monitoring. The following discussions draw heavily on the work of Hairston (1989), Hicks et al. (1999), Krebs (1999), Manly (1992, 2001), and Hillman and Giorgi (2002). (See: Hillman et al. 2004, section 3, pages 9-13.)

Sampling Design Considerations

Once the investigator has selected a valid statistical design, the next step is to select sampling sites. Sampling is a process of selecting a number of units for a study in such a way that the units represent the larger group from which they were selected. The units selected comprise a sample, and the larger group is referred to as a population.[12] All the possible sampling units available within the area (population) constitute the sampling frame.[13] The purpose of sampling is to gain information about a population. If the sample is well selected, results based on the sample can be generalized to the population. Statistical theory assists in the process of drawing conclusions about the population using information from a sample of units.

Defining the population and the sample units may not always be straightforward because the extent of the population may be unknown, and natural sample units may not exist. For example, a researcher may exclude livestock grazing from sensitive riparian areas in a watershed where grazing impacts are widespread. In this case, the management action may affect aquatic habitat conditions well downstream from the area of grazing. Therefore, the extent of the area (population) that might be affected by the management action may be unclear, and it may not be obvious which sections of streams to use as sampling units.

When the population and/or sample units cannot be clearly defined, the investigator should subjectively choose the potentially affected area and impose some type of sampling structure. For example, sampling units could be stream habitat types (e.g., pools, riffles, or glides), fixed lengths of stream (e.g., 150 metre [~500 feet] long stream reaches), or reach lengths that vary according to stream widths (e.g., see Simonson et al. 1994). Before selecting a sampling method, the investigator should define the population, size, and number of sample units, as well as the sampling frame. (See: Hillman et al. 2004, section 4, pages 9-13).

Spatial Scale

Because monitoring will occur at a range of spatial scales, there may be some confusion between the roles of status/trend monitoring and effectiveness monitoring. Generally, one thinks of status/trend monitoring as monitoring that occurs at coarser scales, and effectiveness monitoring occurring at finer scales. In reality, both occur across different spatial scales, and the integration of both is needed to develop a valid monitoring program (ISAB 2003; AA/NOAA Fisheries 2003; WSRFB 2003).

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12 This definition makes it clear that a "*population*" is not limited to a group of organisms. In statistics, it is the total set of elements or units that are the target of our curiosity. For example, habitat parameters will be monitored at sites selected from the *population* of all possible stream sites in the watershed.

13 The *sampling frame* is a "list" of all the available units or elements from which the sample can be selected. The sampling frame should have the property that every unit or element in the list has some chance of being selected in the sample. A sampling frame does not have to list all units or elements in the population.

The scale at which status/trend and effectiveness monitoring occurs depends on the objectives of the study, the size or distribution of the target population, and the indicators that will be measured. In status/trend monitoring, for example, the objective may be to measure egg-parr survival of spring Chinook salmon in the Methow Basin, but because the Methow subbasin likely consisted of multiple sub-populations of Chinook (spring and summer/fall), status/trend monitoring can occur at various scales depending on the distribution of the population of interest.

In the same way, effectiveness monitoring can occur at different spatial scales. That is, one can assess the effect of a tributary action on a specific Recovery Unit or ESU (which may encompass several populations), a specific population (may include several sub-populations), at the sub-population level (may encompass a watershed within a basin), or at the reach scale. Clearly, the objectives, and hence the indicators measured, dictate the spatial scale at which effectiveness monitoring is conducted. For example, if the objective is to assess the effects of nutrient enhancement on egg-smolt survival of spring Chinook in the Chiwawa Basin (a sub-population of the Wenatchee spring Chinook population), then the spatial scale covered by the study should include the entire area inhabited by the eggs, fry, parr, and smolts. If, on the other hand, the objective is to assess the effects of a sediment reduction project on egg-fry survival of a local group of spring Chinook (i.e., Chinook within a specific reach of stream), then the study area would only encompass the reach of stream used by spawners of that local group.

In theory, there might be no limit to the scale at which effectiveness monitoring can be applied, but in practice there is a limit. This is because, as the spatial scale increases, the tendency for multiple treatments (several habitat actions) affecting the same population increases. That is, at the spatial scale representing a Recovery Unit, ESU, or population, there may be many habitat actions within that area. Multiple treatment effects make it very difficult to assess the effects of specific actions on an ESU. Even though it may be impossible to assess specific treatment effects at larger spatial scales, it does not preclude one from conducting effectiveness monitoring at this scale. Indeed, one can assess the combined or cumulative effects of tributary actions on the Recovery Unit, ESU, or population. However, additional effectiveness monitoring may be needed at finer scales to assess the effects of individual actions on the ESU or population. (See: Hillman et al. 2004, section 5, pages 31-33.)

Classification

Both status/trend and effectiveness monitoring require landscape classification. The purpose of classification is to describe the “setting” in which monitoring occurs. This is necessary because biological and physical/environmental indicators may respond differently to tributary actions depending on landscape characteristics. A hierarchical classification system, that captures a range of landscape characteristics, should adequately describe the setting in which monitoring occurs. The idea advanced by hierarchical theory is that ecosystem processes and functions, operating at different scales, form a nested, interdependent system where one level influences other levels. Thus, an understanding of one level in a system is greatly informed by those levels above and below it.

A defensible classification system should include both ultimate and proximate control factors (Naiman et al. 1992). Ultimate controls include factors such as climate, geology, and vegetation that operate over large areas, are stable over long time periods, and act to shape the overall character and attainable conditions within a watershed or basin. Proximate controls are a function of ultimate factors and refer to local conditions of geology, landform, and biotic processes that operate over smaller areas and over shorter time periods. These factors include processes such as discharge, temperature, sediment input, and channel migration. Ultimate and proximate control characteristics help define flow (water and sediment) characteristics, which in turn help shape channel characteristics within broadly predictable ranges (Rosgen 1996).

The UCMS plan proposes a classification system that incorporates the entire spectrum of processes influencing stream features, and recognizes the tiered/nested nature of landscape and aquatic features. This system captures physical/environmental differences spanning from the largest scale (regional setting) down to the channel segment. The Action Agencies/NOAA Fisheries RME plan proposes a similar classification system. By recording these descriptive characteristics, the investigator will be able to assess differential responses of indicator variables to proposed actions within different classes of streams and watersheds. Importantly, the classification work described here fits well with Level 1 monitoring under the ISAB (2003) recommended strategies for restoring tributary habitat. Classification variables and recommended methods for measuring each variable are defined below. (See: Hillman et al. 2004) section 6, pages 33-45.).

The Upper Columbia Recovery Plan process is currently collecting information (GIS-based) to include this element.

Indicators

The Methow subbasin planners have identified the following as a subset of key indicators: bankfull width, reach length, bankfull depth, sediment, wood, gradient, pools, residual pool depth, bank stability, temperature, invertebrates, shade, and riparian characteristics.

Additional indicators that provide information for use in assessing fish population structure, distribution, and habitat conditions as described generally in the EDT analytical model and method, are also targeted in the Methow Baseline Program.

These indicators represent a subset of variables that should be measured. Investigators can measure additional variables depending on their objectives and past activities. For example, reclamation of mining-impact areas may require the monitoring of pollutants, toxicants, or metals. Some management actions may require the measurement of thalweg[14] profile, placement of artificial instream structures, or livestock presence. Adding other needed indicators will supplement the core list.

Indicator variables identified in the UCMS template are consistent with those identified in the Action Agencies/NOAA Fisheries RME Plan and with most of the indicators identified in the WSRFB (2003) monitoring strategy. The Action Agencies/NOAA Fisheries selected indicators based on their review of the literature (e.g., Bjornn and Reiser 1991; Spence et al. 1996; and Gregory and Bisson 1997) and several regional monitoring programs (e.g., PIBO, AREMP, EMAP, WSRFB, and the Oregon Plan). They selected variables that met various purposes, including assessment of fish production and survival, identifying limiting factors, assessing effects of various land uses, and evaluating habitat actions. Their criteria for selecting variables were based on the following characteristics:

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14 “Thalweg” is defined as the path of a stream that follows the deepest part of the channel (Armantrout 1998).

- Indicators should be sensitive to land use activities or stresses.
- They should be consistent with other regional monitoring programs.
- They should lend themselves to reliable measurement.
- Physical/environmental indicators would relate quantitatively with fish production.

Table 56 Biological indicator variables (with conceptual protocols) to be monitored in the Methow Baseline M&E Program

General characteristics	Specific indicators	Recommended protocol	Sampling frequency	HGMP Performance Indicator
Adults	Escapement/ Number	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	--Total number of fish harvested in Colville Tribes summer/fall fisheries. --Annual number of summer/fall Chinook spawners in each spawning area, by age (Similkameen River, Methow River, Columbia River above Wells Dam). Etc.
	Age structure	Borgerson (1992)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Sex ratio	Strange (1996)	Annual	To be completed as above
	Origin (hatchery or wild)	Borgerson (1992)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above
	Fecundity	Cailliet et al. (1986)	Annual	To be completed as above
Redds	Number	Mosey and Murphy (2002)	Annual	To be completed as above
	Distribution	Mosey and Murphy (2002)	Annual	To be completed as above
Parr/Juveniles	Abundance/ Distribution	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
Smolts	Number	Murdoch et al. (2000)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above

General characteristics	Specific indicators	Recommended protocol	Sampling frequency	HGMP Performance Indicator
Macroinvertebrates	Transport	Wipfli and Gregovich (2002)	Annual/Monthly	To be completed as above
	Composition	Peck et al. (2001)1	Annual	To be completed as above

Measuring Protocols

An important component of all regional monitoring strategies (ISAB, Action Agencies/NOAA Fisheries, and WSRFB) is that the same measurement method be used to measure a given indicator. The reason for this is to allow comparisons of biological and physical/environmental conditions within and among watersheds and basins.[15] This section identifies methods to be used to measure biological and physical/environmental indicators. The methods identified in this plan are consistent with those described in the Action Agencies/NOAA Fisheries RME Plan and, for the most part, are consistent with EMAP and WSRFB protocols.

PNAMP is supporting an initiative to coordinate a side-by-side comparison of protocols, and will communicate to subbasin planners which protocols will be included in the test. This comparison, which is proposed to take place in 2005, will be done to identify which protocols are best for determining watershed condition status and trend. It is possible a pilot study in the John Day basin will take place in 2004 if funding and logistical constraints are resolved.

The Action Agencies/NOAA Fisheries monitoring group reviewed several publications, including the work of Johnson et al. (2001) that describe methods for measuring indicators. Not surprisingly, there can be several different methods for measuring the same variable. For example, channel substrate can be described using surface visual analysis, pebble counts, or substrate core samples (either McNeil core samples or freeze-core samples). These techniques range from the easiest and fastest to the most involved and informative. As a result, one can define two levels of sampling methods. Level 1 (extensive methods) involves fast and easy methods that can be completed at multiple sites, while Level 2 (intensive methods) includes methods that increase accuracy and precision, but require more sampling time. The Action Agencies/NOAA Fisheries monitoring group selected primarily Level 2 methods, which minimize sampling error, but maximize cost.

Before identifying measuring protocols, it is important to define a few terms. These terms are consistent with the Action Agencies/NOAA Fisheries RME Plan.

Reach (effectiveness monitoring) – for effectiveness monitoring, a stream reach is defined as a relatively homogeneous stretch of a stream having similar regional, drainage basin, valley segment, and channel segment characteristics, and a repetitious sequence of habitat types. Reaches are identified by using a list of classification (stratification) variables. Reaches may contain one or more sites. The starting point and ending point of reaches will be measured with Global Positioning System (GPS) and recorded as Universal Transverse Mercator (UTM).

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15 Bonar and Hubert (2002) and Hayes et al. (2003) review the benefits, challenges, and the need for standardized sampling.

Although the level of accuracy expected from GPS reporting of stream locations may not be sufficient for all subbasin monitoring and evaluation purposes, the researchers for the John Day and Upper Columbia projects are planning to use it for the subbasin pilot efforts.

Reach (status/trend monitoring) – For status/trend monitoring, this section refers only to a “sampling reach” as defined by the EMAP design and referenced in the UC Strategy document. This is one method to consider using to initially locate a reach, with the “X” point being the place where bankfull width is determined. From this location, the extent of the upstream and downstream boundaries (total reach length) are determined according to the protocol used. Data collected in the sampling reach should be linked to the best available hydrograpghy layers to facilitate mapping and use in a GIS. Typically the 1:100,000 scale has been used, but a routed 1:24,000 scale hydrography may soon become available.

Note: Standardized GIS and post processing of spatial data will require a standardized protocol that does not currently exist. In the interim PNAMP recommends the following: 1. all GIS data should be provided with Federal Geographic Data Committee compliant metadata, including information on projection used; 2. data should be linked to a standardized stream each identification system to facilitate mapping and use in GIS; and, 3. use existing 1:100,000 and 1:24,000 hydrography layers where they have been cleaned and routed, and if not, use the best available information.

Site (effectiveness monitoring) – a site is an area of the effectiveness monitoring stream reach that forms the smallest sampling unit with a defined boundary. Site length depends on the width of the stream channel. Sites will be 20 times the average bankfull width with a minimum length of 150 metres (492 feet) and a maximum length of 500 metres (1640 feet). Site lengths are measured along the thalweg. The upstream and downstream boundaries of the site will be measured with GPS and recorded as UTM. For purposes of re-measurements, these points will also be photographed, marked with permanent markers (e.g., orange plastic survey stakes), and carefully identified on maps and site diagrams. Site lengths and boundaries will be “fixed” the first time they are surveyed and they will not change over time even if future conditions change.

Transect – a transect is a straight line across a stream channel, perpendicular to the flow, along which habitat features such as width, depth, and substrate are measured at predetermined intervals. Effectiveness monitoring sites and status/trend monitoring reaches will be divided into 11 evenly-spaced transects by dividing the site into 10 equidistant intervals with “transect 1” at the downstream end of the site or reach, and “transect 11” at the upstream end of the site or reach. The number of transects varies for different attributes.

Habitat Type – Habitat types, or channel geomorphic units, are discrete, relatively homogenous areas of a channel that differ in depth, velocity, and substrate characteristics from adjoining areas. This plan recommends that the investigator identify the habitat type under each transect within a site or reach following the Level II classification system in Hawkins et al. (1993). That is, habitat will be classified as turbulent fast water, non-turbulent fast water, scour pool, or dammed pool (see definitions in Hawkins et al. 1993). By definition, for a habitat unit to be classified, it should be longer than it is wide. Plunge pools, a type of scour pool, are the exception, because they can be shorter than they are wide (See: Hillman et al. 2004, section 8, pages 59-76).

Status/Trend Monitoring

If the objective of the monitoring program is to assess the current status of populations and/or environmental conditions, or to assess long-term trends in these parameters, then the following steps will help the investigator design a valid status/trend monitoring program.

Problem Statement and Overarching Issues:

1. Identify and describe the problem to be addressed.

94. Identify boundaries of the study area.

95. Describe the goal or purpose of the study.

96. List hypotheses to be tested.

- Statistical Design (see Section 3 of UCMS Strategy):

1. Describe the statistical design to be used (e.g., EMAP design).

97. List and describe potential threats to external validity and how these threats will be addressed.

98. If this is a pilot test, explain why it is needed.

99. Describe descriptive and inferential statistics to be used and how precision of statistical estimates will be calculated.

Sampling Design (see Sections 4 & 5 of UCMS Strategy):

1. Describe the statistical population(s) to be sampled.

100. Define and describe sampling units.

101. Identify the number of sampling units that make up the sampling frame.

102. Describe how sampling units will be selected (e.g., random, stratified-random, systematic, etc.).

103. Describe variability or estimated variability of the statistical population(s).

104. Define Type I and II errors to be used in statistical tests (the plan recommends no less than 0.80 power).

Measurements (see Sections 7 & 8 of UCMS Strategy):

1. Identify indicator variables to be measured.

105. Describe methods and instruments to be used to measure indicators.

106. Describe precision of measuring instruments.

107. Describe possible effects of measuring instruments on sampling units (e.g., core sampling for sediment may affect local sediment conditions). If such effects are expected, describe how the study will deal with them.

108. Describe steps to be taken to minimize systematic errors.

109. Describe QA/QC plan, if any.

110. Describe sampling frequency for field measurements.

Results:

1. Explain how the results of this study will yield information relevant to management decisions.

Subbasin planners should include a section to explain how the data from the study (with metadata) will be stored, managed and made available to others. A starting point, for some subbasin data collection efforts, could be the data definitions document for the Upper Columbia and John Day pilot projects once it has been reviewed. Proponents for the Upper Columbia and John Day projects are reviewing the final data dictionary on which their data system will be developed. The mechanics of data management in the Upper Columbia and John Day systems are being developed by the respective project teams and need significant additional work.

Data Management

Several forms of analysis will be required as data are gathered. Statistical tests, design components, database management architecture, and various reporting format requirements are things the sponsor will take into consideration. A data management protocol will be established following the general outline:

- Develop Data Dictionary
- Other Documentation
- Develop Data Flow Diagram
- Process Flow Diagram
- Prepare Data Management Plan (who, what, when, how)
- Develop Forms
- Develop Field Forms
- Create List of Useful Existing Forms
- Create Rough Drafts of Needed Forms
- Edit Forms to Coincide with Finalized Data Dictionary (when complete)
- Finalize Field Forms
- Develop PDA Forms
- Develop Data Loggers
- Establish Data Collection and Reporting Standards
- Establish appropriate level of granularity

- Create/Adopt Chain of Custody Protocols
- Create/Adopt QA/QC Protocols
- Create/Adopt All Methods, Indicators, Metrics and Protocols (sampling and statistical design)
- Create/Adopt Field Manuals
- Field Forms
- PDAs
- Data Loggers
- Test Field Manuals and Equipment
- Training of all field crews and outside contractors
- Collect Data
- Field Forms
- PDAs
- Data Loggers
- Data Reporting Timelines, Protocols and Formats
- QA/QC
- Data Transition
- Develop data transition methods (including 10.0 Below)
- Field Forms to Electronic Entry Form
- Data Loggers to Individual PCs
- Individual PCs to Central Server
- PDAs to Individual PCs
- Individual PCs to Central Server
- Test data transitions
- All data to single repository
- Develop Repository capability
- Test Repository capability
- Final Testing Check off
- Documentation

From steps above, derive a program Data Management Protocol.

Some additional considerations include:

All M&E data will be held within the data archive system developed for the Baseline M&E Plan. This system will consist of standardized Access/Excel database formats (Geospatial database structure and data dictionary being developed for the John Day will be used in the Upper Columbia), and will be compatible with other industry and BPA structures. Data will be unrestricted and available to all resource management agencies and subbasin planners. It will remain in this data archive system until delivered to BPA, the Upper Columbia RTT, CBFWA, and other basin database systems such as StreamNet, IBIS, and SSHIAP etc.

Finally, data should follow a common form for definitions. The Pacific Costal Salmon Recovery Fund project has a set of draft definitions that are currently under review by PNAMP and others, and could be used.

Wildlife

Methow Subbasin Wildlife Management Plan

The Research, Monitoring, and Evaluation (RME) plan for the subbasin is intended as a tool that will allow managers to evaluate the efficacy of employed strategies in achieving corresponding focal habitat objectives for the subbasin. If implemented, elements of the plan will also facilitate coordination and tracking of management activities within the subbasin, periodic review of progress, and a basis for recommended adjustments to management direction over time (adaptive management).

The RME plan, as presented, consists of a variety of quantitative elements, ranging from scientific wildlife and vegetation surveys, spatial analyses of project location and acreage, to simple enumeration of land use projects/regulations commented upon by cooperating agencies.

Implementation of the Subbasin Plans is ultimately the responsibility of all managers and stakeholders who participated in its development. It is recommended that this group form an "Implementation Oversight Committee," to track and guide research, monitoring and reporting activities included in the plan.

Organization of the RME plan is as follows:

Research

- Research needs, with justification, are also listed. Detailed research project design is not presented, however, being beyond the scope of the current planning effort
- Existing Data Gaps, as identified through the subbasin planning process, are listed in this section, because many will require effort above routine monitoring and evaluation to address

Monitoring and Evaluation

- Focal habitat monitoring methodology, and Management Plan strategies addressed
- Focal species monitoring methodology, and Management Plan strategies addressed

EXISTING DATA GAPS AND RESEARCH NEEDS

In the course of subbasin plan development, a number of data gaps were identified. Some of these gaps will be filled as data is collected via the monitoring and evaluation process as the plan is implemented. Others will require formal research efforts to address. Data gaps and research needs identified during development of the subbasin plan are listed in **Table 57**.

As part of the adaptive management philosophy of subbasin planning, managers believe that additional research needs not yet identified will become apparent over time. These needs will be addressed in future subbasin plan iterations.

Table 57 Data Gaps and Research Needs, Okanogan subbasin, as identified during subbasin planning

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
GENERAL		
Testing of assumption that focal habitats are functional if a focal species assemblage's recommended management conditions are achieved		Coordinated government & NGO effort
Testing of assumption that selected species assemblages adequately represent focal habitats		Coordinated government & NGO effort
Current, broad-scale habitat data	Spatial data collection and GIS analysis	Coordinated government & NGO effort
RIPARIAN WETLANDS		
Research Needs, recommended priority order		
Refinement of recommended management conditions for Riparian Wetlands	Research need; use for update to future subbasin plan iterations	Coordinated government & NGO effort.
Data are needed on all aspects of red-eyed vireo, yellow-breasted chat and beaver ecology in the subbasin.		Coordinated government & NGO effort
Data Gaps		
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current riparian wetland data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Riparian habitat quality data. Assessment data do not address habitat quality.	Monitoring activities	Subbasin managers
Refined habitat type maps	Spatial data collection and GIS analysis	Subbasin managers
GIS soils products including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution data for red-eyed vireo, yellow-breasted chat, and beaver	Species Monitoring, Spatial data collection,	WDFW, Subbasin managers

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
	and GIS analysis	
PONDEROSA PINE		
Research Needs, recommended priority order		
Data are needed on all aspects of white-headed woodpecker nesting ecology and habitat use within the Okanogan subbasin		Coordinated government & NGO effort
Data are needed on all aspects of pygmy nuthatch and gray flycatcher nesting ecology and habitat use within the Okanogan subbasin		Coordinated government & NGO effort
Data are needed on all aspects of flammulated owl nesting ecology and habitat use, specifically related to the size, configuration, and abundance of grassy openings for foraging and clumped thickets of sapling/pole trees for roosting		Coordinated government & NGO effort
Research to determine if restored sites attract white-headed woodpeckers and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine if restored sites attract pygmy nuthatches and gray flycatchers and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine whether an intensively harvested landscape that meets snag and large tree objectives support viable white-headed woodpecker populations		Coordinated government & NGO effort
Research to determine whether a managed site attracts flammulated owls and provides viable habitat. Identification of the most effective treatment processes and conditions most effective.		Coordinated government & NGO effort
Data Gaps		
Refinement of recommended management conditions for Ponderosa pine: collect current ponderosa pine structural condition/habitat variable data	Management Objective for Ponderosa pine	Subbasin managers
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current ponderosa pine data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data do not address habitat quality.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers
Finer resolution GIS habitat type maps that include structural component and KEC data.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
GIS soils products	Spatial data collection and GIS analysis	Subbasin managers
Identify current distribution and population levels of white-headed woodpeckers, pygmy nuthatches, gray flycatchers, and flammulated owls	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Identify current and potential areas of high quality flammulated owl habitat (short-term strategy i.e., <2 years).	Habitat Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor white-headed woodpecker, pygmy nuthatch, gray flycatcher, and flammulated owl distributions within the Okanogan subbasin, to determine current distributions, population levels and population trends	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
SHRUBSTEPPE		
Research Needs, recommended priority order		
Data are needed on all aspects of Brewer's sparrow nesting ecology, especially area requirements to maintain populations		WDFW, Subbasin managers
Data are needed on all aspects of Brewer's sparrow nesting ecology, particularly relationship to livestock grazing and pesticide use		WDFW, Subbasin managers
An assessment of the viability of small populations of Brewer's sparrow in fragments of habitat versus those in large contiguous blocks		WDFW, Subbasin managers
Data Gaps		
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current shrubsteppe data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data bases do not address habitat quality	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Refined habitat type maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
GIS soils products, including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution distribution for Brewer's sparrow and Sharp-tailed grouse.	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor Brewer's sparrow and Sharp-tailed grouse distribution within the	Species Monitoring,	WDFW, Subbasin

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
Okanogan subbasin, to determine current distribution, population level and population trends	Spatial data collection, and GIS analysis	managers
Evaluate the role of fire, mowing, and other management treatments to maintain/improve shrupsteppe habitat quality	Coordinated, standardized monitoring efforts	Subbasin managers

5.10.2 Monitoring And Evaluation: Focal Habitat And Species Monitoring Methodology

Recommended monitoring and evaluation strategies contained below for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established by Partners in Flight for avian species (Ralph et al, 1993, 1995) and habitat monitoring (Nott et al, 2003). Deer sampling methodology follow standard protocols established by the Washington Department of Fish and Wildlife. In addition, protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure standards (USFWS 1980a and 1980b). A common thread in the monitoring strategies, which follow, is the establishment of permanent census stations to monitor bird population and habitat changes.

Wildlife managers will include statically rigorous sampling methods to establish links between habitat enhancement prescriptions, changes in habitat conditions and target wildlife population responses.

Specific methodology for selection of Monitoring and Evaluation sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest. The following protocols describe how M&E sites will be selected (from WDFW response to ISRP http://www.cbfwa.org/files/province/cascade/projects/199609400resp.pdf):

- Vegetation/HEP monitoring and evaluation sites are selected by combining stratified random sampling elements with systematic sampling. Project sites are stratified by cover types (strata) to provide homogeneity within strata, which tends to reduce the standard error, allows for use of different sampling techniques between strata, improves precision, and allows for optimal allocation of sampling effort resulting in possible cost savings (Block et al. 2001). Macro cover types such as shrub-steppe and forest are further sub-cover typed based on dominant vegetation features i.e., percent shrub cover, percent tree cover, and/or deciduous versus evergreen shrubs and conifer versus deciduous forest. Cover type designations and maps are validated prior to conducting surveys in order to reduce sampling inaccuracies.

- Pilot studies are conducted to estimate the sample size needed for a 95% confidence level with a 10% tolerable error level (Avery 1975) and to determine the most appropriate sampling unit for the habitat variable of interest (BLM 1998). In addition, a power analysis is conducted on pilot study data (and periodically throughout data collection) to ensure that sample sizes are sufficient to identify a minimal detectable change of 20% in the variable of interest with a Type I error rate # 0.10 and P = 0.9 (BLM 1998, Hintze 1999, Block et al. 2001). M&E includes habitat trend condition monitoring on the landscape scale (Tier 1-HEP) and plant community monitoring (Tier 2) i.e., measuring changes in vegetative communities on specific sites.

- For HEP surveys, specific transect locations within strata are determined by placing a Universal Transverse Mercator (UTM) grid over the study area (strata) and randomly selecting “X” and “Y” coordinates to designate transect start points. Random transect azimuths are chosen from a computer generated random number program, or from a standard random number table. Data points and micro plots are systematically placed along the line intercept transect at assigned intervals as described in Part 2 – monitoring section of the proposal. Sample sizes for statistical inferences are determined by replication and systematic placement of lines of intercept within the strata with sufficient distance between the lines to assume independence and to provide uniform coverage over the study site.

- Permanent vegetation monitoring transect locations are determined by placing a UTM grid over the strata and randomly selecting “X” and “Y” coordinates to designate plot locations as described for HEP surveys. One hundred meter baseline transect azimuths are randomly selected from a random numbers table. Ten perpendicular 30 meter transects are established at 10 meter intervals along the baseline transect to form a 100m x 30m rectangle (sample unit). Micro plot and shrub intercept data are collected at systematic intervals on the perpendicular transects.

By systematically collecting and analyzing plant species frequency, abundance, density, height, and percent cover data, vegetative trends through time can be described. Likewise, the effectiveness of exotic weed control methods can be evaluated and weed control plans can be adjusted accordingly.

Presence of all exotic weeds i.e., knapweeds, yellow starthistle, etc. will be mapped in GIS using Global Positioning System (GPS) equipment. This information will be used to develop an annual exotic vegetation control plan.

Causes of seeding or planting failure will be identified and planting methods/site preparation will be modified as necessary. Data will be collected and analyzed, and, where necessary, changes in the management plan (adaptive management) will be identified and implemented.

General and site specific M&E protocols, outlining monitoring goals and objectives and specific sampling designs are included in the following monitoring section.

In addition to defining habitat and species population trends, monitoring will also be used to determine if management actions have been carried out as planned (implementation monitoring). In addition to monitoring plan implementation, monitoring results will be evaluated to determine if management actions are achieving desired goals and objectives (effectiveness monitoring) and to provide evidence supporting the continuation of proposed management actions. Areas planted to native shrubs/trees and/or seeded to herbaceous cover will be monitored twice a year to determine shrub/seeding survival, and causes of shrub mortality and seeding failure i.e. depredation, climatic impacts, poor site conditions, poor seed/shrub sources.

Monitoring of habitat attributes and focal species in this manner will provide a standardized means of tracking progress towards conservation, not only within the Okanogan subbasin, but within a national context as well. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in the subbasin planning process.

The Role of Research

Subbasin plans can be used to help list key uncertainties and assumptions to test.

Monitoring can be designed to answer some research questions, in the sense of adaptive management. Implementing the subbasin plans can be done as management experiments to track and test.

As an example, the main hypotheses and key assumptions pertaining to the "key ecological functions" part of the IBIS database can be listed (see http://www.spiritone.com/~brucem/kef1.htm#Hypotheses) as a basis for selected research studies.

6 References

During the Quality Control/Quality Assurance phase of document review, several references were found to be improperly cited or improperly used (i.e., secondary references or missing information). Thus, an exhaustive review of the subbasin plan and the following reference section will turn up a small number of missing citations. These are available upon request from the subbasin coordinators, but have not been reconciled for accuracy.

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7 Technical Appendices

Appendix A: Wildlife Species and Associated Habitat types in the Methow subbasin Washington (IBIS 2003)

Table 58 Wildlife Species and Associated Habitat types in the Methow subbasin Washington

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
American Badger	American Avocet	American Badger	Great Blue Heron
American Beaver	American Badger	American Beaver	Tundra Swan
American Crow	American Crow	American Crow	American Wigeon
American Goldfinch	American Goldfinch	American Dipper	Blue-winged Teal
American Kestrel	American Kestrel	American Goldfinch	Cinnamon Teal
American Marten	American Robin	American Kestrel	Swainson's Hawk
American Robin	Bank Swallow	American Marten	Red-tailed Hawk
Bald Eagel		Bald Eagle	
Bank Swallow	Barn Owl	American Redstart	Gray Partridge
Barn Swallow	Barn Swallow	American Robin	Ring-necked Pheasant
Barred Owl	Barrow's Goldeneye	American Tree Sparrow	Killdeer
Big Brown Bat	Big Brown Bat	American Wigeon	Solitary Sandpiper
Black Bear	Black Bear	Bank Swallow	Long-billed Curlew
Black Swift	Black-billed Magpie	Barn Owl	Long-billed Dowitcher
Black-backed Woodpecker	Black-chinned Hummingbird	Barn Swallow	Wilson's Snipe
Black-billed Magpie	Black-tailed Jackrabbit	Barred Owl	Rock Dove
Black-capped Chickadee	Black-throated Sparrow	Belted Kingfisher	Mourning Dove
Black-chinned Hummingbird	Blue Grouse	Big Brown Bat	Barn Owl
Black-headed Grosbeak	Bobcat	Black Bear	Short-eared Owl
Black-throated Gray Warbler	Brewer's Blackbird	Black Swift	Loggerhead Shrike
Blue Grouse	Brewer's Sparrow	Black-backed Woodpecker	Northern Shrike
Bobcat	Brown-headed Cowbird	Black-billed Magpie	Black-billed Magpie
Brewer's Blackbird	Bullfrog	Black-capped Chickadee	American Crow
Brewer's Sparrow	Burrowing Owl	Black-chinned Hummingbird	Barn Swallow
Brown Creeper	Bushy-tailed Woodrat	Black-crowned Night-heron	European Starling

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
Brown-headed Cowbird	California Myotis	Black-headed Grosbeak	American Pipit
Bullfrog	California Quail	Black-throated Gray Warbler	Vesper Sparrow
Bushy-tailed Woodrat	Canada Goose	Blue Grouse	Savannah Sparrow
California Myotis	Canyon Wren	Bobcat	Grasshopper Sparrow
California Quail	Chipping Sparrow	Bobolink	Lazuli Bunting
Calliope Hummingbird	Chukar	Bohemian Waxwing	Bobolink
Canyon Wren	Cliff Swallow	Brewer's Blackbird	Western Meadowlark
Cascade Golden-mantled Ground Squirrel	Columbia Spotted Frog	Brown Creeper	Brewer's Blackbird
Cassin's Finch	Columbian Ground Squirrel	Brown-headed Cowbird	Brown-headed Cowbird
Cassin's Vireo	Common Garter Snake	Bullfrog	House Finch
Cedar Waxwing	Common Nighthawk	Bullock's Oriole	House Sparrow
Chipping Sparrow	Common Poorwill	Bushy-tailed Woodrat	Virginia Opossum
Clark's Nutcracker	Common Porcupine	California Myotis	Big Brown Bat
Cliff Swallow	Common Raven	California Quail	Eastern Fox Squirrel
Coast Mole	Cooper's Hawk	Calliope Hummingbird	Northern Pocket Gopher
Columbia Spotted Frog	Coyote	Canada Goose	Deer Mouse
Columbian Ground Squirrel	Deer Mouse	Canyon Wren	Bushy-tailed Woodrat
Common Garter Snake	Eastern Kingbird	Cascades Frog	Montane Vole
Common Nighthawk	European Starling	Cassin's Finch	House Mouse
Common Poorwill	Fringed Myotis	Cassin's Vireo	Raccoon
Common Porcupine	Golden Eagle	Cedar Waxwing	
Common Raven	Golden-mantled Ground Squirrel	Chipping Sparrow	
Cooper's Hawk	Gopher Snake	Chukar	
Coyote	Grasshopper Sparrow	Cliff Swallow	
Dark-eyed Junco	Gray Flycatcher	Coast Mole	
Deer Mouse	Gray Partridge	Columbia Spotted Frog	
Douglas' Squirrel	Great Basin Pocket Mouse	Columbian Ground Squirrel	
Downy Woodpecker	Great Basin Spadefoot	Columbian Mouse	
Dusky Flycatcher	Great Horned Owl	Common Garter Snake	

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
Eastern Kingbird	Greater Yellowlegs	Common Merganser	
Ermine	Hoary Bat	Common Nighthawk	
European Starling	Horned Lark	Common Porcupine	
Evening Grosbeak	Killdeer	Common Raven	
Fisher	Lark Sparrow	Common Redpoll	
Flammulated Owl	Least Chipmunk	Common Yellowthroat	
Fox Sparrow	Lesser Yellowlegs	Cooper's Hawk	
Fringed Myotis	Little Brown Myotis	Cordilleran Flycatcher	
Golden Eagle	Loggerhead Shrike	Coyote	
Golden-crowned Kinglet	Long-billed Curlew	Creeping Vole	
Golden-mantled Ground Squirrel	Long-eared Myotis	Dark-eyed Junco	
Gopher Snake	Long-eared Owl	Deer Mouse	
Gray Flycatcher	Long-legged Myotis	Downy Woodpecker	
Gray Jay	Long-tailed Vole	Dusky Flycatcher	
Gray Wolf	Long-tailed Weasel	Eastern Fox Squirrel	
Great Basin Spadefoot	Long-toed Salamander	Eastern Kingbird	
Great Gray Owl	Mallard	Ermine	
Great Horned Owl	Merriam's Shrew	European Starling	
Grizzly Bear	Mink	Evening Grosbeak	
Hairy Woodpecker	Montane Vole	Fisher	
Hammond's Flycatcher	Mountain Bluebird	Flammulated Owl	
Hermit Thrush	Mourning Dove	Fox Sparrow	
Hoary Bat	Mule Deer	Fringed Myotis	
House Finch	Nashville Warbler	Golden Eagle	
House Wren	Night Snake	Golden-crowned Kinglet	
Killdeer	Northern Flicker	Golden-mantled Ground Squirrel	
Lark Sparrow	Northern Goshawk	Gopher Snake	
Lazuli Bunting	Northern Grasshopper Mouse	Gray Catbird	
Least Chipmunk	Northern Harrier	Gray Jay	
Lewis's Woodpecker	Northern Pocket Gopher	Great Basin Spadefoot	

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
Little Brown Myotis	Northern Rough-winged Swallow	Great Blue Heron	
Long-eared Myotis	Northern Shrike	Great Horned Owl	
Long-eared Owl	Nuttall's (Mountain) Cottontail	Greater Yellowlegs	
Long-legged Myotis	Orange-crowned Warbler	Green-winged Teal	
Long-tailed Vole	Osprey	Grizzly Bear	
Long-tailed Weasel	Pacific Chorus (Tree) Frog	Hairy Woodpecker	
Long-toed Salamander	Painted Turtle	Harlequin Duck	
Macgillivray's Warbler	Pallid Bat	Heather Vole	
Masked Shrew	Prairie Falcon	Hermit Thrush	
Mink	Racer	Hoary Bat	
Montane Vole	Red-tailed Hawk	Hooded Merganser	
Mountain Bluebird	Ring-necked Pheasant	House Finch	
Mountain Chickadee	Rock Dove	House Wren	
Mountain Lion	Rock Wren	Killdeer	
Mourning Dove	Rocky Mountain Elk	Lazuli Bunting	
Mule Deer	Rough-legged Hawk	Least Chipmunk	
Nashville Warbler	Rough-skinned Newt	Lesser Yellowlegs	
Night Snake	Rubber Boa	Lewis's Woodpecker	
Northern Alligator Lizard	Sage Sparrow	Lincoln's Sparrow	
Northern Flicker	Sage Thrasher	Little Brown Myotis	
Northern Flying Squirrel	Sagebrush Lizard	Long-eared Myotis	
Northern Goshawk	Sagebrush Vole	Long-eared Owl	
Northern Pocket Gopher	Savannah Sparrow	Long-legged Myotis	
Northern Pygmy-owl	Say's Phoebe	Long-tailed Vole	
Northern Rough-winged Swallow	Sharp-shinned Hawk	Long-tailed Weasel	
Northern Saw-whet Owl	Sharp-tailed Grouse	Long-toed Salamander	
Northern Spotted Owl		Northern Spotted Owl	
Olive-sided Flycatcher	Short-eared Owl	Macgillivray's Warbler	
Orange-crowned Warbler	Short-horned Lizard	Mallard	
Osprey	Side-blotched Lizard	Masked Shrew	
Pacific Chorus (Tree) Frog	Snow Bunting	Meadow Vole	

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
Pacific Jumping Mouse	Solitary Sandpiper	Mink	
Painted Turtle	Spotted Bat	Montane Shrew	
Pallid Bat	Spotted Sandpiper	Montane Vole	
Pileated Woodpecker	Striped Whipsnake	Moose	
Pine Siskin	Swainson's Hawk	Mountain Bluebird	
Prairie Falcon	Tiger Salamander	Mountain Chickadee	
Pygmy Nuthatch	Townsend's Big-eared Bat	Mountain Lion	
Racer	Townsend's Solitaire	Mourning Dove	
Red Crossbill	Turkey Vulture	Mule Deer	
Red Fox	Vagrant Shrew	Muskrat	
Red Squirrel	Vesper Sparrow	Nashville Warbler	
Red-breasted Nuthatch	Washington Ground Squirrel	Northern Alligator Lizard	
Red-breasted Sapsucker	Western Fence Lizard	Northern Flicker	
Red-naped Sapsucker	Western Harvest Mouse	Northern Flying Squirrel	
Red-tailed Hawk	Western Kingbird	Northern Goshawk	
Ring-necked Pheasant	Western Meadowlark	Northern Harrier	
Rock Wren	Western Pipistrelle	Northern Pocket Gopher	
Rocky Mountain Elk	Western Rattlesnake	Northern Pygmy-owl	
Rough-legged Hawk	Western Skink	Northern River Otter	
Rough-skinned Newt	Western Small-footed Myotis	Northern Rough-winged Swallow	
Rubber Boa	Western Terrestrial Garter Snake	Northern Saw-whet Owl	
Ruby-crowned Kinglet	Western Toad	Northern Waterthrush	
Ruffed Grouse	White-crowned Sparrow	Olive-sided Flycatcher	
Rufous Hummingbird	White-tailed Jackrabbit	Orange-crowned Warbler	
Sagebrush Lizard	White-throated Swift	Osprey	
Say's Phoebe	Yellow-bellied Marmot	Pacific Chorus (Tree) Frog	
Sharp-shinned Hawk	Yuma Myotis	Pacific Jumping Mouse	
Sharp-tail Snake		Pacific Water Shrew	
Short-horned Lizard		Painted Turtle	
Silver-haired Bat		Pallid Bat	
Snowshoe Hare		Pied-billed Grebe	

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
Song Sparrow		Pileated Woodpecker	
Spotted Bat		Pine Siskin	
		Prairie Falcon	
Spotted Towhee		Pygmy Nuthatch	
Steller's Jay		Raccoon	
Striped Skunk		Racer	
Striped Whipsnake		Red Crossbill	
Tailed Frog		Red Fox	
Three-toed Woodpecker		Red-breasted Nuthatch	
Tiger Salamander		Red-breasted Sapsucker	
Townsend's Big-eared Bat		Red-eyed Vireo	
Townsend's Solitaire		Red-naped Sapsucker	
Townsend's Warbler		Red-tailed Hawk	
Tree Swallow		Red-winged Blackbird	
Trowbridge's Shrew		Ring-necked Duck	
Turkey Vulture		Ring-necked Pheasant	
Vagrant Shrew		Rocky Mountain Elk	
Varied Thrush		Rough-legged Hawk	
Vaux's Swift		Rough-skinned Newt	
Violet-green Swallow		Rubber Boa	
Warbling Vireo		Ruby-crowned Kinglet	
Western Bluebird		Ruffed Grouse	
Western Fence Lizard		Rufous Hummingbird	
Western Gray Squirrel		Savannah Sparrow	
Western Jumping Mouse		Say's Phoebe	
Western Kingbird		Sharp-tail Snake	
Western Pipistrelle		Sharp-tailed Grouse	
Western Rattlesnake		Shrew-mole	
Western Screech-owl		Silver-haired Bat	
Western Skink		Snowshoe Hare	
Western Small-footed Myotis		Solitary Sandpiper	
Western Tanager		Song Sparrow	

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
Western Terrestrial Garter Snake		Southern Red-backed Vole	
Western Toad		Spotted Bat	
Western Wood-pewee		Spotted Sandpiper	
White-breasted Nuthatch		Spotted Towhee	
White-crowned Sparrow		Steller's Jay	
White-headed Woodpecker		Striped Skunk	
White-throated Swift		Swainson's Hawk	
Wild Turkey		Swainson's Thrush	
Williamson's Sapsucker		Tailed Frog	
Willow Flycatcher		Three-toed Woodpecker	
Wilson's Warbler		Tiger Salamander	
Yellow-bellied Marmot		Townsend's Big-eared Bat	
Yellow-pine Chipmunk		Townsend's Solitaire	
Yellow-rumped Warbler		Townsend's Warbler	
Yuma Myotis		Tree Swallow	
		Trowbridge's Shrew	
		Turkey Vulture	
		Vagrant Shrew	
		Vaux's Swift	
		Veery	
		Violet-green Swallow	
		Virginia Opossum	
		Warbling Vireo	
		Water Shrew	
		Water Vole	
		Western Bluebird	
		Western Harvest Mouse	
		Western Jumping Mouse	
		Western Pipistrelle	
		Western Rattlesnake	
		Western Screech-owl	

Ponderosa Pine	Shrubsteppe	Riparian Wetlands	Agriculture
		Western Small-footed Myotis	
		Western Tanager	
		Western Terrestrial Garter Snake	
		Western Toad	
		Western Wood-pewee	
		White-breasted Nuthatch	
		White-crowned Sparrow	
		White-headed Woodpecker	
		White-tailed Jackrabbit	
		White-throated Swift	
		Wild Turkey	
		Williamson's Sapsucker	
		Willow Flycatcher	
		Wilson's Warbler	
		Winter Wren	
		Wood Duck	
		Yellow Warbler	
		Yellow-bellied Marmot	
		Yellow-breasted Chat	
		Yellow-pine Chipmunk	
		Yellow-rumped Warbler	
		Yuma Myotis	

(IBIS 2003)

Appendix B: Wildlife Species, Aquatic Habitat and Salmonid Associations in the Methow subbasin

Table 59 Wildlife Species, Aquatic Habitat and Salmonid Associations in the Methow subbasin

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
Amphibians					
	Tiger Salamander	*Ambystoma tigrinum*		1	
	Long-toed Salamander	*Ambystoma macrodactylum*		1	
	Pacific Giant Salamander	*Dicamptodon tenebrosus*	1		
	Rough-skinned Newt	*Taricha granulosa*			1
	Tailed Frog	*Ascaphus truei*		1	
	Great Basin Spadefoot	*Scaphiopus intermontanus*		1	
	Western Toad	*Bufo boreas*		1	
	Pacific Chorus (Tree) Frog	*Pseudacris regilla*		1	
	Cascades Frog	*Rana cascadae*			
	Columbia Spotted Frog	*Rana luteiventris*		1	
	Bullfrog	*Rana catesbeiana*		1	
	Total Amphibians:	11 Total:	1	8	1
Birds					
	Common Loon	*Gavia immer*	1		1
	Pied-billed Grebe	*Podilymbus podiceps*	1		1
	Red-necked Grebe	*Podiceps grisegena*	1		1
	Eared Grebe	*Podiceps nigricollis*			1
	American Bittern	*Botaurus lentiginosus*			1
	Great Blue Heron	*Ardea herodias*	1	1	

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Black-crowned Night-heron	*Nycticorax nycticorax*	1	1	
	Turkey Vulture	*Cathartes aura*	1		
	Canada Goose	*Branta canadensis*			1
	Tundra Swan	*Cygnus columbianus*			
	Wood Duck	*Aix sponsa*		1	
	Gadwall	*Anas strepera*			1
	American Wigeon	*Anas americana*			1
	Mallard	*Anas platyrhynchos*	1	1	
	Blue-winged Teal	*Anas discors*			1
	Cinnamon Teal	*Anas cyanoptera*			1
	Northern Shoveler	*Anas clypeata*			1
	Northern Pintail	*Anas acuta*			1
	Green-winged Teal	*Anas crecca*	1		1
	Canvasback	*Aythya valisineria*	1		1
	Redhead	*Aythya americana*			1
	Ring-necked Duck	*Aythya collaris*			
	Greater Scaup	*Aythya marila*	1		
	Harlequin Duck	*Histrionicus histrionicus*	1	1	
	Barrow's Goldeneye	*Bucephala islandica*	1		
	Hooded Merganser	*Lophodytes cucullatus*	1	1	
	Common Merganser	*Mergus merganser*	1	1	
	Ruddy Duck	*Oxyura jamaicensis*			1
	Osprey	*Pandion haliaetus*	1		

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Northern Harrier	*Circus cyaneus*			
	Sharp-shinned Hawk	*Accipiter striatus*			
	Cooper's Hawk	*Accipiter cooperii*			
	Northern Goshawk	*Accipiter gentilis*			
	Swainson's Hawk	*Buteo swainsoni*			
	Red-tailed Hawk	*Buteo jamaicensis*	1		
	Rough-legged Hawk	*Buteo lagopus*			
	Golden Eagle	*Aquila chrysaetos*	1		
	American Kestrel	*Falco sparverius*			
	Gyrfalcon	*Falco rusticolus*	1		
	Prairie Falcon	*Falco mexicanus*			
	Chukar	*Alectoris chukar*			
	Gray Partridge	*Perdix perdix*			
	Ring-necked Pheasant	*Phasianus colchicus*		1	
	Ruffed Grouse	*Bonasa umbellus*		1	
	Spruce Grouse	*Falcipennis canadensis*			
	White-tailed Ptarmigan	*Lagopus leucurus*			
	Blue Grouse	*Dendragapus obscurus*		1	
	Sharp-tailed Grouse	*Tympanuchus phasianellus*		1	
	Wild Turkey	*Meleagris gallopavo*			
	California Quail	*Callipepla californica*			
	Virginia Rail	*Rallus limicola*			1
	Sora	*Porzana carolina*			1
	American Coot	*Fulica americana*			1

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Killdeer	*Charadrius vociferus*	1		
	American Avocet	*Recurvirostra americana*			1
	Greater Yellowlegs	*Tringa melanoleuca*	1		
	Lesser Yellowlegs	*Tringa flavipes*			
	Solitary Sandpiper	*Tringa solitaria*		1	
	Spotted Sandpiper	*Actitis macularia*	1		
	Long-billed Curlew	*Numenius americanus*			
	Semipalmated Sandpiper	*Calidris pusilla*			
	Western Sandpiper	*Calidris mauri*			
	Least Sandpiper	*Calidris minutilla*			
	Baird's Sandpiper	*Calidris bairdii*			
	Pectoral Sandpiper	*Calidris melanotos*			
	Stilt Sandpiper	*Calidris himantopus*			
	Long-billed Dowitcher	*Limnodromus scolopaceus*			
	Common Snipe	*Gallinago gallinago*			1
	Wilson's Phalarope	*Phalaropus tricolor*			1
	Red-necked Phalarope	*Phalaropus lobatus*			
	Ring-billed Gull	*Larus delawarensis*	1		
	California Gull	*Larus californicus*	1		
	Herring Gull	*Larus argentatus*	1		
	Thayer's Gull	*Larus thayeri*	1		

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Glaucous Gull	*Larus hyperboreus*	1		
	Black Tern	*Chlidonias niger*			1
	Rock Dove	*Columba livia*			
	Mourning Dove	*Zenaida macroura*		1	
	Barn Owl	*Tyto alba*			
	Flammulated Owl	*Otus flammeolus*			
	Western Screech-owl	*Otus kennicottii*		1	
	Great Horned Owl	*Bubo virginianus*			
	Snowy Owl	*Nyctea scandiaca*	1		
	Northern Pygmy-owl	*Glaucidium gnoma*			
	Burrowing Owl	*Athene cunicularia*			
	Barred Owl	*Strix varia*			
	Great Gray Owl	*Strix nebulosa*			
	Long-eared Owl	*Asio otus*		1	
	Short-eared Owl	*Asio flammeus*			1
	Boreal Owl	*Aegolius funereus*			
	Northern Saw-whet Owl	*Aegolius acadicus*			
	Common Nighthawk	*Chordeiles minor*			
	Common Poorwill	*Phalaenoptilus nuttallii*			
	Black Swift	*Cypseloides niger*			
	Vaux's Swift	*Chaetura vauxi*			
	White-throated Swift	*Aeronautes saxatalis*			
	Black-chinned Hummingbird	*Archilochus alexandri*			
	Calliope Hummingbird	*Stellula calliope*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Rufous Hummingbird	*Selasphorus rufus*			
	Belted Kingfisher	*Ceryle alcyon*	1	1	
	Lewis's Woodpecker	*Melanerpes lewis*			
	Williamson's Sapsucker	*Sphyrapicus thyroideus*			
	Red-naped Sapsucker	*Sphyrapicus nuchalis*		1	
	Red-breasted Sapsucker	*Sphyrapicus ruber*			
	Downy Woodpecker	*Picoides pubescens*			
	Hairy Woodpecker	*Picoides villosus*			
	White-headed Woodpecker	*Picoides albolarvatus*			
	Three-toed Woodpecker	*Picoides tridactylus*			
	Black-backed Woodpecker	*Picoides arcticus*			
	Northern Flicker	*Colaptes auratus*			
	Pileated Woodpecker	*Dryocopus pileatus*			
	Olive-sided Flycatcher	*Contopus cooperi*			
	Western Wood-pewee	*Contopus sordidulus*			
	Willow Flycatcher	*Empidonax traillii*	1	1	
	Hammond's Flycatcher	*Empidonax hammondii*			
	Gray Flycatcher	*Empidonax wrightii*			
	Dusky Flycatcher	*Empidonax oberholseri*			
	Pacific-slope Flycatcher	*Empidonax difficilis*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Cordilleran Flycatcher	*Empidonax occidentalis*		1	
	Say's Phoebe	*Sayornis saya*			
	Western Kingbird	*Tyrannus verticalis*			
	Eastern Kingbird	*Tyrannus tyrannus*			
	Loggerhead Shrike	*Lanius ludovicianus*			
	Northern Shrike	*Lanius excubitor*			
	Cassin's Vireo	*Vireo cassinii*			
	Warbling Vireo	*Vireo gilvus*		1	
	Red-eyed Vireo	*Vireo olivaceus*		1	
	Gray Jay	*Perisoreus canadensis*	1		
	Steller's Jay	*Cyanocitta stelleri*	1		
	Clark's Nutcracker	*Nucifraga columbiana*			
	Black-billed Magpie	*Pica pica*	1	1	
	American Crow	*Corvus brachyrhynchos*	1		
	Northwestern Crow	*Corvus caurinus*	1		
	Common Raven	*Corvus corax*	1		
	Horned Lark	*Eremophila alpestris*			
	Tree Swallow	*Tachycineta bicolor*	1	1	
	Violet-green Swallow	*Tachycineta thalassina*	1		
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	1	1	
	Bank Swallow	*Riparia riparia*	1	1	
	Cliff Swallow	*Petrochelidon pyrrhonota*	1	1	
	Barn Swallow	*Hirundo rustica*	1	1	

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Black-capped Chickadee	*Poecile atricapillus*			
	Mountain Chickadee	*Poecile gambeli*			
	Chestnut-backed Chickadee	*Poecile rufescens*			
	Boreal Chickadee	*Poecile hudsonicus*			
	Red-breasted Nuthatch	*Sitta canadensis*			
	White-breasted Nuthatch	*Sitta carolinensis*			
	Pygmy Nuthatch	*Sitta pygmaea*		1	
	Brown Creeper	*Certhia americana*			
	Rock Wren	*Salpinctes obsoletus*			
	Canyon Wren	*Catherpes mexicanus*			
	House Wren	*Troglodytes aedon*			
	Winter Wren	*Troglodytes troglodytes*	1		
	Marsh Wren	*Cistothorus palustris*			1
	American Dipper	*Cinclus mexicanus*	1	1	
	Golden-crowned Kinglet	*Regulus satrapa*			
	Ruby-crowned Kinglet	*Regulus calendula*			
	Western Bluebird	*Sialia mexicana*			
	Mountain Bluebird	*Sialia currucoides*			
	Townsend's Solitaire	*Myadestes townsendi*			
	Veery	*Catharus fuscescens*		1	

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Swainson's Thrush	*Catharus ustulatus*			
	Hermit Thrush	*Catharus guttatus*			
	American Robin	*Turdus migratorius*	1		
	Varied Thrush	*Ixoreus naevius*	1		
	Gray Catbird	*Dumetella carolinensis*		1	
	Sage Thrasher	*Oreoscoptes montanus*			
	European Starling	*Sturnus vulgaris*		1	
	American Pipit	*Anthus rubescens*			
	Bohemian Waxwing	*Bombycilla garrulus*			
	Cedar Waxwing	*Bombycilla cedrorum*		1	
	Orange-crowned Warbler	*Vermivora celata*			
	Nashville Warbler	*Vermivora ruficapilla*			
	Yellow Warbler	*Dendroica petechia*		1	
	Yellow-rumped Warbler	*Dendroica coronata*			
	Black-throated Gray Warbler	*Dendroica nigrescens*			
	Townsend's Warbler	*Dendroica townsendi*			
	American Redstart	*Setophaga ruticilla*		1	
	Northern Waterthrush	*Seiurus noveboracensis*		1	
	Macgillivray's Warbler	*Oporornis tolmiei*			
	Common Yellowthroat	*Geothlypis trichas*		1	
	Wilson's Warbler	*Wilsonia pusilla*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Yellow-breasted Chat	*Icteria virens*		1	
	Western Tanager	*Piranga ludoviciana*			
	Spotted Towhee	*Pipilo maculatus*	1		
	American Tree Sparrow	*Spizella arborea*			
	Chipping Sparrow	*Spizella passerina*			
	Brewer's Sparrow	*Spizella breweri*			
	Vesper Sparrow	*Pooecetes gramineus*			
	Lark Sparrow	*Chondestes grammacus*			
	Black-throated Sparrow	*Amphispiza bilineata*			
	Sage Sparrow	*Amphispiza belli*			
	Savannah Sparrow	*Passerculus sandwichensis*			
	Grasshopper Sparrow	*Ammodramus savannarum*			
	Fox Sparrow	*Passerella iliaca*		1	
	Song Sparrow	*Melospiza melodia*	1		
	Lincoln's Sparrow	*Melospiza lincolnii*		1	
	White-crowned Sparrow	*Zonotrichia leucophrys*			
	Dark-eyed Junco	*Junco hyemalis*			
	Lapland Longspur	*Calcarius lapponicus*			
	Snow Bunting	*Plectrophenax nivalis*			
	Black-headed Grosbeak	*Pheucticus melanocephalus*			
	Lazuli Bunting	*Passerina amoena*		1	

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Bobolink	*Dolichonyx oryzivorus*			
	Red-winged Blackbird	*Agelaius phoeniceus*			1
	Western Meadowlark	*Sturnella neglecta*			
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*			1
	Brewer's Blackbird	*Euphagus cyanocephalus*			
	Brown-headed Cowbird	*Molothrus ater*			
	Bullock's Oriole	*Icterus bullockii*		1	
	Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*			
	Pine Grosbeak	*Pinicola enucleator*			
	Cassin's Finch	*Carpodacus cassinii*			
	House Finch	*Carpodacus mexicanus*			
	Red Crossbill	*Loxia curvirostra*			
	White-winged Crossbill	*Loxia leucoptera*			
	Common Redpoll	*Carduelis flammea*			
	Pine Siskin	*Carduelis pinus*			
	American Goldfinch	*Carduelis tristis*			
	Evening Grosbeak	*Coccothraustes vespertinus*			
	House Sparrow	*Passer domesticus*			1
	Total Birds:	221 Total:	47	42	28
Mammals					
	Virginia Opossum	*Didelphis virginiana*	1		
	Masked Shrew	*Sorex cinereus*	1		

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Vagrant Shrew	*Sorex vagrans*	1		
	Montane Shrew	*Sorex monticolus*	1		
	Water Shrew	*Sorex palustris*	1	1	
	Pacific Water Shrew	*Sorex bendirii*	1		
	Trowbridge's Shrew	*Sorex trowbridgii*	1		
	Merriam's Shrew	*Sorex merriami*			
	Shrew-mole	*Neurotrichus gibbsii*			
	Coast Mole	*Scapanus orarius*			
	California Myotis	*Myotis californicus*			
	Western Small-footed Myotis	*Myotis ciliolabrum*		1	
	Yuma Myotis	*Myotis yumanensis*		1	
	Little Brown Myotis	*Myotis lucifugus*			
	Long-legged Myotis	*Myotis volans*		1	
	Fringed Myotis	*Myotis thysanodes*			
	Long-eared Myotis	*Myotis evotis*			
	Silver-haired Bat	*Lasionycteris noctivagans*			
	Western Pipistrelle	*Pipistrellus hesperus*		1	
	Big Brown Bat	*Eptesicus fuscus*		1	
	Hoary Bat	*Lasiurus cinereus*			
	Spotted Bat	*Euderma maculatum*			
	Townsend's Big-eared Bat	*Corynorhinus townsendii*			
	Pallid Bat	*Antrozous pallidus*		1	
	American Pika	*Ochotona princeps*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Nuttall's (Mountain) Cottontail	*Sylvilagus nuttallii*			
	Snowshoe Hare	*Lepus americanus*		1	
	White-tailed Jackrabbit	*Lepus townsendii*			
	Black-tailed Jackrabbit	*Lepus californicus*			
	Mountain Beaver	*Aplodontia rufa*			
	Least Chipmunk	*Tamias minimus*			
	Yellow-pine Chipmunk	*Tamias amoenus*			
	Townsend's Chipmunk	*Tamias townsendii*			
	Yellow-bellied Marmot	*Marmota flaviventris*			
	Hoary Marmot	*Marmota caligata*			
	Washington Ground Squirrel	*Spermophilus washingtoni*			
	Columbian Ground Squirrel	*Spermophilus columbianus*			
	Golden-mantled Ground Squirrel	*Spermophilus lateralis*			
	Cascade Golden-mantled Ground Squirrel	*Spermophilus saturatus*			
	Eastern Fox Squirrel	*Sciurus niger*			
	Western Gray Squirrel	*Sciurus griseus*			
	Red Squirrel	*Tamiasciurus hudsonicus*			
	Douglas' Squirrel	*Tamiasciurus douglasii*	1		
	Northern Flying Squirrel	*Glaucomys sabrinus*	1		
	Northern Pocket Gopher	*Thomomys talpoides*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Great Basin Pocket Mouse	*Perognathus parvus*			
	American Beaver	*Castor canadensis*		1	
	Western Harvest Mouse	*Reithrodontomys megalotis*		1	
	Deer Mouse	*Peromyscus maniculatus*	1	1	
	Columbian Mouse	*Peromyscus keeni*			
	Northern Grasshopper Mouse	*Onychomys leucogaster*			
	Bushy-tailed Woodrat	*Neotoma cinerea*		1	
	Southern Red-backed Vole	*Clethrionomys gapperi*		1	
	Heather Vole	*Phenacomys intermedius*			
	Meadow Vole	*Microtus pennsylvanicus*		1	
	Montane Vole	*Microtus montanus*			1
	Long-tailed Vole	*Microtus longicaudus*		1	
	Creeping Vole	*Microtus oregoni*			
	Water Vole	*Microtus richardsoni*		1	
	Sagebrush Vole	*Lemmiscus curtatus*			
	Muskrat	*Ondatra zibethicus*		1	
	Northern Bog Lemming	*Synaptomys borealis*			1
	Black Rat	*Rattus rattus*			
	Norway Rat	*Rattus norvegicus*			
	House Mouse	*Mus musculus*			
	Western Jumping Mouse	*Zapus princeps*		1	

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Pacific Jumping Mouse	*Zapus trinotatus*		1	
	Common Porcupine	*Erethizon dorsatum*			
	Nutria	*Myocastor coypus*			1
	Coyote	*Canis latrans*	1		
	Gray Wolf	*Canis lupus*	1		
	Red Fox	*Vulpes vulpes*	1		
	Black Bear	*Ursus americanus*	1		
	Grizzly Bear	*Ursus arctos*	1		
	Raccoon	*Procyon lotor*	1	1	
	American Marten	*Martes americana*	1		
	Fisher	*Martes pennanti*	1		
	Ermine	*Mustela erminea*			
	Long-tailed Weasel	*Mustela frenata*	1		
	Mink	*Mustela vison*	1	1	
	Wolverine	*Gulo gulo*	1		
	American Badger	*Taxidea taxus*			
	Striped Skunk	*Mephitis mephitis*	1		
	Northern River Otter	*Lutra canadensis*	1	1	
	Mountain Lion	*Puma concolor*	1		
	Canadian Lynx	*Lynx canadensis*			
	Bobcat	*Lynx rufus*	1		
	Elk	*Cervus elaphus*			
	Mule Deer	*Odocoileus hemionus*			
	White-tailed Deer	*Odocoileus virginianus*			
	Moose	*Alces alces*			
	Mountain Goat	*Oreamnos americanus*			

	Common Name	Scientific Name		Salmonid Relationship	Closely Associated with Riparian Wetland	Closely Associated with Other Wetlands
	Bighorn Sheep	*Ovis canadensis*				
	Total Mammals:	93	Total:	25	22	3
Reptiles						
	Painted Turtle	*Chrysemys picta*				
	Northern Alligator Lizard	*Elgaria coerulea*				
	Short-horned Lizard	*Phrynosoma douglassii*				
	Sagebrush Lizard	*Sceloporus graciosus*				
	Western Fence Lizard	*Sceloporus occidentalis*				
	Side-blotched Lizard	*Uta stansburiana*				
	Western Skink	*Eumeces skiltonianus*				
	Rubber Boa	*Charina bottae*				
	Racer	*Coluber constrictor*				
	Sharp-tail Snake	*Contia tenuis*				
	Night Snake	*Hypsiglena torquata*				
	Striped Whipsnake	*Masticophis taeniatus*				
	Gopher Snake	*Pituophis catenifer*				
	Western Terrestrial Garter Snake	*Thamnophis elegans*		1		
	Common Garter Snake	*Thamnophis sirtalis*		1	1	
	Western Rattlesnake	*Crotalus viridis*				
	Total Reptiles:	16	Total:	2	1	0
	Total Species:	341	Total:	75	73	32

Appendix C: Relevant Species Ranking, Status and Management Lists

Table 60 Rare plants in the Methow subbasin, Washington

Scientific Name	Common Name
Abies Amabilis / Achlys Triphylla Forest	Pacific Silver Fir / Vanillaleaf
Abies Amabilis Cover Type	Pacific Silver Fir Forest
Abies Lasiocarpa / Calamagrostis Rubescens Forest	Subalpine Fir / Pinegrass
Abies Lasiocarpa / Ledum Glandulosum Forest	Subalpine Fir / Glandular Labrador-Tea
Abies Lasiocarpa / Rhododendron Albiflorum Woodland	Subalpine Fir / Cascade Azalea
Abies Lasiocarpa / Vaccinium Scoparium Forest	Subalpine Fir / Grouseberry
Abies Lasiocarpa Cover Type	Subalpine Fir Forest
Alnus Viridis Ssp. *Sinuata Shrubland (Provisional)*	Sitka Alder
Artemisia Tridentata Ssp. *Wyomingensis / Pseudoroegneria Spicata Shrub Herbaceous Vegetation*	Wyoming Big Sagebrush / Bluebunch Wheatgrass
Artemisia Tridentata Ssp. *Wyomingensis / Stipa Comata Shrubland*	Wyoming Big Sagebrush / Needle-And-Thread
Artemisia Tripartita / Festuca Idahoensis Shrub Herbaceous Vegetation	Threetip Sagebrush / Idaho Fescue
Artemisia Tripartita / Pseudoroegneria Spicata Shrub Herbaceous Vegetation	Threetip Sagebrush / Bluebunch Wheatgrass
Artemisia Tripartita / Stipa Comata Shrub Herbaceous Vegetation	Threetip Sagebrush / Needle-And-Thread
Carex Cover Type	Sedge Spp. Grassland
Carex Scopulorum Herbaceous Vegetation	Holm's Rocky Mountain Sedge
Carex Utriculata Herbaceous Vegetation	Northwest Territory Sedge
Danthonia Intermedia Herbaceous Vegetation	Timber Oatgrass
Dryas Octopetala Dwarf-Shrub Herbaceous Vegetation	Eight Petal Mountain-Avens
Festuca Idahoensis - Eriogonum Heracleoides Herbaceous Vegetation	Idaho Fescue - Parsnip-Flower Buckwheat
Inland Saline Wetland Cb	Inland Saline Wetland Cb
Larix Lyallii Association	Subalpine Larch Community
Larix Occidentalis Cover Type	Western Larch Forest
Picea Engelmannii - Abies Lasiocarpa Cover Type	Engelmann Spruce - Subalpine Fir Forest
Picea Engelmannii / Equisetum Arvense Forest	Engelmann Spruce / Field Horsetail
Pinus Albicaulis - Abies Lasiocarpa Cover Type	White-Bark Pine - Subalpine Fir Forest
Pinus Albicaulis Cover Type	White-Bark Pine Forest
Pinus Contorta Cover Type	Lodgepole Pine Forest
Pinus Ponderosa - Pseudotsuga Menziesii / Pseudoroegneria Spicata Ssp. *Inermis Woodland*	Ponderosa Pine - Douglas-Fir / Bluebunch Wheatgrass

Scientific Name	Common Name
Pinus Ponderosa - Pseudotsuga Menziesii / Purshia Tridentata Woodland	Ponderosa Pine - Douglas-Fir / Bitterbrush
Pinus Ponderosa - Pseudotsuga Menziesii Cover Type	Ponderosa Pine - Douglas-Fir Forest
Pinus Ponderosa / Calamagrostis Rubescens Forest	Ponderosa Pine / Pinegrass
Pinus Ponderosa / Purshia Tridentata Woodland	Ponderosa Pine / Bitterbrush
Pinus Ponderosa Cover Type	Ponderosa Pine Forest
Populus Tremuloides / Symphoricarpos Albus Forest	Quaking Aspen / Common Snowberry
Populus Tremuloides Cover Type	Quaking Aspen Forest
Pseudoroegneria Spicata Cover Type	Bluebunch Wheatgrass Grassland
Pseudotsuga Menziesii / Arctostaphylos Uva-Ursi - Purshia Tridentata Forest	Douglas-Fir / Kinikinnick - Bitterbrush
Pseudotsuga Menziesii / Arctostaphylos Uva-Ursi Cascadian Forest	Douglas-Fir / Kinikinnick Cascadian Forest
Pseudotsuga Menziesii / Calamagrostis Rubescens Forest	Douglas-Fir / Pinegrass
Pseudotsuga Menziesii / Symphoricarpos Albus Forest	Douglas-Fir / Common Snowberry
Purshia Tridentata / Festuca Idahoensis Shrub Herbaceous Vegetation	Bitterbrush / Idaho Fescue
Purshia Tridentata / Pseudoroegneria Spicata Shrub Herbaceous Vegetation	Bitterbrush / Bluebunch Wheatgrass
Purshia Tridentata / Stipa Comata Shrub Herbaceous Vegetation	Bitterbrush / Needle-And-Thread
Rhus Glabra / Pseudoroegneria Spicata Shrub Herbaceous Vegetation	Smooth Sumac / Bluebunch Wheatgrass
Salix Drummondiana / Carex Scopulorum Var. Prionophylla Shrubland	Drummond's Willow / Holm's Rocky Mountain Sedge
Salix Planifolia / Carex Scopulorum Shrubland	Tea-Leaf Willow / Holm's Rocky Mountain Sedge
Scirpus Maritimus Herbaceous Vegetation	Seacoast Bulrush
Stipa Comata Cover Type	Needle-And-Thread Grassland
Subalpine Freshwater Wetland Ec	Subalpine Freshwater Wetland Ec
Subalpine Riparian Wetland Ec	Subalpine Riparian Wetland Ec

(WNHP 2003)

Table 61 Threatened and Endangered wildlife species of the Methow subbasin, Washington

	Common Name	Scientific Name	State Status		Federal Status
Amphibians					
	Dunn's Salamander	*Plethodon dunni*	WA	Candidate Species	
	Western Toad	*Bufo boreas*	WA	Candidate Species	
	Columbia Spotted Frog	*Rana luteiventris*	WA	Candidate Species	
	Northern Leopard Frog	*Rana pipiens*	WA	Endangered	
Total Listed Amphibians:		4			
Birds					
	Common Loon	*Gavia immer*	WA	Sensitive	
	Western Grebe	*Aechmophorus occidentalis*	WA	Candidate Species	
	Northern Goshawk	*Accipiter gentiles*	WA	Candidate Species	
	Ferruginous Hawk	*Buteo regalis*	WA	Threatened	
	Golden Eagle	*Aquila chrysaetos*	WA	Candidate Species	
	Bald Eagle	*Haliaeetus leucocephalusi*		Threatened	
	Sage Grouse	*Centrocercus urophasianus*	WA	Threatened	Anticipated Candidate
	Sharp-tailed Grouse	*Tympanuchus phasianellus*	WA	Threatened	
	Marbled Murrelet	*Brachyramphus marmoratus*	WA	Threatened	Threatened
	Flammulated Owl	*Otus flammeolus*	WA	Candidate Species	
	Burrowing Owl	*Athene cunicularia*	WA	Candidate Species	
	Northern Spotted Owl	*Strix occidentalis*	WA	Endangered	Threatened
	Vaux's Swift	*Chaetura vauxi*	WA	Candidate Species	
	Lewis's Woodpecker	*Melanerpes lewis*	WA	Candidate Species	
	White-headed Woodpecker	*Picoides albolarvatus*	WA	Candidate Species	

	Common Name	Scientific Name	State Status		Federal Status
	Black-backed Woodpecker	*Picoides arcticus*	WA	Candidate Species	
	Pileated Woodpecker	*Dryocopus pileatus*	WA	Candidate Species	
	Loggerhead Shrike	*Lanius ludovicianus*	WA	Candidate Species	
	Horned Lark	*Eremophila alpestris*	WA	Candidate Species	Candidate
	White-breasted Nuthatch	*Sitta carolinensis*	WA	Candidate Species	
	Sage Thrasher	*Oreoscoptes montanus*	WA	Candidate Species	
	Vesper Sparrow	*Pooecetes gramineus*	WA	Candidate Species	
	Sage Sparrow	*Amphispiza belli*	WA	Candidate Species	
Total Listed Birds:		22			
Mammals					
	Merriam's Shrew	*Sorex merriami*	WA	Candidate Species	
	Townsend's Big-eared Bat	*Corynorhinus townsendii*	WA	Candidate Species	
	Pygmy Rabbit	*Brachylagus idahoensis*	WA	Endangered	Endangered
	White-tailed Jackrabbit	*Lepus townsendii*	WA	Candidate Species	
	Black-tailed Jackrabbit	*Lepus californicus*	WA	Candidate Species	
	Washington Ground Squirrel	*Spermophilus washingtoni*	WA	Candidate Species	Anticipated Candidate
	Western Gray Squirrel	*Sciurus griseus*	WA	Threatened	
	Northern Pocket Gopher	*Thomomys talpoides*	WA	Candidate Species	
	Gray Wolf	*Canis lupus*	WA	Endangered	Endangered
	Grizzly Bear	*Ursus arctos*	WA	Endangered	Threatened
	Fisher	*Martes pennanti*	WA	Endangered	
	Wolverine	*Gulo gulo*	WA	Candidate Species	
	Canadian Lynx	*Lynx canadensis*	WA	Threatened	Threatened
	White-tailed Deer	*Odocoileus virginianus*	WA	Endangered	Endangered

	Common Name	Scientific Name		State Status		Federal Status
Total Listed Mammals:		14				
Reptiles						
	Sharp-tail Snake	*Contia tenuis*		WA	Candidate Species	
	Striped Whipsnake	*Masticophis taeniatus*		WA	Candidate Species	
Total Listed Reptiles:		2				
Total Listed Species:		42				

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Table 62 Fish species status under the Endangered Species Act and the Salmon and Steelhead Stock Inventory in the Methow River subbasin

Species	ESA Status	SASSI Status
Spring Chinook	Endangered (1999)	-
Summer Chinook	-	Depressed (1993)
Summer steelhead	Endangered (1997)	Depressed (1993)
Bull trout	Threatened (1998)	Depressed (1993)
Redband trout	Species of concern	-
Pacific lamprey	Species of concern	-
Westslope cutthroat	Species of concern	-

Table 63 Partners in Flight species of the Methow subbasin, Washington

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
Northern Harrier	*Circus cyaneus*			Yes
Swainson's Hawk	*Buteo swainsoni*		MO (Intermountain West, Prairies)	Yes
Ferruginous Hawk	*Buteo regalis*			Yes
Rough-legged Hawk	*Buteo lagopus*		PR (Arctic)	
American Kestrel	*Falco sparverius*			Yes
Gyrfalcon	*Falco rusticolus*		PR (Arctic)	
Sage Grouse	*Centrocercus urophasianus*		MA (Intermountain West, Prairies)	
Spruce Grouse	*Falcipennis canadensis*		PR (Northern Forests)	
White-tailed Ptarmigan	*Lagopus leucurus*		MO (Arctic)	
Blue Grouse	*Dendragapus obscurus*		MA (Pacific, Intermountain West)	
Sharp-tailed Grouse	*Tympanuchus phasianellus*		MO (Prairies)	Yes
Long-billed Curlew	*Numenius americanus*	Yes		
Stilt Sandpiper	*Calidris himantopus*	Yes		
Flammulated Owl	*Otus flammeolus*		MO (Pacific, Intermountain West, Southwest)	Yes

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
Snowy Owl	*Nyctea scandiaca*		PR (Arctic)	
Northern Pygmy-owl	*Glaucidium gnoma*		PR (Pacific)	
Burrowing Owl	*Athene cunicularia*			Yes
Spotted Owl	*Strix occidentalis*		IM (Pacific, Intermountain West, Southwest)	
Great Gray Owl	*Strix nebulosa*			Yes
Short-eared Owl	*Asio flammeus*	Yes	MA (Arctic, Northern Forests, Intermountain West, Prairies)	Yes
Common Poorwill	*Phalaenoptilus nuttallii*			Yes
Black Swift	*Cypseloides niger*	Yes	IM (Pacific, Intermountain West)	Yes
Vaux's Swift	*Chaetura vauxi*			Yes
White-throated Swift	*Aeronautes saxatalis*		MA (Intermountain West, Southwest)	Yes
Calliope Hummingbird	*Stellula calliope*		MO (Intermountain West)	Yes
Rufous Hummingbird	*Selasphorus rufus*	Yes	MA (Pacific, Intermountain West)	Yes
Lewis's Woodpecker	*Melanerpes lewis*	Yes	MO (Intermountain West, Prairies)	Yes
Williamson's Sapsucker	*Sphyrapicus thyroideus*		MO (Intermountain West)	Yes
Red-naped Sapsucker	*Sphyrapicus nuchalis*		MO (Intermountain West)	Yes
Red-breasted Sapsucker	*Sphyrapicus ruber*		MO (Pacific)	Yes
Downy Woodpecker	*Picoides pubescens*			Yes
White-headed Woodpecker	*Picoides albolarvatus*	Yes	PR (Pacific, Intermountain West)	Yes
Three-toed Woodpecker	*Picoides tridactylus*		PR (Northern Forests)	
Black-backed Woodpecker	*Picoides arcticus*		PR (Northern Forests)	Yes
Pileated Woodpecker	*Dryocopus pileatus*			Yes

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
Olive-sided Flycatcher	*Contopus cooperi*		MA (Pacific, Northern Forests, Intermountain West)	Yes
Western Wood-pewee	*Contopus sordidulus*			Yes
Willow Flycatcher	*Empidonax traillii*		MA (Prairies, East)	Yes
Hammond's Flycatcher	*Empidonax hammondii*			Yes
Gray Flycatcher	*Empidonax wrightii*		PR (Intermountain West)	Yes
Dusky Flycatcher	*Empidonax oberholseri*		MA (Intermountain West)	Yes
Pacific-slope Flycatcher	*Empidonax difficilis*		PR (Pacific)	Yes
Loggerhead Shrike	*Lanius ludovicianus*			Yes
Northern Shrike	*Lanius excubitor*		PR (Northern Forests)	
Warbling Vireo	*Vireo gilvus*			Yes
Red-eyed Vireo	*Vireo olivaceus*			Yes
Gray Jay	*Perisoreus canadensis*		PR (Northern Forests)	
Clark's Nutcracker	*Nucifraga columbiana*		PR (Intermountain West)	Yes
Horned Lark	*Eremophila alpestris*			Yes
Bank Swallow	*Riparia riparia*			Yes
Chestnut-backed Chickadee	*Poecile rufescens*		PR (Pacific)	
Boreal Chickadee	*Poecile hudsonicus*		MA (Northern Forests)	
White-breasted Nuthatch	*Sitta carolinensis*			Yes
Brown Creeper	*Certhia americana*			Yes
House Wren	*Troglodytes aedon*			Yes
Winter Wren	*Troglodytes troglodytes*			Yes
American Dipper	*Cinclus mexicanus*			Yes
Western Bluebird	*Sialia mexicana*			Yes
Mountain Bluebird	*Sialia currucoides*		PR (Intermountain West)	

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
Townsend's Solitaire	*Myadestes townsendi*			Yes
Veery	*Catharus fuscescens*			Yes
Swainson's Thrush	*Catharus ustulatus*			Yes
Hermit Thrush	*Catharus guttatus*			Yes
Varied Thrush	*Ixoreus naevius*			Yes
Sage Thrasher	*Oreoscoptes montanus*		PR (Intermountain West)	Yes
American Pipit	*Anthus rubescens*		PR (Arctic)	Yes
Bohemian Waxwing	*Bombycilla garrulus*		MA (Northern Forests)	
Orange-crowned Warbler	*Vermivora celata*			Yes
Nashville Warbler	*Vermivora ruficapilla*		PR (Northern Forests)	Yes
Yellow Warbler	*Dendroica petechia*			Yes
Yellow-rumped Warbler	*Dendroica coronata*			Yes
Black-throated Gray Warbler	*Dendroica nigrescens*		MO (Pacific)	Yes
Townsend's Warbler	*Dendroica townsendi*			Yes
Hermit Warbler	*Dendroica occidentalis*	Yes	MO (Pacific)	Yes
Macgillivray's Warbler	*Oporornis tolmiei*			Yes
Wilson's Warbler	*Wilsonia pusilla*			Yes
Yellow-breasted Chat	*Icteria virens*			Yes
Western Tanager	*Piranga ludoviciana*			Yes
Chipping Sparrow	*Spizella passerina*			Yes
Brewer's Sparrow	*Spizella breweri*	Yes	MA (Intermountain West)	Yes
Vesper Sparrow	*Pooecetes gramineus*			Yes
Lark Sparrow	*Chondestes grammacus*			Yes

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
Black-throated Sparrow	*Amphispiza bilineata*			Yes
Sage Sparrow	*Amphispiza belli*	Yes	PR (Intermountain West)	Yes
Grasshopper Sparrow	*Ammodramus savannarum*		MA (Prairies)	Yes
Fox Sparrow	*Passerella iliaca*			Yes
Lincoln's Sparrow	*Melospiza lincolnii*		PR (Northern Forests)	Yes
Lapland Longspur	*Calcarius lapponicus*		PR (Arctic)	
Snow Bunting	*Plectrophenax nivalis*		PR (Arctic)	
Black-headed Grosbeak	*Pheucticus melanocephalus*			Yes
Bobolink	*Dolichonyx oryzivorus*	Yes		
Western Meadowlark	*Sturnella neglecta*			Yes
Bullock's Oriole	*Icterus bullockii*			Yes
Pine Grosbeak	*Pinicola enucleator*		MO (Northern Forests)	
Purple Finch	*Carpodacus purpureus*			Yes
Cassin's Finch	*Carpodacus cassinii*		MA (Intermountain West)	
Red Crossbill	*Loxia curvirostra*			Yes
White-winged Crossbill	*Loxia leucoptera*		PR (Northern Forests)	
Total Species:	98			

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Appendix D: Projects in the Methow subbasin

Table 64 Projects in the Methow subbasin

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Methow subbasin				
Yakama Nation	Alaska	2003 to present	Monitor summer chinook status	
Yakama Nation	PCSRF		Spring chinook pedigree study	
Yakama Nation	BPA Project #9208200		Eastern Washington Landowners Adopt-Stream Training	Groups were targeted for training in stream and watershed management to enhance habitat for anadromous fish. Six watershed-training meetings were held for target groups of Native Americans, ranchers, and foresters in eastern Washington. Conducted 6 watershed-training meetings for various groups in eastern Washington.
Yakama Nation	Funding WDOE and BPA	1999 - 2000	Methow Valley Irrigation District, Reorganization to wells,	Lower ditch was shut off and individuals served by the lower ditch were converted to wells.
Yakama Nation and Methow River Valley Irrigation District	BPA Project # 199603401	ongoing project		Examine the feasibility of alternatives and recommend a project to address water conservation, benefit fish and continue to provide water for irrigation.
Yakama Nation	BPA Project #199802500	2000-2001	Early Winters Creek Habitat Restoration	Restored historic fish, riparian and floodplain habitat, identified methods to augment instream flow to increase spawner success and juvenile survival. Project was completed the summer of 2000 with some follow-up monitoring in 2001.
Yakama Nation	BPA Project #9604000	1996 ongoing	Mid-Columbia Coho Feasibility Reintroduction Study	This project was initiated in 1996. The project is designed to gather data and develop and implement plans for coho restoration in the Methow, Entiat, and Wenatchee river basins in concert with various state and federal agencies. The project is centered on the development of a localized broodstock while minimizing potential negative interactions among coho and listed and sensitive species.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Yakama Nation	BPA Project #23024 200106500	2003	Hancock Springs Passage and Habitat Restoration Improvements, Yakama Nation	The project is designed to increase juvenile salmonid access to, and enhance the habitat of Hancock Springs, a spring fed off-channel to the upper Methow River. Project objectives are to 1) increase the number of juvenile spring Chinook and steelhead utilizing Hancock Springs, and 2) increase the overwinter survival of juvenile spring Chinook and steelhead in the Methow River.
Yakama Nation FWS	BPA Project #199802900	1998-2001	Goat Creek Instream Habitat Restoration	Instream habitat restoration work and instream rehabilitation.
Yakama Nation	BPA Project #200103700		Arrowleaf/Methow River Conservation Easement	Purchase prime riparian habitat in the form of a conservation easement.
Yakama Nation WDFW	BPA Project #200106300	2002	Methow Basin Screening	Provide fish screen facilities and new fish screen construction at Methow subbasin irrigation diversions including Foghoorn, Rockview, McKinney Mountain, Kum Holloway. Some equipment upgrades are also included under the project.
Yakama Nation	Douglas County PUD	Ongoing since 1987	Methow Basin spring Chinook spawner surveys	Basin wide spawner surveys have been conducted. This information is summarized each year in an annual report submitted to Douglas County PUD. The data set consists of redd counts by stream reach for each major tributary in which spring Chinook spawn, estimated spawner escapement, plus bio-sample data (i.e. scale samples, recovery of CWTs, notation of external marks, sex, body length and extent of gamete retention).
Yakama Nation	Douglas County PUD	1993 ongoing	Methow Basin Spring Chinook Salmon Supplementation Program (MBSCSP)	The Yakama Nation contracted with Douglas County PUD in 1993 to conduct monitoring and evaluation activities as part of the MBSCSP. The Methow Basin Spring Chinook Supplementation Plan dictates specific monitoring and evaluation tasks associated with the Program. Since 1993 the spawner surveys have been incorporated into the MBSCSP.
Yakama Nation and Methow Valley Irrigation District				Negotiations to resolve the issue of inadequate instream flows in the lower Twisp River.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Implemented by WDFW	BPA		Methow Watershed Project II	An ongoing $12 million effort to identify and secure more than 5,000 acres of critical riparian/floodplain habitat and linkages to protected upland through fee title acquisition and conservation easements. BPA contributed over $2 million to purchase conservation easements on portions of over 1000 acres of habitat.
USFS	BPA Project #9026,	1993 - ongoing	Respect the River	Respect the River is an ongoing interpretive and public contact program that started out with informational/educational signs along the Methow River and its tributaries. The program has been repeatedly expanded to include both media and one-on-one contacts with river users and to include numerous additional drainages within the Methow subbasin.
University of Washington	BPA Project #199803500	1998-2003	Measure Mine Drainage Effects of Alder Creek	The project involved analyzing the leachable metals in the Methow River and Alder Creek drainages resulting from the abandoned Alder Mine. The Alder Creek Mine is on the western slope of McClure Mountain at 3600 feet on private land surrounded by National Forest. While it is clear that Alder Creek has been impaired, the extent of impact has not been determined.
	BPA Project #199603450		Methow River Valley NEPA Study	NEPA archaeological and historical studies of the Methow Irrigation District. This contract provided for public involvement, communication and coordination support for the NEPA process.
	American Bird Conservancy	1997	Conservations Strategy for Landbirds	Program identified important habitats and desired habitat conditions, and provided interim management targets and recommended management actions for land birds and their habitats.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Methow Conservancy	Funded by State of Washington Interagency Committee for Outdoor Recreation 97-1310	1997-2001	Methow Conservancy Riparian Habitat Project	For the facilitation or purchase of conservation easements that would protect riparian habitat in the Methow Watershed for perpetuity. By the summer of 2001, nine property owners, representing 526 acres and over $930,000 of donated easement value had completed these voluntary conservation restrictions on their properties. The areas include riparian/agricultural lands on the mainstem Methow River and the Little Cub Creek (Rendezvous) complex, an important, upland watershed of the Chewuch River, a tributary of the Methow. Landowners have created protective buffer zones along the critical riparian areas near the river and creeks, have agreed to forest management and land use plans to promote values of watershed and wildlife enhancement, and have agreed that this is to be done for perpetuity.
FWS	BPA Funded	2001	Goat Creek Menader Reconstruction	Restore function floodplain and natural stream morphology within the confines of the lower 1.5 miles of Goat Creek to improve the migrational corridor for bull trout and steelhead,
			Twisp Acclamation ponds	
Methow Conservancy	Funded by State of Washington Salmon Recovery Funding Board 00-1677	2001-ongoing	Methow Watershed Riparian Habitat Acquisition	To help protect spring Chinook salmon, bull trout and steelhead trout habitat in the Methow subbasin. The award to the Conservancy provides financial assistance to landowners who want to assure that their lands along the Twisp, Chewuch and Methow Rivers remain as relatively pristine habitat for fish and wildlife. As of September of 2001, seventeen property owners, representing 870 plus acres and over four miles of riverfront in the areas identified by the Upper Columbia Regional Technical team and Washington State Conservation Commission's Limiting Factors Analysis as of the utmost importance to salmon recovery have signed Letters of Understanding to begin the easement process with the Methow Conservancy.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Methow Conservancy		November 2000 to October 2001	Partners in Flight Habitat Prioritization	This Songbird Conservation Project brought a land trust (the Methow Conservancy) and several conservation biologists (from the U.S. Forest Service, American Bird Conservatory, and the Washington Department of Fish and Wildlife) together to survey and recommend ways to protect the best privately owned riparian areas in the Methow Valley. The Project allowed for detailed landscape-level mapping and analysis of Methow Valley songbird habitat, along with extensive one-to-one habitat conservation education and many hours of on-the-ground surveys, which formed an important foundation for future conservation easements, research and planning.
Methow Valley Irrigation District	Funding WDOE and BPA, project is also listed under BPA funded projects	1999 to 2000.	Reorganization to wells	Lower ditch was shut off and individuals served by the lower ditch were converted to wells.
Methow Valley Irrigation District	Funding WDFW	2001	Remeshing of MVID screens	Screens along both the Methow and Twisp rivers were remeshed to NMFS standard in the spring of 2001.
Okanogan County/ FWS	Salmon Recovery Act RCW 77.85/HB2496 00-1643	2000	Wolf Creek Channel Restoration	Enhanced fish passage and created additional instream habitat during summer low flow for steelhead and Chinook and bull trout in Wolf Creek.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 00-1629	NA	Skyline Ditch Pipe Installation	Assisted in piping part of the 6.2 mile Skyline Ditch in high water loss areas. This irrigation diversion is located on the Methow River.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1612	NA	Airey/Risley Ditch Removal	Removed an irrigation diversion structure and reduced the length of conveyance on an irrigation canal on the Twisp River.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1613	NA	Buttermilk Creek Ditch Fish Screen	Installed a fish screen on the Buttermilk Creek irrigation ditch on the Twisp River.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1691	NA	Skyline Ditch repair	Repaired the headgate at the Skyline Ditch diversion on the Chewuch River and replaced the delivery ditch with pipe in a high water loss area.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1347	NA	Aspen Meadows Ditch Piping	Replaced a portion of the Aspen Meadows irrigation ditch with pipe to prevent water loss on Little Bridge Creek, a tributary to the Twisp River.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1345	NA	Fulton Ditch Lining Project	Lined a portion of the Fulton irrigation canal to prevent seepage/water loss. The Fulton diversion is located on the Chewuch River.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1340	NA	Eagle Creek Ditch Fish Screen	Removed an irrigation ditch and installed a well on Eagle Creek, a tributary to the Twisp River.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1339	NA	Tourangeau Ditch retirement	Abandoned the Tourangeau irrigation canal and installed a well on Little Bridge Creek, a tributary to the Twisp River.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1344	NA	Early Winters Ditch Diversion Structure	Constructed a fish friendly diversion structure that ensures flow to the Early Winters irrigation canal.
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496 99-1692	NA	Little Bridge Creek Culvert passage	Provided engineering & design work to determine alternatives and costs associated with solving a culvert blockage problem on Little Bridge Creek.
Okanogan Conservation District	Department of Natural Resources	1997	Pete's Creek planting and fencing	Seeded 65 acres with grass and planted 880 cottonwood and dogwood whips. Also installed 7,745 feet of cross fence to control grazing and protect riparian areas in the upper watershed.
Okanogan Conservation District	Department of Natural Resources	1997	French Creek fencing	Installed 6,792 feet of fence to protect riparian zone.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Okanogan Conservation District	Department of Natural Resources	1998	Pete's Creek planting and road deactivation	Project to control access road erosion control. Planted 2,000 cottonwoods, 100 pines, and 100 aspen. Developed spring for stock water outside the riparian zone.
Okanogan Conservation District	Department of Natural Resources	1998	French Creek fencing & livestock watering	Installed 6,864 feet fence to protect riparian zone. Installed two miles of pipeline and two troughs for livestock water outside the riparian zone. Planted 6,000 cottonwoods and dogwood whips.
Okanogan Conservation District/NRCS	Department of Natural Resources	1998	Cow Creek planting and erosion control	Instituted measures to control road erosion on an access road. Planted 2,000 cottonwoods, 6,000 dogwoods, 200 pine and stabilized headcut.
Okanogan Conservation District/ NRCS	Department of Natural Resources	1998	Texas Creek planting and livestock control	Planted 6000 dogwoods and 2,000 cottonwoods. Created livestock barriers in creek channel by felling trees.
Okanogan Conservation District,NRCS, DNR, USFS, MVSTA	Department of Natural Resources	1998-1999	Wolf Creek fencing and livestock watering	Built 1.7 miles of fence to exclude livestock from the river. Drilled wells and installed 2,000 feet of pipe and two troughs for stock water outside of riparian zone.
Okanogan Conservation District and the Pacific Watershed Institute	USFW	2000	Methow River, Lehman Site fencing, planting and livestock watering	Drilled a well and installed 500 feet of pipe and one trough for fall stock water outside the riparian zone. Installed 2,640 feet exclusion fence creating a 175-foot riparian buffer. Installed 2,000 feet of pipeline and two troughs for winter stock water outside the riparian zone. Removed corrals from riverbank and rebuild 350 feet away from the river. Replanted the old corral site with native trees and shrubs.
Okanogan Conservation District and the Pacific Watershed Institute	USFW	2000	Methow River, Konrad site planting and livestock watering	Fenced .75 miles of river bank and planted .25 miles of streambank and irrigate riparian plantings. Developed solar stock water system for trough and storage.
Okanogan Conservation District and the Pacific Watershed Institute	Salmon Recovery Funding Board 00-1681	2000 - ongoing	Beaver Creek Fish Passage Barrier Amelioration	This project will provide fish passage that is compatible with irrigation needs on Beaver Creek in addition to eliminating one diversion dam and replacing it with a well.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Okanogan Conservation District and the Pacific Watershed Institute	Salmon Recovery Funding Board	ongoing	Okanogan County Fish Passage Barrier Survey	This project will inventory and access all potential fish passage barriers including unscreened diversions in Okanogan County. Identified barriers will be prioritized for correction based on quality and quantity of habitat.
Pacific Watershed Institute	Jobs for the Environment Program & USFS, FWS, WDFW and PWI	1996 - 1998	Restored riparian vegetation in a mile long dispersed recreation area near the Chewuch River	Activities included road obliteration, fencing, seeding in meadow areas, stream bank re-grading and re-vegetation with associated LWD (LWD) placement in key locations. Construction of a bar apex jam to retain and encourage development of off-channel habitat areas. Placement of non-anchored log complexes within the off-channel area for cover.
Pacific Watershed Institute	Jobs for the Environment Program & USFS, FWS, WDFW and PWI	1996 - 1998	Enhanced and added road slope protection in a large side channel of Chewuch	Activities included: 1) development of a smaller pilot-channel across and island to deflect flow away from the road slope and provide future side channel development opportunities; 2) construction of lateral bar jams to deflect flow into the new side channel; and 3) construction of a large chaotic crib structure to protect the road slope while providing instream habitat and cover.
Pacific Watershed Institute	Jobs for the Environment Program & USFS, FWS, WDFW and PWI	1996 - 1998	Opened .5 mile side channel to increase year-round flow for juvenile rearing and flood refugia habitat	Enhanced the stream channel with 6 LWD complexes to provide summer and winter cover. Investigated ground water relationships to alluvial fan geomorphology as it relates to side channel development and winter habitat availability.
Pacific Watershed Institute	Jobs for the Environment Program & USFS, FWS, WDFW and PWI	1996 - 1998	Restored access to flood channels on a channelized alluvial fan	Activities included the excavation of portions of constructed boulder berms to bankfill level and reshaping connections to the main flow to prevent sub-surface flow during summer.
Pacific Watershed Institute	Jobs for the Environment Program & USFS, FWS, WDFW and PWI	1996 - 1998	Chewuch off channel restoration	Addition of 6 LWD structures to a depositional area of the Chewuch in order to maintain an off–channel area, provide hiding cover and shading. Also, restoration of riparian area in a dispersed campsite.
Pacific Watershed Institute	Jobs for the Environment Program & USFS, FWS, WDFW and PWI	1996 - 1998	Metho0w River native plant collection and propagation program for re-vegetation projects	Propagation methods include transplants, shrub, tree and forb rooted cuttings, and seed collection and propagation to container stock. Project includes work with local and regional nurseries to propagate plants.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Pacific Watershed Institute	Jobs for the Environment Program & USFS, FWS, WDFW and PWI	1998	Monitoring of 6 restoration projects completed in 1996 & 1997	Monitoring includes re-vegetation success, LWD structures, channel geometry, sediment, habitat condition, hydrology and fish presence.
Upper Columbia Regional Fisheries Enhancement Group (UCRFEG) NCRS, OCD		2000	Fraser Creek Riparian Fence	Installed 1.25 miles of fencing to prevent livestock access to the stream and riparian zone.
UCRFEG		2002	Black Pine Basin Riparian Fence	Installed 1.1 miles of fencing to prevent livestock access to the stream and riparian zone.
UCRFEG		2002	South Fork Beaver Creek Riparian Fence	Installed .1 miles of fencing to prevent livestock access to the stream and riparian zone.
UCRFEG			Okanogan Fish Passage Inventory	Assisted Okanogan Conservation District with their assessment of barriers to fish migration.
WDFW	WWRP		Methow Corridors Project, Methow Corridors II Project, Methow Corridors Project III, Methow Watershed Project	Over $20 million of Washington Wildlife Recreation Program (WWRP) funding used to secure several thousand acres of critical lower elevation fish and wildlife habitats.
WDFW	Douglas County Public Utility District as part of the Wells Dam Settlement Agreement	ongoing	Spring Chinook artificial supplementation and captive broodstock program	Artificial supplementation and captive broodstock for spring Chinook
WDFW		ongoing	Operation and Management of the Methow Fish Hatchery for the production of ESA-listed upper Columbia River spring Chinook salmon	The program is responsible for broodstock collection spawning, rearing and releasing up to 550,000 spring Chinook smolts into the Methow River Basin annually.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
WDFW		ongoing	Summer Chinook artificial supplementation program	Operation and management of the Carlton Acclimation Pond and Eastbank Hatchery Facility for production of summer Chinook (400,000 smolts) as a component of the summer Chinook supplementation program associated with mitigation for the construction and operation of Rock Island Dam. The program collects broodstock and spawns, incubates, and releases 400,000 yearling summer Chinook into the Methow subbasin annually.
WDFW			Summer Chinook supplementation program evaluation	The program is funded by Chelan County Public Utility District as part of the Rock Island Project Settlement Agreement. Implementation of the summer Chinook supplementation hatchery evaluation program. The program monitors and evaluates the efficacy of supplementation efforts in the enhancement of summer the Chinook population in the Methow subbasin.
WDFW	Douglas County Public Utility District	ongoing	Summer steelhead hatchery supplementation program.	Operation and management of the Wells Dam Hatchery for the production of ESA-listed upper Columbia River steelhead in the Methow subbasin. The program collects broodstock and spawns, incubates and releases approximately 350,000 steelhead smolts in to the Methow Basin annually. It also provides the egg source for the 100,000- steelhead smolts stocked annually in to Methow subbasin from the Winthrop NFH.
WDFW	Chelan, Douglas and Grant County PUDs		Adult steelhead migration and spawning disposition	WDFW participated in a steelhead radio telemetry study in the mid-Columbia Region to assess the upstream migration and eventual spawning disposition of Upper Columbia River ESA-listed summer steelhead. The radio tags are applied at Priest Rapids Dam and monitored throughout migration and spawning, and includes the monitoring in Methow subbasin.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
WDFW	WDFW	ongoing	Upper Columbia River steelhead stock assessment	The stock assessment project occurs at Priest Rapids Dam and collects biological data related to enumeration, origin (hatchery/wild), age (fork-length and scale), and record of marked/tagged steelhead migrating above Priest Rapids Dam, including those destined for the Methow basin.
WDFW	WDFW	ongoing	Species abundance and distribution	WDFW fisheries personnel conduct annual and periodic species distribution abundance surveys in the Methow Basin.
WDFW	WDFW	ongoing	Creel Census Survey Information	Creel census information is gathered annually during the Methow River trout fishery season to assess angler success, angler effort, species assemblage, and population characteristics.
WDFW	WDFW	ongoing	Methow Wildlife Area Management Plan	Plan developed for WDFW lands in the Methow subbasin to conserve fish and wildlife resources and maximize wildlife-based recreation. Includes removing fish passage barriers and installing fish friendly irrigation components.
WDFW	WDFW		Wildlife species management or recovery plans	Developed Sharp-tailed Grouse Recovery Plan, Lynx Recovery Plan, Elk Management Plan, Black Bear Management Plan, Bald Eagle Recovery Plan.
WDFW	WDFW		Lynx research	Completed ongoing research projects in the 1980s documenting lynx ecology and potential management conflicts.
WDFW	WDFW & Northwest Ecosystem Alliance	ongoing	North Cascades Rare Carnivore Camera Survey	An ongoing volunteer partnership with Northwest Ecosystem Alliance to survey North Cascades backcountry areas with self-activated cameras for rare carnivores. Multiple occurrences of lynx and wolverine documented to date.
WDFW & USFS	Trust for Public Lands		Townsend's Big-eared Bat Project	Project involved construction of a "bat house" to replace a currently occupied structure (Rattlesnake House) slated for demolition or relocation and site preparation in anticipation of new funds to move an existing structure.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
WDFW & USFS			Mule Deer Research	Research projects in the 1970s and 1980s collected data on mule deer ecology and habitat needs for the West Okanogan herd.
WDFW & USFS & National Park Service (NPS)	WDFW & USFS & National Park Service (NPS)		Grizzly Bear/Gray Wolf Investigations Project	Project evaluated the status of grizzly bears and gray wolves in the North Cascades, and the ability of the North Cascades Ecosystem to support a viable grizzly population
WDFW & USFS & National Fish and Wildlife Foundation	WDFW & USFS & National Fish and Wildlife Foundation		Forest Carnivore Survey	Challenge cost-share project with National Fish and Wildlife Foundation to survey Okanogan National Forest lands for lynx, wolverine, fisher, and marten.
WDFW & USFS	WDFW & USFS, FWS & Skagit Environmental Endowment Commission		Wolverine Investigations	Document wolverine distribution and reproductive status.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	1998	Barkley (Methow River)	Fish screen completed summer 1998. On line 1999 irrigation season, tuneup complete spring 2001.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	1998	Chewuch (Chewuch River)	Completed fall 1998. Tuneup completed. Contributed 10 cfs to river.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	1999	Larson Ditch (Libby Creek)	Completed spring 99, Cap funded, owner cost-share.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	1999	WCRD (Wolf Creek)	Completed sprint 1999, did not divert until spring 2000, tuneup complete 5/31/00. Low flow season 10 cfs contributed to river because of Patterson Lake storage. Owner cost share SRFB. EI 75k, NMFS 25k.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	1999	Buttermilk (Buttermilk Creek)	Completed summer 1999, tuneup complete 5/31/00, (*) GSRO 17.5K, NMFS 11.5K, owner cost-share, (IAC not used)
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	1999	Eightmile (USFS, Eightmile Creek)	Completed spring 1999, USFS funded 18K. Point of diversion change contributed 8cfs to Chewuch.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2000	Twisp Power (Twisp River)	Completed spring 00, tuneup complete by 5/31/00, SRFB EI 80 K, NMFS 40K. WDFW negotiations returned 3 cfs to river.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2000?	Beaver Creek Basin (Beaver, Frazer, Storer)	IAC contract extension to 10/31/00, SRFB EI 100K, Proviso 50K. Will be completed Spring of 1991.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2000	Fulton (Chewuch River)	Completed spring 00, tuneup complete fall 2000, SRFB EI 100K, NMFS 50K, SRFB early 2000 33.5K, NMFS 16.5K. Saved 6 cfs with WDFW negotiations.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2000	Twisp Airey (Twisp River)	Conversion to pump completed spring 2000,GSRO 30K, [Cap Sup 25K, tuneup not yet completed, County has lead] 4 cfs returned to river, change of point of diversion.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2000	Skyline (Chewuch River)	Completed summer 00, SRFB early 2000 100K, NMFS 40K, Proviso 25K. Lined ditch. Saved 8 cfs.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2001	Early Winters (Early Winters Creek)	Pre-design, scheduled construction spring 01, funded SRFB early 2000 100K, NMFS 36.5K, Proviso 14.5K. Creek rebuilt by USFW. Point of diversion changes negotiated and completed. Low flow trigger returned to creek. 6cfs.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2001	McKinney Mtn. (Methow River)	Re-screened with 3/32 perforated plate 1999. Meets current criteria, scoping stage, flows an issue, scheduled spring 2001. Cap funded 25K.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2001	Fog Horn (Methow River)	FWS responsibility, scoping stage, construction scheduled fall 2001. Cap support 65K, FWS 100K.
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2001?	Rockview (Methow River)	Agency screen, re-screened with 3/32 mesh 2000 meeting criteria, pre-design 2001, Proviso 120K
WDFW, Irrigation Districts, USFS, FWS, others	WDFW, Irrigation Districts, USFS, FWS, others	2001	Kumn Holloway (Methow River)	Re-screened with 3/32 perforated plate 99. meets current criteria, scoping stage, construction scheduled spring 2001, Proviso 20K.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2000	Patterson Lake	Modified spillway to allow additional 450 acre-feet of water storage.
Wolf Creek Reclamation District, USFS	SRF Board and National Wildlife Foundation Funds	1999 - 2000	Lower Wolf Creek	Modified creek channel to improve passage opportunities for migrating fish.
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2000 - 2001	WCRD Distribution System	Installed 1,100 feet of new 21" PVC piping. Estimated saving of 500 to 800 acre-feet per year.
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2001	WCRD Distribution System	Installed 5,500 feet of new 18" PVC pipe in WCRD distribution system.
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2001	WCRD Distribution System	Reconstructed existing WCRD structure.
U.S. Forest Service	U.S. Forest Service	1994	Doe Creek	Completed road cut and fill stabilization. Project shifted road further into the hill, seeded, matted, planted, created a drainage ditch and kept sediment laden water from reaching the stream.
U.S. Forest Service	U.S. Forest Service	1994	Chewuch Road	21 miles of non-system roads retired.
U.S. Forest Service	U.S. Forest Service	1994	Chewuch	Survey done to identify the dispersed sites along the Chewuch. Modifying sites to reduce their impact on riparian and aquatic resources prioritized.
U.S. Forest Service	U.S. Forest Service	1994	Chewuch	Installed two miles of electric fence, two miles of barbed wire fencing (E. Chewuch). Cattle guard installed to protect main Chewuch River from migrating cattle.
U.S. Forest Service	U.S. Forest Service	1994	Poorman Creek	Completed variety of road obliteration, planting seeding, riparian rehabilitation projects.
U.S. Forest Service	U.S. Forest Service	1994	Eightmile Ranch	Pulled the fence line back from the river and planted Ponderosa pine.
U.S. Forest Service	U.S. Forest Service	1994	Lake Creek Trail	Rerouted short segments of trail and rehabilitated part that could deliver sediment into the river.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
U.S. Forest Service	U.S. Forest Service	1995	Chewuch Trail	Rerouted short segments of trail and rehabilitated part that could deliver sediment into the river.
U.S. Forest Service	U.S. Forest Service	1994	East Chewuch	Completed riparian surveys.
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Pre-work for LWD material for Chewuch, includes low elevation flights, channel cross-sections and design.
U.S. Forest Service	U.S. Forest Service	1995	Chewuch Campsites	Dispersed sites. Rehab work in 15-20 sites. Minor maintenance on work done previous year.
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Contracted with Watershed Restoration Program at Wenatchee Valley College for road/culvert inventory in uplands.
U.S. Forest Service	U.S. Forest Service	1995	Bromas	Completed road stabilization project.
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Replaced culverts off East Chewuch.
U.S. Forest Service	U.S. Forest Service	1995	Poorman Creek	Replanted riparian units and obliterated some road.
U.S. Forest Service	U.S. Forest Service	1995	Falls Creek	Completed seeding and cut/fill of slopes. Tested various approaches to see what worked best. Results were variable depending on slope orientation.
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Installed 2 miles fencing.
U.S. Forest Service	U.S. Forest Service	1995	Chewuch?	Began Proper Functioning Condition survey for riparian areas and instituted appropriate responses.
U.S. Forest Service	U.S. Forest Service	1996	Chewuch	Implemented large woody material project, two sites included large wood jams in streams and re-vegetation of area.
U.S. Forest Service	U.S. Forest Service	1996	Chewuch	Rehabilitation work on developed sites includes defining river access and moving use further away from shore.
U.S. Forest Service	U.S. Forest Service	1996	Chewuch and others	Many small road fixes, some obliteration of roads, closure, culvert work. Includes Chewuch, Eightmile, Falls, Ortell, Island Mountain, Sherwood, Sweetgrass, War Creek, Little Bridge and Buttermilk.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
U.S. Forest Service	U.S. Forest Service	1996	Long Creek	Moved water troughs in Long Creek and Cub Pass.
U.S. Forest Service	U.S. Forest Service	1996	Reynolds Landing	Rehabilitation work completed.
U.S. Forest Service	U.S. Forest Service	1996	Rogers Lake	Research Natural Areas designation in process, results in compilation of biological and physical information about Rogers's lake and Chewuch above Andrews Creek.
U.S. Forest Service	U.S. Forest Service	1997	Chewuch River	Site 9 on Chewuch River, added large wood.
U.S. Forest Service	U.S. Forest Service	1997	Vanderpool Crossing	Removed culvert, made passage fish friendly and re-vegitated area.
U.S. Forest Service	U.S. Forest Service	1997	Eightmile	Dispersed and developed site rehabilitation.
U.S. Forest Service	U.S. Forest Service	1997	Blackpine Lake	Beaver Creek fence.
U.S. Forest Service	U.S. Forest Service	1997	Chewuch	Rehabilitation and maintenance of Chewuch sites.
U.S. Forest Service	U.S. Forest Service	1998	Cub Creek	Road package prepared to determine which roads could be closed in preparation for implementation in 2000.
U.S. Forest Service	U.S. Forest Service	1998	Twentymile Creek	Road rehabilitation.
U.S. Forest Service	U.S. Forest Service	1999	Throughout	Modifications in campsites and campgrounds are revisited and maintained.
U.S. Forest Service	U.S. Forest Service	1999	Chewuch	Closed or obliterated USFS roads in Chewuch area.
U.S. Forest Service	U.S. Forest Service	1999	Barney creek (Falls Creek)	Road obliteration halfway completed.
U.S. Forest Service	U.S. Forest Service	2000	Throughout	Dispersed campsite maintenance
BOR	NA	2001 – ongoing	Methow Habitat Mitigation	All listed species – Greg Knott 509.997.0028 gknott@pn.usbr.gov
CBC	02-1524R	2003-2003	Chewuch Basin Irrigators Conveyance	All listed species – Chris Johnson 509.422.0300 $ 349,360
Chewuch Canal/Fulton Ditch Co	00-1679N	2000	Chewuch & Fulton Canal Joint Study	All listed species – Dave Sabold 509.996.2368 $ 61,592

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Methow Conservancy	01-1434	2003 – ongoing	Methow R/H Acquisition Supplement 2001	Katharine Bill $ 499,800
Methow Conservancy	02-1650	2003 – ongoing	Methow Critical Riparian Habitat Acq	Katharine Bill 2,303,542
Methow Valley Flyfishers, Methow	NA	2001 - 2001	Belsby Spring Ck Restoration Project	Ben and Leslea Dennis 509.996.2784 $ 12,000+
MSRF	00-1676	2000 - ongoing	Lower Twisp R side Channel Acquistion	Steelhead, Spring Chinook Terry O'Reilly 509.996.3689 $ 365,626
MSRF	01-1419	2001 - ongoing	Sloan Witchert Slough Habitat/Irrigation	Steelhead, Spring Chinook Terry O'Reilly 509.996.3689 $ 281,397
MSRF	01-1427	2001 - ongoing	Early Winters CK Dike Removal	Steelhead, Spring Chinook Terry O'Reilly 509.996.3689 $ 255,041
MSRF	NA	2001 - ongoing	Lower Twisp Habitat Restoration	Steelhead, Spring Chinook Terry O'Reilly 509.996.3689 $ 300,000
MSRF	NA	2002 - ongoing	Eightmile ditch conversion to wells	Steelhead, Spring Chinook Terry O'Reilly 509.996.3689 $ 140,000
NRCS	NA	1998	French Ck revegetation and water development	Randy Kelley 509.422.2750 ext 3 randy.kelley@wa.usda.gov
NRCS, Okanogan County	NA	2000	Hancock Ck cattle exclusion and revegetation	Randy Kelley
OCD	01-1395	2002 – ongoing	Beaver Ck Coordinated Resource Mgt Plan	Craig Nelson $ 81,464
OCD	NA	1992 - 1994	Lower Methow tributary restoration	Craig Nelson
Okanogan County	99-1346	?	Skyline Ditch Pipe Installation	All listed species Julie Dagnon $ 18,415
Okanogan County	NA	2000 – ongoing	Methow Stream Gaging	All listed species Julie Dagnon

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Okanogan County	NA	2002 – ongoing	Methow Ditch Diversion Measuring Devices	All listed species Julie Dagnon
Okanogan County	NA	2002 – ongoing	Methow Habitat Area Assessment	All listed species Julie Dagnon
Okanogan County	NA	2001 - 2003	Methow Groundwater Assessement	All listed species Julie Dagnon
PWI	00-1678	2001 - 2002	Assessment Twisp R Watershed	All Species Sandra Strieby 509.996.3452 $ 185,626
PWI, USFS	NA	1995 - 1996	Chewuch Wateshed Strategy	All Species Sandra Strieby
PWI, USFS, MVRD, JFE, YIN	NA	1996 – 1999	Chewuch Watershed Restoration	All Species Sandra Strieby
PWI	NA	1998 – 2001	Early Winters Ck Restoration	All Species Sandra Strieby $ 159,000
PWI	NA	1998 - 2002	Cub, Little Cub, Bearfight creeks Restoraiton	All Species Sandra Strieby $ 523,003
PWI, OCD, MSRF, JITW, Landowners	NA	2000 – 2004	Methow Basin Restoration	All Species Sandra Strieby $ 490,830
FWS	NA	2002 - 2002	Goat Ck instream habitat restoration	Bull Trout, rainbow, spring Chinook Kate Terrelll
USFS	NA	1993 - ongoing	Basinwide Fencing Projects	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us $ 47,777
USFS	NA	1999 - ongoing	Basinwide campground improvement	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us $

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
USFS	NA	1996 - ongoing	Basinwide Dispersed Campsite Maintenance and Rehabilitaiton	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us $ 14,100
USFS	NA	1993 - ongoing	Chewuch dispersed recreation site restoration	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us $ 30,000
USFS	NA	2000 - 2000	Basinwide Culvert Inventory	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us
USFS	NA	1995 - 1996	Chewuch Basin Road and Culvert Inventory	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us $ 4040 +
USFS	NA	1993 - ongoing	Basinwide Road Obliteration, Restoration, Closure	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us $ 57,000
USFS	NA	1995 - 2002	Basinwide Culvert Replacement	All Species Jennifer Molesworth 509.996.4010 jmolesworth@fs.fed.us
USFS	NA	1995 - 1996	Basinwide Proper Function Condition surveys	All Species Jennifer Molesworth 509.996.4010
USFS	NA	1994 - 1994	Texas Ck water development	Jennifer Molesworth 509.996.4010
USFS	NA	1996	Poorman Ck revegatation	Jennifer Molesworth 509.996.4010
USFS	NA	1996 - 1996	Chewuch trail rehab	Jennifer Molesworth 509.996.4010

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
USFS	NA	1996 - 1998	Pete Ck reveg and weed control	Jennifer Molesworth 509.996.4010
UCRFEG	00-1217	2001 - 2003	Hancock Creek Restoration Project	Juvenile Chinook, Steelhead Larry Bailey 509.486.2400 larry@ncidata.com $ 17,654
WDFW	00-1158	C	Skyline Canal Fish Screen	All Species Pat Schille $ 165,000
WDFW	00-1165	NA	Fulton Canal Fish Screen	All Species Pat Schille $ 50,000
WDFW	99-1324	C	Beaver Ck Watershed Fish Passage	All Species John Easterbrooks $ 142,727
WDFW	99-1325	C	Twisp-Power Ditch Fish Screen	All Species John Easterbrooks $ 130,000
WDFW	99-1328	C	Fulton Canal Fish Screen	All Species Pat Schille $ 150,000
WDFW	00-1156	C	Early Winters Canal Fish Screen	All Species Pat Schille $ 151,000
WDFW, TPL	23012	NA	Arrowleaf/Methow River Conservation Easement	Craig Lee
WCRD	00-1682	2001 - ongoing	Wolf Ck Diversion /Patterson Mtn	Spring Chinook, Bull trout Nim Titcomb 509.996.3302 ntitcomb@methow.com $ 275,373
WCRD	NA	2004	Wolf Creek Rock Pool Structures	Spring Chinook, Bull trout Nim Titcomb 509.996.3302 ntitcomb@methow.com $ 90,000

Appendix E: Methow Subbasin Hatcheries and Production Summaries

Winthrop National Fish Hatchery

The Winthrop NFH was established by the GCFMP in 1937 to help mitigate for anticipated anadromous fish losses above Grand Coulee Dam (Grand Coulee Dam was completed in 1942). The hatchery is funded by the Bureau of Reclamation and operated by the U.S. Fish and Wildlife Service and is a sub-station of the Leavenworth NFH Complex. The Columbia River Fisheries Management Plan under the U.S. v Oregon decision of 1969 set production goals. Winthrop NFH is located near Winthrop, Washington on the Methow River.

Prior to the mid-1970s, cutthroat, rainbow, and brook trout, sockeye, summer steelhead, coho, and spring and summer Chinook salmon were propagated at Winthrop NFH. Current production consists of an Endangered stock of spring Chinook, with a total release goal of 600,000 smolts annually.

Table 65 Yearling spring Chinook salmon released from Winthrop NFH, 1990 to 1999

Year	Number Released	Year	Number Released
1990	1,121,395	1995	770,847
1991	1,055,056	1996	112,395
1992	624,771	1997	14,620
1993	950,624	1998	324,851
1994	556,313	1999	545,062

The hatchery also propagates listed summer steelhead and unlisted coho salmon. From 1990 to 1999, an average of 197 spring Chinook adults have returned to the facility (Carie and Hamstreet 2000). Return% by brood year has varied considerably, ranging from a high of .165% in 1980 to a low of .001% in 1990 ().

Non-indigenous Carson origin stock are being phased out and replaced with Methow Basin Composite Stock (Carie and Hamstreet 1999). At present no sport or tribal harvest occurs in the Methow subbasin. Winthrop National Fish Hatchery developed an HGMP which was submitted to NOAA-fisheries November 2002.

Table 66 Yearling spring Chinook releases, total returns and% returns to Winthrop NFH 1979-1993

Brood Year	Releases	Total Returns	% Return
1979	966,300	402	0.042
1980	712700	1175	0.165
1981	953508	1028	0.108
1982	985081	877	0.089
1983	1167625	1031	0.088
1984	1062794	736	0.069

Brood Year	Releases	Total Returns	% Return
1985	1069293	163	0.015
1986	1090200	90	0.008
1987	865734	117	0.014
1988	1121395	703	0.063
1989	1055056	263	0.025
1990	624771	3	0.001
1991	950624	21	0.002
1992	556,313	202	0.036
1993	770,847	370	0.048

Source: Carie and Hamstreet 1999

Coho salmon are cultured at the Winthrop NFH as part of the of coho reintroduction feasibility study. The Yakama Nation acclimated and released between 69,000 and 341,000 yearling coho smolts in the Methow subbasin between 1995 and 1998 from the Winthrop NFH and acclimation sites on the Chewuch River and Wolf Creek. Subsequent releases from the Winthrop NFH occurred in 2000 and 2001 and totaled 199,763 and 260,319 smolts respectively (K. Murdoch, YIN, pers.comm.).

Estimates of hatchery coho smolt-to-adult survival in the Methow for releases made in 1995-1997 averaged 0.001% (). This survival rate was based on the number of coho adults and jacks passing Wells Dam as enumerated via video monitoring (Dunnigan 2000).

Table 67 Release years, numbers, locations, and smolt-to-adult survival estimates for all coho smolt releases in the Methow sub-basins 1995-2001

Year	Release Location	Release Number	Adult Returns	Smolt-to Adult Survival (%)	Counting Location
1995	Winthrop NFH	70,000	1	0.001%	Wells Dam
1996	Winthrop NFH	235,300			
	Chewuch R.	100,000			
		335,300	3	0.001%	Wells Dam
1997	Winthrop NFH	69,200			
	Chewuch R.	5,000			
		74,200	1	0.001%	Wells Dam
1998*	Winthrop NFH	169,200			
	Chewuch R.	95,099			
	Wolf Creek	76,847			
		341,146	246	0.072%	Wells Dam Trapping and Video
1999	Wenatchee River releases only				
2000	Winthrop NFH	199,763	N/A	N/A	N/A
2001	Winthrop NFH	260,319	N/A	N/A	N/A

*Note: In 1998 program emphasis shifted to local broodstock development.

In 1998 the reintroduction program shifted emphasis to the development of a localized broodstock. As the program transitions from the exclusive use of lower Columbia River hatchery coho towards the exclusive use of in-basin returning broodstock, it is expected that positive trends in smolt-to-adult survival will be observed.

Returns in 1999 calculated from the total number of coho collected for broodstock at Wells Dam and the Wells Dam passage counts, were an order of magnitude higher than previous smolt-to-adult estimates. Based on trapping and video counts, 246 adult coho returned to the Methow Basin resulting in a smolt-to-adult survival rate of 0.07%.

Methow Fish Hatchery

The Methow Fish Hatchery was constructed in 1992 to compensate for passage mortality of spring Chinook salmon at Wells and Rock Island dams. Douglas County PUD funded the construction and is responsible for funding operations and maintenance (Wells Dam Settlement Agreement 1990), while WDFW operates the facility. The Methow Fish Hatchery is located on the Methow River.

The central facility consists of 24 start tanks, 15 raceways and an acclimation pond. In addition 3 of the existing raceways function as adult holding ponds. The facility also has two satellite facilities located on the Chewuch and Twisp rivers. The satellite facilities provide adult trapping and juvenile acclimation capabilities. Details of the hatchery facility and acclimation ponds are included in a 1995 Washington Department of Fish and Wildlife summary report on the Methow subbasin spring Chinook salmon hatchery program (Bartlett 1997).

The Methow Fish Hatchery operates as an adult-based supplementation program using multiple adult broodstock collection locations including the Chewuch, Twisp, and upper Methow rivers. Additional supplementation includes volunteer returns to Methow Fish Hatchery, Winthrop NFH and Wells Hatchery on the Columbia Mainstem.

The hatchery also operates as a captive broodstock program in the Twisp River. The long-term production objective for the Methow Fish Hatchery was set at 738,000 yearling spring Chinook smolts in the Wells Dam Settlement Agreement (1990). However, that production objective was modified during the development of the Mid-Columbia Habitat Conservation Plan (MCHCP) to 550,000 yearlings at 15 fish/lb. (BAMP 1998).

In years with adequate adult returns, production is limited by an insufficient number of start tanks and raceways. In low water years, production is limited by insufficient water volume because the Methow Fish Hatchery's water supply depends on a combination of ground water and surface water from the Methow River.

The long-term production objective and the interim production objective are both consistent with the Draft Biological Opinion for Section 10 Permit 1196 (ESA-Section 7 Biological Opinion for Section 10 Permit 1196, NMFS, 1999).

The location and extent of the trapping for the adult based supplementation program is determined by the expected adult return to Wells Dam (based on lower river dam counts). Broodstock collection in 1994 and 1995 maximized escapement for natural production and created a "bottleneck" in the supplementation program by limiting effective population size.

Effective population size for all artificial production in the subbasin consisted of 63 fish (32% extraction rate) in 1994 and 20 fish (20% extraction rate) in 1995. A summary of the number and location of spring Chinook broodstock collected and retained as part of the Methow River Basin spring Chinook adult based supplementation program, 1992-1999 is contained in **Table 68**.

Table 68 Number and location of spring Chinook broodstock collected and retained as part of the Methow River Basin spring Chinook adult based supplementation program, 1992-1999

	Brood Cycle							
Trapping Location	1992	1993	1994	1995	1996	1997	1998	1999
Wells Dam	0	0	0	6	461	192	409	309
Tributaries	54	152	17	0	0	0	0	0
Winthrop NFH	332	646	29	7	0	231	0	12
Methow FH	0	99	17	7	0	131	0	56
Total Escapement to Wells Dam	1573	2626	258	113	461	1163	439	649

Source: Brown 2000. Unpublished data, WDFW.

Poor returns and related limited broodstock collection compounded with by historically poor spring Chinook replacement rate of .669 recruits per spawner (1985-1990; LaVoy unpublished) prompted the development of a 3-tiered broodstock collection protocol for the spring Chinook supplementation program in the Methow subbasin (**Table 69**).

Under a revised approach adopted in 1996, the location and extent of broodstock collections is based on projected escapement at Wells Dam. Broodstock collection protocols are now developed annually and are determined by adult escapement above Wells Dam, expected escapement to tributary and hatchery locations, estimated wild/hatchery proportion, and production objectives and stock origin (endemic/non-endemic).

Table 69 Broodstock collection guidelines of the Methow Basin spring Chinook supplementation plan (ESA Section 7 Draft Biological Opinion, Section 10 Permit 1196)

Wells Escapement Projection	Broodstock Collection Objective
< 668	100% collection of Wells Dam escapement; place all fish into the adult-based supplementation program.
>668 <964	Pass a minimum of 296 adults upstream of Wells Dam for natural spawning.
> 964	Collection at levels to meet interim production level of 550,000 and 600,000 smolts at Methow Fish Hatchery and Winthrop NFH, respectively.

The Captive Broodstock Program promotes the unique population-specific attributes of the Twisp River population and constitutes an alternative to the spread the risk hatchery production strategy. Beginning with brood year 1997, approximately 1,000 to 1,500 eyed-eggs of pre-emergent fry were hydraulically removed from redds on the Twisp River (Bartlett, WDFW pers.comm.).

The eggs/pre-emergent fry were then transferred to the Methow Fish Hatchery where they reared to a yearling stage, and later transferred to AquaSeed Inc. in Rochester, Washington, to mature to adult stage. However, because of funding allocation difficulties, the Twisp River captive broodstock program has not obtained brood year components since 2000.

The hatchery and acclimation ponds are operated in a manner that is consistent with accepted aquaculture standards and those identified in the Wells Dam Settlement Agreement. Broodstock handling, spawning, fertilization, incubation, rearing, fish transport, and release activities are detailed in annual summary reports of specific brood years for the Methow Basin Spring Chinook Salmon Hatchery Program (Bartlett et al. 1994; Bartlett 1996; Bartlett 1997; Bartlett 1998; Bartlett 1999; and Jateff 2001).

Production at the Methow Fish Hatchery has varied considerably since the program began with brood year 1992 (). The variability in production is entirely a function of poor adult returns and different broodstock collection strategies stemming from adaptive management strategies for this tenuous population. Smolt production from the Methow Fish Hatchery has averaged 288,442 smolts annually, representing 52.4% of the interim production level identified in the BAMP (1998).

Table 70 Methow Fish Hatchery complex spring Chinook production, 1994-2001 (PSMFC Coded-Wire Tag Data Base)

Brood Year	Migration Year	Stock	Rearing site	Release site	Number released	ESA Status
1992	1994	Twisp	Methow FH	Twisp R.	35,881	No
1992	1994	Chewuch	Methow FH	Chewuch R.	40,882	No
1993	1995	Twisp	Methow FH	Twisp R.	116,749	No
1993	1995	Chewuch	Methow FH	Chewuch R.	284,165	No
1993	1995	Methow	Methow FH	Methow R.	210,849	No
1994	1996	Twisp	Methow FH	Twisp R.	19,835	No
1994	1996	Chewuch	Methow FH	Chewuch R.	11,854	No
1994	1996	Methow	Methow FH	Methow R.	4,477	No
1995	1997	Methow	Methow FH	Methow R.	14,258	No
1996	1998	Methow	Methow FH	Methow R.	202,947	No
1996	1998	Twisp	Methow FH	Twisp R.	76,689	No
1996	1998	Chewuch	Methow FH	Chewuch R.	91,672	No
1997	1999	Methow	Methow FH	Methow R.	332,484	Yes*
1997	1999	Twisp	Methow FH	Twisp R.	26,714	Yes*
1997	1999	Chewuch	Methow FH	Chewuch R.	132,759	Yes*
1998	2000	Methow	Methow FH	Chewuch R.	217,171	Yes*
1998	2000	Methow	Methow FH	Methow R.	218,499	Yes*
1998	2000	Twisp	Methow FH	Twisp R.	15,470	Yes*
1999	2001	Methow Comp.	Methow FH	Methow R.	186,775	Yes*
1999	2001	Twisp	Methow FH	Twisp R.	67,408	Yes*
Total					2,307,538	
Average					288,442	

* Formal ESA Endangered-listing March 24, 1999

Smolt to adult return rates are currently available for brood years 1992-1995. The brood year 1995 Methow origin production component resulted in the greatest smolt-to-adult return rate at .7% through age 4. It is likely that the brood year 1995 smolt-to-adult survival rate will be greater once the entire brood year has returned (age 4-6). The remaining brood years smolt-adult survival rates ranged between .10% and .01% ().

Production of Methow, Chewuch and Twisp origin fish were segregated into low and high ELISA designations and differentially marked to assess BKD impacts on smolt-adult survival rates. Survival rates between high and low ELISA groups within a specific production group generally favored the low ELISA groups.

Table 71 Smolt to adult survival rates for spring Chinook propagated at the Methow Fish Hatchery, Brood Year 1992-1995

	Brood year			
Stock	1992	1993	1994	1995
Methow	NA	Low ELISA -.09%	.02%	.7% *
		High ELISA -.08%		
Chewuch	0.10%	Low ELISA - .05%	.02%	NA
		High ELISA - .02%		
Twisp	0.06%	Low ELISA - 0.04%	.03%	NA
		High ELISA - .01%		

*Survival rate through age 4

Source: BY 1992-1993, Bartlett 1997; BY 1994-1995, B. Jateff, WDFW, pers.comm.

Wells Dam Hatchery

Wells Dam Hatchery currently provides the majority of the steelhead production for the Methow subbasin as part of the Wells Dam Settlement Agreement in 1990. The hatchery's production objective is 350,000 steelhead smolts destined for the Methow subbasin (NMFS 1998).

The Winthrop NFH also contributes 100,000 steelhead smolts to artificial production in the Methow Basin as part of the GCFMP. The entire Methow subbasin steelhead production is derived from broodstock collections on the west ladder at Wells Dam.

The current broodstock objective is to collect a maximum of 420 adult steelhead from the run-at-large. Adults are held at Wells Hatchery until maturity. Spawning, incubation and rearing all take place at Wells Hatchery. Stocking is conducted primarily as scatter plantings throughout the upper Methow Basin, including upper Methow River, Gold Creek, Eight Mile Creek, Early Winters Creek, Chewuch River, Lost River and Twisp River ().

Throughout the 1980s, smolt production was very high, peaking with brood years 1981 and 1987. Since 1994 production has generally been consistent with the 350,000 smolt objective. Hatchery return rates were variable for brood years 1986/87 through 1993/94 with a return rate average of 1.0% (Bartlett 1999).

Naturally produced steelhead in the Methow subbasin persist at threshold population levels making it difficult to provide a substantial infusion of naturally produced steelhead to complement the hatchery broodstock. Nevertheless, at this time the hatchery program plays an important role in sustaining the steelhead population in the Methow subbasin.

Table 72 Summer steelhead production from the Wells Hatchery stocked into the Methow subbasin, Brood Year 1981-1999

Brood year	Number released	Stock	Release location
1981	38,728	Wells Dam/Chief Joseph dam	Chewuch R.
	784,531	Wells Dam/Chief Joseph dam	Methow R.
	35,745	Wells Dam/Chief Joseph dam	Twisp R.
1982	35,842	Wells Dam/Chief Joseph dam	Chewuch R.
	1,554	Wells Dam/Chief Joseph dam	Gold Cr.
	2,817	Wells Dam/Chief Joseph dam	Lost R.
	143,046	Wells Dam/Chief Joseph dam	Methow R.
	46,143	Wells Dam/Chief Joseph dam	Twisp R.
1983	35,842	Wells Dam/Chief Joseph dam	Chewuch R.
	373,798	Wells Dam/Chief Joseph dam	Methow R.
	24,218	Wells Dam/Chief Joseph dam	Twisp R.
1984	12,600	Wells Dam/Chief Joseph dam	Chewuch R.
	353,862	Wells Dam/Chief Joseph dam	Methow R.
	14,033	Wells Dam/Chief Joseph dam	Twisp R.
1985	32,212	Wells Dam/Chief Joseph dam	Chewuch R.
	1,400	Wells Dam/Chief Joseph dam	Eight Mile Cr.
	3,275	Wells Dam/Chief Joseph dam	Lost R.
	351,537	Wells Dam/Chief Joseph dam	Methow R.
	34,485	Wells Dam/Chief Joseph dam	Twisp R.
1986	37,584	Wells Dam/Chief Joseph dam	Chewuch R.
	1,470	Wells Dam/Chief Joseph dam	Eight Mile Cr.
	60,160	Wells Dam/Chief Joseph dam	Gold Cr.
	339,859	Wells Dam/Chief Joseph dam	Methow R.
	43,980	Wells Dam/Chief Joseph dam	Twisp R.
1987	50,275	Wells Dam/Chief Joseph dam	Chewuch R.
	1,700	Wells Dam/Chief Joseph dam	Eight Mile Cr.
	3,870	Wells Dam/Chief Joseph dam	Lost R.
	593,060	Wells Dam/Chief Joseph dam	Methow R.
	50,835	Wells Dam/Chief Joseph dam	Twisp R.
1988	38,600	Wells Dam/Chief Joseph dam	Chewuch R.
	2,650	Wells Dam/Chief Joseph dam	Eight Mile Cr.

Brood year	Number released	Stock	Release location
	2,650	Wells Dam/Chief Joseph dam	Lost R.
	389,079	Wells Dam/Chief Joseph dam	Methow R.
	48,390	Wells Dam/Chief Joseph dam	Twisp R.
1989	33,300	Wells Dam/Chief Joseph dam	Chewuch R.
	1,500	Wells Dam/Chief Joseph dam	Eight Mile Cr.
	3,075	Wells Dam/Chief Joseph dam	Lost R.
	487,239	Wells Dam/Chief Joseph dam	Methow R.
	35,500	Wells Dam/Chief Joseph dam	Twisp R.
1990	8,000	Wells Dam/Chief Joseph dam	Chewuch R.
	1,680	Wells Dam/Chief Joseph dam	Eight Mile Cr.
	487,567	Wells Dam/Chief Joseph dam	Methow R.
	5,200	Wells Dam/Chief Joseph dam	Twisp R.
1991	4,300	Wells Dam/Chief Joseph dam	Chewuch R.
	1,290	Wells Dam/Chief Joseph dam	Eight Mile Cr.
	1,935	Wells Dam/Chief Joseph dam	Lost R.
	395,350	Wells Dam/Chief Joseph dam	Methow R.
	5,805	Wells Dam/Chief Joseph dam	Twisp R.
1992	5,400	Wells Dam/Chief Joseph dam	Chewuch R.
	2,250	Wells Dam/Chief Joseph dam	Lost R.
	392,815	Wells Dam/Chief Joseph dam	Methow R.
	7,752	Wells Dam/Chief Joseph dam	Twisp R.
1993	4,070	Wells Dam/Chief Joseph dam	Chewuch R.
	324,200	Wells Dam/Chief Joseph dam	Methow R.
	5,920	Wells Dam/Chief Joseph dam	Twisp R.
1994	359,170	Wells Hatchery	Methow R.
1995	255,000	Wells Hatchery	Methow R.
1996	310,480	Wells Hatchery	Methow R.
1997	125,300	Wells Hatchery	Chewuch R.
	127,020	Wells Hatchery	Methow R.
	126,000	Wells Hatchery	Twisp R.
1998	96,225	Wells Hatchery	Chewuch R.
	350,431	Wells Hatchery	Methow R.

Brood year	Number released	Stock	Release location
	127,515	Wells Hatchery	Twisp R.
1999	138,300	Wells Hatchery	Chewuch R.
	39,172	Wells Hatchery	Early Winters Cr.
	126,728	Wells Hatchery	Methow R.
	136,680	Wells Hatchery	Twisp R.
TOTAL	8,521,999		
AVERAGE	448,526		

Carlton Acclimation Pond/Eastbank Hatchery

Artificial production of summer Chinook in the Methow subbasin takes place at the Carlton Acclimation Pond as part of the Rock Island Project Settlement Agreement. The production objective for the Methow subbasin is 400,000 yearling spring Chinook. Since its inception in 1992, the program's average annual smolt production total is 347,508 fish ().

Brood year smolt-adult survival rates for hatchery origin Methow River yearling summer Chinook is outlined in __, and Brood year smolt-adult survival rates for hatchery origin Methow River yearling summer Chinook in __. Stock originated from the Wells Hatchery between 1992 to1995 and from the Methow/Okanogan between 1996 to 1998.

Table 73 Summer Chinook production from the Carlton Acclimation Ponds located on the Methow River

Brood year	Release year	Number released	Stock
1989	1991	420,000	Wells
1990	1992	391,650	Wells
1991	1993	540,900	Wells
1992	1994	402,641	Wells
1993	1995	431,149	Wells
1994	1996	394,042	Methow/Okanogan
1995	1997	346,806	Methow/Okanogan
1996	1998	275,573	Methow/Okanogan
1997	1999	377,211	Methow/Okanogan
1998	2000	205,133	Methow/Okanogan
Total		3,785,105	
Average		378,511	

Table 74 Brood year smolt-adult survival rates for hatchery origin Methow River yearling summer Chinook

Brood year	Release year	Adults produced	Smolt-adult survival%1
1989	1991	2,743	0.653%
1990	1992	415	0.106%
1991	1993	174	0.032%
1992	1994	138	0.034%
1993	1995	126	0.029%
1994	1996	195	0.048%

(Murdoch and Petersen 2000)

[1] The Methow River summer Chinook population adult returns are typically dominated by 4 and 5 year old age classes. The modal age for return years 1993-1998 was five years, with the exception of 1993 and 1998 (Murdoch and Petersen 2000).

Table 75 Methow River adult escapement contribution of Methow/Okanogan summer Chinook released from the Carlton Acclimation Pond

Return year	Hatchery contribution	Tributary escapement	% contribution
1991	0	530a	0
1992	0	364a	0
1993	126	524a	24
1994	474	1054a	45
1995	447	1213a	36.9
1996	97	615a	15.8
1997	64	697a	9.2
1998	150	675b	22.2

(Murdoch and Petersen 2000)

[a] Based on total redd count multiplied by 3.4 fish/redd (Meekin 1967; LaVoy, WDFW, pers.comm.)

[b] Based on total redd count multiplied by 3.0 fish/redd (calculated from broodstock male to female ratio of 2.0:1.0).

Winthrop NFH

Winthrop National Fish Hatchery developed an HGMP which was submitted to NOAA-fisheries November 2002.

Appendix F: EDT Supporting Material

Table 76 Ecological Attribute, Level of Proof, Data Sources and Comments

Ecological Attribute	Level of Proof	Data Sources and Comments
Alkalinity	1) 5% 2) 43% 3) 51%	7 WDOE/USGS watershed monitoring sites (www.ecy.wa.gov/apps/watersheds)
Bed Scour	3) 100%	No empirical data existed for bed scour in the Methow basin. EDT values for bed scour were derived using a multiple regression equation developed in the Yakima basin. Variables included gradient, hydroconfinement, LWD, % pools, fine sediment, high flow, and flow flashy with an r^2 of 0.77. Bed scour estimates were then adjusted to an index value of 2 in known core spawning areas of steelhead and spring Chinook and this correction factor was applied to all other bed scour estimates. Finally, bed scour was given an index score of 4 in all areas over 8% gradient.
Benthic Community Richness	1) 3% 2) 6% 3) 2% 4) 0% 5) 79%	4 WDOE watershed monitoring sites: Values were extrapolated to 8 reaches that were adjacent to the monitoring sites and derived for 3 reaches in the Twisp River that were in between two monitoring sites. The remaining 133 reaches were given the average B-IBI score from the four stations and the level of proof was categorized as "hypothetical". This extrapolation was not based on the opinion or first hand knowledge of an aquatic entomologist so we did not classify it as "expert opinion". Benthic community richness was considered a critical data gap that needs more monitoring and research. (www.ecy.wa.gov/apps/watersheds)
Channel Length	1) 100%	Channel length was measured in Terrain Navigator Pro and was considered empirical data for all reaches.
Channel Width Maximum	1) 66% 2) 1% 3) 19% 4) 14%	USFS habitat surveys PWI (private lands in the lower Twisp River) OCD barrier surveys (private land in Beaver, Gold, and Libby Creeks), unpublished WDFW data (Methow River mainstem from river mile 0-52) USFWS (Goat Creek).
Channel Width Minimum	1) 69% 2) 1% 3) 17% 4) 14%	USFS habitat surveys PWI (private lands in the lower Twisp River) OCD barrier surveys (private land in Beaver, Gold, and Libby Creeks), unpublished WDFW data (Methow River mainstem from river mile 0-52) USFWS (Goat Creek). Notes: Minimum widths of 10 feet were used for all losing reaches that were known to go dry in some or most years (Upper Twisp and Upper Middle Methow). It was important to maintain some minimum width for these reaches or else the model would kill off all fish trajectories every year. Very little detailed information was available to allow us to refine our modeling efforts to accurately capture the spatial and temporal characteristics of these complex hydrological areas. The reaches we defined include areas with some flow and other stretches that go dry in most years. It was known that there was consistent populations of steelhead and spring Chinook above these dry reaches so it was critical to model a usable minimum width throughout the reach.
Confinement	3) 100%	Terrain Navigator Pro (Roads in the floodplain), LFA (described and

Ecological Attribute	Level of Proof	Data Sources and Comments
Man-Caused		sometimes quantified dikes and rip rap), USFS Biological Assessments. This was considered a major data gap. Quantification of dikes, rip rapped areas, and road encroachment is critical to understand loss of riparian function and changes in key habitat types.
Confinement Natural	3) 100%	Terrain Navigator Pro
Dissolved Oxygen	1) 5% 2) 95%	WDOE watershed monitoring stations. Because DO was always adequate for salmonids it was expanded to all other sites with confidence.
Embedded-ness	3) 100%	Used regression equation (provided by Mobrand) to predict from % fines (USFS habitat surveys), except where USFS measurements did not match up, then we considered both to derive the score.
% Fines	1) 45% 2) 8% 3) 7% 4) 32% 5) 7%	USFS habitat surveys PWI (private lands in the lower Twisp and Chewuch Rivers) USFWS (Goat Creek) This is a critical data gap in the lower and middle mainstem Methow River. Many of the small order tributaries that the USFS has not surveyed are low priority, but they contribute to the 32% "expert opinion" category.
Fish Community Richness	3) 100%	Distribution taken from the subbasin summary (2002). Not considered empirical because the descriptions did not reference studies for each stream. Future efforts should refine this attribute rating using USFS, USFWS, and WDFW fisheries survey data.
Pathogens	3) 100%	No studies exist for ambient pathogen levels. Derived via proximity to hatcheries, acclimation ponds, and release sites. Assumed historic stocking occurred in all drainages.
Fish Species Exotic	3) 100%	Fish distribution taken from the subbasin summary (2002). Not considered empirical because the descriptions did not reference studies for each stream. Future efforts should refine this attribute rating using fisheries survey data.
Flow High	3) 100%	Gauging station data showed no trends, no high flow measurements are available for pre-development so we used road density (USFS data base) as an indicator to scale the EDT score between a 2 and 3. Confirmed with USFS hydrologists that this was the appropriate scale that road density would change runoff patterns.
Flow Low	3) 100%	Mullan et al. 1992, Golder Assoc. 2003, Subbasin summary. Calculated as a percentage of base flow by the equation (CFS diverted * (0.63)/ CFS base flow), where 0.63 is a correction factor for groundwater return of diverted flow.
Flow Diel Variation	1) 100%	Wells Pool effect in inundated reach. No other hydroelectric projects so this attribute is not applicable to the rest of the basin.
Flow Flashy	3) 100%	We used road density (USFS data base) as an indicator to scale the EDT score between a 2.25 and 3.25. Confirmed with USFS hydrologists that this was the appropriate scale that road density would increase flashy runoff patterns.
Gradient	1) 99% 2) 1%	Measured in Terrain Navigator Pro. One short reach had a negative slope so we applied the average gradient from the reach above and below it.

Ecological Attribute	Level of Proof	Data Sources and Comments
Habitat: Backwater-Pools; Large Cobble Riffles; Pool- Tailouts; Small Cobble-Riffles; Glides; Beaver Ponds; Primary-Pools;	1) 0% 2) 0% 3) 78% 4) 10% 5) 11%	USFS Stream surveys, USFWS surveys (Goat Creek, Wolf Creek), WDFW Survey 2003 (Methow River mainstem RM 0-52), PWI (Lower Twisp and Chewuch Rivers), OCD barrier inventory (private lands in Beaver Creek, Gold Creek, Libby Creek). Methow mainstem: measurements were estimated or taken with laser rangefinder (while floating the river); did not follow a standard protocol so its still considered derived. Tributaries: Survey data for pools and riffles were split into the 8 habitat categories based on Rosgen channel type and local expert knowledge (Dave Hopkins, USFS). Protocol for OCD surveys was not known, probably not consistent with USFS habitat surveys.
Offchannel Habitat	1) 60% 2) 0% 3) 18% 4) 10% 5) 11%	USFS Stream surveys, USFWS surveys (Goat Creek, Wolf Creek), PWI (Lower Twisp and Chewuch Rivers), OCD barrier inventory (private lands in Beaver Creek, Gold Creek, Libby Creek). Methow mainstem: Length measurements were taken in Terrain Navigator Pro from 1:12000 aerial photos for side channels in the lower and middle mainstem; used an average width of 20 feet. Need a formal survey of current and potential offchannel habitat. Tributaries: Survey data for pools and riffles were split into the 8 habitat categories based on Rosgen channel type and local expert knowledge (Dave Hopkins, USFS). Protocol for OCD surveys was not known, probably not consistent with USFS habitat surveys.
Harassment	3) 100%	Used Terrain Navigator Pro to evaluate proximity to towns and roads (C. Baldwin).
Hatchery Fish Outplants	1) 100%	Stocking records and locations provided by WDFW, Yakama Nation, and USFWS; A value of 2 was used for reaches in tributaries of watersheds with stocking. A 0 was used for lower subbasin watersheds with no stocking.
Hydrologic Regime Natural	1) 7% 2) 43% 3) 49%	USGS gauging stations. Flow patterns were extrapolated up- and downstream of gauges within a watershed and derived for sub watersheds with no gauge by applying the regime from a similar sub watershed.
Hydrologic Regime Regulated	1) 98% 2) 0% 3) 0% 4) 2%	This attribute was only applicable in reach Met1 (Wells Pool effect) and in the lower 2 reaches of Wolf Creek (below Patterson Lake).
Icing	5) 100%	No data exists. Winter temperatures, flows, and icing are such an important data gap that we wanted to stress our uncertainty by categorizing the level of proof as “hypothetical” instead of “expert opinion”.
Metals in Water Column	1) 1% 2) 6% 3) 0% 4) 93%	Metal concentrations at 2 USGS gauging stations (Methow RM 5,39) were below toxicity standards (USEPA 1986). If it was not elevated near Twisp (Alder Mine) then it is not likely to be elevated anywhere in the basin (D. Peplow, personal communication).

Ecological Attribute	Level of Proof	Data Sources and Comments
Metals in Soils/ Sediment	1) 3% 2) 1% 3) 1% 4) 0% 5) 95%	Peplow and Edmonds 2003. Reaches below Alder Ck. should get an elevated score due to transport and deposition, but we have no measurements and this attribute is hard to predict; hypothetical default index score = 1. If we had no data then it was assumed to be at background levels (Peplow and Edmonds 2003).
Miscellaneous Toxins	3) 100%	We used the 303d list, however, because it was binomial and not inclusive we categorized it as "derived".
Nutrients	1) 0% 2) 0% 3) 16% 4) 84%	No data available on Chl-a so Nitrogen and Phosphorus (USGS gauging stations) were used to derive scores for the mainstem reaches. Tributaries were evaluated qualitatively based on development and agriculture use.
Obstructions	NA	Obstructions were assessed individually and level of proof was not evaluated as it was for other attributes in standard reaches. Most of the obstructions had been surveyed but uncertainties still existed for some species/lifestages.
Predation Risk	3) 100%	Fish distribution taken from the subbasin summary (2002). Predation risk was assessed based on increased number of piscivorous exotic species, or reduced native predators (bull trout).
Riparian Function	1) 3% 2) 0% 3) 36% 4) 56% 5) 5%	LFA 2000; USFS stream surveys and biological assessments; USFWS (Goat Creek, Wolf Creek); PWI (Lower Twisp and Chewuch).
Salmon Carcasses	3) 100%	Used WDFW redd counts, adjusted for fish per redd, and adjusted to the 10 yr average run size over Wells Dam. Used Mullen et al. (1992) for historic run re-creation and distributed coho salmon carcasses in areas where steelhead currently spawn.
Temperature Maximum	1) 22% 2) 35% 3) 18% 4) 21% 5) 4%	USGS gauging stations (n=7); USFS temperature loggers (n=44); Mullen et al. 1992; PWI 2003 (FLIR in Twisp and Chewuch).
Temperature Minimum	1) 2% 2) 18% 3) 0% 4) 0% 5) 80%	USGS gauging stations (n=3). These data were extrapolated to other reaches in the mainstem, but no other data was available for the tributaries. We did use FLIR results (Twisp and Chewuch Rivers) to identify areas of potential winter thermal refuge and reduced the severity of the of the minimum temperature effects in the gaining reaches.
Temperature Spatial Variation	1) 0% 2) 0% 3) 29% 4) 5%	PWI 2001 FLIR analysis for the Twisp and Chewuch. LFA 2000 and Mullen et al. 1992 also identified reaches that go dry in the upper middle mainstem of the Methow. No data for the rest of the basin.

Ecological Attribute	Level of Proof	Data Sources and Comments
	5) 66%	
Turbidity	1) 2% 2) 25% 3) 0% 4) 73% 5) 0%	USGS gauging stations (n=6). We had good turbidity estimates across many years but it was not continuous data sets so we could not empirically evaluate the duration of the events.
Withdrawals	1) 100%	WDOE GWIS data. 2003
Woody Debris	1) 0% 2) 0% 3) 95% 4) 1% 5) 4%	USFS habitat surveys; PWI (private lands in the lower Twisp River) unpublished WDFW data (Methow River mainstem from river mile 0-52) USFWS (Goat Creek). We had very good empirical data on # of pieces per mile throughout much of the watershed but the EDT index score formula (which divided by channel width) gave erroneous results. Therefore, we derived it qualitatively using pieces per mile and properly functioning conditions.

Out of subbasin survival factors in Ecosystem Diagnosis and Treatment

Mobrand Biometrics, Inc.

October 9, 2003

Many subbasin planners have elected to use Ecosystem Diagnosis and Treatment (EDT) as a primary assessment tool for aquatic habitats. The EDT assessment of aquatic habitat is based on construction of life history trajectories that begin and end with spawning at particular points within a subbasin at specific times of the year. EDT estimates survival and capacity of a focal species (e.g. spring Chinook salmon) within a defined study area (e.g. a subbasin) based on habitat characteristics and combines this with predefined survival rates outside the study area. These predefined survival rates have been termed the “Out of Subbasin Effects” or OOSE.

As a contribution to the need to supply subbasin planners with a set of assumptions regarding the out of subbasin effects, we are providing here the assumptions that are currently incorporated in the Ecosystem Diagnosis and Treatment model that is being used by subbasin planners. These out of subbasin assumptions in EDT were developed as part of the Council’s Multi-species Framework Project. Calculations behind the results provided here were documented in the final project report to the Council from Mobrand Biometrics and in Marcot and others (2002). The Framework assumptions were intended to capture conditions prevailing in the region around the year 2000. The current out of subbasin assumptions in EDT are based on passage and hydrologic modeling done by the Council, National Marine Fisheries Service and other participants in the Council’s Framework Project.

The OOSE are defined for this memo as the total survival rate of juvenile fish from the mouth of the subbasin to their return to the subbasin as adults. OOSE accounts for survival conditions through the hydroelectric system, the Columbia River below Bonneville Dam, the estuary, the ocean and any harvest occurring outside the subbasin. To be specific, OOSE = Survival through the hydro system X survival in the lower Columbia River X survival through the estuary X survival in the ocean X overall harvest rate. For sub basins below Bonneville Dam the first term is omitted. This definition of the OOSE makes it equivalent to the smolt to adult survival rate or SAR that has been used in other modeling efforts. The SAR is specific for a species and is related to the position of the subbasin within the Columbia Basin and especially relative to its position within the hydroelectric system. In other words, because the SAR (OOSE) is affected by survival through the hydroelectric system (see equation above), the SAR is affected by the number of dams that fish must traverse to get to and from the subbasin. As a result, we see SARs generally decline going upstream in the Columbia River.

Because the out of subbasin assumptions reduce to the SARs that result from the model, we have represented the combined effect of all current OOSE assumptions in EDT as the SARs for spring and fall Chinook salmon projected from various points in the Columbia Basin. These SARs include all considerations for dam passage, survival below Bonneville Dam, survival through the Columbia estuary and the ocean and assumed harvest outside the subbasin. The hope is that by focusing on the SARs (which can be related to empirical survival estimates), the region can avoid becoming embroiled in debates over details of individual survival components as part of the subbasin planning process. This is consistent with direction provided by the Council in previous reports on the Out of Subbasin Effects issue.

	Spring Chinook		*Fall Chinook migrants*	
	SAR	**Expl. Rate**	**SAR**	**Expl. Rate**
Lower Granite Pool	0.9%		0.4%	
Little Goose Pool	1.0%		0.4%	
Lower Monumental Pool	1.1%	6.8%	0.5%	45%
Ice Harbor Pool	1.3%		0.6%	
Lower Snake	1.4%		0.8%	
McNary Pool	1.4%		0.7%	
John Day Pool	1.5%	6.8%	0.8%	45%
The Dalles Pool	2.0%		0.9%	
Bonneville Pool	2.2%		1.0%	
Lower Columbia	3.1%		1.4%	
Wells Pool	0.7%		0.3%	
Rock Island Pool	0.9%		0.4%	
Wanapum Pool	1.1%	6.8%	0.4%	45%
Priest Rapids Pool	1.2%		0.6%	
Hanford Reach	1.4%		0.8%	

Figure 70 Smolt to adult survival rates (SAR) for spring and fall Chinook currently used in the Ecosystem Diagnosis and Treatment model

The results in (Figure 70) are provided to clarify the assumptions that are available to subbasin planners regarding the SARs in EDT. SAR has been estimated from empirical data in a few sub basins in the PATH process and elsewhere. We have compared the estimated SARs in EDT to available empirical estimates of SARs and find them generally in agreement. However, if managers and planners feel that other SAR assumptions are more appropriate for subbasin planning, the assumptions in EDT can be modified.

The results in (Figure 70) approximate the survival rates that would be applied to spring and fall Chinook entering the Columbia River or Snake River at the points in the table. For example, spring Chinook entering the Snake River at the head of Lower Granite Pool would be subject to a SAR of 0.9 percent in EDT. This SAR incorporates an assumed harvest on spring Chinook of 6.8 percent. The SAR for the Lower Columbia represents survival of fish entering just below Bonneville Dam. The total SAR that is actually applied to each population may vary slightly from these rates. For example, if the subbasin enters at the midpoint of a reservoir, the population will not receive the mortality associated with the entire pool but will receive a mortality rate adjusted for the travel speed through the shorter distance. The SARs for fall Chinook represent survival of actively migrating juveniles. Because fall Chinook also include a component of fish that rear for some period within the mainstem Columbia and Snake rivers, total survival of fall Chinook from each point may differ from the results in Table 1.

The SARs in represent survival under “typical” conditions in the Columbia River and the ocean. Empirical estimates of SAR that have been reported in the PATH process and elsewhere vary widely between years reflecting environmental variation including regime shifts in ocean survival conditions. However, the EDT assessment is intended to characterize the potential of current habitat in a subbasin with respect to a focal species and does not include environmental variability.

Attachment 1: Dam survival assumed as part of the SAR in EDT.

The tables below from Marcot and others (2002) provide the schedule of survival rates at each dam for each month of the year for spring and fall Chinook salmon. In EDT, fish leave the subbasin and enter the mainstem across a range of months. They move down at travel speeds related to flow, encountering daily survival rates in the reservoirs. Fish are then passed through a dam where they encounter the survival rates in the tables below. A portion of the fish may be transported downstream. The dam survival rates below were calculated using the National Marine Fisheries Service's SimPass model with conditions specified in the Biological Opinion prevailing in 2000. Other mainstem passage survival assumptions are described in Marcot and others (2002).

Table 77 Yearlings Chinook dam survival rates currently used in EDT

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lower Granite	0.9	0.9	0.93	0.98	0.98	0.98	0.95	0.95	0.95	0.95	0.9	0.9
Little Goose	0.9	0.9	0.93	0.98	0.98	0.98	0.95	0.95	0.95	0.95	0.9	0.9
Lower Monumental	0.9	0.9	0.93	0.96	0.96	0.96	0.94	0.94	0.94	0.94	0.9	0.9
Ice Harbor	0.9	0.9	0.94	0.97	0.97	0.97	0.97	0.97	0.95	0.95	0.9	0.9
McNary	0.9	0.9	0.94	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97
John Day	0.9	0.9	0.93	0.96	0.96	0.96	0.96	0.96	0.94	0.94	0.9	0.9
The Dalles	0.9	0.9	0.94	0.98	0.98	0.98	0.98	0.98	0.9	0.9	0.9	0.9
Bonneville	0.9	0.9	0.92	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.9	0.9
Rocky Reach	0.89	0.89	0.89	0.95	0.95	0.95	0.95	0.95	0.89	0.89	0.89	0.89
Rock Island	0.89	0.89	0.89	0.95	0.95	0.95	0.95	0.95	0.89	0.89	0.89	0.89
Wanapum	0.89	0.89	0.89	0.95	0.95	0.95	0.95	0.95	0.89	0.89	0.89	0.89
Priest Rapids	0.89	0.89	0.89	0.95	0.95	0.95	0.95	0.95	0.89	0.89	0.89	0.89
Wells	0.9	0.9	0.9	0.97	0.97	0.97	0.97	0.97	0.89	0.89	0.89	0.89

Table 78 Subyearlings Chinook dam survival assumptions used in EDT

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lower Granite	0.9	0.9	0.95	0.96	0.96	0.96	0.95	0.95	0.95	0.95	0.9	0.9
Little Goose	0.9	0.9	0.94	0.96	0.96	0.96	0.94	0.94	0.94	0.94	0.9	0.9
Lower Monumental	0.9	0.9	0.94	0.95	0.95	0.95	0.95	0.94	0.94	0.93	0.9	0.9
Ice Harbor	0.9	0.9	0.93	0.96	0.96	0.96	0.96	0.96	0.94	0.94	0.9	0.9
McNary	0.9	0.9	0.96	0.98	0.98	0.98	0.98	0.98	0.95	0.95	0.95	0.95
John Day	0.9	0.9	0.95	0.97	0.97	0.97	0.97	0.97	0.95	0.95	0.9	0.9
The Dalles	0.9	0.9	0.93	0.98	0.98	0.98	0.98	0.98	0.9	0.9	0.9	0.9
Bonneville	0.9	0.9	0.91	0.93	0.93	0.93	0.93	0.93	0.91	0.91	0.9	0.9
Rocky Reach	0.89	0.89	0.91	0.93	0.93	0.93	0.93	0.93	0.89	0.89	0.89	0.89
Rock Island	0.89	0.89	0.9	0.93	0.93	0.93	0.93	0.93	0.89	0.89	0.89	0.89
Wanapum	0.89	0.89	0.91	0.92	0.92	0.92	0.92	0.92	0.89	0.89	0.89	0.89
Priest Rapids	0.89	0.89	0.9	0.92	0.92	0.92	0.92	0.92	0.89	0.89	0.89	0.89
Wells	0.89	0.89	0.94	0.97	0.97	0.97	0.97	0.97	0.89	0.89	0.89	0.89

Appendix G: EDT Reach Analysis Results

Table 79 Definitions for key headings in the Reach Analysis Reports

Species/ Component	Identifies the species to which the reach analysis applies.
Restoration Potential	Identifies the comparison being used to determine the restoration potential of the reach.
Restoration Emphasis	Identifies whether the results of the analysis depict historic or current fish distribution.
Geographic Area (Assessment Unit)	Identifies the geographic area in which the specific focus reach is located. Reaches were aggregated into geographic areas (called Assessment Units in the Methow and Okanogan/Okanagan) for the sake of analyzing restoration and preservation (protection) benefits and for combining areas with similar Limiting Factors. For example, a single major tributary might be identified as a single geographic area, although many stream reaches might be contained within the reach analysis.
Reach	Provides a brief description of the reach location.
Stream	Identifies the stream name on which the reach is located.
Reach Length	Identifies reach length in miles.
Reach Code	Identifies the reach code used in the database for the focus reach.
Restoration Benefit Category	Identifies the benefit category in which the geographic area is classified with regard to potential restoration benefits to the fish population. Each geographic area is classified into one of four categories based on the potential for affecting overall population performance if all of the reaches within the geographic area were restored to historic conditions. It identifies the strategic importance of restoration in this geographic area relative to the other areas.
Overall Restoration Potential Rank	Overall rank of the geographic area used in plotting to derive the benefit category grade.
Productivity, Average Abundance (NEQ), and Life History Diversity Ranks	Identify the rankings of the geographic area relative to other areas for the three performance measures.
Potential% Change in Productivity, Abundance (Neq), and Diversity	The basic metrics for comparing the benefit category and ranking of the reaches. They show the potential for improvement in overall population performance if the geographic area was fully restored to historic conditions. The metrics are expressed as the% change in overall population performance, e.g., the% increase in average abundance of adults.
Preservation Benefit Category	Identifies the benefit category in which the geographic area is classified with regard to potential preservation (or protection) benefits to the fish population. Potential benefits of protection are assessed by considering the potential for loss in fish performance if the geographic area's reaches are altered through extensive development. Each geographic area is classified into one of four categories based on the potential loss to overall population performance if all of the reaches within the geographic area were impacted by environmental development, changing it to a representative fully developed area.

	The category identifies the strategic importance of preserving the geographic area in its current state relative to the other areas. The categories are designated A (highest benefits of protection) through D (lowest benefits of protection). No consideration is given to these assignments as to feasibility, cost, or desirability of implementing protection actions in the reaches—simply, what would be the benefits to the fish population if the geographic area was to be preserved in its current state. Areas that designated grade A for protection benefits are those that currently have a major role in supporting existing fish performance. Hence environmental degradation of those areas, i.e., degrading to a state worse than its current condition, would result in the greatest loss in population performance. Areas designated grade D are those that are either already largely developed, i.e., those that already have experienced the most dramatic change from pristine condition and little is left to degrade, or are peripheral areas that contribute little to overall population performance. The other items listed with Preservation Benefit Category are derived in the same manner as described above for restoration benefits. Estuarine reaches were not assigned to a preservation benefit category because no representative developed reach characteristics were formulated. The abbreviation "NA" is indicated for these reaches for this item.
Life Stage	Indicates the life-stages examined in the analysis.
Relevant Months	The relevant months or target month when the life-stage occurs. Months vary by species.
% of Life History Trajectories Affected By Life Stage	Shows how the entire fish population uses the reach. Trajectories are computer-generated pathways that define the exact route followed through the aquatic landscape for analytical purposes. Trajectories originate with spawning and end with prespawning holding (i.e., closed life history). e aware of: The percentage of the total life history trajectories affected is reach-specific. The percentage of total life history trajectories affected is life stage specific. For example, the percentage of life history trajectories affected during the 0-age active rearing life stage may differ from those during the spawning life stage. Information on life history trajectories usage in a reach is the means of determining the extent that the population might use a given reach. This measure of usage is analogous to the number of hits that a web site experiences relative to other websites. Productivity change (%) - This item indicates the change in life stage specific productivity resulting from the changes in the attributes to the right on the chart (where change in attribute condition is shown by the size of black dots).
Life Stage Rank	Indicates the extent that distinct environmental attributes have affected species performance by each life stage in the reach. Hence the life stage ranked as "1" has experienced the greatest impact with respect to overall effect on the population performance. The rank is determined through the combination of productivity loss and relative utilization (% life history

	trajectories affected) of the reach by that life stage. A reach that is heavily used for a particular life stage and that has experienced a large loss will rank high (low ranking numbers). A reach may have experienced a large change in productivity for a life stage but if the reach is not used heavily by that life stage it will rank lower (high ranking numbers). Change in attribute impact on survival - A Consumer Report style format is used to show the change in each attribute in comparison to the historic condition. Attributes shown here are actually attribute classes (or umbrella attributes) that encompass the full suite of detailed attributes described through the EDT process. Larger black circles indicate greater effect on survival as a result of a decrease in habitat quality (represented by all attributes shown except Key Habitat Quantity. Circles are scaled in comparison to all other circles presented for the reach. The reader should note that a lot of small black circles spread across multiple attributes could equal or exceed the effect of a single large circle. Thus, it is important to look at both the life stage rank and the size of the circles to draw conclusions from the chart. Clear or open circles indicate that attributes conditions have actually improved for life stage survival compared to historic condition. Circle size for Key Habitat indicates the extent that the amount of key habitat (preferred habitat types by life stage) has been altered in the reach compared to historic levels (change could be because of the percentage of key habitat available or the size of the reach or both). The chart only identifies the extent that an attribute has been altered compared to historic condition, and further, how this change is perceived by the species with respect to survival. Therefore, if a stream naturally carried a high sediment load (glacial melt) and it still does, then the chart would register no change from the historic condition and no increased impact on species survival. The chart also only identifies where the effect occurs to the species in the watershed—it does not show the source of the problem. Hence an increased effect of sediment in a reach does not mean that the sediment is actually generated within the reach—it may be produced from a distant subbasin in the watershed. It is therefore essential when applying the results of the analysis to consider the source of the environmental change and what has caused the change. Corrective actions need to be targeted at the source and the cause.

Appendix H: Public Comments

Comments Received on the Draft Okanogan and Methow Sub basin Plans

Note: Every effort has been made to fully consider and implement applicable comments that were received during the formal public comment periods for the subbasin plan. However, given this, it is recognized that it may be possible that this was not completely accomplished due to the time constraint of meeting the May 28, 2004 NPCC deadline. During the NPCC's Response Period (after the 90 public and ISRP comment period), comments received on the initial plan will then be reconsidered.

PUBLIC COMMENTS ON THE METHOW AND OKANOGAN SUB BASIN PLANS

FEBRUARY 11, 2004 – APRIL 16, 2004

Sub-Basin - Comments on Draft Sub-basin Plan

Thanks for the opportunity to comment. Please note my attached comments. Thank you,

Dick Ewing

From: "Dick Ewing" <fawn@mymethow.com>

To: "Sub-Basin" <sbp@co.okanogan.wa.us>

Date: 3/10/2004 8:08 AM

Subject: Comments on Draft Sub-basin Plan

COMMENTS ON SUB-BASIN SUMMARY FOR METHOW BASIN:

1. P. 22. the USGS Water Resources Investigations Report # 03-4246 needs to be included in this section. So model runs with and without groundwater seepage from canals have already been made. What has been found needs to be cited here.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

2. P. 22: regarding a test site for examining the affects of seepage from canals ….

This has already been done with the Twisp Power and Irrigation Canal study

initiated by the USGS. This work needs to be cited with its present conclusions.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

3. Unfortunately the present draft is not complete. The information presented contains most of the background materials and ESA technobabble that we are all familiar with concerning the region and listed species. What is missing is the core of the draft that actually explains the sub-basin planning perspective, its analysis of the problem and its proposed goals and solutions. Most

importantly the present draft does not show any linkage with present watershed planning efforts and how they will be incorporated into sub-basin planning.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

Last sentence of the paragraph: Sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st,2004.

4. References to the Methow Sub Basin Summary by the Conservation Commission do not cite the deficiencies in this summary noted by Ken Williams' review of this summary which was part of the materials submitted for this process. It would be helpful to have as part of the sub basin plan a process cited on how these deficiencies are going to be addressed so a more accurate approach may be initiated in the Methow.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

# # # # # # # # # # # # # # #

Sub-Basin - Okanogan County Subbasin Planning

Comments on Subbasin Plans attached. Thanks. Darlene

From: "hajny" <hajny@pctelecom.us>

To: "Julie Dagnon" <jdagnon@co.okanogan.wa.us>

Date: 3/11/2004 11:56 PM

Subject: Okanogan County Subbasin Planning

CC: "Mike Wilson" <mjwilson@televar.com>, <Commissioners@okanogan.wa.us>,

"Kurt Danison" <kdanison@ncidata.com>

Julie Dagnon, Water Resource Division Manager

Okanogan County Water Resources

123 N 5th Avenue – Room 110

Okanogan, WA 98840

Re: Comment Letter on Draft Subbasin Plans: Okanogan/Similkameen and Methow

Dear Ms. Dagnon:

There is growing concern that the Northwest Power and Conservation Council (NPCC) Subbasin Plans will ultimately be used to direct land management decisions on public and private lands.

We adamantly oppose the use of sub basin Plans for land management purposes and strongly encourage our Legislators and Commissioners to support our position.

Response: Sub basin plans are not land management plans, as such. Local land use management continues to be the responsibility of local government. State government has existing land-use regulatory responsibilities in certain cases. The Sub basin plans are permissive, not prescriptive; they provide a framework for proposed projects. That framework recognizes existing legal mandates and may inform ongoing updates to existing regulations. Local and state government agencies and willing landowners may use the framework to inform land management actions. Effective species recovery will need to include land use management considerations.

The brief comment period of 13 days makes complete review of the draft Subbasin Plans impossible; however following is a list of several major concerns and specific comments on material that has been reviewed to date. It should be noted that the draft plans are very sketchy and core information about how or why species management assumptions were made is not included in the draft plans.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23 – May 10, 2004.) EDT does explicitly document the assumptions made in habitat assessment and working hypotheses. Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

Subbasin Planning Limitations: The reported purpose of sub basin planning is to direct Bonneville Power Administration mitigation funding through the Northwest Power and Conservation Council. It is important that subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans, which include:

•Subbasin plans are being developed solely for the benefit of fish and wildlife, with no consideration of costs, economic losses or conflicting human interests, which results in faulty findings.

Response: The purpose of Sub basin Planning is to develop management strategies to recover fish and wildlife. The April 23 draft plan will include economic goals, and the feasibility of the projects that are proposed to be implemented. Sub basin planning strategies may be constrained by human costs and interests. Sub basin planning does not impose mandatory actions, but provides a framework within which projects may be proposed. Projects may benefit the human community as well as target species.

•The "ecosystem approach" used does not make any distinction between public land and privately owned land in its determination of fish and wildlife management plans.

Response: Because ecosystems cross land boundaries, assessments included all land within each sub basin. Management strategies and actions may distinguish between public and private lands.

•Private property rights and land rights including water rights are not recognized.

Response: The April 23 draft sub basin plan will explicitly state that sub basin planning recognizes and will not impeded those legal rights.

•Management plan goals are based on comparisons to “historic” or perfect, untouched conditions that are thought to exist prior to European settlement, which are not attainable, sensible or necessary.

Response: A baseline of some sort is needed to provide a benchmark against which change can be measured. Where the baseline is set does not affect the focus of the assessment, which reflects the condition of the resource today. The baseline simply allows changes to be compared across reaches and streams. If the baseline were raised or lowered, relative change (compared to today’s conditions) would remain the same. The issue remains the condition of the resource today and what to do about that. The sub basin plans do not advocate returning to a pristine baseline. Management strategies seek to return to properly functioning conditions when necessary for species recovery.

•Goals are widely based on data with significant information gaps and unmeasurable outcomes with minimal public involvement.

Response: Data gaps are explicitly documented in the process. Sub basin planning is not funded (nor intended) to remediate data gaps by new field work, but its recommendations provide the framework for proposals to conduct additional work to fill data gaps. Measurable objectives are included. The sub basin Coordinators have conducted a very substantial public outreach and involvement effort. This effort is more explained in the April 23 draft sub basin plan. Public outreach has included inviting the public to participate in defining goals and management strategies.

•The cumulative effects of restrictions and regulations on private property ownership and land use are not measured.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

•The economic losses to the private landowner, agriculture, natural resource-based industries and county economic viability are not considered.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

•The subbasin planning process bypasses land management planning safeguards and requirements such as economic review, public notice and public involvement.

Response: Sub basin plans provide a framework within which projects may be proposed. Land management planning requirements will be met prior to implementation of any proposed project.

•There is no legislative oversight of back-door ecosystem approaches to manage lands.

Response: Sub basin planning is a federal process, and has been the subject of considerable federal oversight. It is not subject to state legislative oversight; however, state and local (as well as federal) requirements will be met prior to implementation of any proposed project.

Examples of Faulty Model Outcomes: Ecosystem Diagnosis and Treatment (EDT) was elected as the model to establish watershed management plans in Okanogan County. The EDT dispenses priority ratings for management actions based on the input or assumptions it receives. The EDT does not consider costs or other competing human interests, which has resulted in flawed and shortsighted outcomes such as:

Response: EDT is a tool used for biological and ecological assessments. It is not intended to incorporate competing human interests. Human factors are addressed in the sub basin plan's goals, and may be addressed in project development and implementation.

The controversial Salmon Creek Project rising to the top of the priority list even though funding has been consistently denied in the past because of the unreasonable high costs per benefit and potential ongoing and escalating costs for maintenance of a pumping stations. Competing human interests and rights again are not considered in the EDT prioritization.

Response: Project prioritization is not complete, and won't be until recovery planning is complete. To the extent that Salmon Creek has been discussed in the sub basin planning process, it has been in an open public process with a multi-stakeholder sub basin core team.

Land acquisition and conservation easements identified as a recurring management priority in a county already burdened with excessive government ownership. This would place more land and land rights under state and federal control and ownership and further expand federal and state regulatory control over land use.

Response: Land and easements can be acquired by state, federal, or local agencies, by private nonprofit organizations. Easements neither take land out of production nor convert it from private ownership. They help keep land in production and in private ownership. Land acquired by agencies is sold to those agencies by willing landowners, often because its productive capacity has been depleted and the owner no longer finds it profitable to manage. Both acquisition and easements can prevent subdivision; landowners sell land or easements as a means of keeping their holdings intact. We have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.

Acquisitions and easements are particularly noticeable as a management strategy in the Methow Watershed. The draft plan recognizes that the government has accumulated 85% of the entire watershed, with only 15% remaining in private ownership; still the management plans call for continuous acquisitions and easements under the guise of increased protection of fish and wildlife.

Response: The comment has been forwarded to the SCT. As stated above as well, we have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.

Increasing flows irregardless of competing water rights and human demands is a dominant management outcome, as well as returning to “natural” pre-European conditions in post-European settlement areas.

Response: Flow rates are frequently a limiting factor, and management strategies address this concern. Flow recommendations seek improvements to flow regimes, but do not necessarily advocate restoring pristine flow regimes. There are numerous strategies to increase flows, many are listed in the Methow Basin watershed plan; may of these recommendations could be potential projects.

Sub basin planning process: Public outreach did not begin until approximately six months after the technical team began work on the plans and public involvement occurred at seven months. The technical team, called the Habitat Work Group, apparently consists of agency staff and consulting firms. Members of the group remain unidentified although we have asked for a list of who is involved in the group.

Response: Technical staff (the HWG) did begin to organize and assess data prior to public involvement, with the intention of efficiently completing the very technical work prior to inviting public participation. Stakeholders were offered opportunities to comment and to participate in development of the su bbasin assessment, including opportunities to review the data being used and comment on decisions made about the use of that data. HWG members were identified in a list sent to the entire sub basin planning outreach email list; HWG members were introduced at early su bbasin core team meetings and lists of HWG members were posted at those meetings.

The draft plans acknowledge some of the scheduling difficulties people have experienced throughout the sub basin planning process, which was attributed to NPCC’s lack of adequate time for public outreach. Although there were scheduling conflicts and problems, the biggest problem has been the lack of core information.

Response: The su bbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

Public outreach and involvement consists of 1) e-mails that advise only meeting dates and times and what “stage” the process is in, 2) evening meetings with a slide show and verbal presentations with no handouts and at times no technical person to answer questions and 3) day-long meetings consisting of technical people and “stakeholders.” The day-long meetings are difficult for working people not on the payroll to attend, particularly on a regular basis.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished *handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them. The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.*

As noted, in spite of the complex information, that was shown on slides and presented verbally, no handouts were made available at the evening summary sessions. The complicated information that was presented in this way made it difficult to get a clear picture of the process itself let alone the content information and findings. Requests for handouts and more information have also gone answered. Members who asked questions about the complexity and reliability of the EDT model were referred to the Mobrand website.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. Members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them. Outreach staff gave some information about EDT during presentations, and did refer stakeholders to Mobrand's website for more detailed information in order to use meeting time efficiently.

Agencies and consultants in the Habitat Work Group have generated huge volumes of fast-paced information that has not been made available to the public. There is tremendous frustration throughout the county that this is just another process where an unidentified team of government entities and consultants has come together to write the plans and pass them off as "local" without meaningful local review or input.

Sincerely,

Mike Wilson, President

Okanogan County Farm Bureau

Attachment: Comments on the contents of the plans.

Cc: Okanogan County Commissioners

7th and 12th District Legislators

Kurt Danison, Highlands Associates

Specific Comments

Methow:

1. The USGS Water Resources Investigations Report # 03-4246 needs to be included in this section. So model runs with and without groundwater seepage from canals have already been made. What has been found needs to be cited here on Pg. 22.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

2. Regarding a test site for examining the affects of seepage from canals: This has already been done with the Twisp Power and Irrigation Canal study initiated by the USGS. This work needs to be cited with its present conclusions. (Pg. 22)

Response: The comment has been forwarded to the Habitat Working Group (HWG).

3. The information presented contains most of the background materials and ESA information that we are all familiar with concerning the region and listed species. What is missing is the core of the draft that actually explains the sub basin planning perspective, its analysis of the problem and its proposed goals and solutions.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

4. Most importantly the present draft does not show any linkage with present watershed planning efforts and how they will be incorporated into sub basin planning.

Response: Sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st. An organized planning unit for the Okanogan sub basin has not been developed.

5. References to the Methow Sub basin Summary by the Conservation Commission do not cite the deficiencies in the summary noted by Ken Williams' review, which was part of the materials submitted for this process. It would be helpful to have as part of the sub basin plan a process cited on how these noted deficiencies are going to be addressed so a more accurate approach may be initiated in the Methow.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

Okanogan:

Comments Regarding Farm Bureau Outreach: Please correct your statements to reflect that an article was submitted to Okanogan County Farm Bureau for consideration of printing in the B Newsletter." Sandra contacted us and asked us if she could write an article for our newsletter; we did not request it. I told her to feel free to submit an article if she would like.

Response: Flow rates are frequently a limiting factor, and management strategies address this concern. Flow recommendations seek improvements to flow regimes, but do not necessarily advocate restoring pristine flow regimes. There are numerous strategies to increase flows, many are listed in the Methow Basin watershed plan; may of these recommendations could be potential projects.

General: Numerous statements are made and conclusion rendered without benefit of resources cited. It is difficult to determine what is author's opinion and what is cited references, particularly as related to perceived environmental threats. (Third Paragraph, Page 21, 5th Paragraph, Page 21, Paragraph 2, Page 24)

Response: The comment has been forwarded to the technical writer. This is a very early rough draft. Some references are missing and need to be supplied, and the references section needs to be edited. The assessment of environmental conditions was done by the Habitat Work Group.

The Projects Inventories should show costs of projects as an accountability feature to the public.

Response: The comment has been forwarded to the technical writer.

In an apparent effort to combine BC and US portions of the watershed yet keep them distinct, it is difficult to distinguish between the two in portions of the material.

Response: The comment has been forwarded to the technical writer.

Paragraph 3, Page 23 (statement repeated in Paragraph 5)

The Forest section appears to have numerous unreferenced claims.

Response: The comment has been forwarded to the technical writer. "North of Oroville" has been corrected to read "south of Oroville."

Sub basin in Relation to Region, 2nd Paragraph, Page 18

The following statements appear to be more philosophically poetic than factual which does not seem appropriate, and the first sentence in particular is unclear in its meaning.

Response: The comment has been forwarded to the technical writer.

No references are cited.

The Okanogan Subbasin exemplifies the popularity of the modern rural lifestyle and the controlling-protection paradox practiced by the growing number of valley residents. Constraints to the sustainability of anadromous and resident fish, wildlife, and their habitats result from the footprints of this growth within the basin; many of these impacts and their resolution have cross-border implications. Such impacts include matured agriculture, forest and hydroelectric industries, and their extended affects which reach from the alpine mountain tops to the confluence with the Columbia River and beyond.

5th Paragraph, Page 18

The following statement is unclear. Also, is this author's opinion?

Dealing with these constraints will require both institutional and technical approaches, and links between communities of science, interest and place.

Paragraph 1, Page 26

No reference quoted for final portion of the sentence. Is this author's opinion?

Dominant riparian species include black cottonwood, water birch, and white and thinleaf alder (Arno, 1977), but riparian forests and shrubsteppe have been virtually eliminated in the basin.

Paragraph 3, Page 27

Who/what is OWSAC? Is this listed in references?

Conversion of privately owned timber areas into other uses, such as residential subdivisions, is a trend, but not on the large scale that it is further south, in Wenatchee and Entiat (NMFS, 1998). During a recent four year period (1994 1997), approximately 11,000 acres of forestland were subdivided (OWSAC, 2000).

Land Use and Demographics, Paragraph 1, Page 28

In order to present a more accurate and complete picture, more specifics on protected land would be in order, i.e. how much land is in wildlife areas, etc. What does "dominated" mean? Perhaps forestry and range should be broken down rather than grouped together. Is this author's opinion?

Forestry and range are by the far the major uses of land in the Okanogan Basin, followed by croplands (Figure 8). Most of the landscape, from the riparian areas to the upper elevation forests, have been used extensively for agriculture and resource extraction. The valley bottom is dominated by agriculture, primarily orchards and livestock feed. The benches are dominated by livestock grazing, and the lower to mid-upper elevation forests have been harvested for timber and used for livestock grazing. The Okanogan Basin contains six state wildlife areas, a natural preserve in the DNR's Loomis Forest, and a portion of the USFS.s Pasayten Wilderness.

Response: The comment has been forwarded to the technical writer. Forest and range are represented in different parts of Figure 8. "Dominated" has been changed to "predominantly".

Urbanization and population growth, Table, Page 29

Is the 2000 census that last census available?

Response: Yes

Socio-Economic Conditions – Colville Reservation

Is the following statement actual wording of the court's findings? Reference to court ruling?

The Court also ruled that the Colville Tribes possess federally reserved water rights to stream flows sufficient to preserve or restore tribal fisheries.

Response: Federally reserved water rights are established for all tribes under the Winters Doctrine. The statement cited is an accurate reflection of that doctrine.

Starting Paragraph 3, Page 30

Treaties and mitigation for dams are complex issues. Is this the correct forum to discuss the "unfairness" of the mitigation programs to the Colville Tribe? Are some of the following statements fact or opinion?

In 2000, the Bureau of Reclamation agreed with the Colville Confederated Tribes that the Federal government had not completed its authorized anadromous fish mitigation for construction of Grand Coulee Dam over 60 years ago. Planned artificial production programs were not implemented for the Okanogan River Basin when the outbreak of World War II halted non-war related construction projects.

Tribes of the Colville Reservation have been seriously harmed by the lack of Grand Coulee mitigation, with ceremonial and subsistence fisheries declining to minimal levels, even in years of substantial runs entering the Columbia River. Fishing opportunity is now severely limited to summer/fall Chinook immediately below Chief Joseph Dam and an occasional sockeye fishery in the Okanogan River. This situation has been adversely compounded by later formulas for mitigation of mid-Columbia Public Utility District dams where the Federal Energy Regulatory Commission does not require mitigation for now, non-existing. Additional hatchery production under the proposed mitigation agreement with the PUDs is based on the run sizes of salmon and steelhead in a 10-year period during the 1970.s and 1980.s (Bugert 1998). Most of these post-dam runs were supported in large part by the initial hatchery mitigation programs funded by the PUDs and the Federal government. Since the CCT did not receive the initial mitigation from the construction of Federal and PUD dams, the basis for the new agreements discounts obligations to the CCT. Without the initial Federal salmon mitigation that other watersheds in the province obtained, the Okanogan Basin and Colville Tribes again were provided without mitigation. Additionally, the Federal government has never provided Okanogan anadromous fish mitigation for the Colville Tribes for the loss of adult and juvenile fish passing through the four Corps of Engineers hydroelectric projects on the Lower Columbia River. Fish mortality at these projects have been generally estimated at about 10% per project, but were historically higher. Finally, Chinook mitigation by Douglas PUD for losses due to inundation and passage has been sited downriver, at Wells Hatchery and in the Methow River, away from the Colville Tribes reservation fisheries. The Colville Tribes total anadromous salmonid harvest is normally below 1,000 total salmon and steelhead combined and similar estimates are reflected in the Okanagan Nation fisheries upstream in Canada. Yet, in the 1800.s prior to over harvest in lower river commercial fisheries and subsequent habitat destruction, the Colville Tribes were estimated to have harvested in excess of 2 million pounds of salmon and steelhead annually (Koch 1976).

Response: The Tribes' representative advises that the points made in the text have been upheld. The mitigation cited is directly germane to sub basin planning.

Agriculture, Paragraph 5, Page 31

Says who?

Livestock grazing practices have led to trampled stream banks, increased bank erosion and sedimentation, and changes in vegetation, including loss of native grasses, impacts to woody vegetation, and establishment of noxious weeds.

Response: Livestock impacts are based on the habitat assessment conducted by the HWG and reviewed by the SCT. The assessment process documented the level of certainty associated with each habitat attribute. The sub basin plan should recognize the benefits of limited grazing under proper management and monitoring.

Paragraph 6, Page 31

Who is PNRBC? Is a 1970s report relevant?

A 1970s rangeland evaluation indicated that 25 percent of rangeland in the basin was in good condition, 34 percent in fair condition, and 41 percent was in poor condition (PNRBC, 1977).

Response: PNRBC is the Pacific Northwest River Basin Commission. The technical writer has been asked to search for more current information.

Appendix A, Page 147

Federal ESA species are listed "that are present or may be present in Okanogan" but there is no way to know which listings are actually present and affect Okanogan County. Two separate lists would correct that.

Response: The comment has been forwarded to the technical writer.

# # # # # # # # # # # # # # #

Sub-Basin - Comments on Draft Methow Subbasin plan

Comments on Draft Methow Subbasin plan:

To All on distribution:

My comments prior to 11 March initial comment period deadline attached as MS Word2002 .doc. Please let me know if you have any problem reading that document.

Cordially,

Ken Sletten

360-620-5008 (cell)

From: <wasbra@wavecable.com>

To: <sbp@co.okanogan.wa.us>

Date: 3/8/2004 12:20 AM

Subject: Comments on Draft Methow Subbasin plan

CC: <tkarier@ewu.edu>, <fcassidy@nwcouncil.org>, <lpalensky@nwcouncil.org>, <parlette_li@leg.wa.gov>, <armstron_mi@leg.wa.gov>, <condotta_ca@leg.wa.gov>, <commissioners@co.okanogan.wa.us>, <jdagnon@co.okanogan.wa.us>,

<beichdvb@dfw.wa.gov>, <kdanison@ncidata.com>, <JPratt@entrix.com>, <fawn@mymethow.com>, <ramshead@methow.com>, wasbra@wavecable.com Sub-Basin - Methow Subbasin issues; + missing document.

FROM:

Ken Sletten

Box 902

688 Wolf Creek Road

Winthrop, WA 98862-0902

wasbra@charter.net cell: 360-620-5008

TO:

Lynn Palensky, NWPCC Subbasin Planning Coordinator lpalensky@nwcouncil.org 503-222-5161

COPIES:

Senator Linda Evans Parlette parlette_li@leg.wa.gov, Senator Bob Morton morton_bo@leg.wa.gov, Rep. Mike Armstrong armstron_mi@leg.wa.gov, Rep. Cary Condotta condotta_ca@leg.wa.gov, Okanogan County Commissioners commissioners@co.okanogan.wa.us, Okanogan County - Julie Dagnon sbp@co.okanogan.wa.us, MBWPU: Dick Ewing fawn@mymethow.com, Ron Perrow ramshead@methow.com

SUBJECT:

Methow Subbasin planning issues; and important missing document.

REFERENCE:

(a) http://www.nwcouncil.org/fw/subbasinplanning/Methow/default.asp

(b) http://www.nwcouncil.org/fw/subbasinplanning/admin/recommendations.htm

(c) http://www.cbfwa.org/cfsite/ReviewCycle.cfm?ReviewCycleURL=FY%202003%20Columbia%20Cascade#reports (CBFWA draft Methow

Subbasin Summary dated 2002-05-17)

Lynn,

I am aware from the 11 February 2004 Okanogan Chronicle that the Methow Basin Watershed Planning Unit (MBWPU) has filed a formal complaint with the NWPCC about effectively being left out of the regional subbasin planning process. I'm not necessarily saying the reasons for this complaint are completely the fault of the NWPCC: There are some issues internal to Okanogan County with respect to officially finishing 'final final' revisions to the Methow Basin Watershed

Management Plan (MBWMP). However, given looming NWPCC subbasin planning deadlines I'm afraid that an opportunity to integrate the MBWMP in the NWPCC subbasin process will be lost if steps are not taken to immediately correct this situation. Three key points:

(1) Under headings of full disclosure and presenting an honest picture of the situation in each subbasin, a formal complaint by key players in local watershed planning like members of the MBWPU clearly deserves and needs to be prominently accessible through your Methow Subbasin web page (reference (a)). Now it's possible that it COULD be hidden somewhere on the very extensive NWPCC web site (which is generally pretty well put together and organized); all I can say is I can't find it. I guess nothing is stopping me or members of the MBWPU from posting their complaint to the currently-empty Methow Subbasin public file exchange page, but in my opinion citizens should not have to informally take action to get a document this important and pertinent to Methow Subbasin planning included on the reference (a) web page. This should be done officially by the NWPCC: Please add a link to the MBWPU complaint at least at the reference (a) level ASAP.

Response: The comment letter was addressed to the NPCC; we are not sure what comment is appropriate from us.

(2) I am fully in accord with opinions expressed by the MBWPU in their complaint. I note a few key snippets from your 'Notice of request for recommendations' document on the NWPCC web site at reference (b):

'.... The Council intends to incorporate these specific objectives and measures into the program in locally developed subbasin plans for the 62 subbasins of the Columbia River'

and especially:

'Integration with local efforts - The Council recognizes that there are other watershed and recovery planning efforts taking place across the Columbia basin. Where groups are already working at a local level, the Council will work in partnership with those efforts. The desired approach is to make those existing planning groups aware of the opportunity to have their subbasin plans adopted as part of the fish and wildlife Program, and where there is interest, to make additional resources and guidance available to those planners so that they can assimilate the Council's subbasin planning components into their existing efforts.'

After many years of intensive, dedicated work by members of the MBWPU, no one can deny that they are (and have been) actively working at the local level; and they are without doubt 'interested'. The next phrase in your above sez: ' the Council will work in partnership with those efforts.' It does not say 'might' or 'may': It sez WILL work. I respectfully suggest that the apparent complete failure to date by the NWPCC subbasin planning process to work with the MBWPU or to in any substantive way recognize and incorporate the large amount of excellent technical work already done by that group is unacceptable. In fact, that omission appears to be such a glaring violation of above quoted NWPCC principles that from my admittedly amateur perspective it appears that if the situation is not promptly corrected it might be a valid legal 'cause for action'. At the very least it will be cause for serious complaint to the Washington State Legislature.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.

(3) If you click on reference (a) 'Read full subbasin summary', you get redirected to the reference (c) CBFWA web site. The 'Draft Methow Subbasin Summary' info listed on that page is dated 17 May 2002. Given that public meetings have already been held this month to discuss the latest updates, shouldn't the CBFWA web site be better than nearly two years out of date ?... wherever they are publicly posted, latest draft versions of the various subbasin plans should be as up to date as possible.

Response: Since the comment letter was addressed to the NPCC we are unsure as to what comment is appropriate from us.

Respectfully submitted,

Ken Sletten

# # # # # # # # # # # # # # #

Sub-Basin - Comments on Okanogan/Methow subbasin planning

From: "Patrick Plumb" <pplumb@nvhospital.org>

To: <lpalensky@nwcouncil.org>, <jdagnon@co.okanogan.wa.us>, "Mary Lou Peterson"

<PETE6976@co.okanogan.wa.us>, <jsto461@ecy.wa.gov>, <barbaram@iac.wa.gov>

Date: 3/18/2004 3:37 PM

Subject: Comments on Okanogan/Methow subbasin planning

CC: <oc3@northcascades.net>, "hajny" <hajny@pctelecom.us>, <plr@bossig.com>

As a Tonasket City Councilman and also as the Chairman Elect of Okanogan County Citizens Coalition, I would like to concur with the Okanogan County Farm Bureau on the statement below, and also air my cautionary position that local involvement in this subbasin planning process has not been satisfactory to having my input. Whether that be my fault or a fault of bureaucracy I am not sure yet, but I would like to be a part of this process. Promises made in the plan that I have read so far says that local officials will be made aware of what is going on, and I would like to see someone give an update to the Tonasket City Council on where this process is and how we should be able to give input to the watershed planning. I am not sure if a WIRA has been formed for the Okanogan River Watershed, and also I have attended a WIRA meeting for the Kettle River watershed, and I would like to be involved with the watershed that I have a direct connection to (Okanogan River). The comments that I concur with the Okanogan County Farm Bureau are listed below.

Response: Sub basin plans are not land management plans, as such. Local land use management continues to be the responsibility of local government. State government has existing land-use regulatory responsibilities in certain cases. The Sub basin plans are permissive, not prescriptive; they provide a framework for proposed projects. That framework recognizes existing legal mandates and may inform ongoing updates to existing regulations. Local and state government agencies and willing landowners may use the framework to inform land management actions. Effective species recovery will need to include land use management considerations.

There is growing concern that the Northwest Power and Conservation Council (NPPC) Subbasin Plans will ultimately be used to direct land management decisions on public and private lands. I adamantly oppose the use of Subbasin Plans for land management purposes and strongly encourage our Legislators and Commissioners to support our position.

The brief comment period of 13 days makes complete review of the draft Subbasin Plans impossible; however following is a list of several major concerns and specific comments on material that has been reviewed to date. It should be noted that the draft plans are very sketchy and core information about how or why species management assumptions were made is not included in the draft plans.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.) Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact. EDT does explicitly document the assumptions made in habitat assessment and working hypotheses.

Subbasin Planning Limitations: The reported purpose of subbasin planning is to direct Bonneville Power Administration mitigation funding through the Northwest Power and Conservation Council. It is important that subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans, which include:

Subbasin plans are being developed solely for the benefit of fish and wildlife, with no consideration of costs, economic losses or conflicting human interests, which results in faulty findings.

Response: The purpose of Sub basin Planning is to develop management strategies to recover fish and wildlife. The April 23 draft plan will include economic goals, and the feasibility of the projects that are proposed to be implemented. Sub basin planning strategies may be constrained by human costs and interests. Sub basin planning does not impose mandatory actions, but provides a framework within which projects may be proposed. Projects may benefit the human community as well as target species.

The "ecosystem approach" used does not make any distinction between public land and privately owned land in its determination of fish and wildlife management plans. Private property rights and land rights including water rights are not recognized.

Response: Because ecosystems cross land boundaries, assessments included all land within each sub basin. Management strategies and actions may distinguish between public and private lands. The April 23 draft sub basin plan will explicitly state that sub basin planning recognizes and will not impeded those legal rights.

Management plan goals are based on comparisons to “historic” or perfect, untouched conditions that are thought to exist prior to European settlement, which are not attainable, sensible or necessary.

Response: A baseline of some sort is needed to provide a benchmark against which change can be measured. Where the baseline is set does not affect the focus of the assessment, which reflects the condition of the resource today. The baseline simply allows changes to be compared across reaches and streams. If the baseline were raised or lowered, relative change (compared to today’s conditions) would remain the same. The issue remains the condition of the resource today and what to do about that. The sub basin plans do not advocate returning to a pristine baseline. Management strategies seek to return to properly functioning conditions when necessary for species recovery.

Goals are widely based on data with significant information gaps and unmeasurable outcomes with minimal public involvement.

Response: Data gaps are explicitly documented in the process. Sub basin planning is not funded (nor intended) to remediate data gaps by new field work, but its recommendations provide the framework for proposals to conduct additional work to fill data gaps. Measurable objectives are included. The sub basin Coordinators have conducted a very substantial public outreach and involvement effort. This effort is more explained in the April 23 draft sub basin plan. Public outreach has included inviting the public to participate in defining goals and management strategies.

The cumulative effects of restrictions and regulations on private property ownership and land use are not measured.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

The economic losses to the private landowner, agriculture, natural resource-based industries and county economic viability are not considered.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

The subbasin planning process bypasses land management planning safeguards and requirements such as economic review, public notice and public involvement.

Response: Sub basin plans provide a framework within which projects may be proposed. Land management planning requirements will be met prior to implementation of any proposed project.

There is no legislative oversight of back-door ecosystem approaches to manage lands.

Response: Sub basin planning is a federal process, and has been the subject of considerable federal oversight. It is not subject to state legislative oversight; however, state and local (as well as federal) requirements will be met prior to implementation of any proposed project.

Examples of Faulty Model Outcomes: Ecosystem Diagnosis and Treatment (EDT) was selected as the model to establish watershed management plans in Okanogan County. The EDT dispenses priority ratings for management actions based on the input or assumptions it receives. The EDT does not consider costs or other competing human interests, which has resulted in flawed and shortsighted outcomes such as:

Response: EDT is a tool used for biological and ecological assessments. It is not intended to incorporate competing human interests. Human factors are addressed in the sub basin plan's goals, and may be addressed in project development and implementation.

The controversial Salmon Creek Project rising to the top of the priority list even though funding has been consistently denied in the past because of the unreasonably high costs per benefit and potential ongoing and escalating costs for maintenance of a pumping station. Competing human interests and rights again are not considered in the EDT prioritization.

Response: Project prioritization is not complete, and won't be until recovery planning is complete. To the extent that Salmon Creek has been discussed in the sub basin planning process, it has been in an open public process with a multi-stakeholder sub basin core team.

Land acquisitions and conservation easements identified as a recurring management priority in a county already burdened with excessive government ownership. This would place more land and land rights under state and federal control and ownership and further expand federal and state regulatory control over land use.

Response: Land and easements can be acquired by state, federal, or local agencies, by private nonprofit organizations. Easements neither take land out of production nor convert it from private ownership. They help keep land in production and in private ownership. Land acquired by agencies is sold to those agencies by willing landowners, often because its productive capacity has been depleted and the owner no longer finds it profitable to manage. Both acquisition and easements can prevent subdivision; landowners sell land or easements as a means of keeping their holdings intact. We have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.

Acquisitions and easements are particularly noticeable as a management strategy in the Methow Watershed. The draft plan recognizes that the government has accumulated 85% of the entire watershed, with only 15% remaining in private ownership; still the management plans call for continuous acquisitions and easements under the guise of increased protection of fish and wildlife.

Response: The comment has been forwarded to the SCT. As stated above as well, we have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.

Increasing flows irregardless of competing water rights and human demands is a dominant management outcome, as well as returning to “natural” pre-European conditions in post-European settlement areas.

Response: Flow rates are frequently a limiting factor, and management strategies address this concern. Flow recommendations seek improvements to flow regimes, but do not necessarily advocate restoring pristine flow regimes. There are numerous strategies to increase flows, many are listed in the Methow Basin watershed plan; may of these recommendations could be potential projects.

Subbasin Planning Process: Public outreach did not begin until approximately six months after the technical team began work on the plans and public involvement occurred at seven months. The technical team, called the Habitat Work Group, apparently consists of agency staff and consulting firms. Members of the group remain unidentified although we have asked for a list of who is involved in the group.

Response: Technical staff (the HWG) did begin to organize and assess data prior to public involvement, with the intention of efficiently completing the very technical work prior to inviting public participation. Stakeholders were offered opportunities to comment and to participate in development of the su bbasin assessment, including opportunities to review the data being used and comment on decisions made about the use of that data. HWG members were identified in a list sent to the entire sub basin planning outreach email list; HWG members were introduced at early subbasin core team meetings and lists of HWG members were posted at those meetings.

The draft plans acknowledge some of the scheduling difficulties people have experienced throughout the subbasin planning process, which was attributed to NPCC’s lack of adequate time for public outreach. Although there were scheduling conflicts and problems, the biggest problem has been the lack of core information.

Response: The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

Public outreach and involvement consists of 1) e-mails that advise only meeting dates and times and what “stage” the process is in, 2) evening meetings with a slide show and verbal presentations with no handouts and at times no technical person to answer questions and 3) day-long meetings consisting of technical people and “stakeholders.” The day-long meetings are difficult for working people not on the payroll to attend, particularly on a regular basis.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished *handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them. The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.*

As noted, in spite of the complex information that was shown on slides and presented verbally, no handouts were made available at the evening summary sessions. The complicated information that was presented in this way made it difficult to get a clear picture of the process itself let alone the content information and findings. Requests for handouts and more information have also gone unanswered. Members who asked questions about the complexity and reliability of the EDT model were referred to the Mobrand website.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them.

Agencies and consultants in the Habitat Work Group have generated huge volumes of fast-paced information that has not been made available to the public. There is tremendous frustration throughout the county that this is just another process where an unidentified team of government entities and consultants has come together to write the plans and pass them off as “local” without meaningful local review or input.

Specific Comments

Methow:

1. The USGS Water Resources Investigations Report # 03-4246 needs to be included in this section. So model runs with and without groundwater seepage from canals have already been made. What has been found needs to be cited here on Pg. 22.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

2. Regarding a test site for examining the affects of seepage from canals: This has already been done with the Twisp Power and Irrigation Canal study initiated by the USGS. This work needs to be cited with its present conclusions. (Pg. 22)

Response: The comment has been forwarded to the Habitat Working Group (HWG).

3. The information presented contains most of the background materials and ESA information that we are all familiar with concerning the region and listed species. What is missing is the core of the draft that actually explains the subbasin planning perspective, its analysis of the problem and its proposed goals and solutions.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

4. Most importantly the present draft does not show any linkage with present watershed planning efforts and how they will be incorporated into subbasin planning.

Response: Sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st.

5. References to the Methow Subbasin Summary by the Conservation Commission do not cite the deficiencies in the summary noted by Ken Williams' review, which was part of the materials submitted for this process. It would be helpful to have as part of the subbasin plan a process cited on how these noted deficiencies are going to be addressed so a more accurate approach may be initiated in the Methow.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

Okanogan:

General: Numerous statements are made and conclusion rendered without benefit of resources cited. It is difficult to determine what is author's opinion and what is cited references, particularly as related to perceived environmental threats. (Third Paragraph, Page 21, 5th Paragraph, Page 21, Paragraph 2, Page 24)

Response: The comment has been forwarded to the technical writer. This is a very early rough draft. Some references are missing and need to be supplied, and the references section needs to be edited. The assessment of environmental conditions was done by the Habitat Work Group.

The Projects Inventories should show costs of projects as an accountability feature to the public.

Response: The comment has been forwarded to the technical writer.

In an apparent effort to combine BC and US portions of the watershed yet keep them distinct, it is difficult to distinguish between the two in portions of the material.

Response: The comment has been forwarded to the technical writer.

Paragraph 3, Page 23 (statement repeated in Paragraph 5)

Response: The comment has been forwarded to the technical writer. "North of Oroville" has been corrected to read "south of Oroville."

The Forest section appears to have numerous unreferenced claims.

<u>Subbasin in Relation to Region</u>, 2nd Paragraph, Page 18

The following statements appear to be more philosophically poetic than factual which does not seem appropriate, and the first sentence in particular is unclear in its meaning. No references are cited.

The Okanogan Subbasin exemplifies the popularity of the modern rural lifestyle and the controlling-protection paradox practiced by the growing number of valley residents.

Constraints to the sustainability of anadromous and resident fish, wildlife, and their habitats result from the footprints of this growth within the basin; many of these impacts and their resolution have cross-border implications. Such impacts include matured agriculture, forest and hydroelectric industries, and their extended affects which reach from the alpine mountain tops to the confluence with the Columbia River and beyond.

Response: The comment has been forwarded to the technical writer.

5th Paragraph, Page 18

The following statement is unclear. Also, is this author's opinion?

Dealing with these constraints will require both institutional and technical approaches, and links

between communities of science, interest and place.

Paragraph 1, Page 26

No reference quoted for final portion of the sentence. Is this author's opinion?

Dominant riparian species include black cottonwood, water birch, and white and thinleaf alder (Arno, 1977), but riparian forests and shrubsteppe have been virtually eliminated in the basin.

Paragraph 3, Page 27

Who/what is OWSAC? Is this listed in references?

Conversion of privately owned timber areas into other uses, such as residential subdivisions, is a trend, but not on the large scale that it is further south, in Wenatchee and Entiat (NMFS, 1998). During a recent four year period (1994 1997), approximately 11,000 acres of forestland were subdivided (OWSAC, 2000).

<u>Land Use and Demographics</u>, Paragraph 1, Page 28

In order to present a more accurate and complete picture, more specifics on protected land would be in order, i.e. how much land is in wildlife areas, etc. What does "dominated" mean? Perhaps forestry and range should be broken down rather than grouped together. Is this author's opinion?

Forestry and range are by the far the major uses of land in the Okanogan Basin, followed by croplands (Figure 8). Most of the landscape, from the riparian areas to the upper elevation forests, have been used extensively for agriculture and resource extraction. The valley bottom is dominated by agriculture, primarily orchards and livestock feed. The benches are dominated by livestock grazing, and the lower to mid-upper elevation forests have been harvested for timber and used for livestock grazing. The Okanogan Basin contains six state wildlife areas, a natural preserve in the DNR.s Loomis Forest, and a portion of the USFS.s Pasayten Wilderness.

Response: The comment has been forwarded to the technical writer. Forest and range are represented in different parts of Figure 8. "Dominated" has been changed to "predominantly".

Socio-Economic Conditions – Colville Reservation

Is the following statement actual wording of the court's findings? Reference to court ruling? The Court also ruled that the Colville Tribes possess federally reserved water rights to stream flows sufficient to preserve or restore tribal fisheries.

Response: Federally reserved water rights are established for all tribes under the Winters Doctrine. The statement cited is an accurate reflection of that doctrine.

Starting Paragraph 3, Page 30

Treaties and mitigation for dams are complex issues. Is this the correct forum to discuss the "unfairness" of the mitigation programs to the Colville Tribe? Are some of the following statements fact or opinion?

In 2000, the Bureau of Reclamation agreed with the Colville Confederated Tribes that the Federal government had not completed its authorized anadromous fish mitigation for construction of Grand Coulee Dam over 60 years ago. Planned artificial production programs were not implemented for the Okanogan River Basin when the outbreak of World War II halted non-war related construction projects. Tribes of the Colville Reservation have been seriously harmed by the lack of Grand Coulee mitigation, with ceremonial and subsistence fisheries declining to minimal levels, even in years of substantial runs entering the Columbia River. Fishing opportunity is now severely limited to summer/fall Chinook immediately below Chief Joseph Dam and an occasional sockeye fishery in the Okanogan River. This situation has been adversely compounded by later formulas for mitigation of mid- Columbia Public Utility District dams where the Federal Energy Regulatory Commission does not require mitigation for now, non-existing. Additional hatchery production under the proposed mitigation agreement with the PUDs is based on the run sizes of salmon and steelhead in a 10-year period during the 1970.s and 1980.s (Bugert 1998). Most of these post-dam runs were supported in large part by the initial hatchery mitigation programs funded by the PUDs and the Federal government. Since the CCT did not receive the initial mitigation from the construction of Federal and PUD dams, the basis for the new agreements discounts obligations to the CCT. Without the initial Federal salmon mitigation that other watersheds in the province obtained, the Okanogan Basin and Colville Tribes again were provided without mitigation. Additionally, the Federal government has never provided Okanogan anadromous fish mitigation for the Colville Tribes for the loss of adult and juvenile fish passing through the four Corps of Engineers. hydroelectric projects on the Lower Columbia River. Fish mortality at these projects have been generally estimated at about 10% per project, but were historically higher. Finally, Chinook mitigation by Douglas PUD for losses due to inundation and passage has been sited downriver, at Wells Hatchery and in the Methow River, away from the Colville Tribes. reservation fisheries. The Colville Tribes. total anadromous salmonid harvest is normally below 1,000 total salmon and steelhead combined and similar estimates are reflected in the Okanagan Nation fisheries upstream in Canada. Yet, in the 1800.s prior to over harvest in lower river commercial fisheries and subsequent habitat destruction, the Colville Tribes were estimated to have harvested in excess of 2 million pounds of salmon and steelhead annually (Koch 1976).

Response: The Tribes' representative advises that the points made in the text have been upheld. The mitigation cited is directly germane to sub basin planning.

Agriculture, Paragraph 5, Page 31

Says who? I cannot agree with a statement that does not list the positive benefits of Livestock Grazing and this needs to be corrected.

Livestock grazing practices have led to trampled stream banks, increased bank erosion and sedimentation, and changes in vegetation, including loss of native grasses, impacts to woody vegetation, and establishment of noxious weeds.

Response: Livestock impacts are based on the habitat assessment conducted by the HWG and reviewed by the SCT. The assessment process documented the level of certainty associated with each habitat attribute. The sub basin plan should recognize the benefits of limited grazing under proper management and monitoring.

Paragraph 6, Page 31

Who is PNRBC? Is a 1970s report relevant?

A 1970s rangeland evaluation indicated that 25 percent of rangeland in the basin was in good condition, 34 percent in fair condition, and 41 percent was in poor condition (PNRBC, 1977).

Response: PNRBC is the Pacific Northwest River Basin Commission. The technical writer has been asked to search for more current information.

Appendix A, Page 147

Federal ESA species are listed "that are present or may be present in Okanogan" but there is no way to know which listings are actually present and affect Okanogan County. Two separate lists would correct that.

Response: The comment has been forwarded to the technical writer.

Thank you for reading my comments and pass them on to any organization or entity that you deem necessary.

Patrick Plumb

Tonasket City Councilman

Okanogan County Citizens Coalition chairman-elect

pplumb@ncidata.com

work: 509-486-3105

home: 509-486-0688

# # # # # # # # # # # # # # #

From: "Ron Perrow" <ramshead@methow.com>

To: <sbp@co.okanogan.wa.us>

Date: 3/8/2004 12:50 PM

Subject: extension for comment

Please see attached letter

Thank you

Ron Perrow, chairman

Methow Basin Watershed Planning Unit

March 8, 2004

Okanogan County Water Resources

Northwest Power and Conservation Council

Re: DRAFT Methow and Okanogan Subbasin Planning

Dear Sirs:

This letter is in response to the February 23rd Memo soliciting comments by March 11th from "Interested Stakeholders" for the Draft Methow and Okanogan Sub-Basin Plans. Many of the individuals involved in watershed planning have been monitoring this process. It is the determination of the planning unit that there should be an extension of the comment deadline for the following reasons:

• Incomplete and inadequate information available for substantive comments.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

• Public meetings provided only verbal/visual presentations without informational handouts or technical personnel to answer questions.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them.

• Failure to provide comment document in a timely fashion. (Several reported they had to make repeated requests for the draft and in fact received it between several days to one week after Feb 23rd Memo.)

Response: Delays in data processing (EDT model runs) resulted in delays in releasing the draft. The sub basin planning Coordinators sent the draft to all those who requested it, as soon as it was available.

• Unknown agency bureaucrats selected information and programmed computer models for subbasins before any public involvement.

Response: Technical staff (the HWG) did begin to organize and assess data prior to public involvement, with the intention of efficiently completing the very technical work prior to inviting public participation. Stakeholders were offered opportunities to comment and to participate in development of the subbasin assessment, including opportunities to review the data being used and comment on decisions made about the use of that data. HWG members were identified in a list sent to the entire sub basin planning outreach email list; HWG members were introduced at early subbasin core team meetings and lists of HWG members were posted at those meetings.

• Public meetings were generally held during the day when much of the public is working and not able to attend.

Response: The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

Since the full extent of how these plans will be used for water management are not known, we are concerned about the fast-track development at the expense of any meaningful public participation.

Sincerely,

Ronald E. Perrow

Chairman

# # # # # # # # # # # # # # #

March 10, 2004

TO: Okanogan County Water Resources

RE: Methow Subbasin Plan

Time for public comment was to brief.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.)

The document is not complete.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

No public comment before EDT model runs were conducted.

Response: The sub basin planning process was designed to solicit and respond to stakeholder comment after the EDT run for each assessment unit. Comments regarding the data used and the outcomes will be incorporated in the findings for each assessment unit and will be considered in establishing priorities and management strategies for each sub basin.

No input from the Methow Basin Planning Unit was included before model runs were conducted.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.

The Methow Basin Planning Unit Rejected the EDT model, it's a black box we don't know anything about, it should not have been used. Because it was this plan looses credibility with the citizens of the valley.

Response: The NPCC required sub-basin planners to use either EDT or QHA. Planners in the Upper Columbia province elected to use EDT because it incorporates empirical data rather than relying solely on expert opinion.

Politics and state policy do show through bright and clear on page 22 – 6th paragraph. For the benefit of the Methow Basin please stop talking about lining our open canals. Look what was done to Skyline and Wolf Cr. It cost one million to destroy Wolf Cr. Now it's costing another million almost to fix it. Two million, it was working fine the way it was.

Response: The comment has been forwarded to the SCT.

Hannelor Vandenhengel

Box 533

Twisp, WA. 98856

# # # # # # # # # # # # # # #

Okanogan County Water Resources

Comments on Methow Subbasin Plan

March 10, 2004

The time allowed for responses was to short. Please extend it.

Response:The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.)

The plan is not complete. The plan should have been complete. Putting out incomplete plans is a strategy that's used when you have something to hide, or something you don't want the public to see just yet. This reduces the publics response time overall on specific information that may be controversial.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

It's my understanding that the Methow Planning Unit (PU) was not a part of this plan. The integration of all information in the planning process is key to successful planning. Your desire for citizen input in this plan seems a shame without input from the PU.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.

EDT model runs were made prior to input from the public. This process is backwards, unless your plan has a predetermined outcome, then public comments are just a nuisance and will probably end up in the trash can.

Response: The sub basin planning process was designed to solicit and respond to stakeholder comment after the EDT run for each assessment unit. Comments regarding the data used and the outcomes will be incorporated in the findings for each assessment unit and will be considered in establishing priorities and management strategies for each sub basin.

State agencies have ignored the possibility that recharge from unlined canals is a benefit. When I read page 22 I can see the plan was not based on science, just politics and state policy. The county and state have been represented on the PU. Why hasn't Okanogan County given direction as to the multiple benefits of recharge water form open canals as identified by the PU? Why hasn't the state seen to it that this information was incorporated in the Subbasin Plan?

Response: The comment has been forwarded to the SCT.

The determinations made by the PU do not jive with Washington state policy. So it seems the state has decided to go out on their own with backing from the NWPCC, using rate payer monies, ignoring the PU findings, and push state policy down our throats.

Response: Please note that the sub basin plan is permissive, not prescriptive. It includes a range of strategies that may be used depending on the limiting factors being addressed in a particular situation, and the characteristics of the project site.

Ken Bruce

488 Twisp-Carlton Rd.

Carlton, WA 98856

# # # # # # # # # # # # # # #

March 12, 2004

To: Julie Dagnon, Okanogan County Water Resources

From: Mike Gage

Re: Methow Subbasin Plan Comments

Julie,

The comment time on the Subbasin Plan was not along enough. There's a lot to read. Then you need time to digest it and respond.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.)

The subbasin Plan is not a complete plan, there's a lot missing. This means that in future drafts the public will have even less time to correct problems in the plan.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

There has been no attempt to coordinate planning efforts with the citizens driven MBPU. This is not what was indicated by the county over one year ago. There is a feeling by some members of the MBPU that the county and state are trying to do an end run around the MBPU. I hope that's not true.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.

I have a problem with the EDT model that was used in the Subbasin Plan. The MBPU was not comfortable with EDT. We has our TAG member, Ken Williams review information regarding

EDT, Ken recommended the MBPU not use the EDT model. Models can be manipulated and they are only as good as the data that's put into them. If you control the input of data going into the model you control the results the model will spit out. The MBPU was not allowed a part in the control of data that went into the Subbasin Plan. I now have no confidence in the model results. The citizens of the Methow Basin have been hammered, by state and Federal agencies to the point where we would be total fools to trust anything they tell us. The county sits on both planning groups, why didn't the county step in and ask that EDT not be used, you knew it was very controversial.

Response: The NPCC required sub-basin planners to use either EDT or QHA. Planners in the Upper Columbia province elected to use EDT because it incorporates empirical data rather than relying solely on expert opinion. Material addressing the deficiencies of EDT and the MBPU's rationale for rejecting it will be appended to the Methow sub basin plan.

Through the parts of the Subbasin Plan that I had time to read the plan talks about bringing things back to natural. Yes there Probably is less "natural" riparian habitat today than there was 110 years ago. But there is more riparian habitat over all in the Methow Basin today then there ever was naturally. RCW 90.82 is about not just protecting existing habitat but enhancing what we have. Today we have more trees in the basin than it ever had before the white man came. We have more habitat for wildlife than was here naturally. Because of our farming practices etc. we have more nutrients going into the streams, these enhance the food web providing more food for fish, thus increasing the fish populations by as much as 30% in some streams. Pollution is not a problem in the Methow Basin, nor is sediment. Mullan & Willimas found that sediment was only 10% above natural levels. The gradients in the basin are steep and sediments are washed away causing no problems. Natural is not always better.

Response: A baseline of some sort is needed to provide a benchmark against which change can be measured. Where the baseline is set does not affect the focus of the assessment, which reflects the condition of the resource today. The baseline simply allows changes to be compared across reaches and streams. If the baseline were raised or lowered, relative change (compared to today's conditions) would remain the same. The issue remains the condition of the resource today and what to do about that. The sub basin plans do not advocate returning to a pristine baseline. Management strategies seek to return to properly functioning conditions when necessary for species recovery.

Page 22 is scary, the authors of this plan are still looking at unlined canals as being detrimental. These ideas come from state policy. State policy lags way behind good current science. This is another area where the county should have stepped in and contributed recharge information from the MBPU plan, the county didn't, now we have two plans that will be conflicting with one another in the direction they take. The county is creating a big mess, will the residents ever get out of it, and how much will it cost them in the end.

Response: The comment has been forwarded to the SCT. In addition, sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st. Please note that the sub basin plan is permissive, not prescriptive. It includes a range of strategies that may be used depending on the limiting factors being addressed in a particular situation, and the characteristics of the project site.

Reading this plan has been irritating. After 20 years of trying to see the truth come out I now wonder if it ever will. I feel like a thief is going from door to door and window to window at my house, every time he finds a door locked and bared he tries another then he tries the windows, if one is locked he goes to another. Doors and windows keep appearing and I keep running around locking them and baring them but it never ends. You call for help and they send out more thieves to help the ones already there. The state wants our water, they will take it anyway they can. Next it will be our property.

MBPU members sent a letter of concern to the county and NWPCC. I am sending a copy of the letter and would like it to be part of my comments on the Subbasin plan.

Michael D Gage

Carlton

MBPU Letter enclosed with Michael D Gage's letter:

Northwest Power and Conservation Council

Bonneville Power Administration

Upper Columbia Salmon Recovery Board

Okanogan County Commissioners

RE: Sub-basin Planning

Attention: Sub-basin Planners

It appears that the Northwest Power and Conservation Council (NPCC) sub-basin planning process (SBP) initiated by Okanogan County, Colville Tribes and Washington Department of Fish and Wildlife for determining the restoration measures in the Methow Basin is flawed. The Methow Basin Watershed Planning Unit (planning unit) has not been included in this process. In fact the planning unit has not been contacted nor allowed input into this process. The planning unit ws told the process was being initiated well over a year ago. We were told we would be receiving a letter from the SBP group asking that a representative from the planning unit sit on a board with the three SBP agencies named above to set the course in determining the restoration measures that would be taken in the Methow Basin, this never happened. Later we were told the SBP group would be attending a planning unit meeting to gather input in determining restoration measures, this has not happened.

Response: The comment letter was addressed to the NPCC; we are not sure what comment is appropriate from us.

We can not overlook the fact that the key to successful sub-basin planning is the integration of any efforts into the watershed plan developed by the planning unit. Further more the planning unit has been involved in watershed issues for the last five years with some members also having involvement in the Pilot Plan and Ground water advisory Board, which goes back to the 1980s.

Due to the planning unit not being included in the SBP, the ingredients for good planning is not there. This is primarily because the studies and information developed by the planning unit are not being considered or included in the SBP. Thus your desire for local expertise is not even represented.

Response: The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem. Because most of the SCT meetings were held during the day, a summary meeting was held to accommodate those stakeholders who were not able to attend day-time meetings. The MBPU's schedule was a factor in choosing the meeting date; the sub basin coordinators chose an evening on which the MBPU had decided not to meet. After the SCT meeting had been scheduled and advertised, the MBPU decided to hold a meeting on the same evening. While the conflict was regrettable, the coordinators did not think it would be fair to other members of the public to cancel a meeting that had already been advertised. Sub basin Planning outreach staff met with the MBPU on March 31st to discuss the sub basin plan and receive comments. The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process. The NPCC required sub-basin planners to use either EDT or QHA. Planners in the Upper Columbia province elected to use EDT because it incorporates empirical data rather than relying solely on expert opinion. Material addressing the deficiencies of EDT and the MBPU's rationale for rejecting it will be appended to the Methow sub basin plan.

While some efforts have been made to make this process know to the planning unit this ignores the fact that the planning unit is on a fast track to complete its plan, and that the planning unit was told that this process would be integrated with watershed planning. It now appears that an end run is being made around the planning unit because there has been no contact nor integration attempted and because the SBP effort is creating a demanding schedule in parallel with the planning units heavy schedule.

In observing these things there is a real fear that efforts such as this will create conflicting or duplicate planning. This is reinforced by the fact that recent key meetings have been held during the day or in conflict with the planning unit meetings. This has eliminated in effect comments that could be provided by experienced planning unit members. Also sub-basin planning is being done without integration of the planning unit priorities. One such priority is that the planning unit on advise from its TAG rejected the EDT modeling technique as a valid tool for assessing habitat conditions and functions in the Methow Basin. This has not been considered by the SBP. The planning unit TAG recommended that an actual habitat assessment be completed focused on what the fish are doing in relation to existing habitat conditions. The planning unit was not able to do this because of funding and time constraints.

Furthermore how can there be valid input if the model runs are already one without citizen or planning unit input? The invitational letter shows that the Upper Columbia Salmon Recovery Board is doing the integrating. They are forming an overall strategy not a Methow Basin specific strategy. The planning unit has specifically made provisions for future planning by setting up a Methow Watershed Council (MWC). The SBP should be seeking to make provisions to integrate its efforts with the planning unit and in the future with the MWC. Without such considerations it is our belief that the SBP group is doing an end run around the state legislature which specifically intended that watershed planning be done by the local citizens. Salmon recovery was a key component of the watershed planning act.

There are too many mandates and differing agendas not based on real science, which in the long run look to be more damaging to the environment than helpful. Such pitfalls should be avoided and agencies responsible for funding restoration and recovery efforts are obligated to see that the process was not done incorrectly, and that funds were spent wisely.

Would it be appropriate for you to come directly to the planning unit for recommendations on recovery and funding projects?

Please send your responses to:

Methow Basin Watershed Planning Unit

PO Box 247

Twisp, WA 98856

Signed by:

Marty Williams – Planning Unit Member

Ron Perrow - Planning Unit Member

Mike Fort - Planning Unit Member

Mark Love - Planning Unit Member

Karla Christianson - Planning Unit Member

John Umberger - Planning Unit Member

Michael D Gage - Planning Unit Member

Dick Ewing - Planning Unit Member

Fred Colley - Planning Unit Member

Ray Campbell - Planning Unit Member

Gary W Erickson - Planning Unit Member

Cc: Sen. Linda Evans Parlette

Sen. Bob Morton

Rep. Cary Condotta

Rep. Michael Armstrong

Rep. Bob Sump

Rep. Cathy McMorris

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April 13, 2004

TO: Okanogan County Water Resources

Northwest Power and Conservation Subbasin Planning

123 North 5th Avenue Rm. 110

Okanogan, WA. 98840

RE: Methow Subbasin Plan

In 1999, Okanogan County, the Town of Twisp, the Methow Valley Irrigation District (MVID), and the Colville Tribe established themselves as "initiating governments" for the watershed planning process, and began developing a stakeholder group, now called the Methow Basin Planning Unit, or MBPU. Members of the MBPU represent the diverse interests in the Methow Valley, and the group has been meeting regularly for about five years.

The MVID represents about 200 members. The Methow Valley Canal Associates (MVCA) is also represented on the MBPU and has about 90 members. I have represented the MVID and the MVCA for just about 5 years. I have concerns with the Methow Subbasin Plan (MSP). Why wasn't the MBPU involved in the MSP? Its true a meeting was set up between the MBPU and the MSP but this happened only after the plan came out for public review and after many comments and complaints over this. The group of MBPU members that attended the meeting were given a lot of lip service. We were told that you realized things were not done right, but tough you were going forward anyway. I guess we'll see if any of our comments will be incorporated in the next draft.

The legislature felt that the local development of watershed plans for managing water resources and for protecting existing water rights was vital to both state and local interests. The development of such plans serves the state's vital interests by ensuring that the state's water resources are used wisely, while protecting existing water rights and ESA listed fish, and by providing for the economic well-being of the state's citizenry and communities.

Okanogan County was sent a letter of concern from members of the MBPU, and I was one of those concerned members that signed on to the letter. Okanogan County Water Resources replied to the letter, but did not address the concerns of the MBPU members. The counties reply was just a whitewash. This sends up red flags of warning.

On page iii – you state coordinators delivered briefings to interest groups, and you have a list of interest groups that were included in the MSP. The MBPU is a much larger interest group with about 26 stakeholder groups being represented. The MBPU was told over a year ago we would be included in the MSP and would have a member sitting on your board, this never happened. The MBPU was latter told the MSP group would be attending a MBPU meeting to get input from the MBPU, it never happened. It appears you have misrepresented your intentions and were purposely avoiding the MBPU.

On page iv – you mention EDT, the model used to develop your management strategies. The EDT model is a black box, the public is keep in the dark as to how it works. The MBPU TAG rejected the EDT modeling technique as a valid tool for assessing habitat conditions and functions in the Methow Basin. The MBPU TAG recommended that an actual habitat assessment be completed focused on what the fish are doing in relation to existing habitat conditions. Furthermore the model runs were already done without citizen or planning unit input. When asked for the information that was feed to the model I was not supplied with it but was told there was to much paper to deal with. At this time I do not know what information was feed to the EDT model. Was the information any good? Was the information controversial? There was no information/input from the MBPU, nor from local citizens that went into the EDT model. Models can be manipulated just like a crooked roulette wheel, the person in control of the wheel will get the numbers he wants. More red flags.

On page xii – the Methow Basin Summary is mentioned. The Methow Basin Summary was done using the limiting factors review. The MBPU was to have input on the Limiting Factors Review, MBPU TAG member Ken Williams reviewed it, Ken stated it should not go to print in its presently written form. Many MBPU members also had input on the Limiting Factors review and were waiting for Ken to finish his review so all input from the MBPU could be included at one time. The review and the comments from the MBPU were never looked at because the Limiting Factors Review was completed without the MBPU input being allowed. The MBPU was never told what the comment closing date was. The County Water Resources head at that time was Dennis Beich, Beich was also the county representative to the MBPU and at this time MBPU chair. Carmin Andonaegui, Washington Conservation Commission, was writing the limiting factors review. Carmin was living with Beich as his girl friend at the time the Limiting Factors Review was written. Beich was dealing with Ken Williams and was the MBPU go between. When the review was completed Beich said sorry to late for comments the Limiting Factors is finished and its being printed. So errors in the Limiting Factors Review were never corrected these errors then were included in the Methow Basin Summary, then were they feed into the EDT model? Garbage in garbage out.

I gave input on the Methow Basin Summary, I asked that winter be recognized as the bottle neck for fish production, I asked that Mullan and Williams statement “Irrigation at current levels in the Methow River Basin, may be more beneficial than detrimental to salmonoid habitat because of its positive influence on groundwater” be included and researched. I thought these were key elements in planning but they were not included in the final product, except Ken Williams review was put in an appendix after much debate with Dennis Beich now the regional head for WDF&W. All three of the above mentioned plans had a very limited amount of time in which to do them. It was rush, rush, rush, no time for this, not enough time to do that. Why is the BPA in such a hurry to spend rate payers money. From the Limiting Factors Review to the Methow summary to the Methow Subbasin Plan the whole process has been questionable and there are a lot of red flags.

On page xii – at the bottom of the page are a number of important heading s that are not complete, why? If you don't know what the Subbasin Goals, Recovery Goals, and the Vision Statement is by now there is a problem. Why didn't you complete all these headings? The plan is incomplete, how did you even make the model runs without some of this information, and the model should have provided the information for the rest. More red flags.

On page 22 – the plan talks about the lining of irrigation canals, you say this plan is based on science, what science has been done in the Methow Basin, that is worth anything, where it has been determined unlined irrigation canals are detrimental. Those of us that have been involved in water planning know, in the Methow Basin unlined canals are beneficial. Transportation water does recharge the water table. This recharge occurrence is but one of the multiple benefits derived from irrigation water rights.

Data provided by the USGS shows that recharge water is significantly delayed in its return to the river. Because of the delay in returning to the river, and other factors, the MBPU has determined that recharge water has many benefits. These benefits have been known by local residents, and were mentioned in previous studies by Mullan and Willams and by Buell & Asso. The DOE has refused to recognize these benefits, and has even denied their existence.

We have seen the negative affects caused by piping unlined canals in the Wolf Creek area. The lowering of the water table, loss of wet lands, and unseen at this time or at least not admitted to, the lost of instream flows for fish during the winter bottle neck. Everyone on the valley floor is a secondary water user of water from an unlined irrigation canal. Wake up, don't screw with our ground water. All of these benefits are supposed to be protected by state agencies like the DOE and WDF&W. I'll bet none of this recharge information went into the EDT model.

<u>The plan and the whole process should to be reevluated.</u>

I have not had time to fully review this plan, its doubtful if anyone has had sufficient time to fully review the MSP.

The plan is incomplete and should not have been set out for review until it was complete.

The final USGS data was not incorporated into the plan nor does it look like the final USGS data was feed to nor part of the EDT modeling.

Information fed to the EDT model may have been incorrect. If information from the limiting factors review was used, or if information from the Methow Subbasin Summary was used, that information may have been wrong because of errors found by the MBPU TAG review. These errors in the Limiting factors Review were never corrected and were passed on to the Methow Subbasin Summary and would have corrupted the EDT models findings.

Information submitted by me on irrigation benefits and the winter bottle were not included in the Methow Subbasin Summary. This was information key to the EDT model and it appears this information may have been purposely left out.

Transportation water from unlined irrigation canals has multiple benefits which need to be protected and not ignored nor done away with as suggested on page 22. Recharge projects will increase instream flows for fish through the entire year, particularly during winter, the bottle neck for fish production. Groundwater recharge projects should be at the top of the funding list. Recharge projects are not mentioned in the MSP, why?

Ratepayer monies are being spent on this process so make sure the process is done right, and is above board. Right now the process is very questionable.

Michael D Gage

Cc:	Rep. Cary Condotta PO Box 40600 414 John O'Brien Bldg. Olympia, WA 98504-0600	Rep Cathy McMorris PO Box 40600 MOD 2 BLDG – Rm 110-E Olympia, WA 98504-0600
	Sen Linda Evans Parlette PO Box 40412 Olympia, WA 98504-0412	Rep Mike Armstrong PO Box 40600 424 John O'Brien Bldg Olympia, WA 98504-0600
	Sen Bob Morton PO Box 40407 Olympia, WA 98504-0407	Rep Bob Sump PO Box 40600 406 John O'Brien Bldg Olympia, WA 98504-0600

Public comments submitted for inclusion in Methow Subbasin Plans

Prepared by: Larry Bailey, Michelle Boshard Phone: 509 486 2400

Submitted to J. Dagnon, Okanogan County Water Resources Coordinator

May 10, 2004

Methow Subbasin Plan

General comments:

1) The plan is grossly incomplete in content (many sections and/or discussion of critical tables and reference documents are not provided in the text where they are brought up—to the point where it is not ready for presentation / understandable). Some sections appear to just be incomplete with notes left for what to include, which might indicate the writers have not met time deadlines for production. This document is marginally better in places than the Okanogan plan in terms of pointing out and acknowledging things like gaps in knowledge which need to be addressed to better implement priorities and projects.

2) Plan is incomplete in presentation (critical tables and figures are missing which makes it impossible for full understanding by public, not to mention that not all the supporting material was made available)

3) Plan lacks professionalism, even for a draft (spelling errors, formatting issues which make it difficult to navigate the document)

4) The document was dated April 23, 2004. The deadline for public review is May 10th, 2004. The article in the newpaper (Omak Chronicle) letting the public know the plan was even available for review did not occur until April 28th. This left effectively 10 days for the public to review the document, which was not posted on the internet in all the places it said it would be (not on County Water Resources website as of April 30, 2004) and copies not easily made available for pickup for public to review when they could (i.e. they would have to photocopy the 400 of 1600 pages made available themselves, or sit in the library for hours). Additionally, the full document was not made available. This is a grossly insufficient amount of time even for the “pared down” version of the document. It took a team of agency people and consultants a year to produce the document and it still appears to be incomplete. The fact community groups and/or local governments could not take this back to regular monthly meetings because they did not have enough time, and that they did not have access to major sections important for understanding the document make it impossible for the kind of review needed to approve the plan and claim stakeholders were involved.

5) There is no evidence that this plan has been based on anything that the public or stakeholders desire(s) or consider(s) important, despite the fact NWPPC and these planning exercises were "created by Congress to give the citizens of Idaho, Montana, Oregon and Washington a stronger voice in determining and balancing the future of key resources". There is a complete lack of appendices of any public feedback, opinion, questionnaires, responses to inquiries or requests for public input anywhere in the document. No information is available on the already completed public review that was supposed to have occurred during the development of the plans.

6) This plan vastly out of step with current thinking regarding the way agencies in the Columbia Basin should be approaching planning exercises such as the Subbasin process. Executive Director of the Columbia Basin Fish and Wildlife Authority, told the Columbia Basin Bulletin, 'Agencies have to come to grips with the idea that they have to let loose of the controls. They have to lead from behind. This is not about controlling people and making them do things. It's about enabling them to do their best. People really respond to that. The vast majority of people want to do things to make things better. But mostly they don't have the ideas of how to do it. Or they don't have the resources to get it done.' ".

Response: Comment noted. An extensive and responsive public outreach program was conducted. The subbasin plan needs to be edited to be more concise, rather than to include more technical information. Supporting technical information can be found in the references cited by the plan. See response to comment S3-S4 regarding public involvement. Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

7) Executive Summary: Vision. The vision statement in this plan is verbatim what is stated as in the Okanogan Plan. The Methow and the Okanogan subbasins are different landscapes physically, socially and economically and require very different solutions tailored to suit the people/demographics, landscapes/impacts and local resource retoration needs. The vision statements of both the Okanogan and Methow plans, if truly based on the individual subbasin and the stakeholders in it, are not likely to be exactly the same. This indicates that the vision comes from the writers of the plan rather than from a collective understanding and agreement reflected in a statement generated by stakeholders based on that basin's needs. What is written just sounds good and is generic enough not to really mean anything in either basin. It does not reflect useful vision which achievement can be measured against in any real terms, which is the point of this plan.

Response: The vision statement is intended to provide broad guidance for future desired conditions. The objectives and strategies are specific to the subbasins and stream reaches.

8) See other comments in Okanogan Subbasin Plan "General Comments" Section.

Specific comments:

1) Section 2.1 Subbasin Assessment--Subbasin Overview. Plan states it will solve challenges facing the Methow by “providing a compendium of resource information and the tools to empower planners and decision-makers to implement programs appropriately and in a coordinated manner at the local level”. The goal of this document was to provide such a plan, not the tools for others to make the plan.

Response: The subbasin plan is not intended to be prescriptive but to provide a framework for implementation.

2) Section 2.1 –Methow watersheds. No simplified comparative impact scale summary provided to help understanding of prioritization of restoration projects and funding expenditures.

Response: The subbasin plan is not intended to address impacts but to assess current condition of habitat for fish and wildlife recovery. It does not identify and prioritize specific projects or funding.

3) Section 2.1 –Anthropogenic Disturbances. No inclusion of public / landowner perspective on results of these disturbances and impact to them as given by the public/ landowners. Neither is there recognition of the considerations resulting from those issues that later will affect the plan implementation, and how to deal with them. This plan is not occurring in a vacuum and will need to deal with these realities. There is no background or linkages to other major initiatives in the area involving public in watershed planning and dealing with anthropogenic disturbances, nor inclusion of reports on already accumulated consensus on how to deal with anthropogenic and social issues.

Response: The subbasin plan is based on an objective habitat assessment and an extensive and responsive public outreach program; see plan section XXX and appendices. The Subbasin Core Team sought public involvement to address the issues raised in this comment.

4) Section 2.1—Terrestrial Wildlife Relationships, Special Plant Species. Not provided.

5) Section 2.2—Focal Species: Population Characterization and Status. Although technical reasons for species selection (and the impacts causing the selections) are provided, there is no information on what implications plans for restoration of these species will have for public, landowners and other stakeholders, nor is there information on how or where the restoration will occur and who will be responsible, which is what the plan is meant to do. Sections such as “Population Management Regimes and Activities “, “Ecologic Effects / Relationships”, “Relationship with Other Species” and other more basic technical information are not provided for some species. The prioritized list of limiting factors for each species and how these limiting factors compare to the limiting factors of other selected focal species in order to determine which species to fix first is neither provided nor discussed in the text in this section. It is impossible for the public to assess and provide feedback on these plans and their impacts to the public when no

information is provided to the public on these issues. If it is not completed, it also seems difficult for agencies to determine priorities based on this information and comes across as a regurgitation of what is already known.

Response: Focal species were selected to be representative of a broad range of habitat types located within the basin. It does not exclude other species from consideration. The subbasin plan develops strategies for species recovery; it is not intended to address the effects of species recovery on landowners and other stakeholders. It addresses action strategies; it does not identify specific projects. Prioritized limiting factors will be provided in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website. S3, S4: An extensive and responsive public outreach program was conducted; see plan section XXX and appendices.

6) Section 2.3—Environmental Conditions, Changes in Wildlife Habitats. Plan only briefly states that major land use changes have cause shifts in critical habitat-type shifts which affect the focal species, but does not discuss or reference technical or objective documents which demonstrate what these implications mean. Neither does it provide references to support the statement that "subbasin wildlife managers, however, believe that significant physical and functional losses have occurred to these important wetland habitats from hydroelectric facility construction and inundation, agricultural development, and livestock grazing." This seems to be either a subjective impression by agency employees which is unsupported or contradicted by their own data, or an unexplained "group conclusion" of the SCT for which no explanation was provided.

It appears landowners or industries influencing the land use changes and habitat itself were not consulted despite the fact their livelihoods depend on having a significant amount of this knowledge. While feedback from such sources is not scientific in nature, the plan writers themselves admit that the technical bases which agency employees use to make their determinations (eg IBIS databases etc) are not accurate. This results in a "we don't have a clue, and we haven't asked anyone who lives there, but we're going to plan anyway" approach which is no longer a scientific debate but a political contest in which the public and landowners don't have an even footing, and often lose.

Response: The comment is not clear.

7) Section 2.3—Environmental Conditions, Re-iteration and Expansion of the Guiding Principles. The plan begins this section by stating "The economic, cultural, and social valuation of fish resources is derived from the characteristics of the ecosystem that supports them" and then launches into technical prioritizations of ecological objectives set by agencies and their technicians (most of which were developed without specific or broad public input in regards to the impacts at local levels where priorities would be applied). The premise that this argument is built on—the statement that economic values are determined by the ecosystem—is

fundamentally untrue. It is not surprising that fish and wildlife scientists writing this plan do not have a firm grasp on economic realities, which are determined by social, cultural and market values not in their realm of expertise. But this affects the appropriateness of the plan because the logic thread proposed by the technical people seems to be basically that "the economy is based on the health of the environment/ watershed and its capacity, which we measure in focal / indicator species performance, and that if we set and meet the objectives we set for how a certain fish does it therefore improves (or meets objectives set by community for) the economy, and furthermore that science technicians would know best about that without asking the local community or researching what economic plans are already in place". There is no true inclusion of economic, social or cultural values referenced or included at all in the priorities set by the Regional Technical Committee (RTT), likely because the RTT is a strictly (and self-admittedly) defined technical body that doesn't deal with non-science issues. There is a vast amount of economic and cultural information in relation to the environment and economy, derived locally and paid for with public money in order that they be specifically included in plans like this, which are not included in this plan. Yet the writers of this plan insist the priorities set by the RTT "reflect a synthesis of goals and objectives from the various management plans directing tribal, state and federal agency policies within the Methow Basin." This is a specific demonstration of how science and government agencies are using their argument (made later in the paper) for separating policies (which they say specifically in the plan should be based on public goals) from the "how to get there" (the guiding principles for technical priorities). This excludes the opportunity for public to comment on specific application. This is a kind of sleight of hand saying "we want technically sound plans and we are technical people so we didn't collect social data--that's the policy department" while the policy department says " we

base our policies on scientific data and broad public goals our agency is given" without referencing or collecting the local economic and social community information a specific subbasin plan should be tied to and of which there is a vast amount. This process therefore never allows for the ground-truthing and reality checking and may cause Public

subbasin plans to be rejected by the public due to conflicts with community interests and ongoing initiatives, not to mention they will be useless to project proponents in seeing where they fit in the big picture in this regard.

Response: The subbasin plan presents broad guiding values and goals in its vision statement. It is not intended to develop these in the body of the plan. The formal draft plan will be edited with this in mind.

8) Section 2.3—"Relationship of Scientific Conceptual Foundation to Subbasin Goals" Not provided (see above—affects publics ability to understand how exactly their needs and interests have been considered or not).

9) Section 2.3—Historical conditions, current conditions, no-action conditions, or future desired conditions are not provided.

10) Section 2.3—"Out-of-Subbasin Effects" and "Environment/Population Relationships" not provided.

11) Section 2.6— Synthesis Of The Most Important Factors For Decline. Plan states it will "summarize and compare some of the central findings and conclusions offered in a number of key reports". Although a lengthy regurgitation of ideas from obviously libraries of information, this section does not then provide a meaningful discussion or prioritization of what the central findings of the current knowledge base mean, or indicate what should be done further based on common knowledge. The plan subsequently states that "to date no quantitatively structured analysis of limiting factors has been reported in the documents discussed here. Such analyses are being considered or planned using EDT or QHA. Until those analyses are published these qualitative assessments will have to suffice." This seems to mean that this subbasin plan, although it could not provide what it was supposed to, was done anyway, and without public input. It does therefore not meet the task assigned for the plan, and admits to itself this plan is not what it is supposed to be. The public cannot make an assessment of this plan based on either its content, or how it meets the goals set out for itself if it is has not been written to respond to the goals set out for it. Even if it manages to get by the public because of the short review period, it will likely never gain true public support and implementation, but instead will either sit on a shelf or draw lawsuits and opposition.

Response: Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

12) Section 2.6—Synthesis and Interpretation of Assessment in regard to Terrestrial / Wildlife. Plan states "Subbasin assessment conclusions are identical to those found at the Ecoprovince level for focal habitat types and species. An assessment synthesis is included in section 6 in Ashley and Stovall (unpublished report 2004)." The draft then has a comment which reads "Need more wildlife material summarizing conclusions

here??". This is evidence of the derivative "cut and paste" nature of the document and unnecessary padding after conclusions are already drawn, perhaps to distract from the obvious lack of content in the plan. This section does not draw ecosystem linkages across fish and wildlife priorities in assessment units or discuss how separate fish and wildlife projects will be prioritized for maximization of funding efficiency.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website. Agree that linkages across fish and wildlife priorities are not made, and *represent an unfinished agenda that should be addressed in future plan update or implementation.*

13) Section 2.6—Fisheries Assessment Methodology. Section does not provide the rationale for the basis of the “exceptions” made during technical prioritizations, was this because they didn’t fit the model? If so, how do those exceptions relate to real life impacts on fish—which is the priority, not making the model run smoothly.

14) Section 2.6—Strengths and Weakness of Assessment Methods / Data Availability and Quality. Not provided. This section is critical to public’s ability to assess the plan in terms of the appropriateness of use based on the model used and the data it generates, on which assumptions for plan are based. Just like the IBIS database, we cannot make plans on incorrect models—no crosscheck process is outlined to verify findings.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

15) Synthesis of Key Findings. Not provided. Social and economic implications for landowners and public not discussed.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

16) Integrated Priority Assessment Units. Plan states “The integrated priority list for restoration and protection can be seen in tables Table 50 and Table 51, respectively.” Not provided.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

17) Plan states “We also integrated the inter-species priority list with the assessment unit limiting habitat attribute summary analysis to provide a matrix of “where” and “what” needs restoration in the Methow Subbasin.” Not provided.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

18) Section 3. Inventory of Existing Activities. This section provides a text summary (some of which is inaccurate) of the groups in the region, but does not provide an assessment of what projects are fulfilling what priorities found in the analysis, how they will be tied together, cost-saving analyses etc for review. Although this would be the foundation piece to a sound management strategy acceptable to the public (is not provided for their consideration), a detailed management strategy and approach is then subsequently proposed for consideration in the following sections. This seems to indicate that despite needing to work with existing bodies and stakeholders already undertaking activities / implementing plans or listening to the public about what will work on the ground in consideration of technical issues, planners are forging ahead alone. The management strategies later proposed do not refer to or link to appropriate sections of other plans by other groups. The writers then refer to their own flawed argument of “mixing of conceptual foundations” (ie keeping public policy and technical separate) as

the reason things aren't working, and as a reason for ignoring anything but technical considerations. The plan states "Too often in the past, the implementation of inappropriate strategies was made possible by altering the science (conceptual foundation) until it was consistent with the favored strategy. That was possible as long as the conceptual foundation remained unstated and hidden from view. In some hatchery and harvest management programs, as well as salmon restoration programs, scientific knowledge was suppressed or "bent" in order to justify the desired strategies". While this is an expectable backlash by science to political decisions which have damaged salmon stocks in the past, it implies another "technical only" solution created in a vacuum rather than a balanced one. Generally judgments made are inappropriate, and the plan's proposed directions do not even live up to its stated plan goal of balancing science, policy and on-ground local community/public needs, concerns and interests (economic and social issues).

19) Section 4. Management Plan. Our Vision for the Methow subbasin. Given the fact that any local and specific watershed based data, public involvement and conceptual conflicts discussed above are not provided or do not exist, the entire Section 4—the Management Plan for the future—becomes entirely suspect as to whether it will work in the Methow at all. Likewise for the Okanogan plan, despite the fact that both plans state in their "Specific Planning Assumptions" portion that "the ultimate success of the projects, process, and programs used to implement the sub basin plan will require a cooperative and collaborative approach that balances the economies, customs, cultures, subsistence and recreational opportunities within the basin with the federal/state mandates to protect fish and wildlife." This plan does not reach this goal in process, content, or direction.

Response: Comment noted.

20) This plan does and will not allow the specific goals in the "Specific Planning Assumptions" section to be reached, including 1) that "The Bonneville Power Administration should make available sufficient funds to implement projects developed within the framework providing by this plan in a timely fashion", because it does not provide the list for funding, and 2) "participation of stakeholders, local and regional planning organizations and/or groups in implementation of subbasin plans should be fostered to the fullest extent possible or where appropriate", for reasons discussed above.

Response: Comment noted.

21) Section 4.1 Recovery Goals. These goals and opinions are not goals as reflected by landowners and public to truly make this plan a reality, but rather either the incompleted or unprovided technical / scientific agency-based goals and priorities (sections 4.2 through 4.4) which may or may not be reachable, given local realities and considerations not incorporated in this plan. Of the five criteria listed presumably for determining for recovery goals (none of which are actually provided or discussed for comment), the community and social considerations (a.k.a. "social based criteria" which presumably

refer to the direct impacts to the landowners and public this plan will have) are listed last, below even the way agencies administrative way will handle the money to come for the projects they have not prioritized yet. This shows exactly the level of interest by planners in ensuring the local community and stakeholders are involved in the plan.

Response: An extensive and responsive public outreach program was conducted; see plan section XXX and appendices. The Subbasin Core Team sought public involvement to address the issues raised in this comment.

22) Section 4.7—Recommendations For Monitoring In Subbasin Plans. Plan states “Both top-down, and bottom-up approaches are necessary to develop a regional monitoring plan. Generally, subbasin plans embody the bottom-up approach, as they will contain input from a wide range of stakeholders and provide professional input from those who are most familiar with the logistical needs for these programs. When first written two years ago, the requirements for the monitoring components of subbasin plans also followed this philosophy, recognizing that the majority of on-going monitoring activity is at the project and subbasin scale.” This plan does not provide a strategy for this. Plan lacks specificity on monitoring needed for this basin and the priority projects planned or ongoing that require monitoring. Misses one of the most cost-effective and beneficial strategies for accomplishing monitoring by not including where, when or how community can be involved in the monitoring, its synthesis, priority development, projects or initiatives to effect improvement of habitat as a result of good monitoring. Noone knows their river or their land better than the landowner or local community members. The public is a vast untapped resource which enjoys and would like to help in resource protection and restoration. Employing volunteer monitoring programs provides cost-effective leverage, relationship building, public outreach opportunities that can never be realized by conventional agency approaches. Well developed, coordinated, supported and funded it can even reach the landscape scale at which the agencies cannot. It requires training, quality assurance and control measures, and consistency in funding support but is a far more cost-effective mechanism for monitoring than currently spent monitoring dollars can do when used in a conventional manner. There are many regional, statewide and national organizations ready to help with a program that makes sense. The fact that this is not included in the plan is a major omission and flies in the face of the plan’s stated goals of “inclusion of communities of science, interest and place”.

Response: The monitoring plan was completed in April 2004 is now available for public review of the NPCC website.

# #

Public Comments on Okanogan Basin Draft Subbasin Plan

Public comments submitted for inclusion in Okanogan Subbasin Plans Prepared by: Larry Bailey, Michelle Boshard Phone: 509 486 2400

Submitted to J. Dagnon, Okanogan County Water Resources Coordinator

May 10, 2004

Public Comments on Okanogan Basin Draft Subbasin Plan

Okanogan Subbasin Plan

General comments:

1) Plan is incomplete in content (many uncompleted sections—to the point where it is not ready for presentation, some sections appear to be incomplete or hold some outdated information). It does not draw conclusions for the reader to consider and debate.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

2) Plan is incomplete in presentation (tables and figures are missing which makes it impossible for full understanding by public, not to mention that not all the supporting material was made available).

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

3) Plan lacks professionalism, even for a draft (spelling errors, formatting issues which make it difficult to navigate the document)

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

4) The document was dated April 23, 2004. The deadline for public review is May 10th, 2004. The article in the newpaper (Omak Chronicle) letting the public know the plan was even

available for review did not occur until April 28th. This left effectively 10 days for the public to review the document, which was not posted on the internet in all the places it said it would be (not on County Water Resources website as of April 30, 2004) and copies not easily made available for pickup for public to review when they could (i.e. they would have to photocopy the 400 of 1600 pages made available themselves, or sit in the library for hours). Additionally, the full document was not made available. This is a grossly insufficient amount of time even for the “pared down” version of the document. It took a team of agency people and consultants a year to produce the document and it still appears to be incomplete. The fact community groups and/or local governments could not take this back to regular monthly meetings because they did not have enough time, and that they did not have access to major sections important for understanding the document make it impossible for the kind of review needed to approve the plan and claim stakeholders were involved.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

5) There is no evidence that this plan has been based on anything that the public or stakeholders desire(s) or consider(s) important, despite the fact NWPPC and these planning exercises were “created by Congress to give the citizens of Idaho, Montana, Oregon and Washington a stronger voice in determining and balancing the future of key resources”. There is a complete lack of appendices of any public feedback, opinion, questionnaires, responses to inquiries or requests for public input anywhere in the document. No information is available on the already completed public review that was supposed to have occurred during the development of the plans.

Response: Extensive public outreach was conducted (see plan section XXX). Public review comments are provided in Appendix XXX.

6) Plan does not provide an overall clear prioritization of fish and wildlife initiatives, projects and activities in basin for funders to contribute towards as their funding envelopes allow.

Response: Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

7) Plan’s “Vision” and foundational principles seem to be limited to tribal and tourist perspectives—those of residents and community organizations and initiatives of their interest are not included at all, or are not referenced. This does not reflect the citizenry of the region as shown in the demographic profiles.

Response: The vision statement was created in a collaborative process through the Subbasin Core Team and included a broad range of interests.

8) Plan does not articulate (or give examples of) how this plan will relate to, or help coordinate multiple existing operational and budgetary linkages of other planning and program documents at all the levels of government. It does not identify how any or all of these plans relate to, or could leverage cost-saving opportunities in conjunction with, major efforts and initiatives by non-profit and community organizations. This plan is supposed to provide a prioritized list of

projects and initiatives for the future, inclusive of those of non-agency community origin, which all regional partners and the public agree can be participated on and that hydropower mitigation and other funding should be spent on. This plan does not include the community projects and initiatives into that prioritization.

Response: The subbasin plan's relationship to other concurrent planning process is addressed in plan section XXX. The subbasin plan is not intended to propose specific projects and initiatives.

9) Overall quality of the plan is neither commensurate with the time and energy, technical knowledge and ability of bureaucrats, staffers, and consultants working on it, nor the level of funding spent to date considering what has yet to be spent and the drastic improvements needed.

10) Overall this comes across as a very expensive library "cut and paste" exercise with nothing new learned and no strategies or action plans proposed for the future, and is unequal in value to the amount of time, energy and funding put into it. It is derivative in approach and contains little new information. The holes that leaves are important, as it does not address vast gaps in knowledge, particularly community knowledge, which creates a plan of dubious value at best.

Response: The subbasin planning process is designed to use existing information.

11) As stated succinctly by international river restoration expert Dr. Bob Newbury who resides in the Canadian portion of this river basin and who has worked on this river system "much of what needs to be done is obvious, simple and locally doable" –this plan does not clarify a plan of attack for what is already known to be important to be done.

Response: The subbasin plan provides a framework to support implementations actions.

Specific Comments

1) Executive Summary. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

2) Section 1.1. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

3) Section 1.1—Participation. Despite the fact public outreach was assigned to the Okanogan County, all key leads on the planning process have access to public outreach

capacity and bear responsibility for lack of public and stakeholder participation, not just

Okanogan County. It is doubtful, for example, for Okanogan County to be expected to reach regular tribal members and constituents regarding the plan and its impacts—something better done by CCT themselves. Likewise, WDFW should use existing and partner programs it is involved with (such as the WDFW hosted and State legislated RFEG program to assist in public outreach) to support the plan regionally. There is no documentation provided on exactly what public outreach occurred, the specific outreach, education or involvement strategies employed and explanation of why they were most effective, and no estimate in any change in level of understanding of those reached. There was no copy of the flier provided to the public to determine if it contained all the information needed for the public. There was no compilation of notes and results on public feedback. There was no list of specific groups spoken with or amount of public reached in the document. The approach to public outreach was a "we'll tell you" rather than "what do you have to say" exercise that effectively blocked true guidance and grounding of the plan which would have provided it the foundation for public acceptance of subsequent plans to spend recovery funds. Other methods and opportunities for collection of this input offered by organizations outside the SCT wishing to partner and who were experts in this arena were specifically declined by Okanogan County.

Response: An extensive and responsibe public outreach plan program was conducted; see plan section XXX and appendices.

4) Section 1.1—Infrastructure and Organization, Subbasin Core Team (SCT). There is no evidence that at any time did the SCT ever provide regular detailed (not summary) updates to the public or specific stakeholders about their intended technical approach and considerations being made in the development of the plan, nor how stakeholders could contribute to the SCT efforts. There was no effective way that stakeholders could input on or affect the approach in which SCT made the plans. 5) Section 1.2—Socioeconomic conditions. The plan state that "dealing with constraints will require both institutional and technical approaches, and links between communities of science, interest and place", but does not indicate how the plan will address or link to those already addressing the critical issue of large existing gaps in communications and coordination between scientists, government and tribal agents and landowners / communities in this region. The public will not accept the plan if it conflicts with their interests in this regard.

Response: An extensive and responsibe public outreach plan program was conducted; see plan section XXX and appendices.

5.)Section 1.2 – Socioeconomic conditions. The state that "dealing with constraints will require both institutional and technical approaches, and links between communities of science, interest, and place", but does not indicate how the plan will address or link to those already addressing the critical issue of large existing gaps in communications and coordination between scienticist, government and tribal agents and landowners / communities of science in this region. The public will not accept the plan if it conflicts with their interest in this regard.

Response: Comment noted.)

6) Section 1.4—Key findings and conclusions. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

7) Section 1.5—Plan Goals. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

8) Section 1.7— Synopsis of Major Findings and Conclusions. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

9) Section 1.8—Review of Recovery Actions. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

10) Section 1.9—Review of Recovery Commitments. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

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11) Section 2.1—Subbasin Overview, Socioeconomic conditions. Although it provides background on tribal socioeconomic impact backgrounds, this section does not assess how the current economic climate in the region might influence the prioritization of funding to be spent based on this plan, which was one of the points of the plan. It does not even mention (or reference available documents that do) any of the many non-tribal related economic issues, including massive changes in economic trade which has regionally and largely affected agricultural patterns in the apple, cattle, and logging industries. These industries have key habitat and resource impacts. It would appear from this that either no-one but tribal members live in the

Okanogan, or that there are no other considerations from a non-tribal perspective considered important in the plan.

Response: The subbasin plan is not intended to provide an economic analysis.

12) Section 2.1—Subbasin Overview, Agriculture. The plan states that as “Agriculture is not a focal wildlife habitat type and there is little opportunity to effect change in agricultural land use at the landscape scale, Ecoprovince and subbasin planners did not conduct a full-scale analysis of agricultural conditions”. This boils down to an untrue excuse to avoid looking at one of the foremost and key issues in the US portion of the Okanogan ecosystem. Most of the major impacts to the most sensitive salmon habitat and overall to watersheds have occurred as a result of agriculture and not addressing this issue is a complete failure by planners. The assertion that there is no way to change things at a landscape scale is untrue—the writers either must not know how, or will not work with the partners necessary to do so. Working with all landowners on all parcels can be done and is currently being worked on, with very little or no support from agencies. If salmon recovery is to take effect in the Okanogan, there is no other way to fix habitat than to deal with individual landowners and involve communities and other land ownership partners. This applies also to the other major land-use impacts discussed in the rest of this section.

13) Section 2.1—Subbasin Overview, Tourism. The plan states that the “most potentially developable land (including many areas formerly covered by wetlands) in the basin has now been developed…” While this might be true in the Canadian portion of the Okanogan basin where impacts are extreme in comparison with the relatively pristine US river conditions, it is extremely untrue that land development has reached its maximum capacity. Regional economic development efforts are in fact pushing development of the region. For example, there is a major development proposed for waterfront and other sensitive habitat on Osoyoos Lake, a critical habitat for the most impacted and limiting lifestage of one of the last two wild Sockeye salmon runs in the Columbia Basin. Additional examples include major landowners planning to do hundreds of property developments in the headwaters of Bonaparte Creek, which has already been recognized in the regional Water Quality Implementation Plan as the single largest contributor of sediment to the Okanogan River in the US portion of the basin. These issues are swept away with the broad statement that somehow development has reached a peak in the US portion of the Okanogan, when in fact it is only beginning. Anyone that goes to the Methow or the Canadian portion of the Okanogan can see the future of this watershed.

and the potential impacts to these resources. Clearly the US portion of the Okanogan is the next target for regional development, and none of these factors are considered in the plan or its priorities for monitoring actions, protection of existing habitat, and restoration efforts.

14) Section 2.2— Focal Wildlife and Fish Species and Representative Habitats. There needs to be more reference to or inclusion of more detailed scientific information on the overall “indicator habitat & indicator species” approach being used to base plans on, such as examples of where it

has been employed to date and how it worked. Also, more information on or reference to specific sections of documents explaining monitoring protocols and procedures, and adaptive management processes would be employed to ensure subbasin plans are always relevant to the on-ground habitat restoration realities discovered by monitoring. Plan does not mention how the public involvement in monitoring (well established as useful in other ecosystems), and does not touch on or consider key strategies that would provide cost-effective support and leverage opportunities to on-ground recovery, general agency knowledge and benefit community relationship building. In the end, it would cost way less if you involved landowners and communities. This plan as stands instead is the kind of plan that draws lawsuits instead of partnership. The minor initial cost of involving public from the beginning saves more in the end. This is given lip-service by agencies but no true in this plan, as exampled by statement by Executive Director of the Columbia Basin Fish and Wildlife Authority, told the Columbia Basin Bulletin, 'Agencies have to come to grips with the idea that they have to let loose of the controls. They have to lead from behind. This is not about controlling people and making them do things. It's about enabling them to do their best. People really respond to that. The vast majority of people want to do things to make things better. But mostly they don't have the ideas of how to do it. Or they don't have the resources to get it done.' ". The specific selection of focal fish and wildlife species identified in this section for recovery focus, including the comparative scientific criteria and processes employed by reviewers and others involved to put them in this plan, are neither explained in the text or appendices, nor referenced elsewhere to provide scientific basis for this approach. A brief rationale for selection is given with each species as to why they are generally selected, but no comparative prioritization for restoration purposes is provided between species, nor is a reference to documents that do. Most of the information contained in this section is a “cut-and-paste” repeat of prior and assembled information and does not fulfill the plan’s goal of providing new and coordinated direction and guidance to restoration priorities. The public can not make an assessment of the appropriateness of this plan on this information.

Response: The subbasin plan needs to be edited to be more concise, rather than to include more technical information. Supporting technical information can be found in the references cited by the plan. See response to comment S3-S4 regarding public involvement. Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

15) Section 2.3 Environmental Conditions, Descriptions of Focal Wildlife Habitat. All major sections relating to fish are not provided, including: In-channel condition and function, Riparian/floodplain condition and function, Water quality, Water quantity,

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Flow, Future No-action Conditions (2050). This completely disallows public ability to provide feedback on whether they feel the plan is appropriate for the existing conditions or not.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

16) Section 2.3 Environmental Conditions, Synthesis of Environment / Population Relationships. This part of the plan states what is already known—that we need to fix things, and we know what is important. It does not provide general or specific recommendations for prioritization and debate. It lists the wildlife species of importance and what their situation is but does not provides a prioritization of (or reference to documents that prioritize) projects to be funded with mitigation money and how this money will leverage additional money. Although it contains wildlife, this section does not provide the aquatically related species of importance and what their desired future condition is, much less a prioritization of projects to be funded. The plan states "To move forward on either (mitigating hydropower development or stopping degradation of ecological function) alone, or delay efforts in one sector, may constrain the rate of recovery, or even prevent it. Implementing improvements in hydro and habitat in tandem should maximize productivity by compounding survival improvements across several life stages in lock-step. We think this interaction will maximize the potential for a swifter recovery of these ESUs." but provides no plan as to how to do these things which is the point of the plan itself. It covers objectives and strategies that are already well known and in place, and is basically a repeated laundry list of things everyone knows should be done but is not structured in a useful way to prioritize which projects get what money when or how to fill gaps in order to proceed through priorities.

Response: The subbasin plan does provide recommendations for prioritization and debate. It is not intended to identify or prioritize specific projects. Desired future conditions for aquatic species will be provided in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website. The subbasin plan identifies the linkage between habitat and hydro but is limited to addressing habitat; it is not intended to develop a plan for hydro and the other "H's".

17) Most sections of Section 2.6, HAVE NOT BEEN WRITTEN including:

Synthesis of Key Findings

Status of species

Status and Health of the Environment

Biological Performance of the Environment

Summary Key Limiting Factors

Working Hypothesis

Description of Key Assumptions

Key Decisions and Rational

Desired Future Conditions

Reference Conditions

Species Loss from Historic Conditions

Estimated Species Abundance and Productivity

Relationship to Subbasin Goals

Opportunities and Challenges

Despite the technical background information that is included on specific species, this section is supposed to provide "the point" and is one of the most critical section to the

plan for the public in terms of understanding what the basis and background for management is. It does not provide understanding of the basis of the prioritization of future actions and spending of funding which the plan is meant to provide. If this has not been synthesized already after a year, the management plans provided in section 4 become suspect. If it has been synthesized, then the plan should include it for public review. The public can not make assessments based on this level of information.

18) Section 3. Inventory of Existing Activities. GROSSLY INCOMPLETED, with outdated information included. No summary of how these plans or ongoing initiatives interrelate or will be coordinated for the accomplishment of subbasin priorities is provided. No summary of ongoing initiatives outside of government and tribal agents are listed. This is an insult to community efforts and non-profit initiatives making some of the biggest differences to habitat improvement on ground, and who in comparison to agencies have no resources. Some of the most extensive studies on the largets stretchs of the most important habitat has been coordinated by or done by non-profit groups and is not really mentioned or discussed. The public cannot decide whether it wants to participate or support the plans if they don't know the players and the scene correctly—they also cannot determine if the plan's priorities are appropriate based on this incomplete and in places inaccurate picture of efforts in the basin.

Response: Comment noted.

19) Section 4 Management Plan—Definition of Conceptual Foundation. The plan states that its "Goals are a result of a public process, while the conceptual foundation is result of a scientific process. Strategies are derived from the combination of goals (what we want to achieve) and conceptual foundation (the ecological condition needed to achieve the goals)." While once public sets the goals science can provide the answer to "how we get there", this section seems to completely inappropriately infer that public should not, is not capable of, or has no place in being involved in developing and determining if the "how we get there" answer is appropriate one or will have the most cost-effective and/or beneficial results to the public. This is often used to effectively block community involvement in salmon recovery and watershed planning which

results in the very clash that is even specifically recognized in the plan between strategy and on-ground implementation. It is, in fact, imperative that the public be involved in the “how we get there” in order to point out ground truths that will affect the effectiveness of the strategies employed. There is no mechanism for this proposed in the plan. Science and government / tribal bureaucrats argue their tactical reasons for keeping technical or logistical planning and policy development on separate tracks, which ends up continually creating the well-known and almost universally acknowledged difference between having a plan with goals that doesn’t really result in getting something done or spending money well. What it does result in is the ability of science and government to control the plans, spend money on

their portions of the plans and programs without public interference, and keep Public communities excluded to the detriment of the entire process. This plan reflects the needs of the consultants and bureaucrats writing it and not the best interest of public money expenditure. Rather than developing this strategy and have the public continually reject it, the public should be involved the development of the strategy (not just goal setting) so the plan that results is automatically accepted and well-coordinated at the ground level for maximum cost-effectiveness. This has been done in other areas and can be done if the scientists, agencies and tribes embrace it.

Response: An extensive and responsive public outreach program was conducted. The Subbasin Core Team sought public involvement to address the issues raised in this comment.

20) Section 4 Management Plan, Management and Recovery goals. NOT PROVIDED FOR FISHERIES SECTION. The public cannot make a determination on the appropriateness of this plan if there is no information.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

21) Section 4 Near-Term Opportunities AND Prudent Strategies. GROSSLY INCOMPLETE.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

22) Section 4.5 and 4.6 NOT PROVIDED

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

23) Section 4.7 Recommendations for Monitoring. Lacks specificity on monitoring needed for this basin and the priority projects planned or ongoing that require monitoring. Misses one of the most cost-effective and beneficial strategies for accomplishing monitoring by not including where, when or how community can be involved in the monitoring, its synthesis, priority development, projects or initiatives to effect improvement of habitat as a result of good monitoring. No-one knows their river or their land better than the landowner or local community members. The public is a vast untapped resource which enjoys and would like to help in resource protection and restoration. Employing volunteer monitoring programs provides cost-effective leverage, relationship building, public outreach opportunities that can never be realized by conventional agency approaches. Well developed, coordinated, supported and funded it can even reach the landscape scale at which the agencies cannot. It requires training, quality assurance and control measures, and consistency in funding support but is a far more cost-effective mechanism for monitoring than currently spent monitoring dollars can do when used in a conventional manner. There are many regional, statewide and national organizations ready to help with a program that makes sense. The fact that this is not included in the plan is a major omission and flies in the face of the plan's stated goals of "inclusion of communities of science, interest and place".

Response: The monitoring plan was completed in April and is now available for public review on the NPCC website.

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COMMENTS ON PRELIMINARY DRAFT METHOW SUB-BASIN

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Date: May 10, 2004

In general it is not possible to devote the time necessary to review the plan and suggest rewrites for all the sections I am concerned about. In general I feel the plan adopts the usual environmentalist position that: 1) population must be limited, 2) the best way to preserve the environment is to keep it away from human intrusion, 3) government management of lands is better than private ownership and the resulting human activities on it and 4) addresses problems in environmentalist generalities which are not true or specific to the Methow. If we are to succeed as humans in living well with our environment more time and credibility needs to be given to how human activity improves the environment including activities on private lands.

Response: This paragraph addresses several generalities beyond the scope of this planning effort. Thanks for comment.

Below is a snapshot of what I have seen through out the document. If I had the time to be complete in my comments you would have another document of similar size to read.

P. 19 Regulation of land use: The planning assumptions associated with regulation of land use presuppose that only government owned or tribal lands contribute to restoration. None of the planning assumptions addressed the positive contribution of private land ownership to the environment or species recovery. It appears that all human ownership and use of private lands do not contribute to the environment.

Response: The document does not address comparative benefits of public versus private ownership.

P.40 This wording needs to replace the paragraph beginning with "The natural flow..:

The USGS completed in July 2003 a natural flow watershed model. The resulting Water-Resource Investigation Report 03-4246 simulated current, natural flows and the effect of irrigation canal seepage on stream flow. Irrigation- canal seepage contributes to streamflow throughout the year with the greatest effect during the irrigation season.[16]

Response: Wording will be considered by technical reviewers/editors for inclusion. USGS water quality study was not released to subbasin team for review

P. 41 Delete paragraph beginning with "Leaking irrigation canals are expected.." Then add:

Field studies have shown that 50 per cent or more of the canal discharge can be returned to the ground-water system through canal seepage. Data modeled on the Chewuch and Twisp rivers showed that there is an increasing gain in streamflow from May through October 7. When the canals are shut off after October 7 the net gain begins to decrease, but remains throughout the year[17].

Response: Wording will be considered by technical reviewers/editors for inclusion. USGS water quality study was not released to subbasin team for review

P. 41 Delete paragraph beginning with "To date the timing…" replace with:

The seepage from irrigation canals recharges the unconsolidated aquifer during the late spring and summer and may contribute as much as 38,000 acre ft. annually to aquifer recharge to the basin[18]. This represents about 9 percent of annual non-fluvial ground-water recharge in the basin simulated by the water model for years 1992 to 2001. Seepage from the canals is likely to have

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[16] Precipitation-Runoff Simulations of Current and Natural Streamflow conditions in the Methow River Basin, Washington; Water Resources Investigations Report 03-4246; USGS, 2003 p. 1 of Abstract

[17] Precipitation-Runoff Simulations of Current and Natural Streamflow conditions in the Methow River Basin, Washington; Water Resources Investigations Report 03-4246; USGS, 2003 p. 27

[18] Hydrology of the Unconsolidated Sediments, Water Quality and Ground-water/Surface-water Exchanges in the Methow River Basin, Okanogan County, Washington; Water Resources Investigations Report 03-4244, USGS, 2003 p. 1 Abstract.

the greatest effect on stream flow in September and October when streamflow and diversions are relatively low but ground-water flow from the seepage is still relatively high. A transient increase in ground-water discharge of about 30 cfs to the Methow River from Winthrop to Twis and of about 10 cfs to the lower Twisp River was observed in late summer and early autumn correspond to winter[19].

Response: Wording will be considered by technical reviewers/editors for inclusion. USGS water quality study was not released to subbasin team for review

P. 41 Delete the last paragraph beginning with "There is a great deal of conflicting.." Replace with:

Golder Associates as part of the Phase II Assessment of Watershed Planning made an assessment of agriculture uses including water rights, claims, certificates, and actual acreage of irrigated lands. An assessment of municipal, industrial and domestic uses was made as well.

Response: Wording will be considered by technical reviewers/editors for inclusion. USGS water quality study was not released to subbasin team for review

P.45 Water and Habitat Quality. This section failed to mention the USGS study on water quality which concluded: Surface and ground-water generally was of high quality. Water temperature measurements at all surface water sites at the time of sampling was within the criteria for class AA streams[20]. This statement should call into question that more data is needed for the stated 303 (d) listings mentioned and the associated effects of low stream flows or absence of flows associated with natural aquifer properties. Perhaps natural occurrences should be considered when designating a 303(d) listing.

Response: Wording will be considered by technical reviewers/editors for inclusion. USGS water quality study was not released to subbasin team for review.

P. 52 References to anthropogenic disturbances: It is important to note that not all human disturbances are negative, in fact they may improve habitat. For example Mullan, *et. al.* notes the positive contribution of rip rap at certain sites. Conversion of riparian areas to agriculture and residences is not necessarily a negative. There needs to be more of an attitude of a case by case evaluation of human activity.

Response: Agree in concept, but more recent studies and independent scientific review do not support conclusions of Mullen.

P.63 No one has explained why just after the ESA listing of Chinook Salmon there have been good returns up to the present. Mullen *et.al* and later evaluations by Ken Williams showed that spawner recruitment for the Methow was at restocking levels based upon the harvest catch. Harvest and later the dams, not degradation of the Methow basin is more the issue on why salmon returns were low in the Methow.

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[19] *Ibid*, USGS, p. 55.
[20] *Ibid*, USGS, p. 22.

Response: Factors outside the subbasins such as ocean conditions and harvest regulations may account for strong returns

P. 113 References to grazing show an ignorance of various activities by the Okanogan Conservation District, NCRS and rancher which have changed grazing practices and have fenced off livestock from critical riparian areas. The tone and direction of these statements give no credence to the many changes in agricultural practices that have occurred in the Methow since 1988.

Response: Grazing discussion is based on existing published information; authors would appreciate any additional references to be incorporated in subbasin plan.

P. 114 References to Timber management are important. However, I would stress that logging has for the most part been terminated from the Okanogan National Forest. What is left is a forest that in some places has been over harvested and needs restoration and in areas where the forest has returned it is thick dog hair trees. Both situations do not allow for good precipitation capture and water retention which is needed in order to have higher stream flows later in the season. I saw no comments which stressed the need for restoration and management of forests for their potential to increase stream flows.

Response: References are needed for assertions made regarding termination of timber harvest and regarding precipitation capture and retention. Timber harvest management is beyond scope of subbasin plan.

P.114 This particular statement is untrue based upon the USGS water quality study completed in 2003 which said that Methow waters meet drinking water standards. They did not find any levels of pesticides or herbicides that warrant this conclusion Agricultural operations have increased sediment loads and introduced herbicides and pesticides into streams. Its also doubtful that Agricultural activity whether grazing or raising of crops has contributed to the sedimentation load. The Chewuch is naturally high in sediments. Most of the man made influence on sedimentation may come from road banks. Lastly there is a contingent of the WDFW that is seeking to preserve or increase the sediment loading during high flows. So there appears to be a contradiction of fact among the agencies on this one.

Response: USGS water quality study was not released to subbasin team for review. Water quality needs differ for aquatic life (e.g., bioaccumulation due to long exposure) and human consumption.

P.116: This statement: “Channelization and development along water courses has eliminated riparian and wetland habitats.” would be more honest if it said: “Where development along stream banks has occurred riparian and wetland habitat has been confined to the existing channel.”

Response: This will be reworded for accuracy.

P.116: The comments on environmental and ecologic relationships is definitely biased in its conclusions that humans have only done bad things. Current data shows that water quality is high in Methow streams. If that is so how has residential development degraded water quality? Also I would point out that a holistic management of forests by MAN that includes harvest, proper thinning, restoration and use of fire would be a better statement. Is it really true that species are forced out of their habitats due to human development? Initially I would say yes during the development stages, but later once normal human is maintained species return. How do you account for the return of birds, deer, raccoons coyotes etcs. where humans are present? Its more an issue of whether or not people welcome these species and restore habitat they can use after they have built their home. Even the Audubon Society knows this and provides books on how you can do this.

Response: Subbasin plan data is based on objective findings of fact. Additional scientific information has invited through SCT review and public comment.

P.145 In reference to how human land management affects the environment it might also be pointed out that man made decisions to restore the environment by lining canals or doing other activities has negatively impacted the environment because cumulative effects were not considered. This factor of net benefit is never discussed in the document. This evaluation should include both the positive contribution that human presence provides as well as negative and the evaluation of whether or not returning an ecosystem back to its perceived original native state is a better benefit than what now exists.

Response: Subbasin plan did not analyze effects of activities, but assessed current habitat conditions and modeled historic conditions.

P. 145 This statement is a good example of environmental propaganda:

Response: This will be reworded to improve accuracy.

Seasonal naturally occurring and human influenced low stream flows and occasional dewatering can alter fish passage to upstream spawning and rearing habitat. Low flows also affect water quality by contributing to higher stream temperatures in summer months. Stream borne sediment also degrades overall water quality. In addition, low stream flows tend to concentrate any toxic materials or other contaminants entrained in the stream flow.

These are generalized statements which cause the uniformed reader to conclude that low flows and dewatered areas are bad, sediment is always bad, low flows always mean higher stream temperatures etc. For the Methow this is not the case. Most low flows are natural. Its not clear that human use of water has caused low flows that have been passage barriers when fish need it, and water temperatures in the Methow don't necessarily correlate with low flows as much as a streams orientation towards the path of the sun and its not been proven that there are toxic materials and other contaminants in the Methow basin to concentrate. Lately on a project I am working it has just been stress to me that sedimentation recruitment is needed in order to rejuvenate fish habitat each year not to mention the need for significant enough flows to move boulders downstream to rearrange the stream channel. So such statements above are not truthful and of the sort that should be in a plan like this.

# #

May 7, 2004

Okanogan County Water Resources

123 North 5th Ave., Room 110

Okanogan, WA 98840

Attn: Julie Dagnon, OCWR Manager

Mark Walker, Director of Public Affairs
Northwest Power and Conservation Council
851 SW 6th Ave., Suite 1100
Portland, OR 97204

Subject: Subbasin Watershed Planning Recommendations and Comments on two plans

Please accept the following recommendation and comments on behalf of over 800 members of Kettle Range Conservation Group, whose mission is to defend wilderness, protect biodiversity, and restore ecosystems of the Columbia River Basin.

Recommendation

The goals of the Subbasin Watershed Planning Process should remain flexible through the years. Attandance at several meetings during the current effort indicate that the process is being viewed as a “solution” rather than a “process”. To meet this recommendation would require that the Subbasin Watershed Planning Process include a means for incorporating changes. What we found at the meetings was more akin to a few spreadsheets with no formalized procedure or designation of authority. The document provided at your website titled “Considerations for Monitoring in Subbasin Plans”, by the Pacific Northwest Aquatic Monitoring Partnership make the mistake of equating a programmatic approach with a coarse-scale approach. This is a serious flaw which will result in wasted expenditures, because it doesn’t incorporate “adaptive management”.

Response: Adaptive management is integral to the subbasin plan; it is intended to be flexible. The intent is to be strategic, rather than opportunistic in management. The subbasin plan process does incorporate changes through its monitoring program and the use of objectives and working hypotheses.

Yet this is exactly what is being proposed--to move away from project-specific pilot projects toward state and regional models. The document claims that “these pilot projects demonstrate how the top-down approach can work to create monitoring projects that have systemwide applications.” We can only accept this if the program to continue with pilot projects that deliver money to the ground rather than to remove beltway bureaucrats is continued.

The list of projects is then divided into top-down and bottom-up categories, yet these categories are never defined, nor does the document indicate if coarse scale measurements will be applied to time series as well as spatial data. In other words, we believe this is a veiled attempt to keep money within the agencies rather than disbursing it to the collaborators. While there may be good reasons to minimize the huge costs to disbursing funds to individuals or non-profit groups, you can obtain the same results by simply defining the parameters of “monitoring” to define who makes what decision when. What needs to be specifically described are a roadmap of the plan and checkpoints along the way, that identify who will be making decisions and what the criteria will be for “success”.

We believe that it is in the best interest of both the Northwest Power and Conservation Council as well as the public interests to establish a clear and concise process for incorporating changes in input parameters, and hope you can honor our recommendation with specific answers.

Response: The subbasin does not propose projects. The comments in paragraphs 1-3 address the PNAMP document, which is one of a number of sources used to develop the subbasin plan monitoring section. The monitoring section develops a framework that addresses the watershed environment against the objectives of the subbasin plan, rather than specific projects. Adaptive management and criteria are both developed in the subbasin plan monitoring section. The subbasin plan is silent on implementation and funding.

Comments on the Methow Subbasin Plan

We would like to prioritize increased aquifer and groundwater storage within the basin to benefit both fish, wildlife and agricultural uses.

We would like to prioritize restoration of beaver dams and beaver habitats throughout the basin. Basic research on the benefits of beaver dams and their habitats is lacking throughout the northwest. Research should include surveys on the quality and quantity of beaver dams as they relate to water storage, fish habitat, flood protection and wildlife habitat. More research is needed on the value of beaver dams to downstream water users and fisheries.

More funding is needed for protecting riparian and floodplain integrity. Problems continue to increase with flooding, sedimentation, stream gravel embeddedness, lack of quality pools, lack of LWD, and debris flows resulting from managed landscapes. There should be incentive programs to protect these resources and disincentives for shoreline development.

There needs to be more emphasis on shoreline restoration projects that increase fisheries and beaver dam habitats. Funding needs to be targeted toward endangered species restoration. Bull trout should receive special protection as an indicator species for clear water habitats. Projects are needed for restoration of side channels and breeding habitats off of the main channels, including native plant species restoration.

Increase protection for all native fish species including bull trout in all the areas where they historically occurred. Maintain separate demographic tallies for native species and hatchery fish. Do not fund projects that spend funds to count wild and hatchery fish together.

There should be increased funding to support the lower reaches of the Methow River, from Carlton to the mouth, and including tributaries Gold Creek, Libby Creek and Squaw Creek.

Some studies should be concerned with the relationship of upland ponderosa pine and shrub-steppe habitats to the riparian ecosystems. A number of key species may be linked to the protection of both these ecosystems, including moose, beaver, black and grizzly bear.

There should be funding for research on the distribution and abundance of Western Gray Squirrels, a State listed species that occurs in the southern portion of the Methow subbasin. Funding for conservation and restoration projects should be prioritized to protect and enhance Western Gray Squirrel habitat.

There should be more funding for non-chemical noxious weed control programs and plans. The Noxious Weed Control Boards have shown that there is insufficient encouragement from the state to use more sensitive methods of weed control, and as a result, there are a number of areas where healthy ecosystem values along sprayed roads are being lost due to denudification of the ground and vegetation. Areas treated are sometimes directly in streams, and the county Weed Boards do not have the resources to address the technical aspects of the chemical industry.

Response: The suggestions made in these sections of the comment letter exemplify the kind of project that are expected would be conducted during subbasin plan implementation. The subbasin plan does identify specific projects.

Comments on the Okanogan Subbasin Plan

We would like to prioritize increased aquifer and groundwater storage within the basin to benefit both fish, wildlife and agricultural uses.

We would like to prioritize restoration of beaver dams and beaver habitats throughout the basin. Basic research on the benefits of beaver dams and their habitats is lacking throughout the northwest. Research should include surveys on the quality and quantity of beaver dams as they relate to water storage, fish habitat, flood protection and wildlife habitat. More research is needed on the value of beaver dams to downstream water users and fisheries.

More funding is needed for protecting riparian and floodplain integrity. Problems continue to increase with flooding, sedimentation, stream gravel embeddedness, lack of quality pools, lack of LWD, and debris flows resulting from managed landscapes. There should be incentive programs to protect these resources and disincentives for shoreline development.

There needs to be more emphasis on shoreline restoration projects that increase fisheries and beaver dam habitats. Funding needs to be targeted toward endangered species restoration. Bull trout should receive special protection as an indicator species for clear water habitats. Projects are needed for restoration of side channels and breeding habitats off of the main channels, including native plant species restoration.

Increase protection for all native fish species including bull trout in all the areas where they historically occurred. Maintain separate demographic tallies for native species and hatchery fish. Do not fund projects that spend funds to count wild and hatchery fish together.

Some studies should be concerned with the relationship of upland ponderosa pine and shrub-steppe habitats to the riparian ecosystems. A number of key species may be linked to the protection of both these ecosystems, including moose, beaver, black and grizzly bear.

There should be funding for research on the distribution and abundance of Western Gray Squirrels, a State listed species that occurs in the southern portion of the Methow subbasin. Funding for conservation and restoration projects should be prioritized to protect and enhance Western Gray Squirrel habitat.

There should be more funding for non-chemical noxious weed control programs and plans. The Noxious Weed Control Boards have shown that there is insufficient encouragement from the state to use more sensitive methods of weed control, and as a result, there are a number of areas where healthy ecosystem values along sprayed roads are being lost due to denudification of the ground and vegetation. Areas treated are sometimes directly in streams, and the county Weed Boards do not have the resources to address the technical aspects of the chemical industry.

Response: The suggestions made in these sections of the comment letter exemplify the kind of project that are expected would be conducted during subbasin plan implementation. The subbasin plan does identify specific projects.

Thank you. We appreciate the opportunity to participate and comment on these issues.

Sincerely yours,

George Wooten, Botanist
Kettle Range Conservation Group
<gwooten@kettlerange.org>
509-997-6010

# #

From: "Lee Bernheisel" <owl@mymethow.com>

To: "Julie Dagnon" <jdagnon@co.okanogan.wa.us>

Date: Sun, May 9, 2004 7:37 AM

Subject: Subbasin Plan

Julie

Here's a couple of quick comment on the Draft

1. Pateros Dam

On page 42 and 81 the plan still says that the dam in the Methow near Pateros blocked all passage for fish.(Impoundment and Irrigation Projects) This is incorrect and has remained in the literature long enough its time to correct it in this plan with the fisheries agency's addressing its past mistakes. Please contact me if you need more information than I have already submitted.

Response: This will be reworded to improve accuracy.

2. Irrigation Districts

The Methow Valley Irrigation District was reorganized in and around 2000 and at that time the acreage was reduced to about 850 acres. The MVID is not required to supply 12cfs to the Barkley ditch. Their agreement is for the Barkley to supply water to the MVID ditch for its patrons along the ditch. (For conformation or more info check with me or Bob Barwin,WDOE)

Response:Discussion of MVID will be researched and revised.

The Skyline ditch is now completly lined or piped (p44 check with Greg Knott, BPR for details)

Response: The lowest ¼ mile not yet lined/piped.

That's it for now, good luck

Lee Bernheisel

# #

Methow Valley Citizens'Council

P.O. Box 774, Twisp, WA 98856

Okanogan County Water Resources, May 10, 2004

123 North 5th Ave., Room 110

Okanogan, WA 98840

Attn: Julie Dagnon, OCWR Manager

Subject: Subbasin Watershed Plan Draft Comments

We feel the main priority of watershed planning is to increase aquifer surface and groundwater storage for overall subbasin ecosystem health. Areas for which we support funding include:

<u>Removal of bank armoring/dikes/riprap etc.</u>

<u>Riparian and floodplain integrity preservation</u>. Funding for monetary incentive programs that protect and restore fisheries habitat. Disincentives for shoreline development including removal of riparian vegetation, subdivision or any kind of bank armoring.

<u>Shoreline restoration projects to increase suitable fisheries habitat</u>. Funding for projects that will nurture endangered species restoration. Funding of projects for research and restoration of side channel restoration for breeding habitat, water storage and riparian area improvement, including native plant species restoration.

<u>Native fish species protection</u>. Increase protection for all native fish species including bull trout in all the areas where they historically occurred. Keep native species categorized separately from hatchery fish when assessing threatened and endangered species status.

<u>Restoration of beaver habitat</u>. This needs to include funding of research projects such as inventory of existing beaver dams and development of historical data. Also more research is needed on the value of beaver dam induced water storage on downstream water users, benefits to widlife, and fisheries.

<u>Conservation easements and public land aquisition in critical habitat areas.</u>

<u>Funding to support further study of the lower reach of the Methow river, from Carlton to the mouth.</u>

We also believe that the conservation of upland Ponderosa Pine and Shrub- Steppe habitat is crucial to the health of the subbasin. Areas for which we support funding include:

Funding for research on the distribution and abundance of Western Gray Squirrels, a State listed species, in the southern portion of the Methow subbasin. Funding for conservation and restoration projects that protect and enhance Western Gray Squirrel habitat.

Funding to study the local distribution and abundance of focal species identified in the Draft Subbasin Plan, and to conserve key habitat that provides connectivity for these species.

Funding for educational programs that assist private landowners in the Shrubsteppe and Ponderosa Pine habitat types to integrate habitat conservation with forest restoration and fire prevention activities.

Funding that supports landowners and the Okanogan County Weed Board in performing non-toxic noxious weed control for such species as knapweed, white top, toadflax, etc.

Response: The suggestions made in these sections of the comment letter exemplify the kind of project that are expected would be conducted during subbasin plan implementation. The subbasin plan does not identify specific projects.

The draft Subbasin Plan document is missing information under key headings such as "Key findings and Conclusions;" "Synopsis of Major findings;" and "Plan Scope." We expect that these and other headings in the document will be completed before the Final draft, in time for public review.

Response: We recognize that information is missing and will be incorporated in the draft that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

We appreciate the opportunity to participate and comment on this important plan.

Sincerely,

Vicky Welch, Chairman, MVCC

# #

OKANOGAN COUNTY FARM BUREAU

May 10, 2004

10 Wilson Ranch Rd

Riverside, WA 98849

Julie Dagnon, Water Resource Division Manager

Okanogan County Water Resources

123 N 5th Avenue – Room 110

Okanogan, WA 98840

Re: Okanogan County Farm Bureau Comments on 2nd Draft Subbasin Plans: Okanogan/Similkameen and Methow

Dear Ms. Dagnon:

Following are the Okanogan County Farm Bureau comments and concerns.

Local Concerns

<u>County Commissioners' Concerns:</u> Okanogan County Commissioners met on 5/3/04 to outline county concerns about the content and tone of the subbasin plans. Those in attendance (county staff, public outreach contractor, and representatives from WDFW and the Colville Tribe) agreed with the concerns and the need to rewrite large segments prior to submitting the plans to Northwest Power Conservation Council (NPCC). Extensive and repetitive attacks on agriculture, grazing, irrigation and forestry throughout the plans were a major concern and remain very troubling.

Response: Comment noted.

Okanogan County Farm Bureau agrees with the concerns expressed by Okanogan County Commissioners and we support the need for considerable revisions to the plans. The following comments are based on the 4/23/04 draft as the public will not have access to the revised plans before they are submitted to NPCC.

<u>Process Concerns/EDT:</u> Subbasin plans are heralded as *local plans* in spite of inadequate local public involvement and lack of information provided to the public even when requested. The Habitat Working Group (referred to as the "technical folks") met outside public purview for approximately seven months to make assessments relying on "expert opinion." After defining and describing 148 stream reaches, rating 46 habitat attributes for those reaches, reforming those reaches into 21 Assessment Units, the information was fed into the controversial Ecosystem Diagnosis and Treatment (EDT) Model to determine the working hypothesis and management strategies. Excerpts from a scientific review outlines the *pitfalls of the EDT Model* used in subbasin planning (See Appendix A). The review states, "EDT exemplifies how modeling should not be done."

The Methow Watershed Planning Unit elected <u>not</u> to use the EDT because of the problems associated with the model.

Response: All Habitat Work Group meetings were open to the public and were advertised through the County. The habitat assessment relied on the full range of data available, including empirical data, expanded and derived information, expert opinion/local knowledge. The documentation is transparent as to what level of data was available, the confidence associated with the data used, and identifies where more information is needed. EDT is the preferred model authorized by the NPCC for the subbasin planning process.

Local Watershed Planning Ignored: The Methow Watershed Planning Unit that includes years of work and research by local volunteers and experts was virtually ignored in the subbasin process. No direct contact was solicited for input and key on-the-ground studies that were conducted in the Methow were discredited and/or minimized in the Methow subbasin plan and replaced with hypothetical analysis.

Response: The Methow watershed planning unit was invited to participate, and opportunities were made available for their involvement. USGS water quality study was not released to subbasin team for review.

It is of interest also that the Methow USGS study was previously disregarded because it had not been published, and the subbasin plans are riddled with unpublished data.

Summary: The plans touch on some of the limitations of the process with the "compressed process that has allowed little flexibility in stakeholder involvement" [Page 4] but does not give an accurate picture of the difficulties those who tried to participate experienced. The closed-door assessment process by the technical Habitat Working Group, the lack of handouts of information, difficulty in obtaining any core information throughout the process, unanswered requests and disregard for reasonable public input makes these plans "local" in name only. This is just another case of the state and federal agencies and tribe writing the plan; the only difference is that they came to the county to do it. Credibility of information and accountability to the public are lacking.

Response: All Habitat Work Group meetings were open to the public and were advertised through the County. Requests for information were honored and opportunities for reasonable public input were provided throughout the process.

General Concerns

Due to the complexities of the subbasin planning process and plans, repeated revisions, significant data gaps and access to only approximately 378 pages of the 1,600-page plans, it is extremely difficult for Okanogan County Farm Bureau members and other stakeholders and groups to make substantative comment. Many of our comments will be general in nature where continued review has raised several topics of overriding concern.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan and supporting materials in plan appendices will be posted for public review from June 5 through August 12, 2004 on the NPCC website. The subbasin plan is not 1600 pages in length.

Our previous comments stressed the importance that *subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans* (Appendix B). In spite of the severe limitations of the plans:

The original purpose of subbasin planning to direct NPCC funding has been expanded to function as a general "framework" for future projects, actions, activities and land use planning throughout the county.

Subbasin plans expand land management beyond legal mandates for Endangered Species Act (ESA) listed species to include management of all fish and wildlife.

Subbasin plans and the NPCC Fish and Wildlife Program are elevated to ESA and Clean Water Act status, creating another layer of federal land management extended to all fish and wildlife.

Subbasin plans will be used for federal recovery plans.

Response: Subbasin plans are not land management plans, as such. Local land use management continues to be the responsibility of local government. State government has existing land use regulatory responsibilities in certain cases. The subbasin plans provide a framework for proposed projects. That framework recognizes existing legal mandates and may inform ongoing updates to existing regulations. It also provides recommendations to local and state government and willing landowners, that may be implemented by them. Effective species recovery will need to include land use management considerations. The subbasin plan guides Bonneville's actions under the existing Biological Opinion, but has no regulatory authority and is not characterized as having regulatory authority. It does not expand the legal mandates of the ESA. Background information developed through subbasin planning will be used in recovery planning, however implementation of a federal recovery plan is strictly voluntary.

Expanded Purpose: The purpose stated over and over to the public was that subbasin plans would be used by NPCC to prioritize and direct <u>Bonneville Power Administration NPCC</u> mitigation project funding. Language now shows that the NPCC subbasin plans will be used as a "framework" for all actions and activities in the Okanogan and Methow Subbasins:

"Actions taken in the subbasin[s] should be consistent with, and designed to fulfill the vision of the Okanogan [and Methow] subbasins." "This vision and subbasin plan…is intended to provide a framework under which future projects can be developed and implemented*." [Okanogan, Page 207 – Methow, Page 19]*

Response: Subbasin plans will be used as a framework for <u>all BPA-funded</u> actions and activities, not "all actions and activities" in the Okanogan and Methow. The mission statement and introduction language will be clarified.

Expanded to All Fish and Wildlife: NPCC mitigation reaches beyond listed species and includes all fish and wildlife. Use of subbasin plans as a framework for county projects, actions and land management goes beyond legal mandates and expands all fish and wildlife to ESA-listed recovery status.

"Future land use planning and activities that involve potential impacts to fish and wildlife and their habitats should be fully discussed with the agencies and tribes with management authority prior to implementation."

[Okanogan, Page 207 - Methow Page 19]

<u>Subbasin Plans Expand Federal Land Management</u>: The following indicates subbasin plans are being developed as a back-door land management authority despite the lack of openness and credibility of the process and the plans and the limitations of the process, methods and results and elevates NPCC and the Fish and Wildlife Program to federal ESA/CWA status.

Actions taken in the sub basin should be consistent with the Okanogan sub basin plan, the NPCC Columbia Basin Fish and Wildlife Program, Clean Water Act, and the Endangered Species Act."[Okanogan, Page 2]

Use of Subbasin Plans Extended to Federal Recovery Planning: Again in spite of the limitations, the plans will be used as the foundation for NOAA (National Marine Fisheries Service) and US Fish and Wildlife Service ESA federal recovery planning requirements.

Response: Background information developed through subbasin planning will be used in recovery planning.

Management Plans

Conflict of Interest: The plans will direct future project funding and the writers of the plans are the recipients of the project funds. Several project needs continued to resurface throughout the Okanogan plan that are known to be "pet projects" of the agencies and tribe. Among those specifically noted are Salmon Creek, Omak Creek, and the Conservation Reserve Program (CRP). It appears there may be a conflict of interest in order to receive funding.

Response: The subbasin plan is silent on implementation and funding.

Land acquisitions and purchase of water rights are also common management tools throughout the plans.

Wildlife Section: This is the first opportunity the public has had to review the Wildlife portion of the plans. The Wildlife portion was produced outside the public and Subbasin Core Team process and information requested by the public throughout the process was not provided.

The focal species descriptions do not apply to our area and cannot be viewed as "local information." At least one focal species does not inhabit the Okanogan or surrounding areas. Many references are outdated or unpublished and mostly unavailable to the public.

The focal species and broad management appears to follow the information from Partners In Flight referenced in the plan, which is a group of agencies, environmentalists, consultants and academia with established focal species and management plans. It appears the wildlife section for focal bird species used much of the information from Partners in Flight. The wildlife portions were written outside the county with little application to our specific area and no public input, which is a disservice to our county.

Further research will determine whether the wildlife portions of the plans were re-writes of the Partners In Flight information. Regardless, the wildlife portion is far from "local."

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website. The focal species were selected as indicative of habitat types that occur in the subbasins.

Missing Information: As noted above, agriculture, grazing, forestry, irrigation and any human contact with the land are viewed as damage to the environment compared to "natural pre-

European conditions. Agency mismanagement is not listed, such as lack of predator control or predator introduction, bird impacts on migrating smolts, state-required removal of LWD from streams and rivers, etc.

Response: Comment notes. The subbasin plan does not consider land ownership or impacts, but only assesses the current condition of the land and its ability to support fish and wildlife.

Summary

Please refer to the comment letter by Okanogan County Farm Bureau dated March 11, 2004 for further comments and concerns that have yet to be addressed.

We will continue to review the subbasin planning process and make further general and specific comments during the NPCC comment period when it is anticipated the complete plans will be available. We look forward to the NPCC scientific review with the hope that further direction will solve some of the local conflicts and credibility issues.

Sincerely,

Mike Wilson, President

Attachments: Appendix A and B

Cc: Washington Farm Bureau

Okanogan County Commissioners

7th and 12th District Legislators

Northwest Power and Conservation Council

Emphasis added throughout.

[ ] Writer's comments

Appendix A

Excerpts from the

SALMON RECOVERY SCIENCE REVIEW PANEL

Report for the meeting held

December 4-6, 2000

Northwest Fisheries Science Center

National Marine Fisheries Service

Seattle, Washington

II. MODELS

A. STYLES OF MODELS AND THEIR UNDERLYING PHILOSOPHIES

The management of natural populations is an exercise in quantitative science; hence mathematical models are essential and invaluable tools. However, they must be used wisely and with understanding of limitations. Fisheries biology, in particular, has been a a rich breeding ground for mathematical descriptions ever since the great mathematician Vito Volterra turned his attention to the fluctuations of the Adriatic fisheries. Volterra's models were simple in structure, but complex in dynamics; this duality made them powerful aids in understanding key features of complex population fluctuations. Years later, William Ricker, perhaps the most innovative and influential of fishery scientists, showed how fairly simple age-structured models of fish populations could exhibit even more complicated dynamics (Ricker 1954); indeed, his simulations were probably the first demonstrations in ecology of chaotic population dynamics, whose importance was clarified twenty years later in a landmark paper of Robert May (1974).

The lessons of these seminal studies are inescapable: Models can play a fundamental role in demonstrating the mechanisms underlying observed phenomena, but even simple models can have complicated dynamics. The more complex models become, the more easily one can twist them to do almost anything, and the less reliable they become. Ludwig and Walters (1985) explored these truths in detail for fishery models in particular, taking into account explicitly the problems associated with parameter estimation. Their work demonstrated that, although models must include enough detail to capture the essential, unique aspects of a problem, too much detail can render models useless. The key to intelligent modeling is to find the optimal level of detail and to suppress confounding statistical noise. This is basically the approach that has worked so effectively in physics, in which statistical mechanical methods allow one to capture robust macroscopic features in terms of the collective dynamics of large numbers of unpredictable parts. This is the only approach that makes sense for modeling large-scale, intrinsically complex and dynamic systems.

The conclusions to be derived are that large-scale models that attempt to capture the dynamics of many species, or that rely upon the measurement of massive numbers of parameters, are doomed to failure. They substitute sledgehammer simulation for analytical investigation and efforts to identify the few key driving variables. Large models are bedeviled by problems of parameter estimation, the representation of key relationships, and error propagation. When the phenomena are fundamentally non-linear, this leads naturally to path dependence and to sensitivity of results to parameter estimates. As the number of parameters increases, the potential for mischief increases.

Thus it is essential to rid models of irrelevant parameters, and to identify key relationships. It also emphasizes the importance of locating what aspects of the model are most likely to lead to the expansion of error, and to focus on representing these as accurately as possible. This can only be done reliably through data-driven methods, with attention to appropriate statistical methodology.

When the data are not available for the needed estimates of parameter values, there is a tendency to insert values based on opinion or expert testimony. This practice is dangerous. The idea that opinion and "expert testimony" might substitute for rigorous scientific methodology is anathema to a serious modeler and clearly represents a dangerous trend. Indeed, there are limitations even to what can be done on the basis of data: the fact that relationships are often nonlinear, and further that interest often rests on understanding the behavior of populations beyond the range of variables that has been observed, creates vexing problems for the modeler. It provides a compelling argument for experimentation in order to elucidate underlying mechanisms, for the recognition of limits to predictability, and for the use of adaptive assessment and management (Ludwig and Hilborn 1983; Holling 1978).

EDT is a case study of the problems just discussed. The current version which uses 45 habitat variables might be a useful list of things to consider, but the incorporation of so many variables into a formal model renders the predictions of such a model virtually useless. Even more vexing is that EDT depends upon a large number of functional relationships that are simply not known, (and cannot be known adequately) and yet they play key roles in model dynamics. The inclusion of so much detail may creates an unjustified sense of accuracy; but actually it introduces sources of inaccuracy, uncertainty and error propagation. Subjective efforts to quantify these models with "expert opinion" compound these ills. (Pages 4-5)

EDT exemplifies how modeling should not be done. It is overparameterized, includes key functional relationships that cannot be known and cannot be tested, creates a false sense of accuracy, yet introduces error and uncertainty. Its very complexity makes it difficult to determine the effect of various assumptions and parameter values on the model’s behavior and relation to data. The attempt at quantification through subjective “expert opinion” compounds these fatal weaknesses, especially the model's inability to confront and improve with confrontation of data. (Page 8)

Emphasis Added

The entire document can be viewed at: http://publicnwfsc.afsc.noaa.gov/trt/rsrpdoc2.pdf

Appendix B

Subbasin Planning Limitations

Okanogan County Farm Bureau Comment Letter – March 11, 2004

Subbasin Planning Limitations: The reported purpose of subbasin planning is to direct Bonneville Power Administration mitigation funding through the Northwest Power and Conservation Council. It is important that subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans, which include:

Subbasin plans are being developed solely for the benefit of fish and wildlife, with no consideration of costs, economic losses or conflicting human interests, which results in faulty findings.

The "ecosystem approach" used does not make any distinction between public land and privately owned land in its determination of fish and wildlife management plans.

Private property rights and land rights including water rights are not recognized.

Management plan goals are based on comparisons to "historic" or perfect, untouched conditions that are thought to exist prior to European settlement, which are not attainable, sensible or necessary.

Goals are widely based on data with significant information gaps and unmeasurable outcomes with minimal public involvement.

The cumulative effects of restrictions and regulations on private property ownership and land use are not measured.

The economic losses to the private landowner, agriculture, natural resource-based industries and county economic viability are not considered.

The subbasin planning process bypasses land management planning safeguards and requirements such as economic review, public notice and public involvement.

There is no legislative oversight of back-door ecosystem approaches to manage lands.

# #

TO: Okanogan County Water Resources

Northwest Power and Conservation Subbasin Planning

123 North 5th Avenue Rm. 110

Okanogan, WA. 98840

RE: Comments on Methow Subbasin Plan

This document should not be called a plan because it's not a plan. It's a bunch of philosophical statements, most of which have nothing to do with the Methow Basin. It's also made up of policy judgements and a lot of assumptions. Where is the science you claim this plan is based on? Policy judgements and assumptions should not be funded with rate payer monies, and flowery philosophical statements that have no relationship to what really needs to be done in the Methow Basin are nothing but filler for the document. You don't really say anything in this document, it's a complete waste of ratepayers monies. What you do do in this document is leave the door open to do anything you wish. The plans a blank check with nothing but a signature, the citizenry is supposed to trust that the state will do the right thing with it, haven't seen it happen yet. This is why we have a public comment period so we can weed out the garbage. In this case you were afraid of getting caught so you didn't include the garbage "yet", even though what you do present I also consider garbage of another type. The people responsible for this garbage should be fired and put into positions fitting their abilities, garbage collectors.

Again this document is incomplete, the following categories have all been left out.

1.2 Local and Regional Scio-economic Conditions

1.3 Overall Direction and Goal of Subbasin Plan

1.4 Key Findings and Conclusions

1.5 Plan Goals

1.6 Plan Scope

1.7 Synopsis of Major Findings and Conclusions

1.8 Review of Recovery Actions

1.9 Review of recovery Commitments

The above list is the meat of the plan. What you have us reviewing is nothing, you wasted our time, you wasted our money, and you've destroyed your credibility.

I sat on the MBPU for the last five years. We had preliminary information supplied to us by the USGS, which the MBPU wished to incorporate into our plan. John Storman the DOE representative to the MBPU was adamantly opposed to this incorporation of information supplied by the USGS even though it was based on very good science. He stated that USGS information could not be used until the USGS report had been reviewed and completed. I see John Stormon is listed on the Habitat Work Group list representing the DOE. It appears the DOE is now willing to use policy judgements, assumptions and Philosophical statements in place of good science. What ever it takes to get them where they want to be.

You make a statement on page 145 about low flows affecting water quality by contributing to higher stream temperature in summer months. I assume you are claiming this condition is occurring in the methow Basin or why would you have put it in the Methow Subbasin Plan. Well the USGS state that irrigation withdrawals on the Twisp River “were not” raising water temperatures. They also state that they had not done the work to say whether or not recharge water was cooling the Twisp River, but studies have been done that show recharge water from groundwater aquifers helps cool stream flows. I’m sure the folks on the Habitat work Group are aware of this occurrence but I don’t see where you included this language in the plan, I guess it doesn’t fit in with your policy goals.

You seem to think natural or what was here before the white mans settled the area was better than what is here today. You hammer everything the white man has touched. In those times before the white man came the Methow Basin was a very harsh place for all species of life to make a living in. Dry and hot in the summers (high Desert), it lie’s in the coldest of the 24 western climate zones, even the native Americans left the valley in the winter time. In early times the Methow Basin was not the Garden of Eden, we were thrown out of the Garden of Eden because of a liar and manipulator, does this remind you of someone. Today the Methow Basin is a friendlier place to all forms of life due to mans influence on the inviroment. Sure there has been some thing’s done that were not beneficial, hell, Washington State agencies are still doing them under the guise of fish recovery. Today there is more riparian habitat, more habitat of all kinds due to mans influence. There is 10% to 30% more fish being reared naturally in the rivers because of nutrients from mans activities entering wasteways. Recharge water from unlined irrigation canals recharge groundwater aquifers that in turn recharge instream flows. “Salmon populations are greatest in streams that receive high groundwater input, which sterilizes base flows and water temperatures, and promotes greater water fertility” (Hendrickson and Doonan 1972; White et al. 1976; Meisner et al. 1988). This is happening today here in the Methow Basin. Its time to stop hammering the things man has influenced in the basin and start realizing the benefits of mans influence in the basin. These beneficial influences need protection from those that would destroy them. This plan does not recognize the benefits of mans influence on the environment and would destroy 100 years of beneficial influence. The Methow Basin Watershed Planning Units Plan did recognize these benefits, if the Northwest Power and Conservation Council really wants to protect and enhance habitat, fish and wildlife they should contact the MBPU for funding direction.

Michael D Gage

Methow Subbasin Plan

Supplement to Appendix H

The following comments were submitted to the Northwest Power and Conservation Council during the public review period from early June through mid-August 2004. The subbasin planners were not required to address the public comments for the subbasin plans to be adopted, however, Okanogan County staff are committed to incorporating public comment and addressed the comments as well as possible, given the limited time and funding. The following letters are comments from the U.S. Fish and Wildlife Service, Yakama Nation, and Methow Conservancy.

United States Department of the Interior

Fish and Wildlife Service

Mid-Columbia River Fishery Resource Office

7501 Icicle Road

Leavenworth, WA 98826

Phone: (509) 548-7573

Fax: (509) 548-5743

Mark Walker

August 12, 2004

Director of Public Affairs

Northwest Power and Conservation Council

851 SW Sixth Ave. Suite 110

Portland, OR 97204-1348

Dear Mr. Walker:

The U.S. Fish and Wildlife Service (Service) appreciates the opportunity to comment on the May 28, 2004 Draft Methow Subbasin Plan (MSP). The Colville Tribes and Okanogan County in conjunction with KWA Ecological Sciences, Inc., coordinated this planning effort. This effort was initiated in May 2003 and was completed with the presentation of the document to the Northwest Power and Conservation Council (Council) on May 28, 2004.

The Methow Subbasin is located in north central Washington in Okanogan County. The Methow River enters the Columbia River between Wells and Chief Joseph Dams at RM 523.9. The subbasin comprises 12.78% of the Columbia Cascade Province encompassing 1,167,764 acres.

The Methow Planning effort faced many challenges including diverse opinions from fish and wildlife managers, tribal interest, irrigation districts, farmers and other interested parties. Other challenges faced by this planning group included limited staff resources and a compressed time frame.

The Service actively participated in the development of the Methow Subbasin Plan. We focused our time and attention on native fish and wildlife as well as activities that may coordinate or correspond with our mandated programs and responsibilities. Service biologist assisted subbasin coordinators through information and data dissemination. Additionally, they participated in workshops as well as provided review and comments on draft materials provided to them by the coordinators.

The Methow Subbasin Core Team developed a Management Plan as a component of this process. The Management Plan uses Assessment Unit Summaries as a way to convey pertinent information. This information includes focal species, subwatersheds, unit descriptions, level of certainty, limiting factors, working hypotheses and strategies. We would encourage the subbasin coordinators to go one step further and identify the types of projects or studies in specific locations that are necessary to achieve the goals identified within the Plan. Additionally, we would encourage the coordinators to develop a prioritized list of actions within each Assessment Unit.

We have evaluated the effects of the Methow Subbasin Management Plan on the Service's activities. In general, we have found this plan to be consistent with our Federal mandates.

Tribal Trust Responsibilities

The Service implements our fish and wildlife programs in a way that reflects our Federal trust responsibilities to Native American Tribes, respect of tribal rights, acknowledgement of the treaty obligations of the United States toward the Tribes, and protection of the natural resources the Federal government hold in trust for the Tribes. We are held to these principles through numerous treaties between the Tribes and the Federal Government. These include Executive Order 13175 requiring government to government relations, Secretarial Order 3206 relating to Federal/Tribal trust Responsibilities, and the Native American Policy of the U.S. Fish and Wildlife Service. Throughout the Methow Subbasin Planning effort, we have worked cooperatively with the Tribes including the Colville Confederated Tribes (CCT) to ensure that this planning effort protects the trust responsibilities. We believe that the Methow Subbasin Plan is consistent with our tribal trust responsibilities.

Hatcheries

The Winthrop National Fish Hatchery (WNFH), built in 1941, is part of the Service's National Fish Hatchery System in the Columbia Basin. The WNFH operates programs under regional agreements established pursuant to legislative mandates and judicial court proceedings such as *US vs. Oregon*. Additionally, the WNFH facility was built and is being operated to compensate for anadromous fish loss under the Grand Coulee Fish Maintenance Project of April 3, 1937 which was re-authorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. The overall value of the WNFH can be summarized in the following manner:

The WNFH missions is to "*To produce high quality spring Chinook salmon and summer steelhead smolts commensurate with the production goals established by the Columbia River Fisheries Management Plans (FWS 2002a).*

Recommendations for artificial production in the Methow Subbasin Plan may be considered in the management activities of the WNFH provided that they are consistent with the hatcheries mandated responsibilities.

ESA

After reviewing the MSP, we find the goals, objectives and management recommendations to be consistent with the Service's Draft Bull Trout Recovery Plan (BTRP). The MSP identified habitat restoration, protection and information needs that have been identified in the BTRP and will assist in the recovery of bull trout.

It would be helpful for the MSP to have the same amount of detail for listed plants and wildlife species. The MSP did not provide actions specific to the needs of these species, many of which were not considered at the appropriate level of detail.

Other Programs

Many of the management recommendations are consistent with the intent of several of the Service's restoration programs, such as, Partners for Fish and Wildlife and the Fish (PFFW) and Federal Irrigation Mitigation Act of 2000 (FRIMA). These restoration programs should be considered in conjunction with other funding sources to implement some of the identified management strategies such as providing fish passage, riparian restoration and in-stream habitat restoration.

Summary Comments

The Service commends the Methow Coordinators on their efforts to produce a draft subbasin plan. This planning process provided limited opportunities for public involvement from interested land owners through conducting open meetings, updates provided through an extensive e-mail list and a dedicated website. Opportunities were limited because of the compressed time frame of this planning effort. Participation in the MSP included the Colville Tribes, U.S. Forest Service, Washington Department of Fish and Wildlife, Okanogan County, the Service and local interest groups and individuals. With that in mind, The Service has some concerns involving the process and subsequent draft document. The Methow Subbasin Planning process began in May of 2003. We believe that it was unrealistic for the Council to expect a subbasin plan to be developed in a watershed of this size in twelve months. Additionally, this schedule did not allow sufficient time for federal, state, tribal, local agencies and public involvement in the process or adequate review of the final draft prior to being forwarded to the Council. This lack of comprehensive involvement has resulted in a document that falls short of all the necessary requirements for a subbasin plan.

The Service has the following general comments on the document:

- The MSP failed to address native plant and wildlife issues adequately. The plan emphasizes fish but is somewhat general on plants and wildlife. Using ICBEMP as a template was a good starting point, however we feel that subbasin-specific information on plants and wildlife should be include in this planning effort. This plan needs to address the plant and wildlife species listed under the Endangered Species Act of 1973, as amended.
- The MSP Subbasin Plan has many editorial and formatting errors.

We have provided additional specific comments in Appendix A and a species list for Okanogan County in Appendix B.

Despite the MSP short comings, we believe that the MSP is a good first draft but it could be and needs to be greatly improved. The Methow Subbasin Coordinators need a substantial amount of additional time (6 months) along with adequate funding to produce a complete final document that would address all of the components necessary for a subbasin plan.

Thank you again for the opportunity to comment. If you have any questions or comments please contact Kate Terrell at (509) 548-7573

Sincerely,

/s/

Brian Cates

Project Leader

USFWS Comments on the Methow Subbasin Plan

General Comments:

Westslope cutthroat trout and bull trout are not capitalized.

Some clarification on bull trout is need. In this plan, they are listed as a *resident fish*. There are three bull trout life form exhibited in the Columbia Cascade Province, fluvial, adfluvial and resident.

When discussing focal species, little to no information is presented on fish stocking and potential impacts to focal species.

There is very little or no discussion on hybridization in discussion of species interactions. Hybridization has genetic consequences and thus population restoration impacts.

There is very little discussion on fishing regulations and their effect on focal species.

The plan is pulls together a huge amount of information and has much more detail on wildlife issues than the Wildlife Assessment and Inventory dated February 2004. The plan is strong on fish but somewhat general on wildlife. Using ICBEMP as a template was fine but it was obvious that less effort was placed on this discipline.

Please include the following program descriptions for both fish and wildlife in the Okanogan Subbasin Plan

> <u>Partner's for Fish and Wildlife Program</u>
>
> Partner's for Fish and Wildlife is a federal cost-share program to implement voluntary on-the-ground habitat improvement projects on private lands for the benefit of Federal trust species and the landowner. The program is run by the U.S. Fish and Wildlife Service who provides financial and technical assistance.
>
> <u>Fish Restoration and Irrigation Mitigation Act of 2000 (FRIMA)</u>
>
> FRIMA is a federal cost-share program to implement voluntary fish screening and fish passage at water withdrawal projects in Washington, Idaho, Oregon, and western Montana. The program is implemented by the U.S. Fish and Wildlife Service in cooperation with State and Tribal partners within the north western U.S.

1. Executive Summary

Page iii: *Dave Hooper- United States Forest Service* should be changed to Dave Hopkins

Page xix: Need to include a brief description of QHA as one of the tools used in the planning effort.

3.1 Subbasin Overview

Page 4: Need to include the property owned by USFWS Winthrop National Fish Hatchery.

Page 15: First full paragraph, please include the following statement: The confluence of the Methow River is located at RM 523.9 of the Columbia River.

Page 17: Methow Subbasin Ditches should be changed to Chewuch Watershed Ditches

Page 18: Gorman 1899 reference is not included in the reference section.

3.2 Habitat Areas and Quality by SubWatershed

Goat Creek

Page 19: First paragraph, third sentence states: *Goat Creek supports a tenuous population of bull trout in the upper reaches*. This should be changed to: Goat Creek supports small resident and migratory bull trout populations in the upper reaches.

Wolf Creek

Page 20: First sentence delete the word major.

Second Sentence change to the following: Wolf Creek provides spawning and rearing habitat for resident and fluvial bull trout, westslope cutthroat trout, summer steelhead and spring Chinook.

Early Winters

Page 20: Second Paragraph: *The lower half-mile of the river has been riprapped and diked to keep the channel in a stable location in order to accommodate Highway 20 and to protect private property. Levels of LWD in the first two miles are low and pool quality and quantity is poor. Severe low flows persist in the lower 1.4 miles of the creek. Low base flows are naturally occurring during the winter months; however, low flows during late summer and early fall may be exacerbated by two irrigation diversions (USFS 1998c).* In 2000 or 2001, the USFS completed a restoration project on this reach of the creek. The restoration included an increase of large woody debris, pools and quality habitat.

Third Paragraph: *The Early Winters Ditch on Early Winters Creek is currently meeting NMFS* (and: USFWS) *target flow of 35 cfs (*add: for spring Chinook and bull trout), *and the irrigation district is using wells, that are not in* (add: continuity with) *groundwater and surface water to meet the remainder of its irrigation needs.*

Chewuch River

Page 20: Second Paragraph: Add: Bull Trout use of the Lower Chewuch is unknown with the exception as a migratory corridor, *however, it is known that they use the Lower Middle Chewuch and the Lake Creek Tributary for spawning and rearing.*

Middle Methow

Page 21: First Paragraph: Add: Bull trout and westslope cutthroat trout use this portion of the mainstem as a migrational corridor and for over wintering.

Beaver Creek

Page 21: Beaver creek in not a major tributary in this assessment unit. Also fish use need to be included in this description. Suggested language: Steelhead, spring Chinook and bull trout have had limited access to Beaver Creek due to its many obstructions. Most of these obstructions have been removed or are in the process of being modified for passage. The introduction of brook trout may have reduced the historic populations of bull trout.

Twisp River

Page 22: First Paragraph, last sentence: *Bull trout are found in the upper Twisp River and several of its tributaries.* Change to: Bull trout are found throughout the mainstem and several of its tributaries. Bull trout use the lower mainstem for overwintering and as a migrational corridor. Most of the spawning areas for bull trout are located in the upper watershed. Westslope cutthroat trout are found in these areas as well.

Fish Species/Aquatic Relationships

Page 23: Second Paragraph change *bull trout (Endangered*) to bull trout (threatened).

Page 24: Table 12: need to include westslope cutthroat trout and interior red band trout.

Page 25: Need to include information on westslope cutthroat trout.

Focal Species: Population characterization and status

Table 15: Need to include westslope cutthroat trout.

3.3.1 Fish Focal Species

Page 30: Need to include westslope cutthroat trout as a species of concern.

3.3.2 Wildlife Focal Species

Page 31: Table 16: Pygmy rabbits are not located in the Methow Subbasin.

3.4.4 Bull Trout

Page 56: First Paragraph, second sentence: suggested changes: The Methow river subbasin in know to support fluvial, adfluvial and resident populations of bull trout.

Delete second paragraph and add: Adfluvial population of bull trout are found in the Lost River and Lake Creek. Fluvial populations of bull trout are found throughout the Methow subbasin. Resident populations are found in many other streams including upstream of many natural barriers.

Key Life History Strategies, Relationship to Habitat

Page 57: Delete second paragraph and replace with the following: Bull trout have more specific habitat requirements that do other salmonids. Their habitat components requirements are summed up by the "Four C's" – clod, clean, complex and connected. Bull trout are believed to be among the most temperature sensitive cold-water species found in western North America (Dunham et al. 2003). Water temperatures above 15 degrees Celsius (59 degrees Fahrenheit) are believed to limit bull trout distribution, a limitation that may partially explain their patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995; Dunham et al. 2002).

Page 58: Delete first paragraph and replace with the following: Bull trout normally reach sexual maturity in 4 to 7 years and have a life span of 12 or more years. Repeat and alternate year spawning has been reported, although repeat spawning frequency and post spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989: Pratt 1992; Rieman and McIntyre 1996).

Page 58: Delete third paragraph and replace with the following: Migration of bull trout from the Columbia River into the Methow subbasin occurs in May through June (BioAnalysts 2002, 2003). Spawning begins in headwater streams in mid-September and continues through October, with temperatures during spawning of 41 to 48 degrees Fahrenheit (3 to 9 degrees Celsius) (Goetz 1989; Brown 1994).

Page 59: Table 24 should be replaced with the following: See below

Table 24 Bull trout survey summary for the Methow subbasin (1992-2003)

Stream	**'92**	**'93**	**'94**	**'95**	**'96**	**'97**	**'98**	**'99**	**'00**	**'01**	**'02**	**'03**
Chewuch River Mainstem										9	11	6
-Lake Creek up stream of Black Lake				22	13*	9	8	0	8	21	11	10*
-Lake Creek down stream of Black Lake									4	1		4
Methow River												

-Goat Creek				0					11*		4	3
-Lost River	5*		0	0*			0					
-Monument Creek	2*	0										
-Crater Creek					2*	2	1	0		0	1	0
-Wolf Creek					3	3*	27	29	15	20	15	18*
-Early Winters Creek					9*	1*	2	0	3	5	6	0*
-Cedar Creek					1	2*		0				
-West Fork Methow River				27	15	13*	11*	1	2	19	54	
Twisp River												
-Twisp River North Fork to Barrier Falls	3*	5*	4*	18	0*	2*	67	38	72	53	67	30
-Twisp River Reynolds Creek to South Creek										19	13	16
-East Fork Buttermilk				4*	0*		0	0*	0	2	3	3
-West Fork Buttermilk											7	9
-Reynolds Creek	1*				0*					1*	0	
_North Creek				3*			19	63	33	0	2	29

- Incomplete counts as to time(single survey) and/or space (only part of index area surveyed)

Page 59: Delete the last two paragraphs. This is a repeat of previous information

Page 60: First paragraph should be included in the section below, titled: Relationship with Other Species.

Population Delineation and Characterization

Page 60: Delete the first paragraph. It is confusing and not correct.

Page 61: First paragraph, change to: The USFWS Draft Bull Trout Recovery Plan (2002) delineated 8 local populations of bull trout within the Methow Core Area. However; the Upper Columbia Bull Trout Recovery Team has modified their delineation to 9 populations. These populations include Gold, Beaver, Wolf, Goat, and Early Winters creeks and Twisp, Chewuch, Lost and Upper Methow rivers (Barbara Kelly-Ringel 2004, pers.comm.). Comprehensive redd surveys, coupled with preliminary radio telemetry work in the Wenatchee basin, suggests the 9 remaining spawning populations may not be complete genetic isolates of one another but rather possibly co-mingle to some degree. It is possible that the nine spawning aggregates represent the Methow subbasin, but more monitoring and DNA analysis is necessary. The Lost River aggregate gene flow occurs only in high water years and not always between all represented groups. Assumptions regarding the historic and current distribution of bull trout in the Methow subbasin as part of the QHA Analysis are summarized in Appendix J.

Hydroelectric Effects

Page 64: Second Paragraph: Need to add - recent studies indicate that adult bull trout are passing the Mid-Columbia dams at rates similar to their anadromous salmonid counter parts (Bio Analysis 2003)

Third Paragraph: Add the following- A three year radio telemetry study was initiated in 2001 to track bull trout movement within the Upper Columbia region. A total of 79 bull trout were tag at the three Mid-Columbia Dams (Rock Island, Rocky Reach and Wells). During this study, no mortalities of bull trout associated with the dams were documented (BioAnalysts 2002, 2003).

Page 65: Last paragraph add- This maybe due to the limited sampling periods of juveniles in the by-pass facilities (Chelan PUD, unpublished data).

Harvest Effects

Page 66: Replace current section with the following

Currently, the harvest of bull trout is prohibited on all stocks in the Methow subbasin with the exception of the Lost River. Fishing may have been a leading factor in the decline of bull trout. In streams currently open to fishing of other species, bull trout are vulnerable to take due to misidentification, hooking mortality, poaching, and disturbance. Schmetterling and Long (1999) found that 44 percent of anglers correctly identified bull trout and anglers frequently confused similar species. Incidental hooking mortality varies from less than 5% to 24% for salmonids caught on artificial lures, and between16% and 58% for bait caught salmonids (Taylor and White 1992; Pauley and Thomas 1993; Lee and Bergersen 1996; Shcill 1996; Schill and Scarpella 1997). Eggs and alevins in redds are vulnerable to wading-related mortality which can cause mortality of up to 46% from a single wading event (Roberts and White 1992).

The Lost River, above Drake Creek, is open to bull trout harvest. It is thought that the strength of the healthy population and the remote location will keep harvest within a sustainable level. This fishery should continually be monitored for the effects of this fishery on the population.

Past steelhead fisheries may have negatively impacted migratory bull trout. The closure of steelhead angling in 1997, following the ESA listing, may have played a significant role in the increase of bull trout redds in the Methow subbasin.

Lee, W.C. and E.P. Bergersen. 1996. Influence of thermal and oxygen stratification on lake trout hooking mortality. North American Journal of Fisheries Management 16(1): 175-181.

Long, M.H. 1997. Sociological implications of bull trout management in northwest Montana: Illegal harvest and game warden efforts to deter. Pages 71-74 in Mackey, W.C., M.K. Brewin, and M. Monita, editors, Friends of the bull trout conference proceedings, Bull Trout Task Force (Alberta), c/o trout Unlimited Canada, Calgary.

Pauley, G.B. and G.L. Thomas. 1993. Mortality of anadromous coastal cutthroat trout caught with artificial lures and natural bait. North American Journal of fisheries Management 13(2): 337-345.

Roberts, B.C. and R.G. White. 1992. effects of angler wading on survival of trout eggs and pre-emergent fry. North American Journal of Fisheries Management 12:450-459.

Schill D.J. 1996. Hooking mortality of bait-caught rainbow trout in an Idaho trout stream and a hatchery: Implications for special-regulation management. North American Journal of Fisheries Management 16(2): 348-356.

Schill, D.J. and R.L. Scarpella. 1997. Barbed hook restrictions in catch-and-release trout fisheries. A social issue. North American Journal of Fisheries Management 17(4) 873-881.

Schmetterling, D.A. and M.H. Long. 1999. Montana Anglers' Inability to Identify Bull Trout and Other salmonids. Fisheries 24(7):24-27.

Taylor, M.J. and K.R. white. 1992. a meta-analysis of hooking mortality of nonanadromous trout. North American Journal of Fisheries Management 12(4):760-767.

3.4.5 Westslope cutthroat trout

Page 66: Delete 4th paragraph.

Page 69: 7th paragraph: delete *fall*. The statement should read: In the Methow, flooding has a high frequency of occurrence. Westslope cutthroat trout are spring spawners, therefore fall flooding is not an issue with eggs in the gravel.

3.5 Other fish species important to management in the Methow subbasin.

Page 74: Delete: *Broodstock are collected at Dryden and Tumwater dams and at the Leavenworth NFH in the Wenatchee Basin*. This is Wenatchee subbasin information, not the Methow

3.5.5 Redband trout

Page 79 Delete: *This may have occurred in the Icicle Creek Basin too, where a barrier dam was erected in 1939 for the hatchery*. This information belongs in the Wenatchee subbasin.

Current distribution

Onchorhynchus is mis-spelled. It is spelled *Oncorhynchus.*

3.10.2 Changes in fish habitat

Page 144: There are 29 fish and wildlife species listed as Endangered, Threatened or Species of Concern in the Methow subbasin.

3.12 Community structure

Table 42: Need to include interior redband trout.

Page 158: Need to include bull trout and westslope cutthroat trout.

3.13 Competition

Page 159: what effect will the re-establishment of coho have on bull trout and westslope cutthroat trout?

3.14 Predation

Page 159: Need to include information on the predation of mammals and birds on bull trout and westslope cutthroat trout.

Page 160: Delete first paragraph beginning Channel catfish also have…. This is duplicative.

3.16.1 Chinook/Steelhead

Page 161: What is meant by well-coordinated competition?

3.16.4 Various salmonids

Delete this section and insert section 3.16.11

3.16.11 See above

3.16.12 and 3.16.13 are duplicative of section 3.14

3.17 Habitat conditions and Limiting Factors to Fish Production

Sections: Irrigation and low flows, forest practices, roads, agricultural practices, and mining need to include the effects of steelhead and Chinook.

3.17.1 Summary of Limiting Factors

Page 177: *Instream and floodplain habitat degradation (fish).* Include and wildlife

3.18 The Form and Function of Ecosystem Change

Policy, Social, and Cultural

Page 180: Second paragraph delete last phrase: *and probably caused "bonus" returns in others (as recently occurred, in 2002 and 2003)*

Fishing

Page 181: Delete second paragraph. Information in duplicated in the third paragraph.

Fishing in the future

Page 184: Paragraphs 2, 3 and 5 need citations.

Mainstem Columbia River Dams

Page 186 and 187: Need to include the effect of the mainstem dams on bull trout and lamprey.

Tributary Habitat Degradation

Page 187: Need to include the effects of tributary habitat degradation on bull trout and westslope cutthroat trout.

Public Policy

Page 189: Forth paragraph: need to include the effects of human population growth on bull trout and westslope cutthroat trout.

3.19.2 Mortality Outside the ESU

Page 192: Need to include the out of basin effects on bull trout and pacific lamprey.

3.20 Synthesis and Interpretation of Assessment for Fish Ecosystems

Page 197: QHA needs to be included in this section.

Page 234: Table 50: Goat Creek should be in category B due to the presence of bull trout.

Page 235: Table 51: Goat Creek, Lower Twisp, and Lower Chewuch should be category B due to threaten and endangered species.

Comments on Tables 50 and 51 were based on descriptions provided on page 238.

4.4 .1 Federal Agencies and Programs

Page 248: Need to include language on the USFWS Partners for Fish and Wildlife, and the FIRMA programs.

4.5.4 Principal Policy Processes Managing Hatchery Fish Production

Grand Coulee Fish Maintenance Project (GCFMP)

Page 268: First sentence: change *replace* to mitigate for.

4.5.5 Current Fish Production Program Goals and Objectives

Winthrop National Fish Hatchery

Page 273: Need to include information on the Hatchery Genetic Management Plans.

5.5 Assessment Unit Summaries

Page 288: How are EDT outputs correlated to the QHA outputs in regards to the Limiting Factors Analysis.

Assessment Unit 1

Page 289: Westslope cutthroat trout needs to be included in the focal species.

Hypothesis 1: Include the following- bull trout for holding, migration and overwintering. Westslope cutthroat trout for migration and overwintering.

Page 291: Data Gaps: Include the following for westslope cutthroat trout- fish use activity and life stage, distribution and abundance.

Assessment Unit 2

Page 292: Westslope cutthroat trout needs to be included in the focal species.

Hypothesis 1: Include the following- bull trout for holding, migration and overwintering. Westslope cutthroat trout for migration and overwintering

Page 293: Hypothesis 2: delete *steelhead and Chinook and* replace with all salmonids.

Hypothesis 4: Include the following- bull trout for holding, migration and overwintering. Westslope cutthroat trout for migration and overwintering

Page 294: Hypothesis 6a: Include the following- bull trout for holding, migration and overwintering. Westslope cutthroat trout for migration and overwintering

Page 295: Data Gaps: Include the following for westslope cutthroat trout- fish use activity and life stage, distribution, abundance and genetics.

Assessment Unit 3

Page 296: Westslope cutthroat trout needs to be included in the focal species.

Hypothesis 1: include westslope cutthroat trout for migration and overwintering.

Page 297: Hypothesis 2-5include westslope cutthroat trout for migration and overwintering.

Page 299: Data Gaps: Include genetics for westslope cutthroat trout

Assessment Unit 4

Page 300: Hypothesis 1: Include bull trout and westslope cutthroat trout

Page 301: Hypothesis 2-4: Include bull trout and westslope cutthroat trout

Page302: Hypothesis 5: Include westslope cutthroat trout.

Page 303: Data Gaps: Include genetics for westslope cutthroat trout.

Assessment Unit 6

Page 308: Westslope cutthroat trout needs to be included in the focal species.

Page 309: Hypothesis 2: Need to include westslope cutthroat trout.

Page 310: Hypothesis 4: Include bull trout and westslope cutthroat trout.

Hypothesis 6: include westslope cutthroat trout

Page 312: Data Gaps: Include genetics for westslope cutthroat trout

Assessment Unit 7

Page 314: Hypothesis 3: Include bull trout

Page 315: Hypothesis 4 and 5: Include bull trout.

Page 316: Hypothesis 7: Include bull trout.

Data Gaps: Include genetics for westslope cutthroat trout.

Assessment Unit 8

Page 317: Westslope cutthroat trout needs to be included in the focal species

Page 318: Hypothesis 1: include bull trout and westslope cutthroat trout in all life stages.

Hypothesis 2: include bull trout for rearing, spawning and migration. Westslope cutthroat trout for rearing.

Hypothesis 3: include westslope cutthroat trout for egg incubation and fry colonization.

Hypothesis 4: include westslope cutthroat trout.

Page 319: Data Gaps: Include genetics for westslope cutthroat trout

Assessment Unit 9

Page 320: Westslope cutthroat trout needs to be included in the focal species

Hypothesis 1: include westslope cutthroat trout in all life stages.

Hypothesis 2: include bull trout and westslope cutthroat trout ant all life stages.

Page 321: Hypothesis 3-5: include westslope cutthroat trout.

Page 322: Hypothesis 6: include westslope cutthroat trout.

Page 323: Data Gaps: Include genetics for westslope cutthroat trout.

Assessment Unit 10

Page 324: Westslope cutthroat trout needs to be included in the focal species

Hypothesis 1: include bull trout and westslope cutthroat trout ant all life stages.

Page 325: Hypothesis 2-3b: include bull trout and westslope cutthroat trout.

Page 326: Hypothesis 4: include westslope cutthroat trout.

Hypothesis 5: include bull trout and westslope cutthroat trout ant all life stages.

Hypothesis 6: include steelhead and westslope cutthroat trout.

Hypothesis 7: include bull trout and westslope cutthroat trout.

Page 327: Hypothesis 8: include bull trout and westslope cutthroat trout.

Page 328: Data Gaps: Include genetics for westslope cutthroat trout

Assessment Unit 13

Page 329: Focal Species: add westslope to cutthroat trout.

Hypothesis: include westslope cutthroat trout migration.

Page 330: Hypothesis 3: include westslope cutthroat trout.

Page 331: Hypothesis 4: include westslope cutthroat trout.

Hypothesis 5: include migration.

Hypothesis 6: include cutthroat trout.

Page 332: Hypothesis 8: include bull trout migration and holding

Assessment Unit 11

Page 334 Focal Species: add westslope to cutthroat trout.

Hypothesis 1: include bull trout and westslope cutthroat trout at all life stages.

Page 335: Hypothesis 2: include bull trout and westslope cutthroat trout at all life stages

Hypothesis 3: include bull trout and westslope cutthroat trout at all life stages

Hypothesis 4: include westslope cutthroat trout

Page 336	Hypothesis 5: include bull trout for migration and rearing.

Hypothesis 6: include bull trout at all life stages

Hypothesis 7: include bull trout.

Assessment Unit 12

Page 338: Focal Species: add westslope to cutthroat trout

5.9 Consistency with ESA/CWS

Columbia River Bull Trout ESU

Page 361: ESU should be changed to DPS. Language on core populations should be included from the USFWS Draft Bull Trout Recovery Plan.

Relationship to Other Planning Efforts

Page 365: Include the USFWS Draft Bull Trout Recovery Plan and Critical Habitat Designation for Bull Trout.

Winthrop National Fish Hatchery

Page 480: Second paragraph, last sentence should read the following: Current production consists of an Endangered stock of spring Chinook, with a total release goal of 600,000 smolts annually.

Forth Paragraph, last sentence should read: Winthrop National Fish Hatchery developed an HGMP which was submitted to NOAA-fisheries November 2002.

Page 491: Statement "*There is no HGMP for Winthrop NFH" is incorrect*. Winthrop National Fish Hatchery developed an HGMP which was submitted to NOAA-fisheries November 2002.

Appendix H: Public Comments:

Comments provided in this appendix are a mixture of comments for the Methow as well as the Okanogan subbasin plans.

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES,
CRITICAL HABITAT AND CANDIDATE SPECIES
THAT MAY OCCUR IN
THE COUNTIES OF EASTERN WASHINGTON
AS LISTED BY THE U.S. FISH AND WILDLIFE SERVICE

August 10, 2004

FWS Reference:

COMMENTS

Major concerns that should be addressed in your biological assessment of project impacts to listed threatened, endangered, or proposed animal species are:

1. Level of use of the project area by listed species.
2. Effect of the project on listed species' primary food stocks and foraging areas in all areas influenced by the project.
3. Impacts from project construction and implementation (e.g. increased noise levels, increased human activity and/or access, loss or degradation of habitat) which may result in disturbance to listed species and/or their avoidance of the project area.

Major concerns that should be addressed for listed or proposed plant species are:

1. Distribution of taxon in project vicinity.
2. Disturbance (trampling, uprooting, collecting, etc.) of individual plants and loss of habitat.
3. Changes in hydrology where taxon is found.

For information regarding species listed by the National Marine Fisheries Service, please call (206)526-6150 in Seattle, WA, or (503)231-2319 in Portland, OR.

<u>Please note the Species of Concern Lists may not be accurate and are currently being updated.</u>

OKANOGAN COUNTY

LISTED

Endangered

None

Threatened

Bald eagle *(Haliaeetus leucocephalus)*

Bull trout *(Salvelinus confluentus)*

Canada lynx *(Lynx canadensis)*

Gray wolf *(Canis lupus)*

Grizzly bear *(Ursus arctos = U.a. horribilis)*

Northern spotted owl *(Strix occidentalis caurina)*

Ute ladies'-tresses *(Spiranthes diluvialis)*, plant

Designated

Critical habitat for the northern spotted owl

PROPOSED

Critical habitat for bull trout

CANDIDATE

Fisher *(Martes pennanti)*, West Coast distinct population segment

Yellow-billed cuckoo (*Coccyzus americanus*)

Western sage grouse *(Centrocercus urophasianus phaios)*

SPECIES OF CONCERN

Animals

Black tern *(Chlidonias niger)*

California bighorn sheep *(Ovis canadensis californiana)*

California floater (mussel) *(Anodonta californiensis)*

Cascades frog *(Rana cascadae)*

Columbia pebblesnail *(Fluminicola (=Lithoglyphus) columbianus)* [great Columbia River spire snail]

Columbia spotted frog *(Rana luteiventris)* (= *Rana pretiosa*, eastern population)

Columbian sharp-tailed grouse *(Tympanuchus phasianellus columbianus)*

Fringed myotis (bat) *(Myotis thysanodes)*

Harlequin duck *(Histrionicus histrionicus)*

Interior redband trout *(Oncorhynchus mykiss gairdneri)*

Loggerhead shrike *(Lanius ludovicianus)*

Long-eared myotis (bat) *(Myotis evotis)*

Long-legged myotis (bat) *(Myotis volans)*

Northern goshawk *(Accipiter gentilis)*

Northern leopard frog (*Rana pipiens)*

Northern sagebrush lizard *(Sceloporus graciosus graciosus)*

Olive-sided flycatcher *(Contopus borealis)*

Pacific lamprey *(Lampetra tridentata)*

Pale Townsend's (= western) big-eared bat *(Corynorhinus (=Plecotus) townsendii pallescens)*

Small-footed myotis (bat) *(Myotis ciliolabrum)*

Tailed frog *(Ascaphus truei)*

Western burrowing owl *(Athene cunicularia hypugea)*

Western gray squirrel *(Sciurus griseus griseus)*

Westslope cutthroat trout *(Oncorhynchus clarki lewisi)*

Wolverine *(Gulo gulo luscus)*

Yuma myotis (bat) *(Myotis yumanensis)*

Plants

Crenulate moonwort *(Botrychium crenulatum)*

Stalked moonwort *(Botrychium pedunculosum)*

Triangular-lobed moonwort *(Botrychium ascendens)*

Peculiar moonwort *(Botrychium paradoxum)*

August 12, 2004

Mark Walker, Director of Public Affairs
Northwest Power & Conservation Council
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204-1348
fax 503-820-2370

Dear Mr. Walker:

The Confederated Tribes and Bands of the Yakama Nation (YN) support the submittal of the Okanogan, Methow, Lake Chelan, Entiat, Wenatchee, Yakima, Klickitat, White Salmon, Wind River, and Middle Mainstem Columbia including Rock Creek Subbasin Plans because they represent an advancement of integrated fish and wildlife planning. However, given the inadequate funding levels and arbitrarily constrained time limits, the wide scope and the concurrent nature of the planning effort within these and other subbasins across the YN ceded area, we have been unable to participate at a level we would have preferred; i.e. the YN had no resources to be involved in the development of the Okanogan, Methow, Lake Chelan, and Wind River subbasin plans.

We expect to use the next several months to consider the work done to date and the implications to our treaty reserved rights and resources, and to develop recommended revisions for Council consideration. We also expect that Council will articulate how they intend to assure a clear link between all the subbasin plans and other obligations in the Columbia Basin such as the Pacific Salmon Treaty between the US and Canada, the fish production and rebuilding obligations defined in the *US vs. Oregon* Columbia River Fish Management Plan, Pacific Northwest Salmon Recovery Planning under the Endangered Species Act, and meeting tribal treaty trust obligations.

The Yakama Nation echoes the concern expressed by the Columbia River Intertribal Fish Commission (CRITFC) that most subbasin plans do not include specific measures (actions or projects) which can be expected to be implemented for the protection, mitigation and enhancement of fish and wildlife. The Regional Act requires the NPCC, in amending its Fish and Wildlife Program, to request "recommendations from Federal and regional State and Tribal “for (A) measures which can be expected to be implemented …to protect, mitigate and enhance affected fish and wildlife and their habitat … (B) establishing objectives…(C) fish and wildlife management coordination and research and development (including funding) for fish at and between projects". Though required in the Act and in the 2000 Fish and Wildlife Program, the NPCC specifically deleted requests for budgets and actions in its 2001 Guide to Subbasin Plans that was used by the planners as a plan format. Specifically, the 2001 Guide stated: "Strategies will be implemented through specific projects and/or actions. Projects proposed for funding will not be identified within the subbasin plan. When a plan is approved, it will form the basis for project selection within the subbasin. Projects will be developed through the regional project funding process."

However, in its request for recommendations issued in August 2002, the NPCC requested recommendations in the form of subbasin plans and mentioned implementation strategies "which will guide or describe the actions needed to achieve the desired biological conditions."

This confusion has legal consequences in that specific tribal and fishery agency recommendations are entitled to deference under the Act; the NPCC can not reject them in developing a program without specific findings and, once in the Program, is required to use its funds consistent with the Program. Until such time as the YN is able to develop new measures for fish management in subbasins within our ceded area, we will continue to implement the measures contained in volume 2 of *Wy-Kan-Ush-Mi Wa-Kish-Wit*.

The Yakama Nation supports subbasin planning under the Council's Fish and Wildlife Program and we are committed to working with you and your staff to make the necessary revisions in preparation for amendment of these documents. Given the enormity of that task, however, we ask that you consider the significant challenges placed on the policy and technical staff capabilities of the co-managers and request that the greatest possible flexibility in the review process and schedule be allowed. The products of this investment, including the developing relationships that have been forged, need to be protected and nurtured as we move to integrate and implement these subbasin plans into a regional basin wide management and implementation tool.

Thank you for this opportunity to comment and please feel free to contact me for any questions or comments you may have.

Sincerely,

Steve Parker, Acting Program Manager

Yakama Nation Fisheries Resources Management Program

General statement pertinent to all Subbasin Plans within the Yakama Nation Ceded Area

The following statement must be in each subbasin plan within the YN ceded area, i.e. Wind River, White Salmon, Klickitat, Lower, Middle and Upper Middle mainstem, Yakima, Wenatchee, Entiat, Lake Chelan, Methow and Okanogan. It should be stated in the Executive Summary and at the beginning of the Management Plan sections.

> The Yakama Nation has treaty reserved rights to hunt and fish at all Usual and Accustomed places within the subbasin. The Yakama Nation has standing as a co-manager for fish and wildlife resources in the subbasin and under that responsibility has developed a management plan for fish stocks (*Wy-Kan-Ush-Mi Wa-Kish-Wit*). In the absence of any other measure defined in this subbasin management plan, the Yakama Nation intends to implement the measures defined in *Wy-Kan-Ush-Mi Wa-Kish-Wit*. It is the vision and goal of the Yakama Nation that tribal members will exercise their treaty right to harvest native species at all Usual and Accustomed sites within the subbasin, and toward that goal the YN will act to restore or reintroduce stocks of native species.

General comments regarding all subbasin plans

The Columbia River Intertribal Fish Commission comment letter contains eight Technical Comments with Recommendations. The Yakama Nation endorses those comments and recommendations.

Okanogan, Lake Chelan, Klickitat, White Salmon, Middle Mainstem and Rock Creek, and Wind River Subbasin

There were no staff resources available to review these plans to provide comments at this time.

Methow Subbasin

General

Page xxii: Second paragraph under Implementation. There is **not** universal consensus that the vision, goals, preliminary findings, and management plan that anchors this document outline a reasonable and strategic course for fish and wildlife in the subbasin. The YN has not had sufficient opportunity to review this plan.

Page xxiv. Second paragraph under section 2 Introduction. The last sentence should read, "In addition, both the Colville Tribes and the Yakama Nation have a long history of traditional resource use in the subbasin, and take an active **role** in fish, wildlife, and habitat management."

Page xxiv. First paragraph under section 2.1 Subbasin Planning. The last sentence should read, "…;it serves as a valuable tool to assist local fish and wildlife recovery coordination efforts led by stakeholder groups, Okanogan County, the Colville Tribes, and the fish and wildlife co-managers (Yakama Nation and WDFW).

Page xxx. Second paragraph from top of page. Artificial production of fish is also used to provide for lost treaty fishing opportunities.

Page xxxiii. Okanogan County Comments on Land Acquisition. This is an inappropriate place for this discussion. It would be better placed in an appendix. If it is included in the Executive Summary, then there should also be included the counter-point.

Page 2. First paragraph under Fig. 3. The second sentence should read. "Ancestors of tribes that are presently part of the Yakama Nation and the Colville Tribes…"

Page 3. There needs to be a paragraph added for the Yakama Nation. The YN has treaty rights to utilize Usual and Accustomed sites in the subbasin. Those treaty rights give the YN standing as a fish and wildlife co-manager under US vs. Oregon; standing that the Colville Tribes do not have.

Page 251. The Yakama Nation has also been conducting spawning ground surveys and smolt trapping for at least the last twelve years.

Spring Chinook, Steelhead and Summer Chinook (not coho) Production Comments

Page 39.   "Hatchery Effects" – it should be noted that the genetic data showed more genetic difference between years than between populations within a year. The genetic data are somewhat suspect.

Page 40. "Hatchery Effects" – BAMP included the Twisp in managing stocks as a single population, not just the Chewuch and Methow. See page 87 of the BAMP.

Page 40. "Hatchery Effects" – Even in large run years, to date only the Twisp tributary trap is showing any promise as an effective trap. To count on the tributary traps is not appropriate at this time given their long and ineffective track record.

Page 184. Four solutions. Why get into solutions with harvest alteration when the mainstem habitat is the real problem?

Page 185. "The effects of Fishing on Population Characteristics". What is the citation for extirpation in the 1800s by harvest? First sentence of section.

Page 265. first full para. BAMP included the Twisp in managing stocks as a single population not just the Chewuch and Methow. See page 87 of the BAMP.

Page 265. 2nd to last para. Release sizes at the hatcheries is also dependent on trapping efficiencies and water availability at the hatcheries.

Page 267. PCSRF Section. Include Yakama Nation spring chinook pedigree study.

Page 277. Need to describe the coho fish production program at Winthrop NFH.

Page 280. Monitoring and Evaluation. Include Yakama Nation study to monitor summer chinook stock status funded by Alaska through CRITFC.

Pages 363-364. Given Ford et al (2001) and findings by the TRT, why are we managing for multiple sub-populations in the Methow? Is there a goal to manage for more than one genetic population as identified in the BAMP?

Page 460 or so; Table 64. List YN's pedigree study and summer chinook evaluation.

Technical Comments

Page xxi, Executive Summary **–** A recovery goal for coho salmon is not included. The recovery of coho salmon is listed as a priority in the tribal restoration plan and affirmed as a priority for the NPCC. An appropriate goal for coho salmon would include re-establishment of run sizes that provide for species recovery, mitigation of hydro-system losses and harvestable surpluses.

Page 24, 1st paragraph - Craig and Suomela (1941) reported that coho salmon were historically more abundant in the Methow River than chinook or steelhead.

Page 30, 2nd paragraph **–** Revise the status of coho salmon from extirpated to reintroduced. *For example*: Coho salmon were **once** extirpated but have since been **reintroduced** to the Methow River.

Section 3.4, Focal Fish Species - In **Table 15** coho salmon are listed as a focal species, however in the body of section 3.4, coho are not addressed as a focal species, but are included in section 3.5 'Other Species'. Consistent with Table 15, coho salmon should be considered a focal species. Coho salmon meet the criteria listed in paragraph 4 of section 3.3 for inclusion as a focal species. Criteria a): designation as a Federal Endangered or Threatened Species, or Management Priority as designated by a management authority. The recovery of coho salmon is a Management Priority for the Yakama Nation. The recovery of coho salmon to the Methow River is listed as a priority by the four Columbia River Treaty Tribes in the *Wy-Kan-Ush-Mi Wa-Kish-Wit* document (Tribal Restoration Plan), and has been affirmed as a priority by the Northwest Power and Conservation Council. Criteria b & c): Cultural and Local Significance – Coho salmon are a species of cultural significance to the four Columbia River Treaty Tribes and are of local significance within the Methow Basin. Mullen (1992) estimated the historic coho population in the Methow River to be between 23,000 and 31,000 annually. Craig and Suomela (1941) stated that coho were historically the most abundant anadromous salmon species within the Methow River Basin. Criteria d): Ecological significance or provide the ability to serve as indicators of species and ecosystem health – Coho salmon prefer and occupy different habitat types than the other focal species listed within the sub-basin plan. Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are essential for juvenile rearing, making the recovery of coho salmon a good, if not better, biological indicator for these habitat types than any of the other focal species presented in this document. Since coho salmon clearly meet all the criteria for focal species (and are considered a focal species in Table 15), coho salmon should be discussed in section 3.4 along with the other focal fish species. The format used to discuss coho salmon as a focal species should be consistent with the formats used for the other focal species, an example follows:

Focal Species: Coho Salmon

Rationale for Selection

Historically, the Methow River produced more coho than chinook or steelhead (Craig and Suomela 1941). Mullan (1984) estimated that 23,000-31,000 annually returned to the Methow River. Upstream of the Yakima River, the Methow River and Spokane River historically produced the most coho, with lesser runs into the Wenatchee and Entiat (Mullan 1984). Today, coho reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi Wa-Kish-Wit* document (Tribal Restoration Plan) and has been affirmed as a priority by the Northwest Power and Conservation Council.

Coho salmon prefer and occupy different habitat types, selecting slower velocities and greater depths than the other focal species; Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are important for juvenile rearing making coho good biological indicators for these areas.

While the historic stock of coho salmon are considered extirpated in the Upper Columbia River (Fish and Hanavan 1948, Mullan 1984), the species has since been reintroduced to the Methow River Basin. In cooperation with the Washington Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service, the Yakama Nation is currently leading coho salmon recovery efforts in the basin.

Representative Habitat

Currently, coho salmon returning to the Methow Basin are spawning in the mainstem Methow River and small tributaries such as Gold Creek. As the recovery program continues, reintroduction of coho to tributaries within the Methow Basin will help to aid in species dispersal. A map of known coho salmon distribution can be found in Figure ?.

Figure ?. Coho Salmon distribution in the Methow sub-basin

Key Life History Strategies, Relationship to Habitat.

Coho salmon enter the Methow River in mid-to-late September through late November. Adults ascended the tributaries in the fall and spawning occurred between mid-October and late December, although there is historical evidence of an earlier run of coho salmon (Mullan 1984). As cold water temperatures at that time of year preclude spawning in some areas, it is likely that coho salmon spawn in areas where warmer ground water up-wells through the substrate.

Coho entering in September and October hold in larger pools prior to spawning, later entering fish may migrate quickly upstream to suitable spawning locations. The availability and number of deep pools and cover is important to off set potential pre-spawning mortality. Intact riparian habitat will increase the likelihood of instream cover, and normative channel geofluvial processes will increase the occurrence of deeper pools.

Important habitat needs for redd building include the availability of clean gravel at the appropriate size, and proper water depth and velocity. Burner (1951) reported the range of depths for coho spawning to be between 8 and 51 cm. Coho salmon spawn in velocities ranging from 0.30 to 0.75 m/s and may seek out sites of groundwater seepage (Sandercock 1991).

The length of time required for eggs to incubate in the gravel is largely dependent on temperature. Sandercock (1991) reported that the total heat requirement for coho incubation in the gravel (spawning to emergence) was 1036 (±138) degree (°C) days over zero. The percentage of eggs and alevins that survive to emergence depends on stream and streambed conditions. Fall and winter flooding, low flows, freezing of gravel, and heavy silt loads can significantly reduce survival. Fall flooding may negatively affect incubation and emergence success, especially in years of extreme flow. Road building activities in the upper watersheds, as well as grazing and mining activities, may also increase siltation. All three factors were once more prevalent than they are now in the basin and the conditions have improved in most watersheds. In the Wenatchee subbasin, coho fry emerge from the gravel in April or May; it is likely that emergence timing is similar in the Methow River.

Juvenile coho salmon generally distribute themselves downstream shortly after emergence and seek out suitable low gradient tributary and off channel habitats. They congregate in quiet backwaters, side channels, and shady small creeks with overhanging vegetation (Sandercock 1991). Conservation and restoration of riparian areas and off channel habitat in natal streams within the Methow Basin would increase the type of habitat fry use.

Coho salmon prefer slower velocity rearing areas than chinook salmon or steelhead (Lister and Genoe 1970; Allee 1981; Taylor 1991) Recent work completed by the Yakama Nation supports these findings (Murdoch et. al. 2004). Juvenile coho tend to overwinter in riverine ponds and other off channel habitats. Overwinter survival is strongly correlated to the quantity of woody debris and habitat complexity (Quinn and Peterson 1996). Conservation of and restoration of high functioning habitat in natal tributaries and restoration of riparian and geofluvial processes in or near known and potential parr rearing areas will have the highest likelihood of increasing parr survival.

Naturally produced coho smolts in the Wenatchee Basin emigrate between March and May (Murdoch et. al. 1994). It is likely that naturally produced coho smolts in the Methow River have similar emigration timing. Suspected or potential impediments to migration and sources of injury or mortality should be identified and investigated. If areas are shown to unnaturally impede emigration or injure or kill fish, they should be fixed.

Population Delineation and Characterization

Coho salmon were once extirpated from mid-Columbia tributaries but have since been reintroduced. Reintroduction initially relied on transfers of coho pre-smolts or eggs from Lower Columbia River hatcheries, but is currently transitioning to reliance upon a developing locally adapted broodstock. The developing broodstock is genetically homogeneous with the Wenatchee River broodstock.

Long-run coho are unique among a species that usually migrates very short distances to spawn in freshwater. Historical pictures of the native Methow coho indicate the fish were equal in size to the spring chinook (Mullan et al. 1992b).

Population Status

Washington Water Power blocked the Methow River at Pateros between 1915 and 1929 preventing all fish passage during those years and by the time it was removed, the Methow River run of coho was extinct. By the 1930s, the coho run into the mid- upper Columbia was virtually extirpated (see Rock Island Dam counts above). Tributary dams on the Wenatchee, Entiat, and

Methow rivers appeared to be more destructive to coho than either steelhead (where genetic "storage" presided in resident forms) or chinook.

Because the native stock of coho salmon no longer occur in the Upper Columbia River system, the Methow basin coho are not addressed under the ESA or by the WDFW (1994) Salmon and Steelhead Stock Inventory. Coho salmon returning to the Methow Basin are primarily hatchery origin, but include an increasing naturally produced component as a result of ongoing reintroduction efforts (YN et. al. 2002). It is likely that continued broodstock development and hatchery supplementation will be necessary to prevent coho salmon from becoming extirpated in the future.

Population Management Regimes and Activities

In the early 1940s and the mid-1970s, the USFWS raised and released coho as part of their mitigation responsibilities for the construction of Grand Coulee Dam (Mullan 1984).

Recently the Yakama Nation (YN) has begun a more concerted effort to reintroduce coho into the Upper Columbia (Scribner et al. 2002); results so far are promising. Current efforts to rebuild coho populations in the Upper Columbia are concentrated in the Wenatchee and Methow Basins.

The ideal result would be to restore coho populations in these basins to their historical levels. Because of varying degrees of habitat degradation in each of these basins, historical numbers are unlikely ever to be achieved, but remain a goal towards which to strive.

The current coho reintroduction plan still in the feasibility stage through 2004 relies on existing or temporary facilities. Currently, coho smolts are acclimated and released in the Methow River from the WNFH for the sole purpose of broodstock development, although some natural production does occur. This phase of the program is expected to last through 2004 or 2005, after which the reintroduction program will expand to included acclimated releases in natural production areas of the basin in order to reach the tribal natural production goal.

Coho salmon are collected as volunteers into the Winthrop National Fish hatchery and from the run-at-large at Wells Dam west bank and/or east bank fish traps to support a 250,000 smolt program (YN et al. 2002). Methow basin coho broodstock may be supplement with eyed-eggs transferred from Wenatchee Basin incubation facilities or from hatcheries on the lower Columbia River (Cascade FH, Eagle Creek NFH, or Willard NFH) in years where broodstock collection falls short of production goals. Coho reared at Winthrop NFH are volitionally released into the Methow River or transferred to the Wenatchee River for acclimation and release. Under the current feasibility program, coho releases from the Winthrop National Fish Hatchery are design to contribute to the broodstock development process. Details on mating protocols, rearing and acclimation strategies, size at release and monitoring and evaluation can be found in the Yakama Nation's Mid-Columbia Coho HGMP (YN et al.2002).

Hatchery Effects

The first hatchery in the Methow Basin was built in 1889 (Craig and Suomela 1941) and raised primarily coho salmon. Releases of fish from non-indigenous sources began in the 1940s (Peven 1992CPb).

Between 1904 and 1914, an average of 360 females was used for broodstock from the Methow hatchery annually (Mullan 1984). With the building of a non-passable dam at the Methow River mouth in 1915, this hatchery was moved more towards the confluence with the Columbia.

Between 1915 and 1920, an average of only 194 females was taken, suggesting a 50% decline in the run between this and the previous period. After 1920, no coho were taken from this hatchery and it closed in 1931 (in Mullan 1984).

No further releases of coho into the Methow River occurred until the GCFMP in 1945. Of the 17 years of releases of coho from the Winthrop NFH between 1945 and 1969, in only four of those years did the broodstock originate from the Methow River (which were admixtures of various stocks originally captured at Rock Island Dam; Mullan 1984). Most of the coho released at Winthrop originated from Lower Columbia River stocks from the Eagle, Lewis, and Little White Salmon hatcheries (Mullan 1984).

Chelan PUD also had a coho hatchery program until the early 1990s. While some natural production may have occurred from these releases, the programs overall were not designed to re-establish a naturally spawning populations and relied upon lower Columbia River stocks.

Current coho reintroduction efforts focus on local broodstock development to select for traits which are successful in mid-Columbia tributaries with the long-term goal of restoring naturally reproducing populations. The mid-Columbia coho reintroduction feasibility study has a substantial monitoring and evaluation program to determine if the reintroduction of coho salmon into the upper Columbia basin may affect the production of chinook and steelhead. The results of extensive predation and competition studies indicate that a negative effect is unlikely to occur. Similarly, other researchers have found that the introduction of coho did not negatively affected the abundance or growth of naturally produced chinook or steelhead (Spaulding et. al. 1989; Mullan et. al. 1992)

Hydroelectric Effects

Habitat alteration, especially tributary dams in the Methow River mainstem, reduced the viability and capability of coho to rebuild themselves locally.

Prior to the 1940's, runs of Methow River coho salmon were essentially destroyed as a result of over-harvest, early hatchery practices, habitat degradation and impassable downstream dams. Much of the failure of the GCFMP to re-establish self-perpetuating populations may have been related to reliance upon stocks lacking genetic suitability (Mullan et al. 1992b).

Recent (after GCFMP) programs to restore coho in the mid-upper Columbia began in the 1960's with releases from WDFW hatcheries for Rocky Reach Dam mitigation. Although this program did produce some initial promising results, (Figure CP15), naturally producing runs were not established, primarily because the program was not designed to re-establish naturally producing runs. The coho were released from the Turtle Rock fish hatchery, located in the middle of the Columbia River above Rocky Reach Dam. The release location likely contributed to the inability to produce a naturally spawning coho run. This reach of the Columbia River dies not proved suitable coho spawning and rearing habitat. In the early 1990s, this program was abandoned.

According to the Chelan 2002 HCP, Rocky Reach Hatchery compensation for Methow River coho will be assessed in 2006 following the development of a continuing coho hatchery program and/or the establishment of a Threshold Population of naturally reproducing coho in the Methow Basin (by an entity other than the District and occurring outside this Agreement). The Hatchery Committee shall determine whether a hatchery program and/or, naturally reproducing population of coho is present in the Methow Basin. Should the Hatchery Committee determine that such a program or population exists, then (1) the Hatchery Committee shall determine the most appropriate means to satisfy the 7% hatchery compensation requirement for Methow Basin coho, and (2) the District shall have the next juvenile migration to adjust juvenile protection Measures to accommodate Methow Basin coho. Thereafter, Coordinating Committee shall determine the number of valid studies (not to exceed three years) necessary to make a juvenile phase determination.

Programs to meet NNI for Methow Basin coho may include but are not limited to: (1)provide operation and maintenance funding in the amount equivalent to 7% project passage loss, or (2) provide funding for acclimation or adult collection facilities both in the amount equivalent to 7% juvenile passage loss at the Project. The programs selected to achieve NNI for Methow Basin coho will utilize an interim value of project survival, based upon a Juvenile Project Survival estimate of 93%, until juvenile project survival studies can be conducted on Methow Basin coho.

Harvest Effects

Coho were relatively abundant in upper Columbia River tributaries streams prior to extensive resource exploitation in the 1860's. By the 1880's, the expanding salmon canning industry and rapid growth of the commercial fisheries in the lower Columbia River had heavily depleted the mid and upper Columbia Rive spring and summer chinook runs (McDonald 1895), and eventually the steelhead, sockeye, and coho (Mullan 1984, 1986, 1987; Mullan et al. 1992 CPa).

The runs of coho that ascended the Columbia River were initially reduced from over-harvest in the mainstem and habitat degradation associated with watershed development.

Page 72, 1st paragraph – Coho salmon are no longer considered extirpated in the Upper Columbia River. Coho salmon have been reintroduced, and are in need of continued recovery efforts.

Page 72, 3rd paragraph – Coho salmon are no longer considered extirpated in the CCP. Coho salmon have been reintroduced and are in need of continued recovery efforts.

Page 75, 8th paragraph - The Chelan PUD coho program which began in the 1960's with releases from WDFW hatcheries for Rocky Reach Dam mitigation did not result in naturally producing coho runs because the program was not designed to re-establish naturally producing runs. The coho were released from the Turtle Rock fish hatchery, located in the middle of the Columbia River above Rocky Reach Dam. The release location largely contributed to the inability to produce a naturally spawning coho run. This reach of the Columbia River does not provide suitable coho spawning and rearing habitat. The program was only designed for harvest augmentation. The use of 'maladapted' stocks was likely not the reason why the Chelan PUD program did not result in a naturally producing run of coho salmon.

Page 76, 4th paragraph – The Chelan PUD coho program which began in the 1960's with release from WDFW hatcheries for Rocky Reach Dam mitigation did not result in naturally producing coho runs because the program was not designed to re-establish naturally producing runs. The coho were released from the Turtle Rock fish hatchery, located in the middle of the Columbia River above Rocky Reach Dam. The release location largely contributed to the inability to produce a naturally spawning coho run. This reach of the Columbia River does not provide suitable coho spawning and rearing habitat. The program was only designed for harvest augmentation. The use of 'maladapted' stocks was likely not the reason why the Chelan PUD program did not result in a naturally producing run of coho salmon.

Page 162, section 3.16.3 – in addition to competition studies cited (Murdoch et al. 2004; Spauling et al. 1989), Mullan et al (1992) studied the growth and survival of juvenile coho, chinook, and steelhead in Icicle Creek and concluded that little interaction was apparent among age-0 chinook salmon, coho salmon, and steelhead, and that the introduced coho did not negatively affect the abundance or growth of chinook and steelhead.

Page 205, section 3.22 – As a focal species, coho salmon should be included in the EDT analysis.

Page 264, section 4.5.3, **Current fish production programs in the Methow subbasin** – A description of the coho reintroduction program should be included alongside the spring chinook, summer chinook, and steelhead programs in this section.

Page 289-341**, Assessment Unit M1-M12** – Focal species for these assessment units should include coho salmon.

Page 341, Section 5.7 – Coho salmon need to be addressed under 'Fish Species Objectives and Strategies'. Formerly the most abundant anadromous species in the Methow River, the recovery of coho salmon should be outlined with clear objectives and strategies, similar to spring chinook, summer chinook, and steelhead.

Entiat Subbasin

General Comments

The readability of this document is not very good, especially the Management Plan. There are numerous areas where language, format and content could be cleaned up. Perhaps the brevity of schedule for plan development challenged the authors to thoroughly edit the draft plan. It would be beneficial if time were taken to properly edit this document.

The sub-basin plan should better incorporate and more fully integrate the Entiat WRIA Management Plan (CCCD 2004). This could be done in a number of ways (e.g. excerpts, incorporate by reference).

There is little or no information concerning the role of artificial production within the subbasin nor a proposal for a future role. It is recommended that some description of hatcheries be displayed in the Assessment and Inventory and recommendations be advanced in the Management Plan. This conversation should discuss possibilities for all focal species.

There is little information about Pacific lamprey. This is an important species that has had little attention paid in either sub-basin or watershed plans.

Introductory Information

Additional emphasis should be made about the role of the Entiat Watershed Planning Unit (EWPU) in coordination of the implementation of future projects/activities. Additional language should be added the subbasin plan that illustrates the recent work by the Entiat Watershed Planning Unit and completion of the Watershed Plan, from which the subbasin plan was built.

Assessment

Aquatic / Fisheries

Table 15 (and other related tables) is qualitative in nature yet there are no definitions of the "High-Medium-Low" indicators. These definitions should be provided.

For each of the Assessment Units, the subsection "Environmental / Population Relationships" should be cleaned up and tightened up. The various descriptions for each of the AU's are treated to various degrees – some much better than others. Achieving greater consistency in these descriptions and providing a tighter discussion for each of the focal species will provide a more solid foundation for the Synthesis, later on in the document.

There appears to be a difference in the way water resources (and use of) is characterized in the SBP and the Watershed Plan. Specifically – there seems to be discrepancies in the characterization of current flow patterns with respect to the "normalized" hydrograph and how the hydrograph may be altered with future increases in water withdrawals. This discussion needs to be consistent between both documents.

Terrestrial / Wildlife

The focal habitats used encompass a relatively small area within the subbasin. Additional habitat types should be incorporated to provide a more holistic evaluation of subbasin – even if the habitat type is as general as "mixed coniferous".

Inventory

The inventory section does not seem to have done all the work required under sub-basin planning. A gap analysis needs to be done for each of the assessment units.

Aquatic / Fisheries

The Inventory is missing some of the work done by the US Forest Service – which manages almost 90% of the land base. This information should be included to better represent what has occurred in the subbasin. The Entiat WRIA Management Plan has a more thorough inventory of these activities.

Much of the work identified in the inventory is inadequately described, being much too brief. Additional description is needed for all AU's.

Terrestrial / Wildlife

There is no information concerning wildlife. This information should be included.

Synthesis and Interpretation

Statements describing wildlife seem to be unnecessarily broken into two sub-sections in this synthesis and interpretation section. It should be in one.

It seems reasonable to use the PFC standards as the basis for numeric objectives or as a theoretic target. However, it is common knowledge that not all of these standards are applicable to all areas. These standards are fine as an idealized goal, but modifications should be made where appropriate.

This is a good place to talk about reference conditions. RC's are developed from the fish perspective (VSP) but not in terms of habitat. A comparison should be made by AU's that describes which of the PFC attributes are currently within standards and which ones have dropped below the historic reference condition.

Table 24, page 158 needs to be better defined. It is not clear what this table is telling the reader.

It is not clear what purpose near-term opportunities play in this plan. They appear in the synthesis and interpretation section, but do not seem to be well reflected in the executive summary and management plan sections. Further, the near-term opportunities are sorted by species rather than geographically. The plan needs to pick either a geographic or target species organizational construct, and stick with it. As the Entiat WRIA management plan is geographically-based, perhaps this should be the standard to facilitate consistency.

Certain statements related to flow impacts seem over-stated or unsupported, and could lead to indefensible conclusions. Please cross-reference management recommendations and key findings with assessment information, and supplement with Entiat WRIA Management Plan assessment information to assure consistency throughout the sub-basin plan and between plans.

Management Plan

The overall layout of the Management Plan is cumbersome. Perhaps it is necessary to re-organize this section entirely to correct this problem. It would be helpful if there were some introductory discussion that describes how the Management Plan is laid out. The reader is left wondering about the different goals and objectives. The basic lay-out for fish and wildlife is fundamentally different and this is confusing. Efforts should be made that provide a more consistent discussion for these two areas.

The Management Plan should contain additional information that comes from the EPU Watershed document. The Mgt. Plan appears to be developed from a fish or wildlife perspective only and falls short of the human dimensions. Please draw language from the EPU Watershed Plan and incorporate directly into the subbasin plan. Please draw greater parallels between the EDT Alternative 5 contained in the Entiat WRIA Management Plan, and aquatic habitat recommendations in this sub-basin plan.

Page 174, the sub-title includes "near-term opportunities" which is a term used and addressed in Chapter 6. Perhaps this is where Chapter 6 near-term opportunities should occur within the Management Plan.

Page 175 begins a breakdown of the sub-basin by assessment unit. It is not clear to the reader if these breakdowns are the strategies, objectives, and/or near-term opportunity as this sub-chapter suggests will follow. This is a specific example of the cumbersome and confusing organizations structure mentioned previously. Perhaps the biologic objectives and management recommendations should be kept together, organized on a geographic basis (sub-basin or assessment unit). In this way the reader can find the information in one place rather than scattered throughout the Management Plan.

The reader is not provided information to understand which of the strategies/objectives is most important nor which geographic areas are to be prioritized. This should be apparent at the Sub-basin scale and within each of the Assessment Units.

It is not clear where the numeric objectives (standards and dates) are derived from. Some of these metrics appear to be difficult or impossible to achieve. Also, some of these standards appear to be inconsistent with those derived by the EWPU document.

Certain statements related to flow impacts seem over-stated or unsupported, and could lead to indefensible conclusions. Please cross-reference management recommendations and key findings with assessment information, and supplement with Entiat WRIA Management Plan assessment information to assure consistency throughout the sub-basin plan and between plans.

Bibliography

This section also needs editing. There are references made in the text of this document that do not show up in the bibliography. Also, there are citations listed in the bibliography that show nowhere in the text of this document.

Appendix

Appendices to this sub-basin plan were very limited. We recommend that the Entiat WRIA Management Plan be a primary appendix to this sub-basin plan. Further, appendices and references to the Watershed Plan should be appended to the sub-basin plan. These should include the EDT Analysis, the SNTEMP analysis, in-stream flow assessment work by Entrix and WDOE, and air photographic analyses of land-use by Central Washington University.

Specific Comments:

Page: 56
Coho should be added as a focal species as it is identified later as a focal species.
Page: 85
What does "those" refer to? Sentence does not make sense.
Page: 140
There should not be any habitat competition since all the hatchery releases are smolts which should be actively migrating.
Sequence number: 2
There is also the potential for increased competition for rearing habitat between hatchery and naturally spawned fish.

Wenatchee Subbasin

General Comments

In general the document reads well, although there are numerous areas where language, format and content could be cleaned up.

There is little or no information concerning the role of artificial production within the subbasin nor a proposal for a future role. It is recommended that some description of hatcheries be displayed in the Assessment and Inventory and recommendations be advanced in the Management Plan. This conversation should discuss possibilities for all focal species.

Introductory Information

Section 2.4: The Logic Path that is pictured here does not accurately reflect the contents of the Management Plan. The use of the terms Strategies and Objectives seems to be confused.

Section 2.5.2: Table 1 could provide more information by indicating, to some qualitative degree, the extent of the limiting factor (high-medium-low).

Section 3.2.5: Table 10 is incomplete. Chumstick AU information is missing.

Assessment

Aquatic / Fisheries

Section 4.8.2: Table 15 (and other related tables) is qualitative in nature yet there are no definitions of the "High-Moderate-Low" indicators. These definitions should be provided.

For each of the Assessment Units, the subsection "Environmental / Population Relationships should be cleaned up and tightened up. The various descriptions for each of the Assessment Unit's are treated to various degrees – some much better than others. Achieving greater consistency in these descriptions and providing a tighter discussion for each of the focal species will provide a more solid foundation for the Synthesis, later on in the document.

Terrestrial / Wildlife

The focal habitats used encompass a relatively small area within the subbasin. Additional habitat types should be incorporated to provide a more holistic evaluation of subbasin – even if the habitat type is as general as "mixed coniferous".

Section 4.7: These summaries should be provided in a more site specific manner, possible using the Assessment Units as described in the Aquatic/Fisheries sections.

Inventory

Aquatic / Fisheries

The Inventory is missing work done by the US Forest Service, which manages nearly three-quarters of the land base. This information should be included to better represent what has occurred in the Subbasin.

There is no mention of on-going work in Lake Wenatchee with respect to the Coho program, sockeye net-pens or species interactions.

Much of the work identified in the Inventory is inadequately described, being much too brief. Additional description is needed for all Assessment Units.

Terrestrial / Wildlife

There is no information concerning wildlife. This information should be included.

Synthesis and Interpretation

There is a disconnect in this section. Definitions in Section 6.2 appear to pertain to fisheries only. Terrestrial Key Findings are formatted in a different manner than fisheries.

Many of the terrestrial Key Findings appear to be based upon information not contained in the Assessment. Some of these findings appear to be more speculative and general in nature than factually based. Some discussion of where this information comes from and how the Key Finding was derived would be helpful.

In describing the Level of Confidence for Aquatic Key Findings, it would be helpful to provide a short description as to how (what bases) this “High-Moderate-Low” determination was made.

Key Findings are essentially habitat based. It would be helpful if there was a better tie between focal species and habitat for each of the Assessment Units. Maybe a brief discussion of habitat use by focal species prior to each of the Assessment Units would strengthen or highlight the importance of each of the Key Findings.

There should be some discussion in Key Findings concerning influence of artificial production on naturally reproducing populations.

Section 6.6: This section seems out of place. Maybe if it were to be at or near the beginning of the Synthesis it would help set the stage better.

Management Plan

Section 7.4: It would be helpful if there were some introductory discussion that describes how the Management Plan is laid out. The reader is left wondering about the different goals and objectives and how management strategies are related.

The basic lay-out for fish and wildlife is fundamentally different and this is confusing. Efforts should be made that provide a more consistent discussion for these two areas.

Aquatic / Fisheries

Lake Wenatchee appears to be a very important component of the subbasin yet there are relatively few recommendations.

Section 7.8.3: Please provide a description for each of the tables that summarize the Assessment Units. Please insure that the tie back to the Assessment and Synthesis is apparent.

There is not the ability for the reader to understand which of the strategies/objectives is most important nor which geographic areas are to be prioritized. This should be apparent at the subbasin scale and within each of the Assessment Units.

It might be helpful if there was a brief description provided under each of the key strategies outlining why the strategy is being advanced. This description should go back to the Key Finding and focal species that would benefit.

There appears to be some confusing format errors in the Near-Term Opportunities, making these sections a bit trying to read and understand.

Monitoring

The monitoring chapter looks good. Notably lacking is a component that describes how the information derived from the monitoring program will be stored, accessed, evaluated and reported. What relationship will monitoring information have to the adaptive management concept and how will this information become relevant to the general public?

Appendix

Although five Appendices are listed for Chapter 11, none of these documents are attached.

Chapter 8 (Monitoring) appears to be what is being referenced in Chapter 11.

There is not a clear link in the document that describes the basis of the information used in the Assessment. A summarization of the QHA materials should be made available in the Technical Appendix and referenced in the main body of the Assessment.

Specific Comments:

Page: 88
Seems a pretty high goal when the average has been one-seventh of it.
Page: 143
The migration corridor through the Tumwater Canyon seems to have the greatest negative impact on juvenile survival as indicated by recent pit tag data for coho and spring chinook.
Sequence number: 2
Tumwater Canyon migration corridor.
Page: 144
survival through the Tumwater Canyon
Page: 173
550 plus coho redds were in Icicle Cr. in 2003 below structure 2 and the mouth.

Page: 210

ISSUE OF MIGRATION CORRIDOR FROM UPPER BASIN AN ISSUE FOR ALL SPECIES.

Since the first coho releases in the Wenatchee Basin, the YN has measured emigrating smolt survival rates from point of release to McNary Dam. Initially these survival rates were measured only in the Icicle Creek releases, but in 2002 and 2003 PIT tag releases from coho acclimated in Nason Creek allowed us to evaluate survival rates of coho smolts released within the upper Wenatchee River basin (Table 1). We found a sizable discrepancy in survival rates between coho emigrating from Nason Creek and coho emigrating from Icicle Creek during both years. In 2002 we measured survival indices of 78% and 87% for two PIT tagged releases in Icicle Creek, and an index of 39% for Nason Creek. In 2003 we calculated a survival index of 62% for coho released in Icicle Creek and 37% for coho released in Nason Creek. In 2002 and 2003 lower Wenatchee basin survival rates were 1.7-2.2 times higher than upper basin survival rates (Murdoch, pers. comm.). We searched for comparable survival metrics from the other hatchery programs. Survival rates from release to McNary Dam for hatchery spring chinook emigrating from the Chiwawa River acclimation ponds have not been measured. However, WDFW measured a pooled survival index of 38% for wild spring chinook emigrating from the Chiwawa River in 2003, based on actively migrating PIT tagged chinook smolts (A. Murdoch WDFW personal communication.) This value is similar to survival indices calculated for hatchery coho salmon emigrating from Nason Creek. Hatchery spring chinook released from the LNFH in 2003 had a release to McNary survival rate of 64% (as measured by the DART website, M. Cooper USFWS personal communication.) Survival indices provided by WDFW and the USFWS comport well with survival indices measured for hatchery coho and support the observed trend of decreasing survival rates for salmonids emigrating from the upper Wenatchee Basin.

Page: 394

Why is the monitoring plan limited to just listed stocks? Other focal species should be included that occupy different niches in the habitat.

Yakima Subbasin

General Comments:

1. The Yakima Subbasin Plan has made an excellent effort at summarizing and documenting the vast amount of information that is available from the various reports regarding habitat and focal species status in the basin. The plan is based on the EDT model, with input from the Aquatic Technical Committee, and as such is a habitat-based model. The EDT model has the ability to produce prioritized listings of habitat factors that are limiting the distribution and productivity of focal species within the basin. Unfortunately these limiting factors are buried within the multi-page tables in the Management Plan (Chapter 4). There needs to be a summary table that identifies the highest priority limiting factors. This also applies or the Protection and Restoration Key Findings Tables.
2. There needs to be a numerical objective (spawning escapement plus total ocean, mainstem Columbia, and terminal Yakima harvest) for each of the focal species of salmonids in the basin. Without some numerical objective you cannot measure success of implemented projects. Obviously the numerical objectives should be based on the production capability of each individual subbasin, but they should cumulatively build towards the Council's and fishery managers' regional objective of rebuilding healthy, naturally producing anadromous fish runs to produce 5 million adult returns in 25 years which can withstand a harvest rate of at least 30%.
3. Harvest is prominently mentioned in the Yakima Subbasin Vision 2020 where it states "support self-sustaining and harvestable population of indigenous fish and wildlife… in the basin." However, there is no quantification of harvest objectives for any of the focal species of salmonids. Harvest is obviously an important mitigation component of the Power Act for the Yakama Nation, and as such should be addressed in more quantifiable terms for each species.
4. Supplementation research programs need to be more thoroughly discussed in the plan. There are two major objectives of supplementation within the Yakima subbasin. First, the habitat protection and restoration components identified in the tables may or may not achieve the numerical objectives that we propose be identified for each of the focal species. If these habitat measures fall short of meeting the objectives, supplementation should be used to increase the productivity of the populations. Secondly, several of the supplementation programs within the Yakima are research programs evaluating the efficacy of using supplementation while maintaining genetic integrity and keeping ecological interactions within specified limits, determining the feasibility of reintroduction of extirpated species, and evaluating domestication of multiple generations of hatchery rearing of salmonids. These research programs have been justified and approved through the NPCC processes and are scheduled to continue.
5. Lamprey as focal species – Lamprey are listed as a focal species and then largely ignored because there is very little local data. These treatments can be strengthened with an expanded discussion of lamprey ecology, more local information, and discussion of rebuilding efforts in other subbasins. Passage issues on the mainstem have reduced lamprey populations (more in next section). In many subbasins lamprey will clearly benefit from increasing the amount and complexity of channel habitat.
6. Mainstem issues have not been adequately addressed. No consideration is given to the extensive mortality that Yakima subbasin stocks of anadromous salmonids and lampreys suffer in the four

mainstem dams and associated reservoirs of the Columbia River. This invalidates the objectives and strategies of subbasin plans that need reductions in OOSE mortality to meet local goals and objectives. Obviously this issue is beyond the expertise of the local planners within each subbasin, and should therefore be developed for use in all subbasin plans by appropriate mainstem personnel.

Habitat Comments:

In the exec summary, in addition to the background information on the subbasin cultural and physical geography, stock productivity and existing conditions, I believe the plan should provide a concise summary of:

1. The priorities for habitat restoration, protection and assessment for the entire basin. In other words, where are the habitat protection priorities? The plan should describe how habitat protection in the key reaches compares to priorities by reach for riparian revegetation, stormwater control, instream improvements, etc.

   This provides the NWPPC, BPA, SRF Board, other funding sources and interested parties not familiar with the basin with the actions that managers believe will make the most cost-effective improvements to basin productivity in the short term. It would obviously be a difficult task to flesh these priorities out with plenty of disagreement, but at a coarse scale I believe we can come up with priorities to which most will agree.

2. The plan needs to describe habitat priorities within each reach. For example, say a new interest group forms in the Cowiche Drainage with the intent to make things better in their part of the watershed for fish and wildlife. The plan should lay out for them what the priorities are for the Cowiche. How does habitat protection needs measure up to riparian fencing, purchase of water, passage and screening, etc? This provides local elected officials, new resource managers, the public and other interest groups with the hit list of issues for their part of the watershed.

3. Most importantly, the plan needs to tell folks like the Cowiche group how the priority actions in that watershed compare to actions in the entire Yakima Subbasin. Is water acquisition in the Cowiche a priority for overall basin or not? This helps to avoid wasted effort on grant applications for projects that are out of sequence, or that are not even on the list. This is really just restating #1 above, but for the benefit of the folks here at home.

These needs are vitally important. Their inclusion will help secure funding for the best projects. It is also important to recognize that the priorities by reach and across the basin only relate to future watershed funding, and would not to be tied to regulatory issues for ongoing or proposed construction activities.

Specific Comments:

There are numerous minor inaccuracies within the document, and this is understandable due to the severely limited timeline for production of such an ambitious plan. Personnel from the Yakama Nation will be working with the subbasin planning team to identify and correct these errors over the next several months. Several examples are;

Ch 2-168 key findings. In the key findings the forth bullet states that tribal and sport harvest resulted from the CESRF for the first time in over 40 years. Table 2-14 shows more accurately that while this is true for non-tribal sport harvest, the tribal harvest has continued since 1982, albeit at very low rates in some years.

Ch 2 – 191 Steelhead hatcheries. The Steelhead Kelt Reconditioning Program is operated by the Yakama Nation under a contract with the Columbia River Intertribal Fish Commission, ***not*** under the YKFP.

Ch 2-209 Sockeye Reintroduction Potential. Midway through the paragraph a duplicate 'Yakima Subbasin Yakima Subbasin' occurs.

Ch 2-211 Lamprey current distribution. More recent data exists on observations of lamprey in the Yakima.

Ecosystem Diagnosis and Treatment (EDT) Specific Comments:

Ch 2-150. EDT Summary

States EDT model used as hypothesis generating tool. Should also include other utilities of the model: The model can also be used to assist management actions pertaining to restoration and preservation. The model can also be used to identify uncertainties leading to research proposals.

2. Ch 2-220. Map of EDT limiting factors related to sediment

Map displays areas with high quantities and percentages of fine sediment and turbidity but discussion of sediment is limited to sediment transport and does not address map descriptions or model outputs. Pages are also out of order.

3. Ch2-248. Key Uncertainties at the Subbasin scale:

An initial discussion of what the model is not capable of producing/or calibrated to produce. It would be wise to leave out negative connotations of what the model wasn't able to do based on one or two individual's opinion. This is also a section where uncertainties identified by the model could be included as well, and is not reflected in the current write up.

4. Ch 2-242 thru 245 - Maps with EDT limiting factors.

No discussion and interpretation of these maps exist

5. Preservation sections have very little detail of supporting documents or data sources that justifies the action. Another area that the EDT results generally agree with biological opinions in certain areas and could be used as a scientific justification tool.

6. All comments above can be inferred to all assessment unit write ups in the Yakima Subbasin plan

7. Ch 4-7 Limiting factors analysis

This section supplies key finding, focal species, hypothesis statement, etc but does not document or reference supporting material (field observation, expert opinion, conducted study, EDT). Might be helpful to put something like this in there.

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RE: Methow Conservancy comments on the Methow Subbasin Plan

August 5, 2004

Dear Mr. Walker,

I am submitting the following comments on behalf of the Methow Conservancy, a land trust and conservation organization based in Winthrop, WA. The Methow Conservancy is an independent non-profit organization with over 450 members, and we specialize in conservation easements, stewardship plans and conservation education. We currently hold 40 conservation easements and have protected 10.8 miles of shoreline in the Methow Watershed from the pressures of development, recreation, livestock grazing, large woody debris removal and invasive species.

Over the past 5 years we have received $4.2 million in Salmon Recovery Funding Board grants to help us acquire conservation easements in riparian areas. We have applied for additional funds to continue this incentive-based, voluntary conservation strategy in the Methow Valley. To date we have permanently protected 3,774 acres of private land, which we feel is a significant achievement given the size and age of our organization. This success shows that there is significant conservation interest and sophistication within our local community.

We believe that the Methow Conservancy represents a credible, capable organization, ready to help involve the local conservation community in land use plans, restoration projects and policy decisions that are practical for this Valley. I hope you will look to us as a resource and a community leader as you work to implement this Subbasin Plan.

Please consider the following comments regarding the 5/28/04 draft of the Plan:

Page: xix

The vision statement for this plan is weak as stated because it is so broad as to be impossible to fully achieve, monitor or account for over time. An additional vision for the Subbasin Plan would be helpful to state more prominently. Later in the document it is stated as “a reasonable and strategic course for fish and wildlife in the sub-basin,” or “a durable roadmap for future actions and priorities,” or “to guide BPA in meeting its mitigation obligations.” These statements pertain to a vision for this plan, and that is very useful for the community that is expected to follow it.

Page: xix

The federal government manages 85% of the watershed, the State (both DNR and WDFW) manages 5% and 10% is privately owned. The statement that 15% is privately owned is incorrect.

Page xx:

This statement will generate fear and resistance at the local level: "*To address factors limiting the focal wildlife species, the plan calls for protection of the full size and condition of core areas, physical connections between areas, and buffer zones to ameliorate impacts from incompatible land uses*." The paragraph further describes the monitoring that will take place after the "improvements." Protection of core areas for many of the focal species described in this report will directly depend on voluntary, private landowner cooperation. To ignore the vital role of private landowners so early in this report (in the Executive Summary, which many more people will read), is a serious mistake and will hinder the successful implementation of the plan.

Page xxiv-xxv:

"*These hypotheses….form the basis for management decisions which, based on public policy, will facilitate coordinated recovery planning for the Methow salmon ecosystem. The vision, goals, and supporting principles in this subbasin plan provide the foundation for the implementation of the plan by applying local public jurisdiction to local decisions.*" This is unclear. Please clarify this statement, and its implications.

Page xxv:

There is a typo in the second paragraph. It states: "*Okanogan County has been largely responsible for the technical aspects of the subbasin plan. WDFW has been largely responsible for the technical aspects of the subbasin plan.*"

Page xxvii:

The first paragraph refers to the challenges of managing the Okanogan subbasin, but this plan pertains to the Methow subbasin.

Page xxxii:

Point 3 states, "*High diversity promotes production and long-term persistence at the species level*." This is an ecological theory, and should be stated as such. What does this imply for areas dominated by a diverse population of invasive species? The complexity of the ecological interactions and successional stages that are present in the Methow Valley is not adequately stated or cited.

Page xxxiii:

The third paragraph states: "*Sustainable, harvestable, and diverse populations of fish and wildlife are dependent upon properly functioning environments and the processes that sustain them.*" These types of statements make this document 582 pages long. This statement is so broad as to be meaningless, and in our opinion, serves no purpose in this document.

Page xxxii:

We would like to make it clear that conservation easement acquisitions do not remove land from private ownership, or from the tax rolls of Okanogan County. Instead conservation easements have required private landowners to develop management plans for their property, and invest in land improvements such as weed control and forest thinning, which has a cumulative benefit for all lands (public and private) in the Methow Valley.

Page 4 (Section 3.1):

In the fifth paragraph, the plan states that the State manages 5% of the basin. Of this State land, 51% is managed by DNR, and 49% is managed by WDFW. This paragraph makes WDFW seem like a minor land manager, but they manage far more than just the Methow Wildlife Area.

Section 3.1, Figure 5:

This land use for the Methow Basin chart is from 1977. There have been significant changes in land use in the Methow Valley over the past 27 years. This chart should not be used to represent current conditions in the basin.

Page 8, Drainage area:

This section states that the Methow River drains 1,193,933 acres. On page 4, (Table 2) the total Subbasin area is said to be 1,167,794 acres. Which is the correct number?

Page 26, Table 13:

There are 252 bird species known to occur in the Methow Valley (not 221 as stated). Contact the Methow Biodiversity Project for more information or a species list.

Page 31, Table 16:

Pygmy rabbits do not presently occur in the Methow Valley, and there is significant uncertainty whether they were ever here. A rare/non-existent species such as this does not make a good focal species, as good habitat conditions may never have existed for this species in the Methow Basin. Focusing on protecting a species that may not have ever been here is not likely to result in the most conservation value for the amount of money invested in restoration and recovery.

Page 59

There is an omitted word in the last paragraph, first sentence.

Page 84

Grasshopper sparrows are extremely rare in the Methow Valley, and this rarity is not a recent or anthropocentric phenomenon. While they may be good focal species for the Okanogan region, they are not good indicators for Methow Valley shrub-steppe habitat condition.

Page 95

It would helpful to include mule deer population statistics specific to the Methow Valley in the subbasin plan. The effect of mule and white tailed deer on native vegetation can be dramatic and detrimental, and the carrying capacity for deer in the Methow Valley is unknown. It would be helpful to emphasize the need for deer carrying capacity research, and then to compare the current herd sizes to this carrying capacity.

Including Methow-specific information for all the focal wildlife species would add much important and useful information to this plan.

Page 97

The majority of cottonwood gallery forests in the Methow basin are privately owned, but the plan states (in the third paragraph) that the majority are in public ownership. This is an important point to clarify, because it underscores the importance of working with private landowners to protect riparian zones that so many wildlife species depend on.

In the seventh paragraph, the plan states that blackberry invasion is contributing to the reduction in available habitat for the red-eyed vireo in the Methow basin. This is not true. We have few to no blackberries (*Rubus* spp.) in vireo habitat in this basin.

Page 104

Table 31 is labeled “Specific habitat attributes for Beaver,” but it is actually a list of all the focal species with their habitat types, key relationships and selection rationale.

Page 112

Pygmy nuthatches are not ponderosa pine obligate species in the Methow Valley. They occur throughout the valley floor, even in downtown Winthrop.

Page 118

Figure 34 is missing.

Page 127

The first paragraph states that the planners identified “rugged lands” as a habitat of concern. How are these lands defined? This statement is unclear as to the meaning and significance of rugged lands.

Page 132

The last paragraph states that shrub-steppe habitat has increased in the Methow Valley from 165-462% over historic amounts. This implies that shrub-steppe areas are healthy and expanding in the Methow Valley. The 1850 data that this is based on is likely comparatively inaccurate, and the rapid loss of shrub-steppe habitat and native species diversity needs to be emphasized. According to a local Forest Service wildlife biologist, shrub-steppe habitats are the most under-recognized and highly threatened habitat type in the Methow basin.

Page 137

The Methow Conservancy has permanently protected 10.8 miles of riverfront and 687 acres of riparian land with conservation easements. These easement agreements were mostly purchased through the State Salmon Recovery Funding Board. Table 38 is not an accurate depiction of the status of riparian protection in the Methow subbasin.

Page 138

In the second bullet point, one possible yellow-billed cuckoo has been seen in the Methow Valley. This is not an indicator of fragmentation and loss of habitat in the Methow Valley, instead it is a characteristic of cuckoo distribution.

Page 141

Why is a conservation easement considered “low” or “medium” protection? Conservation easements are considerably more enforceable and durable over time than County ordinances or zoning, which is likely to change over the long term.

Page 142

In the livestock grazing section, the plan states that there are about 100 mother cows in the subbasin. The actual number is over 1,000.

Page 144

Under Current Reference Conditions, in the sixth paragraph, the plan states that almost all the cottonwood gallery forests are in public ownership. This is incorrect. In the Methow basin the majority of cottonwood gallery forests are privately owned. See previous comment for page 97.

Page 147

Given the large amount of protected land that the Methow Conservancy holds in conservation easements (a total of 3,774 acres to date), it is important to include this successful voluntary private land conservation work in the Protection Status section.

Page 241

The shrub-steppe hypothesis does not acknowledge the effects of residential development. Development pressure is a major stressor because of the associated roads, clearing, pets, wildlife disturbance and invasive species.

Page 252

Planned developments are currently not permitted in the Methow basin because the DOE has placed a moratorium on community well permits. This should be made clear in the subbasin plan, so that there is greater awareness that this potential tool for creatively managing and clustering development is not currently available.

Pages 260 and 463

The information about the Methow Conservancy is incomplete. Please replace it with the following:

The Methow Conservancy is an independent land trust and conservation organization dedicated to voluntary protection of the natural and scenic resources in the Methow Valley. As of August 2004, the group has over 450 members and holds 40 conservation easements on 3,774 acres of private land. The Methow Conservancy has received four State grants for riparian conservation easement purchases totaling $4.27 million in the past 5 years. The Methow Conservancy has also received a grant for one agricultural conservation easement to date.

In addition to conservation easements, the Methow Conservancy writes stewardship plans for private landowners, and each conservation easement requires a management plan that is updated annually. The Methow Conservancy published the Good Neighbor Handbook in 2001, a 33-page guide to land conservation for new landowners. The Conservancy sends these to all new landowners in the Valley, and has distributed over 3,500 Handbooks to date. The Conservancy also hosts a monthly natural history lecture series and maintains a conservation resource library.

The Methow Conservancy contracts with WDFW to monitor all WDFW conservation easements in the Methow Valley, and has conducted two landscape-level habitat surveys (the Songbird and Shrub-steppe surveys) for prioritization and outreach to landowners.

Page 355

These guidelines are useful, and should be frequently referred to by multiple agencies and stakeholders. This is a format of information (concise, organized) that can be more easily digested and implemented than the entire plan, which is too long for most people to read. This summary would benefit from a second printing in a separate document, so that more people could read it over and discuss the implications of these goals, objectives and strategies.

Thank you again for the chance to comment on this plan. There is a tremendous amount of information in this document, and by including public review this document should continue to become more meaningful as a management tool. The length of the document is a serious detriment to public involvement, and public involvement will be crucial to successful implementation of this plan.

The Methow Conservancy, as a non-governmental leader in local conservation, may be able to help find ways to involve the local community in implementing parts of this plan. We hope that you and the NWPCC will look to us as a resource. Please do not hesitate to contact me if you need any further clarification of the comments above.

Sincerely,

Katharine Bill

Executive Director

Appendix I: Listed and Proposed Endangered and Threatened Species, Critical Habitat, and Candidate Species that may occur in the Counties of Eastern Washington as listed by the U.S. Fish and Wildlife Service

August 10, 2004

FWS Reference:

COMMENTS

Major concerns that should be addressed in your biological assessment of project impacts to listed threatened, endangered, or proposed animal species are:

1. Level of use of the project area by listed species.
2. Effect of the project on listed species' primary food stocks and foraging areas in all areas influenced by the project.
3. Impacts from project construction and implementation (e.g. increased noise levels, increased human activity and/or access, loss or degradation of habitat) which may result in disturbance to listed species and/or their avoidance of the project area.

Major concerns that should be addressed for listed or proposed plant species are:

1. Distribution of taxon in project vicinity.
2. Disturbance (trampling, uprooting, collecting, etc.) of individual plants and loss of habitat.
3. Changes in hydrology where taxon is found.

For information regarding species listed by the National Marine Fisheries Service, please call (206)526-6150 in Seattle, WA, or (503)231-2319 in Portland, OR.

<u>Please note the Species of Concern Lists may not be accurate and are currently being updated.</u>

OKANOGAN COUNTY

LISTED

Endangered

None

Threatened

Bald eagle *(Haliaeetus leucocephalus)*

Bull trout *(Salvelinus confluentus)*

Canada lynx *(Lynx canadensis)*

Gray wolf *(Canis lupus)*

Grizzly bear *(Ursus arctos = U.a. horribilis)*

Northern spotted owl *(Strix occidentalis caurina)*

Ute ladies'-tresses *(Spiranthes diluvialis)*, plant

Designated

Critical habitat for the northern spotted owl

PROPOSED

Critical habitat for bull trout

CANDIDATE

Fisher *(Martes pennanti)*, West Coast distinct population segment

Yellow-billed cuckoo (*Coccyzus americanus*)

Western sage grouse *(Centrocercus urophasianus phaios)*

SPECIES OF CONCERN

Animals

Black tern *(Chlidonias niger)*

California bighorn sheep *(Ovis canadensis californiana)*

California floater (mussel) *(Anodonta californiensis)*

Cascades frog *(Rana cascadae)*

Columbia pebblesnail *(Fluminicola (=Lithoglyphus) columbianus)* [great Columbia River spire snail]

Columbia spotted frog *(Rana luteiventris)* (= *Rana pretiosa*, eastern population)

Columbian sharp-tailed grouse *(Tympanuchus phasianellus columbianus)*

Fringed myotis (bat) *(Myotis thysanodes)*

Harlequin duck *(Histrionicus histrionicus)*

Interior redband trout *(Oncorhynchus mykiss gairdneri)*

Loggerhead shrike *(Lanius ludovicianus)*

Long-eared myotis (bat) *(Myotis evotis)*

Long-legged myotis (bat) *(Myotis volans)*

Northern goshawk *(Accipiter gentilis)*

Northern leopard frog (*Rana pipiens)*

Northern sagebrush lizard *(Sceloporus graciosus graciosus)*

Olive-sided flycatcher *(Contopus borealis)*

Pacific lamprey *(Lampetra tridentata)*

Pale Townsend's (= western) big-eared bat *(Corynorhinus (=Plecotus) townsendii pallescens)*

Small-footed myotis (bat) *(Myotis ciliolabrum)*

Tailed frog *(Ascaphus truei)*

Western burrowing owl *(Athene cunicularia hypugea)*

Western gray squirrel *(Sciurus griseus griseus)*

Westslope cutthroat trout *(Oncorhynchus clarki lewisi)*

Wolverine *(Gulo gulo luscus)*

Yuma myotis (bat) *(Myotis yumanensis)*

SPECIES OF CONCERN

<u>Plants</u>

Crenulate moonwort *(Botrychium crenulatum)*

Stalked moonwort *(Botrychium pedunculosum)*

Triangular-lobed moonwort *(Botrychium ascendens)*

Peculiar moonwort *(Botrychium paradoxum)*

Appendix J: Final Hatchery and Genetics Management Plan for Mid-Columbia Coho Reintroduction Program

HATCHERY AND GENETIC MANAGEMENT PLAN

(HGMP)

Hatchery Program:	Mid-Columbia Coho Reintroduction Feasibility Project
Species or Hatchery Stock:	Coho salmon (*Oncorhynchus kisutch*)
Agency/Operator:	Yakama Nation/Washington Department of Fish and Wildlife
Watershed and Region:	Wenatchee, Methow, Entiat basins
Date Submitted:	December, 2002
Date Last Updated:	December 1999

HATCHERY AND GENETICS MANAGEMENT PLAN

MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY PROJECT

December 2002

Contributors: T. Scribner, K. Murdoch, J. Dunnigan (YN); G. Ferguson (Sea Springs Co. for YN); Chris Pasley, Mark Ahrens, Julie Collins, Marc Jackson, Loren Jensen (USFWS); Robert Becker (ODFW); Nancy Weintraub (BPA); and members of the Technical Work Group

Editor: Judith Woodward

Yakama Nation **Washington Department of Fish & Wildlife** **Bonneville Power Administration**

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LIST OF FIGURES

LIST OF TABLES

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of Program: Mid-Columbia Coho Reintroduction Feasibility Project (Project #9604000)
1.2) Population (or stock) and species: Coho Salmon *(Oncorhynchus kisutch),* currently extirpated in mid-Columbia basins.
1.3) Responsible organizations and individuals:
Co-managers:
Tom Scribner, Yakama Nation (YN)
Address: 4067 NE 23rd Avenue, Portland, OR 97212
Telephone: 503-331-9850
Fax: 503-331-9892
Email: scribner@easystreet.com
Joe Foster, Washington Department of Fish and Wildlife (WDFW)
Address: 1550 Alder Street, NW, Ephrata, WA 98823-9699
Telephone: 509-754-4624
Fax: 509-754-5257
Email: fostejhf@dfw.wa.gov
Other organizations involved, and extent of involvement in the program:
Technical Work Group (TWG) Members:

- Bonneville Power Administration (BPA) (also is primary funding agency)
- Confederated Tribes of the Colville Indian Reservation
- National Marine Fisheries Service (NMFS) (NOAA Fisheries) (also has decision responsibilities for listed species)
- Northwest Power Planning Council (NPPC) (also makes Fish and Wildlife Program decisions under the Northwest Power Act)
- U.S. Fish and Wildlife Service (USFWS) (also has decision responsibilities for listed species)
- U.S. Forest Service (USFS) (also has decision responsibilities for facilities located on USFS land)
- Chelan Public Utility District (also owns and funds operation of some facilities used by the project)

1.4) Funding source: Bonneville Power Administration
Staffing level: 14 FTEs
Annual hatchery program operational costs: $802,000 (does not include planning/design, construction, or monitoring/evaluation)
Entire project budget: $2,200,000
1.5) Location(s) of hatchery and associated facilities:
Location of program: Feasibility phase (what this HGMP covers—see section 1.7.2): Wenatchee, Methow, and Entiat river basins in Washington State. See Figure 1.
Facilities that would be used (see figures 1-3):
This project is a feasibility study (see section 1.7) As such, it must rely on existing or temporary facilities. Most existing facilities are programmed for other species as their first priority. As a

result, when needs change in the priority program, the coho feasibility project must find another site. Since the coho program's inception in 1996, sites for most activities have changed, often several times. Until feasibility has been demonstrated and a long-term program is approved (see section 1.11.2), sites likely will continue to change. Listed below are facilities approved or formally proposed as of spring 2002.

1. Broodstock collection: Tumwater, Dryden, or Wells dams; Winthrop National Fish Hatchery (NFH) or Leavenworth NFH (fish ladder or Dam 5); mainstem dams above Priest Rapids; or Prosser Dam on the Yakima River.

2. Adult holding/spawning: Winthrop NFH will be used for adults returning to the Methow basin. In the Wenatchee basin, the Chiwawa Ponds were used to hold adult coho in 2000 and 2001; the Entiat NFH will be used to hold adult coho in 2002 and beyond.

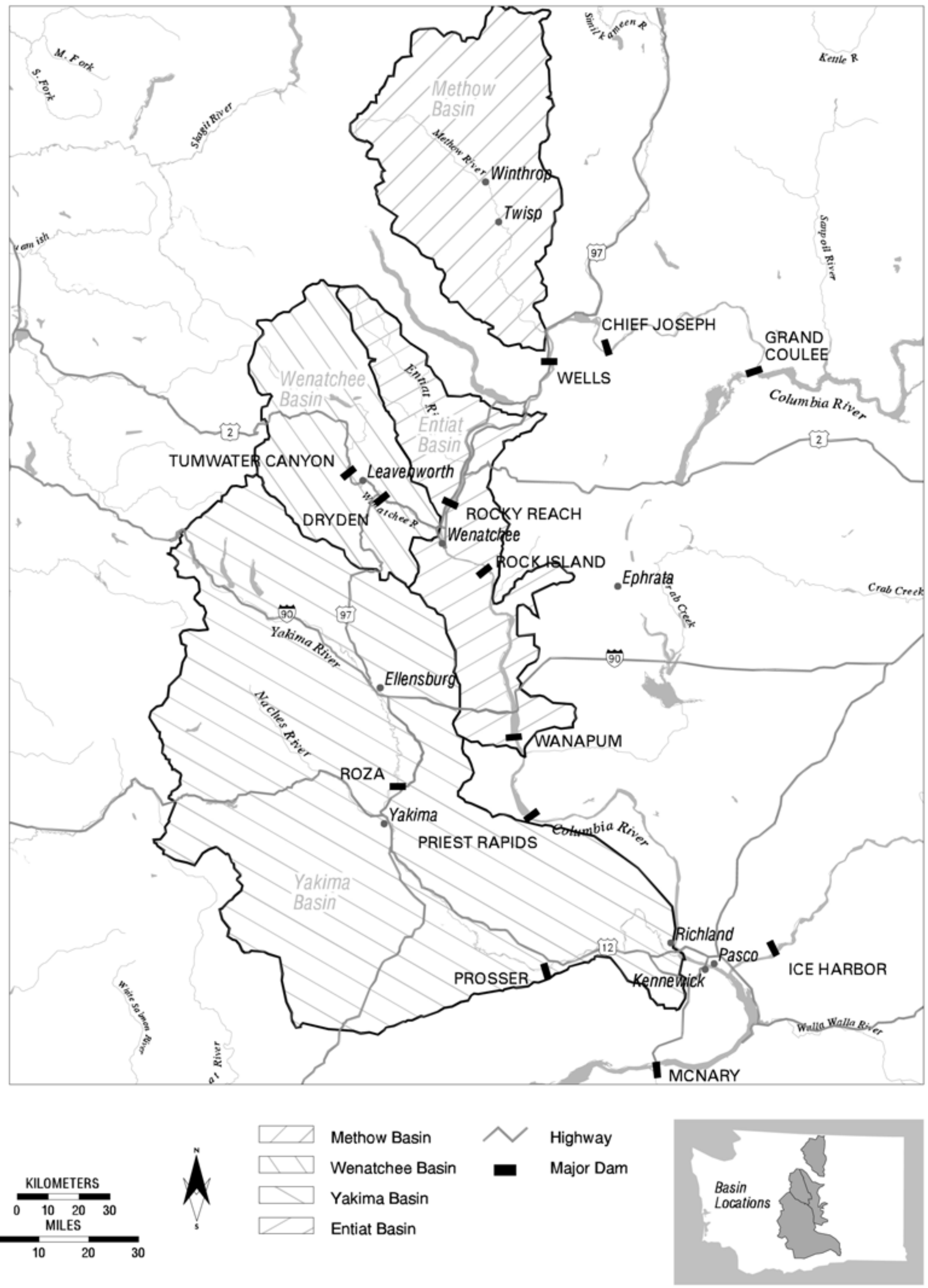
3. **Incubation/Early Rearing:**

Incubation sites include the following locations in the mid-Columbia region: Peshastin incubation facility, Entiat NFH, Leavenworth NFH, and Winthrop NFH. In the lower Columbia, Cascade Hatchery (ODFW) and Willard NFH are used.

Rearing sites include the following locations: Cascade Hatchery, Willard NFH, and Winthrop NFH. In-basin smolt production could be proposed in the future at an as-yet undetermined location. Options currently identified include Chiwawa, White River, Two Rivers (Little Wenatchee), Leavenworth NFH, Entiat NFH, and Dryden Dam, but others could be identified in the future.

4. Acclimation/release: Figures 2 and 3 show potential locations in the Wenatchee and Methow basins. Some sites shown on the maps, and others that may be proposed in the future, would be reviewed by the TWG and various regulatory agencies, and would be subject to environmental analysis of site-specific impacts. The project might not use every site identified. While specific sites in the Entiat basin have not yet been proposed or identified for this phase of the program, potential streams have (the Entiat and Mad rivers). Section 10 provides further details on sites in the Wenatchee and Methow basins.

FIGURE 1 MID - COLUMBIA COHO SALMON STUDY - LOCATION MAP



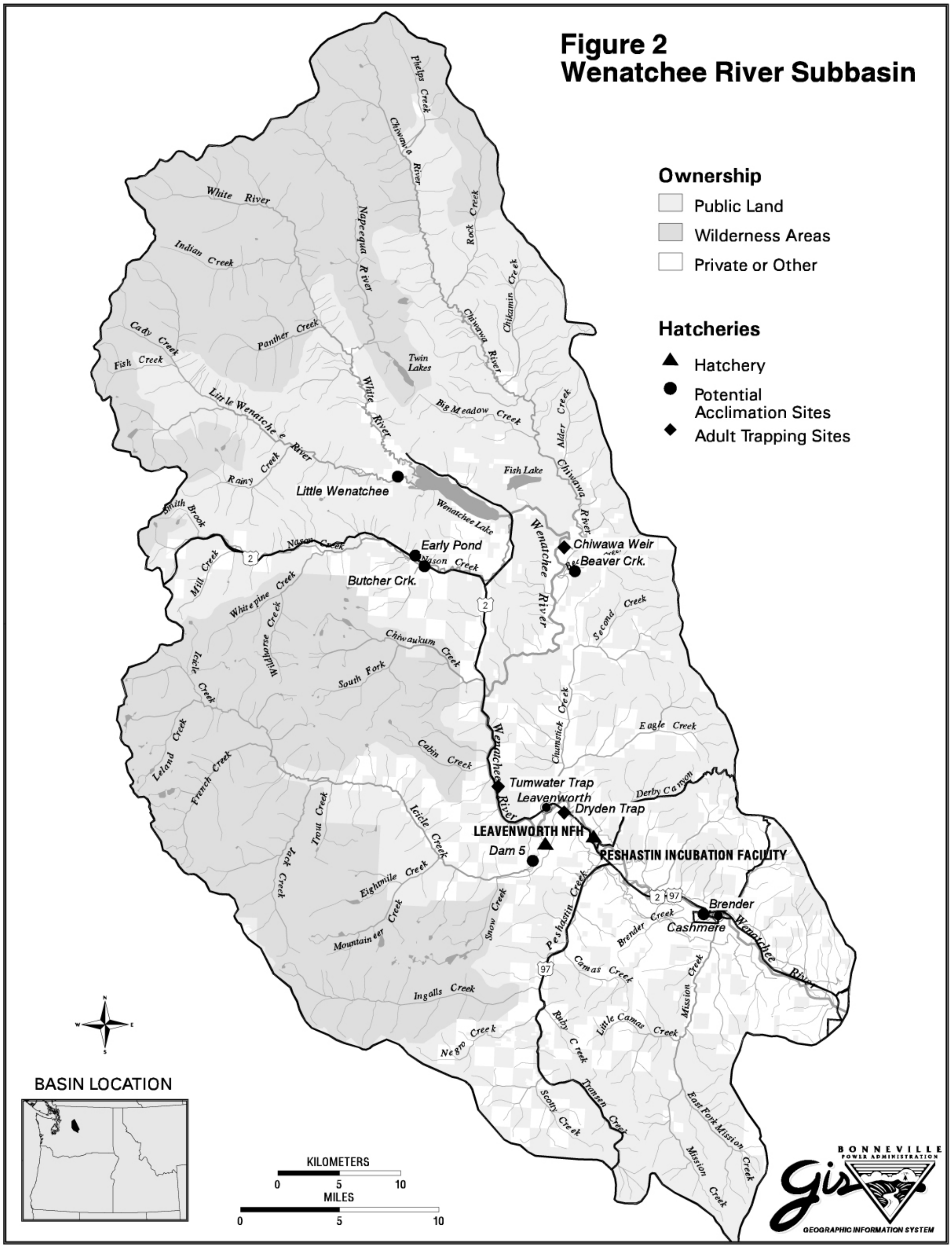


Figure 2
Wenatchee River Subbasin
Ownership
Public Land
Wilderness Areas
Private or Other
Hatcheries
Hatchery
Potential Acclimation Sites
Adult Trapping Sites
Little Wenatchee
Early Pond
Butcher Crk.
Chiwawa Weir
Beaver Crk.
Tumwater Trap
Leavenworth
Dryden Trap
LEAVENWORTH NFH
Dam 5
PESHASTIN INCUBATION FACILITY
Brender
Cashmere
BASIN LOCATION
KILOMETERS
MILES
BONNEVILLE POWER ADMINISTRATION
GEOGRAPHIC INFORMATION SYSTEM

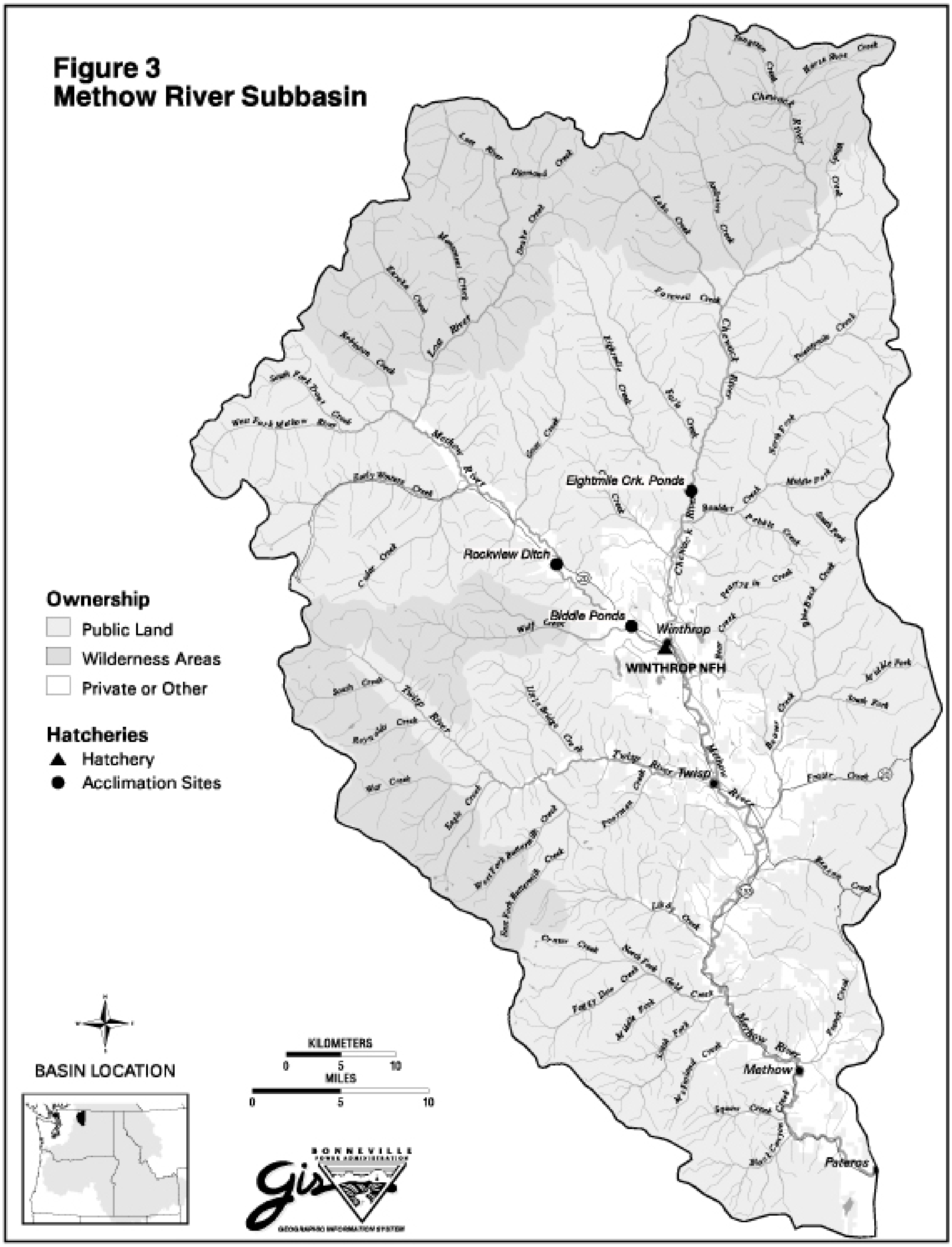


Figure 3
Methow River Subbasin
Ownership
Public Land
Wilderness Areas
Private or Other
Hatcheries
Hatchery
Acclimation Sites
Eightmile Crk. Ponds
Rockview Ditch
Biddle Ponds
Winthrop
WINTHROP NFH
Twisp
Mathow
Pateros
BASIN LOCATION
KILOMETERS
0 5 10
MILES
0 5 10

5. Other: Monitoring. Locations of various types of monitoring activities are identified briefly below. Section 11 describes the activities in detail.

Wenatchee basin:

- Juvenile out-migration and predation would be monitored using rotary traps located near the mouth of Nason Creek (predation on spring chinook) and at the Lake Wenatchee outfall (predation on sockeye). Weirs could be used on smaller tributaries such as Chumstick, Brender, and Beaver creeks. Alternatively, beach seining, tow-netting, or fyke nets could also be used to collect coho to analyze predation on sockeye.
- Juvenile distribution and abundance would be monitored using systematic snorkel surveys upstream, and especially downstream, of all release sites.
- Juvenile coho in Lake Wenatchee may be radio-tagged to determine their potential overlap with sockeye.
- Surveys using hydro-acoustic, beach seining, trawling, and/or purse seining gear would collect information on age-specific sockeye rearing distribution in Lake Wenatchee.
- If necessary, electro-fishing and/or snorkeling would be done in the following places: 1) for spring chinook and bull trout just below the release site near Lake Wenatchee (Two Rivers); and
  2) for spring chinook, steelhead, and naturally spawned coho in Nason Creek.
- PIT tag detection of juvenile coho mainstem survival would be done at existing facilities at Rock Island, McNary, John Day, The Dalles, and Bonneville dams.
- Coded wire tags (CWTs) would be collected from spawned broodstock and from carcasses found during spawning surveys, to estimate smolt-to-adult survival by release group.
- Adults will be monitored at Priest Rapids and Rock Island dams on the Columbia River, at Tumwater and Dryden dams on the Wenatchee, and at the adult broodstock weir on the Chiwawa River. Remote underwater video camera monitoring systems could be installed at some sites.
- Foot/boat redd surveys will be conducted to determine spatial distribution of returning coho adults in potential natural spawning areas including Nason Creek, Beaver Creek, Chumstick Creek, Brender Creek, and the Wenatchee and Little Wenatchee rivers. On smaller tributaries such as Chumstick, Brender, and Beaver creeks, weirs could be used to monitor adult returns.
- Radio telemetry and video monitoring will be used to determine distribution of coho adults returning to the Wenatchee River basin. They could be trapped and radio-tagged at Priest Rapids, Dryden, and/or Tumwater dams.

Methow basin:

- PIT tag detection would be done at the same locations as for Wenatchee fish, with the addition of Rocky Reach Dam.
- Adult monitoring would be done at Wells and Rocky Reach dams to determine conversion rates between dams.
- Juvenile distribution/abundance monitoring would be done using systematic snorkel surveys at all release sites.
- Foot/boat redd surveys along with radio-telemetry techniques may be used to determine the spawning distribution of coho returning to the Methow River basin.

Entiat basin: Locations not proposed at this time.

1.6) Type of program: Integrated Recovery

1.7) Purpose (Goal) of program:

The Mid-Columbia Coho Reintroduction Program encompasses a vision of an optimistic future that may take many years to achieve, as well as short-term goals that will provide information to enable decision-makers to assess whether the vision is achievable. This section has been divided into two parts to describe both long- and short-term (feasibility phase) goals. However, **the remainder of this plan focuses on tasks and impacts related to the short-term goals**. The long-term vision is provided to help reviewers understand the plan's overall context.

1.7.1) Long-term Vision

The long-term vision for this program is to reestablish naturally reproducing coho salmon populations in mid-Columbia river basins, with numbers at or near carrying capacity, that provide opportunities for significant harvest for Tribal and non-Tribal fishers.

The Yakama Nation believes that achieving this vision will be possible only with continued regional efforts to improve habitat for all anadromous species. Until significant improvements are made in conditions such as mainstem passage or agricultural water use, the mid-Columbia coho program, like other salmon programs in the Columbia basin, probably will need to supplement a locally adapted population for many years.

The vision is closely tied to the vision for reintroduction of coho to the Yakima basin and to other areas from which the species has been eliminated. Mid-Columbia coho reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document (Tribal Restoration Plan) by the four Columbia River Treaty Tribes, and has been affirmed as a priority by the Northwest Power Planning Council (see section 3.2).

Mid-Columbia basins historically occupied by coho include the Wenatchee, Methow, Entiat, and Okanogan basins. Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 - 7,000
- Methow—23,000 - 31,000
- Entiat—9,000-13,000
- Okanogan—Numbers were not identified, although their presence was documented

The ideal would be to restore coho populations in these basins to their historical levels. Due to varying degrees of habitat degradation in each of these basins, historical numbers are unlikely ever to be achieved, but remain a goal towards which to strive.

1.7.2) Goals of Feasibility Phase

This phase, which is expected to last at least through 2004, has two primary goals:

- to continue existing studies and to initiate new ones (adapting to changing needs, new information, and concerns of project participants) to determine whether a broodstock can be developed from Lower Columbia River coho stocks, whose progeny can survive in increasing numbers to return as adults to the mid-Columbia region; and
- to initiate natural reproduction in areas of low risk to sensitive species, and in other select areas to study the risks and interactions with sensitive species.

Studies done in this phase will inform future decisions about whether the long-term vision described in 1.7.1 can be achieved.

1.8) Justification for the program

The Mid-Columbia Coho Program is a phased approach to a "Restoration" program as defined in Part II.C of the NPPC's *Artificial Production Review* (NPPC 1999). This section states: "An extreme case of a restoration production program is where the natural population has been eliminated, and fish are reintroduced by artificial production when the problem causing the extirpation is removed. A restoration program is a temporary measure that will be withdrawn once the natural population is rebuilt or a determination is made that restoration is not possible." (NPPC 1999, p. 14)

Because there are listed species in this basin that, unlike coho, have not been extirpated, and because barriers to natural production have been reduced (not eliminated), this project is taking a phased approach to restoration by testing the feasibility of developing a naturally reproducing broodstock as well as testing the risks to other species, before implementing a full-scale restoration program.

1.9) Program "Performance Standards"

Specific objective(s) of program (at least through 2004):

Experience with the project so far has shown that trying to define specific numeric goals for such an experimental project is unrealistic. Too little is known at this stage about the possibilities and risks of an attempt to re-establish a new population of formerly extirpated coho. The project has grappled annually with the study results to determine the significance of survival, interactions, and overall program feasibility and has found that annual agreements with the TWG on release numbers and other program specifics are most effective at meeting feasibility study needs. The list below identifies the feasibility study's objectives.

- Determine whether hatchery adults from lower Columbia River broodstock return in increasing numbers to the Wenatchee and Methow basins so that their progeny may be expected to reach replacement, thus significantly limiting the infusion of the Lower River hatchery stock, with the long-term goal of eliminating use of the Lower River stock altogether.
- Continue to develop a locally adapted broodstock in the Methow and Wenatchee basins.
- Continue coho smolt releases in areas where coho adults will be allowed to return to spawn naturally. These areas currently are expected to be in the Wenatchee basin in Nason, Beaver, Chumstick, and Brender creeks; and in the lower Wenatchee and Little Wenatchee rivers.
- Evaluate rearing and release procedures within the constraints of hatchery operations that maximize adult survival and the creation of naturally spawning populations.

- Study interactions among coho and listed and sensitive species, particularly spring chinook and sockeye salmon, steelhead, and bull trout. Such studies have required, and could continue to require, coho releases in habitat of sensitive species.
- Minimize potential negative interactions among coho and listed and sensitive species while also conducting necessary interaction studies.
- Annually evaluate project performance with TWG and resource managers and expand or adapt studies as data indicate are necessary or appropriate.
- Monitor hatcheries that raise program coho for compliance with IHOT guidelines.

1.10) List of Performance Indicators designated by "benefits" and "risks"

Monitoring studies of these performance indicators are described in detail in section 11.

1.10.1) Benefits to coho

- Trends in survival of hatchery coho as measured by PIT tags (smolt-to-smolt), and by counts at dams/facilities and CWTs (smolt-to-adult).
- Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry, foot/boat redd surveys, and weirs.
- Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts, redd capping, and smolt production estimates.
  - Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and physical and behavioral traits such as fecundity, body morphometry, maturation timing, and straying and homing to acclimation sites.

Risks to other listed species

- Predation on other species by program fish as indicated by stomach content analyses.
- Superimposition of spring chinook redds by spawning coho as measured by superimposition studies.
- Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.
- Other potential ecological interactions as indicated by residualism studies or by F2 evaluations.

1.11) Expected size of program

1.11.1) Program size for the feasibility stage (this plan)

Table 1 shows smolt release numbers, broodstock requirements, and production so far. Total release numbers in the Wenatchee and Methow basins are defined under agreements as part of *U.S. v. Oregon*. Feasibility studies will identify ecological risks, broodstock requirements, and survival of out-of-basin stocks. Current plans are to release only smolts. In the future, however, if the Technical Work Group determines that study objectives would be better served—for example, in interaction studies—another life stage could be used. Total numbers released in each basin are not expected to change for the feasibility phase, although release sites in each basin could change. Release numbers at each site are evaluated and discussed among TWG members annually as study needs require and as facility availability changes.

1.11.2) Program size in the long term

Before implementation of the long-term vision described in section 1.7.1 can begin, a variety of decision processes must be completed, using the results of the feasibility studies. These processes most likely would include, at a minimum, a National Environmental Policy Act (NEPA) document if federal funding is involved, and a Step Two and Three review by the NPPC. Then, if the decision-making entities agree to continue the project, it is expected that release numbers would be calculated taking into account carrying capacity (see section 3.5.1), survival estimates of hatchery produced and naturally produced coho, harvest goals, and any reductions necessary to limit risks to other species. It is possible, however, that future coho releases would be less than the number required to fully seed the habitat, in order to limit interactions with listed species.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Program performance is shown in Table 1.

1.13) Date program started: Research into feasibility began in 1996.

1.14) Expected duration of program:

Program staff expect that results from feasibility studies could be sufficient by 2004 to allow managers to recommend options for the long term. While it is likely that some form of long-term program will be recommended, a number of options will need to be developed and considered in a variety of decision processes that could take several years to complete. Coho releases are unlikely to be suspended while these decision processes continue, and some feasibility studies are expected to continue beyond 2004. Such studies could contribute, for example, to NEPA or ESA analyses that would help resource managers determine specifics of a long-term program. Full-scale implementation could begin <u>formally</u> only after the following three conditions are met: a) initial feasibility and evaluation of the most important critical uncertainties related to coho re-introduction have been determined, b) the project co-managers propose such a program, and c) an Environmental Impact Statement (EIS), the NPPC Step Two and Three reviews, and other decision processes are completed, currently expected in approximately 2008.

Table 80. Summary of Coho Releases and Broodstock Development

Table 1a. Methow Basin Coho Program

Smolt Releases

Smolt Release Year	Winthrop	Total
1998	341,000	341,000
1999	0	0
2000	200,000	200,000
2001	180,000	180,000
2002	200,000	200,000
2003	250,000	250,000
2004	250,000	250,000
2005	250,000	250,000

All progeny derived from adults returning to the Methow will be released into the Methow basin unless the Wenatchee basin is short of local brood fish. In that case, Winthrop production would be released in the Wenatchee basin. See section 10.4 for detailed guidelines on source of releases.

Winthrop Adult Returns					Smolt Production from Methow Returns				
Adult Return Year	Adult Re-turns***	Prespawn Mortality	Broodstock	Natural Spawn-ing****	Females	Spawning Year	Eggs	Smolts	Outplant Year
1999	0*	0	0	0	0	1999	204,000	145,000	2001
2000	0*	0	0	0	0	2000	0	0	2002
2001	536*	54	334	202	93	2001	239,000	165,000	2003
2002**	209	21	130	58	0	2002	175,000	124,000	2004
2003-2005	TBD	TBD	TBD	TBD	TBD	2003	TBD	TBD	2005

* Actual observed numbers
** Adjusted for relatively poor downstream survival rates (9.9%) in 2001
*** Smolt-adult survival for 2001 (only year so far with returns): 0.17 – 0.27% (TWG meeting notes, 1/29/02)
**** This natural spawning is predicted as a result of capture efficiency at Wells and straying

Table 1b. Wenatchee Basin Coho Program

Smolt Releases

Smolt Release Year	**Nason Cr. (TBD)**	**Early Pond**	**Butcher Cr.**	**Beaver Cr.**	**Little Wenat-chee**	**Chumstick Cr.**	**Brender Cr.**	**Leaven -worth**	**Total**
1999			75,000					450,000	525,000
2000			75,000					925,000	1,000,000
2001			145,000					855,000	1,000,000
2002		23,500	150,000	75,000				751,500	1,000,000
2003	155,900*	0	150,100	75,000	100,800		37,500	453,100	1,000,000
2004	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	1,000,000
2005	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	1,000,000

Wenatchee Adult Returns					**Smolt Production from Adult Returns**				
Adult Re-turn Year	Adult Re-turns**	Pres-pawn Mort.	Brood-stock	Natural Spawn-ing	Females	Spawning Year	Eggs	Smolts	Outplant Year
2000	1,113***	111	919	83	407	2000	1,100,000	650,000	2002
2001	1,773****	177	1,219	377	499	2001	1,3000,000	835,000	2003
2002	1,773	177	1,350	246	608	2002	1,640,000	1,000,000	2004
2003	TBD	TBD	TBD	TBD	TBD	2003	TBD	TBD	2005
2004	TBD	TBD	TBD	TBD	TBD	2004	TBD	TBD	2006
2005	TBD	TBD	TBD	TBD	TBD	2005	TBD	TBD	2007

Source of Wenatchee Outplants

Smolt Release Year	Lower River	Wenatchee Production	Methow Production	Total
1999	1,000,000	0	0	1,000,000
2000	1,000,000	0	0	1,000,000
2001	856,000	0	144,000	1,000,000
2002	400,000	600,000	0	1,000,000
2003	0*****	837,000	163,000	1,000,000
2004	0*****	1,000,000	0	1,000,000
2005	0*****	1,000,000	0	1,000,000

* Includes fry plants and several sites in Nason Creek watershed
** Smolt-adult survival in 2001: 0.16%
*** Actual observed numbers
**** Expanded for the days we weren't trapping
***** Only if localized stock production is sufficient to meet total release numbers. See section 10.4 for guidelines.

1.15) Watersheds targeted by the program:

Short-term (this plan)

Wenatchee: Nason Creek, Wenatchee River, Little Wenatchee River, Icicle Creek, Chumstick Creek, Brender Creek, Beaver Creek

Methow: Methow River. In the first few years of this project, we released fish from sites on the Chewuch River (Eightmile and Fulton Ditch) and Wolf Creek (Biddle Pond).

Longer-term vision

Ideally, coho would be re-established into all suitable habitat in mid-Columbia basins and tributaries. Likely areas include:

Wenatchee: All streams targeted in the feasibility phase, plus White River, Chiwawa River, Peshastin Creek
Methow: In addition to Methow River, Chewuch River, Wolf Creek, Twisp River, Eight Mile Creek
Entiat: Entiat River, Mad River
Okanogan: Okanogan River and tributaries

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

When BPA evaluated the proposed feasibility studies in its Environmental Assessment (EA) (USDOE BPA 1999b), it considered three alternatives to the program proposed by the Yakama Nation (the "Tribal Alternative"). The three alternatives to the proposal were: "Phased Study Alternative," which would have funded research in the Wenatchee basin only; "Hatchery Releases Alternative," in which the only question studied would have been whether adult coho could return in sufficient numbers to replace themselves, with no predation studies, and no acclimation or spawning in natural habitat; and "No Action Alternative," which anticipated continued releases of coho in the mid-Columbia region under *U.S. v. Oregon* but without BPA funding and with little or no research. The "Tribal Alternative" was selected as the proposed action because it best met the needs and purposes outlined in the EA (USDOE BPA 1999b, sections 1.1 and 1.2) and was found to have no significant environmental impacts. The December 1999 HGMP outlined the Tribal Alternative in as much detail as was possible at the time. Since then, the program has been modified in certain details, which are presented in this update, but the fundamental goals have not changed.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

2.1) List all ESA permits or authorizations in hand for the hatchery program.

- NMFS Biological Opinion, April 27, 1999 specifies terms and conditions for project studies for one year. This Opinion required preparation of a long-term management plan, which resulted in the 1999 HGMP (NMFS 1999(b)).
- USFWS Biological Opinion 01-F-E0231, May 18, 2001 specifies terms and conditions to minimize incidental take of bull trout, including requirements for electro-fishing (USDI, FWS 2001).
- WDFW Section 10 Permit #1094. Coho broodstock collection is done in conjunction with WDFW steelhead broodstock collection under this permit. Under Modification 2 of this permit, radio tagging coho adults at Priest Rapids Dam is done in conjunction with WDFW adult steelhead radio tagging (NMFS 1998(b)).
- WDFW Section 10 Permit #1203. Coho smolt trapping for predation studies in the Wenatchee basin is done in conjunction with WDFW juvenile salmonid research under this permit.

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) <u>Description of ESA-listed salmonid population(s) affected by the program.</u>

- Identify the ESA-listed population(s) that will be <u>directly</u> affected by the program.
(Includes listed fish used in supplementation programs or other programs that involve integration of a listed natural population.)

No listed species will be directly affected by the program. The program's target species is coho salmon, which has been extirpated from mid-Columbia basins and is not listed under ESA.

- Identify the ESA-listed population(s) that may be <u>incidentally</u> affected by the program.

(Includes ESA-listed fish in target hatchery fish release, adult return, and broodstock collection areas).

Information in this section includes status of species and potential impacts in the Entiat basin, as well as in the Wenatchee and Methow basins, although the project does not propose coho releases in the Entiat at this time. The information is offered to give reviewers a context for the long-term plans and to show similarities and differences among the basins in this region. As well, the information could be useful should adaptive management reviews suggest that studies or other work be undertaken in a basin other than those currently proposed.

Table 81. ESA-Listed Fish Species in the Wenatchee and Methow Basins

Common Name	Endangered Species Act	Washington Species Criteria
Spring chinook salmon (Upper Columbia River)	Endangered	Vulnerable/Species of Importance
Steelhead trout (Upper Columbia River)	Endangered	Species of Importance
Bull trout	Threatened	Vulnerable/Species of Importance

Table 82 lists spawning areas for listed species that are within 8 km (5 mi) of potential coho acclimation sites in the Wenatchee and Methow basins. Although not ESA-listed, sockeye and summer chinook are included in the tables and some of the analyses. Lake Wenatchee sockeye are one of only two sockeye populations remaining in the Columbia River system, and summer chinook are important because, though presently healthy, only a few historically numerous populations still exist in the Columbia River basin. Please see figures 2 and 3 for approved or proposed acclimation site locations as of spring 2002. Other known spawning areas in the two basins that are more than 8 km from acclimation sites are listed by species and stream below the table. Specific acclimation/release sites have not yet been proposed for the Entiat basin.

Table 82. Spawning Areas for Sensitive Anadromous Species Near Potential Coho Acclimation/Release Sites*

Basin/Water Body	Spring chinook	Summer chinook	Sockeye	Steelhead	Bull trout
Wenatchee					
Nason Cr.	**X**			**X**	**U**
Little Wenatchee R.	**X**		**X**	**X**	**U**
Wenatchee R. mainstem	**X**	**X**		**X**	
White R.	**X**		**X**	**X**	**X**
Chiwawa R.	**X**			**X**	**X**
Icicle Cr.				**X**	**U**
Beaver Cr.				**X**	
Brender Cr.				**X**	
Chumstick Cr.				**X**	
Methow					
Upper Methow R.	**X**			**X**	**U**
Methow R. mainstem	**X**			**X**	
Twisp R.	**X**			**X**	**U**
Chewuch R.	**X**			**X**	**U**
Wolf Cr.	**X**			**X**	**U**
Goat Cr.				**U**	

*Legend: X = spawning area overlaps with coho acclimation site
U = spawning area is no further than 8 km (5 mi) upstream of acclimation site

The following lists known spawning areas for listed species in addition to the streams listed in Table 3; they are all more than 8 km (5 mi) from coho acclimation and release sites evaluated for this project.

- **Spring chinook**: Methow basin—Lost River
- **Steelhead:** Wenatchee basin—Mission Creek, Peshastin Creek
  Methow basin—Gold Creek, Libby Creek, Beaver Creek, Early Winters Creek, Lost River

- **Bull trout:** Wenatchee basin—Ingalls Creek, Chiwaukum Creek, Mill Creek (tributary to Nason), White River, Panther Creek (tributary to White R.), Chickamin Creek, Rock Creek, Phelps Creek, Icicle Creek (resident population)

Methow basin—Foggy Dew Creek, Crater Creek, Buttermilk Creek, Reynolds Creek, Blue Buck Creek, Lake Creek, Goat Creek, Early Winters Creek, Cedar Creek, West Fork Methow River, Monument Creek, Lost River

Although potential acclimation and release sites have not been proposed in the Entiat basin, streams most likely to be targeted initially for coho reintroduction (should the long-term vision be implemented) would be the Entiat and Mad rivers. These streams are known to contain the following listed species (USDA FS 1996):

- **Spring chinook:** Lower Entiat, Lower-Mid Entiat (stronghold*), Upper-Mid Entiat, Lower and Middle Mad rivers.
- **Steelhead:** All of the Entiat except Upper; and Middle Mad rivers.
- **Bull trout:** Lower Entiat, Lower-Mid Entiat, Upper-Mid Entiat (stronghold*), all Mad River (stronghold).
- **Late-run chinook:** Lower Entiat, Lower-Mid Entiat (stronghold*), Upper-Mid Entiat.

* (as indicated in USDA FS 1996)

Table 4 shows the temporal overlap of life-history stages for species in these basins. Adult steelhead migrate at similar times to coho. They, like coho, are collected for broodstock at Dryden and Tumwater dams in the Wenatchee basin and at Wells Dam on the mainstem Columbia River. They may migrate up Icicle Creek to Leavenworth NFH, although none have been observed at the trap. Adult bull trout also could be in these broodstock collection areas. Spring chinook would not be affected at trapping sites because they pass these areas in May and June.

Table 83. Life History Timing of Methow and Wenatchee Salmonids

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook (Spring)	Adult Immigration					■	■	■	■				
	Adult Holding						■	■	■				
	Spawning								■	■			
	Incubation	■							■	■	■	■	■
	Emergence		■	■									
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile Emigration				■	■	■						
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Chinook (Summer)	Adult Immigration							■	■	■			
	Adult Holding								■	■	■		
	Spawning									■	■	■	
	Incubation									■	■	■	■
	Emergence	■	■	■	■								
	Rearing	■	■	■									
	Juvenile Emigration				■	■	■	■	■	■	■		
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Chinook (Fall)	Adult Immigration										■	■	
	Adult Holding										■	■	
	Spawning											■	
	Incubation	■	■									■	■
	Emergence		■	■									
	Rearing			■	■	■	■						

	Juvenile Emigration						■						
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Sockeye	Adult Immigration							■	■	■	■		
	Adult Holding								■	■	■		
	Spawning									■	■	■	
	Incubation	■	■	■	■					■	■	■	■
	Emergence				■	■							
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile Emigration				■	■							
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Coho	Adult Immigration									■	■	■	■
	Adult Holding									■	■	■	■
	Spawning										■	■	■
	Incubation	■	■	■								■	■
	Emergence		■	■	■								
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile Emigration				■	■	■						
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Steelhead (Summer)	Adult Immigration	■	■	■	■	■			■	■	■	■	■
	Adult Holding	■	■	■					■	■	■	■	■
	Spawning			■	■	■	■						
	Incubation						■	■	■				
	Emergence								■	■			
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■

	Juvenile Emigration												
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Bull Trout	Spawning												
	Incubation												
	Emergence												
	Rearing												

2.2.2) <u>Status of ESA-listed salmonid population(s) affected by the program.</u>

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds (*see definitions in "Attachment 1").*

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

The following is a brief review of listed fish status in each basin, based on material already published, as noted. WDFW is developing HGMPs for all listed fish in mid-Columbia basins under the jurisdiction of the Mid-Columbia Habitat Conservation Plan (part of the re-licensing process for the mid-Columbia public utility districts). When completed, those documents will have the most up-to-date status of and plans for the listed fish.

UCR Spring Chinook

In general, recent total abundance of Upper Columbia River spring chinook has been quite low (NMFS 1999(a)). Spring chinook run estimates 1986 – 1998 for the Wenatchee, Methow, and Entiat basins are shown in tables 5 – 7 below.

Table 5. Run Estimates, Wenatchee River Spring Chinook

Year	Rock Island Dam Count	Rocky Reach Dam Count	Wenatchee Redd Counts
1986	21,001	4,138	441
1987	18,883	3,480	545

1988	16,212	4,823	491
1989	10,690	3,168	493
1990	7,721	1,909	446
1991	5,781	1,323	251
1992	15,634	2,714	491
1993	19,943	4,128	536
1994	2,041	349	125
1995	887	256	23
1996	2,150	569	72
1997	6,205	1,866	175
1998	3,324	842	78

Source: NMFS 1999(a)

Table 6. Run Estimates, Methow River Spring Chinook

Year	Wells Dam Count	Methow River System Redd Counts
1986	2,896	186
1987	2,272	673
1988	3,024	733
1989	1,633	517
1990	967	482

1991	687	250
1992	1,542	738
1993	2,601	647
1994	258	133
1995	82	15
1996	387	0*
1997	971	145
1998	406	0*

*All fish collected at Wells Dam.

Source: NMFS 1999(a)

Table 7. Run Estimates, Entiat River Spring Chinook

Year	Rocky Reach Dam Count	Wells Dam Count	Wenatchee Redd Counts
1986	4,138	2,896	105
1987	3,480	2,272	64
1988	4,823	3,024	67
1989	3,168	1,633	37
1990	1,909	967	83
1991	1,323	687	32
1992	2,714	1,542	42
1993	4,128	2,601	100

1994	349	258	24
1995	256	82	1
1996	569	387	8
1997	1,866	971	20
1998	842	406	15

Source: NMFS 1999(a)

UCR Steelhead

The following information on UCR steelhead is taken entirely from NMFS 1999(a).

The life history of this ESU is similar to other inland steelhead ESUs. However, smolt ages are some of the oldest on the west coast (up to 7 years old), likely as a result of the ubiquitous cold water temperatures (Mullan et al. 1992). Adults of this ESU spawn later than most downstream populations. Adults of Wenatchee and Entiat River populations return after one year in the ocean, those from the Methow River primarily after two years of ocean life. Adults remain in fresh water up to a year before spawning.

The entire ESU has been heavily hatchery-influenced, with a thorough mixing of stocks as a result of the Grand Coulee Fish Maintenance Project beginning in the 1940s (Fish and Hanavan 1948; Mullan et al. 1992). Until recently, hatchery releases composed of a composite of basin stocks continued. The Wells Hatchery stock is included in the listing. Currently, efforts are underway to develop hatchery programs from more locally adapted stocks, using naturally spawning fish.

Most natural production occurs in the Wenatchee River watershed and in the Methow/Okanogan river systems, with a small run returning to the Entiat River. A majority of fish spawning in natural production areas are of hatchery origin. Indications are that natural populations in the Wenatchee, Methow/Okanogan, and Entiat rivers are not currently self-sustaining.

In recent years it was determined that steelhead habitat in the upper Columbia region was over-seeded, primarily due to the presence of hatchery fish; on the average, hatchery seeding was nearly 110% of the level of production the habitat could support. In addition, it was estimated that the proportion of hatchery-origin steelhead in spawning escapements was 65% in the Wenatchee River and 81% in the Okanogan, and Methow rivers (Busby et al. 1996), a level much higher than that NMFS believes is acceptable to minimize adverse genetic effects to natural populations. This is likely a partial explanation for the low natural replacement rates estimated for the area; populations in the Wenatchee River have a recent Natural Cohort Replacement Rate of 0.3, while those in the Entiat River are no greater that 0.25 (Bugert 1997).

Table 8 shows steelhead counts at mid-Columbia dams. Table 9 shows seeding levels relative to capacity for the Wenatchee, Methow, and Entiat basins.

Table 8. Steelhead Counts at Mid-Columbia Dams

Year	Priest Rapids Dam		Rock Island Dam Count	Rocky Reach Dam Count	Wells Dam Count
	Count	Wild Origin			
1986	22,382	2,342	22,867	15,193	13,234
1987	14,265	4,058	12,706	7,172	5,195
1988	10,208	2,670	9,358	5,678	4,415
1989	10,667	2,685	9,351	6.119	4,608
1990	7,830	1,585	6,936	5,014	3,819
1991	14,027	2,799	11,018	7,741	7,715
1992	14,208	1,618	12,398	7,457	7,120
1993	5,455	890	4,591	2,815	2,400
1994	6,707	855	5,618	2,823	2,138
1995	4,373	993	4,070	1,719	946
1996	8,376	843	7,305	5,774	4,127
1997	8,948	785	7,726	7,726	4,107
1998	5,790	919	4,810	4,265	2,482

Source: NMFS 1999(a)

Table 9. Estimated Steelhead Smolt Production Capacities

Watershed	Smolt Production Capacity	Recent Ten-Year Seeding Levels	Seeding Levels' Percent of Production Capacity
Wenatchee	62,167	73,371	118.2%
Methow	58,552	65,586	112.0%
Entiat	12,739	10,728	84.2%
Total	**133,458**	**149,685**	

Source: NMFS 1999(a)

Bull Trout

The following information is taken entirely from USDI FWS 2001.

The mid-Columbia River region includes watersheds of four major tributaries of the Columbia River in Washington. USFWS identified 16 bull trout subpopulations in the four watersheds (number of subpopulations in each watershed)—Yakima River (8), Wenatchee River (3), Methow River (4), Entiat River (1) (USDI FWS 2001).

Bull trout in this region are most abundant in Rimrock Lake of the Yakima River basin and Lake Wenatchee of the Wenatchee River basin. Both subpopulations are considered "strong" and increasing or stable. The remaining 14 subpopulations are relatively low in abundance, exhibit "depressed" or unknown trends, and primarily have a single life-history form. USFWS considers 10 of the 16 subpopulations at risk of extirpation because of naturally occurring events due to isolation, single life-history form and spawning area, and low abundance (USDI FWS 1998).

Wenatchee River basin. USFWS identified three bull trout subpopulations in the Wenatchee River basin: 1) Lake Wenatchee, 2) Icicle Creek, and 3) Ingalls Creek. In 1995, the Chelan County Public Utility District video-recorded 15 bull trout ascending Tumwater Dam. Although migratory (fluvial) and possibly resident bull trout are present, USFWS believes that the majority of bull trout upstream of Tumwater are migratory (adfluvial) and use Lake Wenatchee.

Of the three subpopulations, the Lake Wenatchee subpopulation has the greatest number of fish in the Wenatchee basin (Brown 1992; K. Williams, WDFW, *in litt*. 1996; A. Murdoch, WDFW, *in litt*. 1997). Anecdotal accounts indicate that the Little Wenatchee River and tributaries to Lake Wenatchee once supported a popular bull trout fishery (WDFW 1997). The bull trout spawning in the Little Wenatchee River basin was last recorded in 1984, and this stock may be extirpated (WDFW 1997). Bull trout have been extirpated from the Napecqua River, a tributary to Lake Wenatchee (WDFW 1997). Four distinct spawning stream reaches remain in this subpopulation (K. MacDonald, USFS, *in litt.* 1996).

The Icicle Creek subpopulation consists of resident bull trout isolated above the Leavenworth NFH dam. A total of 11 bull trout were observed in surveys in 1994 and 1995 (Ringel 1997). Migratory bull trout are observed occasionally below the dam and are believed to originate from the subpopulation upstream (K. MacDonald, USFS, *in litt.* 1996). The Ingalls Creek subpopulation is composed primarily of resident fish. Eight bull trout were observed during snorkel surveys of the creek in 1995 (Ringel 1997). USFWS considers the Icicle and Ingalls creeks subpopulations to be at risk of stochastic extirpation due to their inability to be re-founded, their single life-history form and spawning area, and their low numbers.

Methow River basin. USFWS identified four bull trout subpopulations in the Methow River basin: 1) Methow River, 2) Lost River, 3) Goat Creek, and 4) upper Early Winters (K. Williams, WDFW, *in litt*. 1996*).*

The Methow River subpopulation is composed primarily of migratory (fluvial) fish. In the mainstem Methow River, up to 79 percent of the average flow is removed from a 40-mile reach, occasionally stranding and killing bull trout. Due primarily to temperature constraints in partially dewatered tributaries to the Methow River, 60 percent of the total spawning and rearing area for bull trout has been lost (Mullan et al. 1992). There appears to be sufficient connectivity to allow bull trout access to spawn in various reaches of seven tributaries (Gold, Wolf, and lower Early Winters creeks, and Twisp, West Fork Methow, lower Lost, and Chewack rivers) (WDFW 1997). The number of redds observed at 21 transects in the 7 streams was 0 to 27, with an overall mean of 9.4 per stream (K. Williams, WDFW, *in litt.* 1996).

The Lost River subpopulation is isolated in the upper portion of the watershed, which is considered to be a "stronghold" for bull trout. The subpopulation is composed primarily of resident bull trout, which in 1993 was estimated at over 1,000 resident and migratory fish (K. Williams, WDFW, *in litt.* 1996).

The Goat Creek subpopulation consists of low numbers of resident bull trout that are believed to be genetically distinct (WDFW 1997). They are isolated upstream by a culvert

6.8 miles from the confluence and, in dry years from July through October, by low flows across an alluvial fan at the confluence with the Methow River.

The upper Early Winters Creek subpopulation, also resident, is isolated above a waterfall 7.9 miles from the confluence with the Methow River. USFWS considers the Goat Creek and upper Early Winters Creek subpopulations at risk of stochastic extirpation due to their inability to be re-founded, their single life-history form and spawning area, and their low numbers.

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take</u>.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

- **Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish**.

- **Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).**

- Broodstock collection between early September and early December could take steelhead adults and, less likely, bull trout adults, by handling and delaying migration. (Spring chinook do not migrate when the trap is operating.)
- Trapping for predation studies between March and June at the mouth of Nason Creek could take spring chinook, steelhead, and bull trout juveniles, either by exposing them to greater risk of predation while in the live box, or by handling.
- Weirs in small tributaries such as Chumstick, Brender, and Beaver creeks, could take juvenile or adult steelhead while monitoring juvenile coho emigration or adult returns.
- Tow-net sampling in Lake Wenatchee could take bull trout juveniles through injury or handling stress. A low potential exists for lethal take.
- Electro-fishing for carrying capacity and condition surveys could take bull trout, chinook and steelhead. Adverse effects could be caused by extra handling, or fish could be killed if improper shocking procedures are used.
- Trapping of returning coho adults at Priest Rapids and Tumwater dams for a radio telemetry study could encounter steelhead (and bull trout at Tumwater), causing minimal handling and migration delay.
- Snorkeling surveys could encounter all ages and species of listed fish. A very low potential exists for harassment.
- Juvenile trapping at the outlet to Lake Wenatchee and broodstock collection at Wells Dam would be done within the limits of existing permits, so those activities would not lead to additional take of listed species beyond what already occurs.

- Broodstock at Winthrop NFH are taken from coho that swim into the hatchery, so listed fish would not be affected.

Numbers of listed fish that might be taken during each activity are shown in the "take tables" in Appendix A. Details of the activities and potential take are described below. The risk of adverse ecological interactions between listed fish and coho smolts in the natural environment is discussed in section 3.5.

Wenatchee Basin

- Dryden Dam: The Dryden Dam trap is operated five days per week from July 1 to November 14 each year for steelhead broodstock collection under WDFW's Section 10 permit (#1094). The coho broodstock collection program has been operating within the parameters of that permit. In order to collect coho broodstock throughout the entire run, however, YN requested and was granted an extension of the trapping period from November 14 to December 7.
  Extending the trapping period an additional three weeks (November 14 – December 7) will result in additional handling of an unknown number of Upper Columbia River steelhead. WDFW's 2001 steelhead trapping at Dryden Dam terminated on November 9th and never extends beyond November 14th. Therefore, no data exist to project steelhead captures during the November 14 - December 7 period. During the six trapping days from November 1 – 9, 2001, 10 steelhead were observed, for an average of 1.66 steelhead per day of trapping. If this capture rate were indicative of the expected rate during the requested extension period (approximately 15 trapping days), an estimated 25 additional adult steelhead may be trapped, handled and released as a result of the trapping extension. If the steelhead passage timing observed during 2001 is indicative of a "normal year," then the lengthened trapping period would account for a relatively small proportion of the total steelhead migration. In fact, the low-flow conditions of 2001 delayed steelhead migration, so that in a normal year, even fewer would be encountered during coho trapping. In any event, we do not expect additional steelhead mortality, as no mortality has been observed during the existing trapping period.
  The trap is checked daily to identify captured steelhead as natural or hatchery origin. A Denil ladder is operated up to three hours per day to ensure upstream passage of fish released from the trap (NMFS 1998(b)).
  Bull trout are unlikely to be captured in the Dryden trap. Although USFWS estimated an annual lethal take of one adult bull trout and take by trapping of five adults for all broodstock collection activities (USDI FWS 2001), based on our experience, we expect no lethal take and only two captured and released, with minimal delay in their migration.
- Tumwater Dam: Coho broodstock collection at Tumwater Dam also has operated according to the parameters of the existing WDFW Section 10 permit (#1094) for steelhead broodstock collection. The trap currently operates three days a week, 8 hours a day (although we understand that it is permitted to operate 16 hours a day), and trapping ends in mid-November. YN requested and was granted an extension of the trapping period until December 7. The extension will allow broodstock collection, if necessary, over the entire run. In addition, it will allow more complete enumeration of "natural" adult coho returns to the upper Wenatchee and more opportunity to radio tag adult coho to help identify spawning locations. Recent modifications allow Tumwater, like Dryden Dam, to be operated passively.
  Extending the trapping period an additional three weeks (same time period as Dryden) may result in capture, handling and release of additional upper Columbia River steelhead from that which would have occurred under the existing trapping protocol. During the proposed trapping extension period (November 15 – December 7), 21, 0, 1, and 107 steelhead were observed passing Tumwater Dam in 1998 through 2001, respectively (K. Peterson, NOAA Fisheries, personal communication, September 2002). We do not

anticipate any additional mortality as a direct result of the extended trapping operation, as no mortality has been observed during the existing trapping period.

Bull trout are fall spawners, typically in September and October for most populations (Pratt 1992). Video counts at Tumwater show that bull trout rarely migrate past the dam during September and October. Operation of the trap during the period of bull trout spawning is therefore not likely to impact their seasonal movement, since most likely will be spawning in headwater tributaries during this period. Any bull trout caught in the trap would be removed and released immediately. USFWS estimated an annual lethal take of one adult bull trout and take by trapping of five adults for all broodstock collection activities (USDI FWS2001); however, in our experience, bull trout have not been trapped, and there has been no lethal take.

- Leavenworth NFH: Coho would be trapped at Dam 5 or at the fish ladder, using both the right and left bank ladder traps. There is a very low potential to trap bull trout and steelhead while collecting coho broodstock. Steelhead in Icicle Creek are thought to be remnants of an old USFWS program. An average of 15-20 steelhead adults return per spawning season, most during March and April. The odds of catching one in the coho traps in the fall are extremely low (D. Carie, personal communication, 12/10/99). Bull trout spawn in the fall, but earlier than coho. The potential for catching one in a trap during the coho broodstock collection period is greater than for steelhead, but still low. Traps will be checked daily and any listed species released immediately.
- Nason Creek Smolt Trap: The rotary trap operated at RM 2 on Nason Creek probably will capture some spring chinook, bull trout, and steelhead juveniles. Take tables in Appendix A show numbers of chinook juveniles and eggs/fry expected to be taken for both the hatchery smolt predation and naturalized coho (fry plants) studies. During the 2001 study of coho smolt predation on spring chinook (see section 3.5.3), YN trapped and handled 133 spring chinook smolts and 126 spring chinook fry. Spring chinook runs past a WDFW smolt trap on the Chiwawa River as well as the Monitor trap showed that the spring chinook smolt migration peaked prior to the coho release and start of the predation study. As a result, only a limited number of spring chinook actually encountered our trap. All juvenile spring chinook captured were released and passed downstream within an hour. We observed no spring chinook mortality caused by the trap.

  However, by beginning the trap operation in March rather than May for the naturalized coho predation study, we likely will encounter the peak spring chinook out-migration. For this reason, the take tables in Appendix A show higher numbers of spring chinook encountered than would be indicated by our past experience with this trap.

  During a one-month period, the trap captured 8 juvenile bull trout and 303 juvenile steelhead, with no observed mortality. We estimate an annual incidental lethal take of one juvenile bull trout and the capture, handling, and release of 25 juvenile bull trout annually; and the capture, handling, and release of 500 juvenile steelhead, with a potential for an annual incidental lethal take of 10 steelhead juveniles (Appendix A).
- Tributary weir traps: Weirs might be set up to monitor juvenile emigration or adult returns at smaller tributaries, such as Chumstick, Brender, and Beaver creeks, where natural spawning is expected in the future. Such traps have not yet been used for the project, so we cannot report actual experience with take. Take tables in Appendix A

predict potential steelhead take, including a maximum potential unintentional lethal take of 5 juveniles. Listed spring chinook and bull trout are not expected to be encountered in these tributaries.

- Tow-net sampling: The tow nets proposed for this study (see section 11.1.1) are designed to capture sockeye fry. With the type of nets and the speed at which they would be towed (under 7 mph), bull trout older than one year are unlikely to be captured due to their size and ability to maneuver away from the nets (USDI FWS 2001). In addition, bull trout rear in tributary streams and typically do not migrate to the lake until they are larger than the size fish the nets are designed for (K. Murdoch, pers. comm. 2002).
  While the net is designed to create a safe reservoir for entrained fish, and all listed fish are removed after a 10-minute deployment, USFWS estimated an incidental lethal take of 5 juvenile bull trout and a trapping take of 15 juvenile bull trout (USDI FWS 2001). During 2002 YN staff captured only sockeye fry and sockeye smolts. All smolts were released uninjured (no descaling or visible injury). We encountered no bull trout or spring chinook in 2001 or 2002. If spring chinook are present in the lake, they are not pelagic and will not be found in the center as sockeye are (where we are tow netting). Spring chinook would be found only near the lake edges. Therefore, we estimate no take of spring chinook or bull trout from tow netting.
- Electro-fishing: Electro-fishing has the potential to injure fish. Although most, if not all stunned adult and juvenile fish appear to recover sufficiently to swim away, long-term effects or effects that do not result in immediate mortality are not well understood (USDI FWS 2001). During research in the Columbia River basin, an electro-shocking injury level for incidentally shocked juvenile salmon has been estimated at 10 percent (M. Schuck, fishery biologist, Washington Department of Fisheries, pers. comm. *in* Scholz 1992). Barton and Dwyer (1997) found that, for juvenile bull trout, electro-shock resulted in increased plasma glucose and plasma cortisol levels indicative of acute stress (*in* USDI FWS 2001).
  We estimate that 150 spring chinook juveniles and 150 steelhead juveniles could be captured and released during electro-fishing, with the potential for an unintended lethal take of 15 of each species annually. In its Biological Opinion on the coho feasibility studies, the USFWS assumed that all take of bull trout would be lethal take, to avoid underestimating the level of take, and estimated an annual lethal take of 3 adult and 10 juvenile bull trout; however, to date, we have not encountered bull trout in our electro-fishing activities. To reduce the potential for fish mortality, USFWS required that YN and BPA use the NMFS electro-fishing guidelines (NMFS 1998(a)) *and* guidelines found in Fredenberg (1992).

- Snorkeling surveys: Snorkeling surveys for coho juveniles and adults would be done near release sites. It is possible that a snorkeler could frighten a fish from its hiding place, causing it to be caught and eaten by a predator. However, the low number of surveys per year on any particular stream (up to three on Nason Creek), the short amount of time a snorkeler would spend in any reach, and the snorkeler's training to observe only, make it unlikely that the surveys would cause injury to or significantly disrupt normal behavior of listed fish as described in the NMFS definition of "harass" (NMFS 1996).

Methow Basin

Broodstock collection and snorkeling surveys could encounter listed fish (bull trout and steelhead) in the Methow basin. The effect of snorkeling surveys would be similar to that described for the Wenatchee basin.

Peak adult steelhead migration occurs in September and October, and extends from August through November (L. Brown, WDFW, personal communication, 1999). Wild steelhead adults destined for the Methow basin overwinter in the Wells pool on the Columbia River and spawn in April and May. During the coho broodstock collection period, there is an overlap in adult steelhead and adult coho migration timing past the upper mainstem projects. The overlap is most prevalent in late October and extends into November.

- Wells Dam: Beginning in fall of 1999, coho adults returning to the Methow basin were trapped at Wells Dam on the Columbia River. The dam is equipped with traps to collect adult fish. WDFW currently operates the traps to collect steelhead adults, which return at similar times to coho. The current steelhead protocol is to operate the trap for 3 days a week, up to 16 hours a day. If runs are large enough, we do not trap at Wells but rather allow the coho adults to swim to the WNFH. If the runs are predicted to be less than 150 fish for the Methow, we would trap at Wells as often as WDFW's permit (#1094) allows. We will be trapping at Wells in fall 2002. There has been no steelhead mortality associated with this trap.

  Adult bull trout distribution in the mainstem Columbia River near Wells Dam is unknown. In recent years, no bull trout have been observed via video monitoring at Wells Dam between September 15 and November 7 (R. Klinge, Douglas County Public Utility District, personal communication), probably due to temperature constraints in the mainstem Columbia River during that period. We do not anticipate handling any bull trout at Wells Dam during coho broodstock collection.

  Any listed fish caught in the trap will be released immediately.
- Winthrop NFH: Coho would swim directly into the hatchery, so listed species would not be affected. Because this is the only release site for coho smolts in the Methow basin, the coho are expected to be well-imprinted on the hatchery, resulting in good collection rates.

Priest Rapids Dam

The project is proposing to radio tag up to 400 adults over the next 4 or 5 years at Priest Rapids Dam in order to study homing and straying of coho adults. WDFW currently operates a trap at the dam for stock assessment. The coho project would trap during part of WDFW's trapping period, but also has requested an extension of the trapping date to November 21st from the current ending date of October 14th so that a statistically significant number of adult coho can be trapped and radio tagged. The number of days per week would remain at two.

When WDFW is not trapping for their purposes, steelhead will be incidentally collected in the adult trap at the dam. Tribal or WDFW personnel will be present to sort and handle the fish while the trap is collecting coho adults. There is no off-ladder holding area at the trap. Therefore, when listed steelhead are incidentally trapped, they will be returned immediately back to the fish ladder upstream of the trap. We expect the impacts to steelhead to be minor, with minimal migration delay and no increased mortality. The 50 adult steelhead shown in the take table in Appendix A indicates the number that might be captured during the trapping extension only.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

While YN does not anticipate exceeding any prescribed take levels during any M&E or broodstock collection activities, if they should happen to do so, they will cease the activity, immediately notify the proper regulatory agency, and proceed based on their decision. Options might include reducing trapping days or using other sites.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual* [sic] *Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

There is no ESU-wide hatchery plan for these basins. The *Biological Assessment and Management Plan, Mid-Columbia River Hatchery Program* (NMFS et al. 1998) identifies actions in mid-Columbia basins to address needs of several listed species. Although coho were included in general policy statements, specific actions were not identified for that species. The coho program is consistent with policies addressing restoration projects in NPPC document 99-15, although its phased approach to coho reintroduction is more conservative than the guidelines outlined in the *Artificial Production Review* (NPPC 1999).

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.
Since the 1990s, various entities in the Pacific Northwest have renewed the region's focus on reintroduction of coho to mid-Columbia tributaries.
The four Columbia River Treaty Tribes (Nez Perce, Umatilla, Warm Springs, and Yakama) identified coho reintroduction in the mid-Columbia as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document, commonly referred to as the Tribal Restoration Plan (TRP) (CRITFC 1995).

It is a comprehensive plan put forward by the Tribes to restore the Columbia River fisheries. This project is the initial phase necessary to determine the feasibility of implementing that long-term vision in the mid-Columbia region.

In 1996, the Northwest Power Planning Council (NPPC) recommended the tribal mid-Columbia reintroduction project for funding by BPA, which has responsibilities under the Northwest Electric Power Planning and Conservation Act of 1980 to protect, mitigate, and enhance fish and wildlife that have been affected by the construction and operation of the Federal Columbia River Power System. It was identified as one of fifteen high-priority projects for the Columbia River basin, and was incorporated into the NPPC's Fish and Wildlife Program (program measures 7.1H, 7.4A, 7.4F, and 7.4O) (as documented in NPPC 1994). The project received a partial Step-Two review by the Council in August 2000 and will be subject to full Step-Two and Step-Three reviews once the feasibility phase is completed and the time is ripe to consider full implementation of the long-term vision.

The release of coho from lower Columbia hatcheries into mid-Columbia tributaries is also recognized in the Columbia River Fish Management Plan, a court-mandated plan under the jurisdiction of *U.S. v. Oregon*, involving Federal, state and tribal fish managers in the Columbia basin (CTWSR et al. 1988). While this project is not mandated under that court order, fish produced under that plan supply the project.

The *Biological Assessment and Management Plan, Mid-Columbia River Hatchery Program* (NMFS et al. 1998) also recognizes the potential for coho reintroduction in mid-Columbia basins, although coho-specific plans and analyses were outside the scope of that document.

Plans for the initial feasibility research phase of this project were outlined, revised, and analyzed in several documents, primarily *Mid-Columbia Coho Salmon Study Plan* 11/25/98 (YIN 1998); *Mid-Columbia Coho Reintroduction Feasibility Project Final Environmental Assessment* (USDOE BPA 1999(b)) and *Supplement Analyses* (USDOE/BPA 2001(b) and USDOE/BPA 2001(d)); *Biological Opinion: 1999 Coho Salmon Releases in the Wenatchee River Basin by the Yakama Indian Nation and the Bonneville Power Administration* (NMFS 1999(b)); and *Biological Opinion: Mid-Columbia Coho Reintroduction Feasibility Project, FWS Reference: 01-F-E0231* (USDI FWS 2001). In addition, a Biological Assessment was prepared by BPA on the proposal to dredge the area behind Dam 5 at Leavenworth Hatchery (USDOE/BPA 2001(c); its findings received concurrence from NMFS in a letter dated September 28, 2001 and from USFWS in a letter dated November 16, 2001.

The U.S. District Court ruled on March 22, 1974 that the Yakama Nation and Washington Department of Fish and Wildlife co-manage fish resources in Washington state. This decision is commonly referred to as the Boldt Decision.

A Memorandum of Understanding, dated 12/27/93, stipulates that the Wenatchee National Forest (WNF) and the YN will cooperatively manage fish resources on the Wenatchee National Forest.

This HGMP is consistent with all these plans, analyses, agreements, memoranda, and court orders.

3.3) Relationship to harvest objectives

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

The long-term vision of the Tribes is to re-establish coho in sufficient numbers to provide significant harvest opportunities for Tribal and non-Tribal fishers in mid-Columbia tributary basins. For the period covered by this plan, however, the numbers of returning coho are not expected to be high enough to justify establishing a fishery in the mid-Columbia basins. Harvest levels of all existing Columbia River and ocean fisheries (Tribal and non-Tribal) could be adjusted once escapement goals for upriver coho are agreed to by all parties. Without a coho fishery in the target basins, listed species in those basins would not be at risk.

The marking protocol for program fish has changed from that outlined in the original HGMP (see Tables 19-21, section 11.1.1). The most significant change is a commitment to internally identify or mark with a coded wire tag 100% of the hatchery fish released in both the Methow and Wenatchee basins by 2002 (a year sooner than originally indicated in the HGMP); however, they will not be adipose-clipped, in order to limit their harvest in selective fisheries that target adipose-clipped hatchery coho. This change, combined with current monitoring practices in the relevant fisheries, means that the effect of harvest on survival of program coho will be accurately and effectively assessed.

3.3.1.1) Description of existing fisheries

During their life cycle, this project's research coho might be in waters that are subject to the following fisheries: ocean commercial troll fisheries, ocean recreational fisheries, Buoy 10 recreational fisheries, lower Columbia River commercial fisheries, lower Columbia River recreational fisheries, Zone 6 (Bonneville to McNary) Treaty Indian commercial fisheries, and above Bonneville Dam recreational fisheries.

Ocean fishing seasons and regulations are adopted annually by the Pacific Fisheries Management Council (PFMC). Ocean fisheries for coho are managed on a quota or total allowable catch basis pursuant to objectives in the PFMC's fishery management plan. Because of weak stock constraints, non-Indian commercial troll fisheries targeting coho (especially in areas where Columbia River coho are present) have been very limited since 1994. However, recreational coho fisheries have continued. In 1998, the PFMC adopted the first selective fisheries for coho in recreational fisheries off the mouth of the Columbia River. The states of Washington and Oregon also adopted selective fishery regulations for the popular Buoy 10 fishery in the Columbia River estuary. Washington and Oregon began mass marking (removing adipose fins from) hatchery coho in 1995. Selective fishery regulations required all retained coho to have a healed adipose fin clip. These fisheries generally begin in early August and run through late August to late September.

Mainstem Columbia River sport fisheries typically begin August 1, but generally target chinook and steelhead with minimal harvest of coho. Mainstem commercial fisheries in the lower Columbia River generally occur from mid-September through October. Treaty commercial fisheries in Zone 6 generally occur from late August through early October. Some coho (mostly late stock) are harvested in the latter part of this fishery.

Fisheries may also occur in tributary areas. The Yakama Nation regularly conducts fisheries in the Yakima and Klickitat rivers in the late fall (October to December) targeting fall chinook and coho. The state of Washington also reinitiated a late fall fishery in the Yakima River in 1998 which is expected to continue. The Yakama Nation and/or state of Washington may choose to adopt similar late fall fishing seasons in upper Columbia areas once coho populations are reestablished to levels which would support a fishery; however, adult returns are not expected in sufficient numbers in the next 5-6 years to support a coho fishery in the target basins.

3.3.1.2) Expected harvest rates

Upper Columbia River coho adult returns are a sub-component of the Columbia upriver early stock coho return. Average harvest rates in non-Indian ocean and Columbia River fisheries for marked and unmarked Columbia upriver coho can be estimated using data provided in 1999 by the joint staffs of the Oregon and Washington departments of fish and wildlife. Data include release locations, marking levels, and 1998 selective fishery surveys. Total harvest rates for upriver early coho average about 20% in ocean fisheries and 15% in mainstem Columbia River fisheries for a total harvest rate of about 35% on upriver early-stock coho. Harvest rates on marked (hatchery-released coho) are estimated to average about 30% in ocean fisheries and 20% in river fisheries for a total harvest rate on marked upriver early-stock coho of 50%. Harvest rates on unmarked coho are estimated to average about 12% in ocean fisheries and 11% in river fisheries, for a total harvest rate on unmarked upriver early-stock coho of 23%. Currently non-Indian fisheries are managed to assure that at least 50% of the total upriver coho return (combined early and late stocks) escapes above Bonneville Dam.

Harvest rates of 10% or more on upriver coho stocks in combined Treaty Indian Zone 6 and tributary area fisheries could also occur. Harvest rates for all ocean and Columbia River fisheries (Treaty Indian and non-Indian fisheries) would adjust annually to be consistent with escapement goals for upriver coho once these goals are established and agreed upon by all the parties.

In sum, the total harvest rate on non-adipose-fin-clipped coho is likely to be 20 – 25% due to the selective fisheries that are likely to remain in place for many years as a result of ESA constraints (Mid-Columbia Coho Reintroduction Feasibility Project, Responses to ISRP Comments on Partial Step-Two Review, August 2000).

3.4) Relationship to habitat protection and recovery strategies.

Mid-Columbia coho salmon populations were decimated in the early 1900s by impassable dams and unscreened irrigation diversions in the tributaries, along with an extremely high harvest rate in the lower Columbia River. The loss of natural stream flow degraded habitat quality and further reduced coho productivity. Over the years, irrigation, livestock grazing, mining, timber harvest and fire management also contributed to destruction of salmon habitat.

Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 - 7,000
- Methow—23,000 - 31,000
- Entiat—9,000-13,000
- Okanogan—Presence documented but no numbers specified

Indigenous natural coho salmon no longer occupy the mid-Columbia river basins. Since Priest Rapids Dam was completed in 1960, the peak escapement of adult coho upstream of the dam was probably never greater than 10,000 coho and has not exceeded 1,300 since 1974 (WDFW/ODFW 1998). From 1988 to 1997, adult counts at Priest Rapids Dam averaged only 16 coho, probably a result of releases from Turtle Rock Hatchery, which annually released about 600,000 coho smolts, until the program was terminated in 1994 (WDFW/ODFW 1995).

For several reasons, self-sustaining coho populations were not established in mid-Columbia basins despite plantings of 46 million fry, fingerlings, and smolts from Leavenworth, Entiat, and Winthrop national fish hatcheries between 1942 and 1975:

- The construction and operation of mainstem Columbia River hydropower projects were detrimental to mid-Columbia River salmonid populations because of the number of dams and reservoirs through which they had to pass, leading to deaths from turbines, gas bubble trauma, and so forth.
- A substantial amount of critical physical fish habitat was lost or severely degraded (Tyus 1990; Petts 1980; Diamond and Pribble 1978).
- Existing coho programs were unsuccessful or lower priority than programs for other salmonid species. For example, the most recent coho hatchery program in the mid-Columbia region was at Turtle Rock Hatchery, funded by Chelan PUD. The coho program was terminated due to poor adult returns, thought to be caused in part by disease problems at the hatchery. Because fall chinook and steelhead were higher priority species, they were given priority use of the limited supply of high quality hatchery water. These species currently constitute the program at Turtle Rock. The last coho releases were in 1994.

Since that time, conditions and practices have changed to a certain degree. Some of the local habitat causes of coho depletion have been corrected, although there is still work to be done. For example, many irrigation diversions have been screened, tributary dams have been removed, mining has ended, and grazing practices have been improved. A few specific examples of projects designed to improve conditions for fish in the target basins include:

Wenatchee Basin:

- improvements in fish passage at Tumwater and Dryden dams
- fish screens at Dryden Dam
- replacement of Chumstick Creek culverts

Methow Basin:

- improvements to the Methow Valley Irrigation District system
- restoration of salmonid habitat in Early Winters and Goat creeks

Similar improvements have been made on the mainstem Columbia.

Another significant change in regional conditions is that the ESA listings of several salmonid species that migrate through the lower Columbia River have curtailed coho fisheries that once over-harvested the mid-Columbia stocks of coho. These fisheries restrictions are likely to be in effect for a number of years.

Recent improvements in artificial production methodology may also improve efforts aimed at supporting natural production. Supplementation techniques, featuring refined genetic objectives, the production of “natural-like” hatchery smolts, and acclimation/release in wild habitat, are being developed.

Because of these changed conditions, feasibility studies into restoring coho to these basins are consistent with guidance in NPPC’s document 99-15 (NPPC 1999).

3.5) Ecological interactions

One of the primary goals of the coho feasibility studies is to assess interactions with other species and to minimize any adverse effects identified. The NEPA document prepared on the feasibility studies (USDOE/BPA 1999(b)) assessed potential interactions based on information available at the time. Subsequent residualism and predation studies showed little or no adverse effect of hatchery coho smolt releases. Additional predation and F2 interactions studies are ongoing or planned. Results of existing assessments are summarized in the following sections. Because many negative impacts of ecological interactions among species are density-dependent, the estimated carrying capacities of selected Mid-Columbia rivers and streams (if the habitat were to be "fully seeded") are shown in Table 10 as an aid to assessing the near-term risks to other species. These carrying capacity estimates should be considered minimum for the basins, because they include only the main tributaries listed; the majority of fisheries experts agree that, in natural conditions, coho use small creeks in their early life history. Based on the following analysis, and on other discussions with the Mid-Columbia Technical Work Group, we expect that the numbers of hatchery coho released in the Wenatchee or Methow basins are unlikely to result in returning adults sufficient to produce natural origin juveniles in numbers that would exceed the carrying capacity of the tributaries/reaches near the release locations.

The method used to calculate the carrying capacities is presented below. Other methods used by Technical Work Group members have resulted in similar ranges of numbers.

3.5.1) Method for Estimating Carrying Capacities:

We compiled and summarized existing physical habitat inventory for the largest tributaries of the Wenatchee (Little Wenatchee, Nason Creek, White and Chiwawa rivers) and Methow (upper Methow, Chewuch and Twisp rivers) basins. We did not develop estimates for smaller tributaries, so these estimates likely underestimate the potential available habitat and therefore the coho smolt carrying capacity within these watersheds. The U.S. Forest Service collected the data using the Hankin and Reeves (1988) methodology. For each tributary of interest, we tabulated the total stream area by habitat type (pool, glide, riffle, side channel, etc.). We used summer stocking densities presented by Reeves et al. (1989) to estimate the total potential summer standing crop of coho parr within each tributary. In order to estimate adult coho escapement required to fully seed the habitat at these levels, we needed estimates of adult coho sex ratio (D. Dysart, personal communication), life-stage-specific survival rates, and coho fecundity (Yakama Nation, unpublished data). Life-stage-specific survival rates (L. Lestelle personal communication) were partitioned into the egg-to-emergent fry, emergent fry colonization, and summer and winter parr survival. These survival rates are considered to be near optimal and therefore likely overestimate survival within these watersheds.

Female escapement (FE) and adult coho escapement (AE) required to achieve coho smolt carrying capacities (CC) were estimated using the following formula:

$$FE = \frac{CC}{F \times EFS \times FCS \times SPS \times WPS}$$

$$AE = \frac{FE}{SR}$$

Where F = average fecundity (2750 eggs/female)

EFS = egg-to-emergent fry survival (60%),

FCS = emergent fry colonization survival (80%),

SPS = summer parr survival (75%),

WPS = winter parr survival to spring smolt (50%), and

SR = female sex ratio (percent females: 50%)

Assumptions

- Methodology presented by Reeves et al. (1989) accurately estimates potential natural coho summer parr stocking densities within these watersheds.
- Fecundity, sex ratios, and survival rates are realistic.
- Coho survival at life stages earlier than spring smolt will not limit spring smolt production.

Table 10. Estimated Coho Carrying Capacity of Selected Mid-Columbia Basins

Wenatchee	Summer Natural Stocking Capacity	Spring Smolt Natural Stocking Capacity	Female Escapement	Adult Escapement
Nason Creek	845,676	422,838	854	1,708
White River	681,656	340,828	689	1,377
Chiwawa River	887,348	443,674	896	1,793
Little Wenatchee	157,592	78,796	159	318

Total	2,572,272	1,286,136	2,598	5,196
Methow	**Summer Natural Stocking Capacity**	**Spring Smolt Natural Stocking Capacity**	**Female Escapement**	**Adult Escapement**
Methow River	2,638,180	1,319,090	2,665	5,330
Chewuch River	1,119,008	559,504	1,130	2,261
Twisp River	709,108	354,554	716	1,433
Total	4,466,296	2,233,148	4,511	9,024

Assumptions

1. Reeves et al. (1989) accurately estimates natural coho summer parr stocking densities
2. Fecundity = 2750 eggs/female
3. Egg to fry survival = 60%
4. Fry dispersal survival = 80%
5. Fry to summer parr survival = 75%
6. Over-winter survival = 50%
7. Adult sex ratio (female) = 50%
8. Estimates are minimum because they include only the mainstem tributaries listed

1. Physical habitat inventory for each tributary Hankin and Reeves (1988) collected by USFS
2. Sex ratio (Doug Dysart, personal communication)
3. Survival rates (Larry Lestelle, personal communication)
4. Fecundity estimates (Yakama Nation, unpublished information)
5. Coho summer stocking density estimates (Reeves et al. 1989)

3.5.2) Species that could negatively impact the success of the program:
Historically, bull trout and northern pikeminnow (*Ptychocheilus oregonensis*) were probably the most significant fish predators within the Methow, Wenatchee, and Entiat basins. Today bull trout abundance in most parts of these three basins is low and would not be expected to limit project success. However, Lake Wenatchee is a stronghold for the local bull trout population.

Predation rates by bull trout on coho smolts released into the Little Wenatchee or White River could be significant.

Although little information exists about the abundance of northern pikeminnow for the mainstem Methow, Wenatchee or Entiat basins, the abundance of this species is assumed to be relatively low and probably accounts for a small portion of juvenile mortality in freshwater. Several non-endemic centrarchid and ictalurid species are present in the mainstem Columbia River, but the potential impact of these species on project success is unknown.

River otters, mergansers, and bald eagles, among other non-fish predators, are known to eat coho smolts acclimating in uncovered, natural-style ponds, but exact numbers are unknown. Project staff are examining non-toxic, non-lethal methods to control predation by such species.

Project activities are not expected to appreciably change the functional or numeric response or the long-term abundance of predators within the Methow, Wenatchee, or Entiat basins, or in the mainstem Columbia River. This is due to the relatively large number of all species of hatchery fish that currently rear and/or migrate within these areas.

3.5.3) Species that could be negatively impacted by this program:

Ecological interaction risks include predation by coho on other species of concern, competition between coho and other species, residualism, straying, and transfer of disease.

In this section, analysis of ecological interactions focuses on those that could occur within the Wenatchee and Methow river basins, as these basins are where releases are most likely during the time period of this plan. The nature of the impacts in the Entiat basin, should coho be released there, would for the most part be similar to those expected in the Methow and Wenatchee. The species within each basin that potentially could be adversely affected by the project would be the same for F_2 and hatchery fish and are listed in section 2.2.1.

In addition to listed species in mid-Columbia basins, coho smolts encounter other listed stocks and species while migrating in the Columbia River and its estuary. The potential for adverse interactions between coho and other listed species in the mainstem is discussed at the end of this section.

Predation

Predation effects can be direct or indirect and are related to the release of hatchery smolts into the natural environment. For this analysis, direct predation refers to coho consumption of another species. Indirect predation refers to either the increased or reduced levels of predation on other species as a result of the release of large numbers of coho smolts. These indirect effects are being studied in the Yakima basin with inconclusive results so far (YN YKFP 2000). There is no evidence to suggest that an indirect predation risk exists in mid-Columbia basins.

Although the impact of predation on an individual prey animal is unambiguous, the impact on a population of prey is not. Depending on the abundance and productivity of the prey population, the impact of predation on the persistence and productivity of the prey population may range from negligible to serious. The relative impacts of predation on a prey population are determined by partitioning the sources of freshwater mortality and comparing the relative magnitude of each source. Size of hatchery fish appears to be relevant to whether or not the supplemented species will prey significantly on other fish species (Hillman and Mullan 1989). Coho salmon have been shown to prey on several species of salmonids including sockeye salmon (*O. nerka)* fry (Ricker 1941; Foerster and Ricker 1953; Ruggerone and Rogers 1992); pink (*O.*

gorbuscha) and chum (*O. keta*) salmon fry (Hunter 1959); spring chinook fry (Dunnigan and Hubble 1998); and fall chinook salmon (Thompson 1966; Dunnigan and Hubble 1998).

In the mid-Columbia basins, the species most at risk for direct predation is spring chinook; sockeye salmon could be at risk in certain parts of the Wenatchee basin, especially downstream of any acclimation site above Lake Wenatchee. Spring chinook spawn in higher reaches of the watershed and emerge from the gravel later than summer/fall chinook, due to the colder water; and young-of-the-year spring chinook are smaller than coho when coho begin migrating. Sockeye emerge at about the same time as coho and rear in habitat proposed for coho acclimation in the Wenatchee basin. Summer/fall chinook spawn lower in the watershed, and emerge sooner than coho. They are smaller than coho, and there has been concern that summer/fall chinook would be prey for coho. However, studies in the Yakima basin, as discussed below, have shown that coho predation on fall chinook is very low. Most resident trout and steelhead are not considered to be at risk because these species generally emerge from the gravel after coho have migrated downstream, or, as in the case of bull trout, spawn in upper reaches of tributaries. See section 2.2.1.

The potential for impact to each listed or sensitive species is discussed in more detail below. We include summaries of research that studied coho predation on non-listed species because their findings are relevant to the feasibility questions in these basins.

Coho Salmon Predation on Fall Chinook

Studies of coho predation on fall chinook were conducted in the Yakima basin at the Chandler Juvenile Monitoring Facility (CJMF) in 1997 and 1998. They indicate that coho predation on fall chinook was 0.1% of all fall chinook smolts produced above Prosser, or the equivalent of 3.7 fall chinook adults. However, researchers believe that the artificial conditions associated with CJMF create abnormal opportunities for predation (the fish are at unnaturally high densities in unnatural habitat with no cover against predators, and fish are potentially held several hours in the livebox before being examined) (Dunnigan and Hubble 1998).

Coho predation studies were also conducted in 1997 and 1998 in the open Yakima River (Dunnigan and Hubble 1998). There the observed rate of coho predation on fall chinook was zero: none of the coho sampled in either year contained remains of fall chinook. Calculations were then made, using two different methods, to estimate what total coho predation on fall chinook in the Yakima River might have been. Because the 1997 sample size was small, calculations made from it were not precise and the estimates ranged to absurd numbers. However, despite the small sample size, it seems likely that sampling reflected actual consumption rates in the river during the 1997 coho outmigration (Dunnigan and Hubble 1998). Conditions were not conducive for sight-feeding predators such as coho to be highly successful. Flows were extremely high and the water was turbid. Coho salmon migrated rapidly during this period (averaging 160 kilometers [100 miles] in 3 days) so the potential time for predation was limited. Predation rates on fall chinook by other sight-feeding predators such as smallmouth bass and northern pikeminnow were also relatively low during this period in 1997. It also seems highly unlikely that impacts in the river during 1997 would have been high given that coho predation at CJMF in 1997 was low and CJMF is perhaps the worst-case scenario for fall chinook predation (see above) (Dunnigan and Hubble 1998).

Sample sizes in 1998 allowed for more precise estimates of the total number of fall chinook consumed in the open river. Statistical analysis shows that, given an observed predation rate of 0% and a sample size of 462 coho, there was a 5% chance of observing a predation rate equivalent to the consumption of no more than 349 smolts (or approximately 3.5 adult fall chinook) (Dunnigan and Hubble 1998).

Coho Salmon Predation on Spring Chinook

Yakima River Basin

In 1997, YN snorkeling surveys in the Methow basin generally found emergent spring chinook fry in association with shallow (less than 12 inches), low-velocity backwater and spring brook channels, or close to large woody debris along shallow stream margins (Dunnigan and Hubble 1998). Wild coho juveniles progress through a series of preferred habitat types beginning with back eddies, then moving to log jams, undercut banks, open bank areas, and finally to fast water habitat (Lister and Genoe 1970). Dunnigan and Hubble's observations generally agree with Lister and Genoe's (1970), in that coho prefer deeper and faster water conditions than do spring chinook fry. Minimal spatial overlap tends to indicate limited opportunity for direct predation or competition. However, more definitive studies were required.

In 1998 and 1999, the YN studied coho predation on spring chinook, analyzing the stomach contents of coho sampled at a rotary trap in the Easton reach of the upper Yakima River. In 1998, five coho among the 981 sampled had consumed fish. Two of the prey items were identified as *Oncorhynchus* spp, consumed by a single coho. In 1999, only two of the 1,757 coho smolts sampled had consumed fish, neither of which was *Oncorhynchus* spp. Based on fry consumption estimates using the He and Wurtsbaugh (1993) gut evacuation model, researchers estimate that the total number of adult spring chinook equivalents consumed by coho was no higher than 7 (or 0.38% of the potential number of adult chinook returning to the study reach), assuming a 0.14% egg-to-adult survival rate (Fast et al. 1986) (Dunnigan 1999).

Although data collected in the Yakima basin seem to indicate that direct predation by coho is not a significant risk to spring or fall chinook, because the studies were done in a different basin and results were limited, additional predation studies were done in the Wenatchee basin.

Wenatchee River Basin

In 2001, the YN studied coho predation on spring chinook, analyzing the stomach contents of coho sampled at a rotary trap located at river mile 0.8 on Nason Creek. As reported in Murdoch and LaRue (2002), a total of 4,309 coho smolts were trapped during the study. Of these, a random sample from throughout the run of 1,094 fish were retained for stomach content analysis. Two coho, collected on the same date, had consumed spring chinook fry. This indicates a 0.18% incidence of predation. Using the generic model of gut evacuation rates presented by He and Wurtsbaugh (1993), and the mean residence time of 15.8 days, researchers estimated that the total number of spring chinook fry consumed during the outmigration was 2,436. This number likely is an overestimate because the mean residence time was calculated from the time the barrier nets in the acclimation pond were removed to the time each fish was captured in the smolt trap. However, fish remained in the pond up to three weeks after the net was removed. The actual time each fish spent in Nason Creek after leaving the pond until capture in the trap is unknown, but in most cases it probably was less than the mean residence time used in the calculations.

One hundred spring chinook redds were counted in Nason Creek in 2000, the highest density of spring chinook redds observed within the previous six years. Similar high numbers were observed throughout the region and are thought to be due to exceptionally favorable ocean conditions the previous year. Assuming an average fecundity of 4,200 and egg-to-fry survival rate of 60.0% (Fast et.al. 1986), the estimated number of spring chinook fry consumed by coho during the 2001 smolt migration was less than 1% (0.97%) of the spring chinook fry population in Nason Creek. This study may represent a worst-case scenario for coho smolt predation on spring chinook fry in Nason Creek due to the known over-estimate of residence time and the unusually high density of spring chinook, which is not expected to recur every year (Murdoch and LaRue 2002).

Other factors will further limit the risk of coho predation on spring chinook. In the Wenatchee basin,

1) in the near term, most returning coho adults will be captured for broodstock; and
2) planned natural coho spawning either will be limited to less sensitive areas for spring chinook, like Icicle Creek, or will be carefully monitored to determine the risk of negative interactions with chinook (see section 11.1.1).

In the Methow,

1) a large proportion of adult spring chinook are being collected for an adult-based supplementation program; and
2) most coho adults would be collected for broodstock.

Consequently, the opportunities for predation by naturally spawning progeny of these released fish would be minimal.

Coho Salmon Predation on Summer Chinook

The Yakama Nation, in cooperation with WDFW, evaluated coho predation on summer chinook in the Wenatchee basin during the 2000 smolt out-migration. The study was similar to studies conducted in the Yakima basin on spring and fall chinook. Hatchery coho smolts released from acclimation sites on Icicle Creek and Nason Creek in the spring of 2000 were recaptured in a WDFW-operated 8-foot rotary smolt trap. The trap was located on the Wenatchee River at river mile (RM) 7.1, near the town of Monitor. The study results described below are taken from the annual report by Murdoch and Dunnigan (2001).

During spring 2000, 12,243 coho smolts and 69,239 summer chinook fry were captured in the Monitor smolt trap. Of the 12,243 coho caught, 837 were retained for stomach content analysis. Protocol for the study required that the trap's live box be emptied of fish hourly. Unfortunately, this protocol was violated during the latter part of the study (after May 27th) and the live box was emptied once every three hours. During the study, coho predation of fish generally was uncommon. Between the release date and May 27th, four coho in the sample (0.6%) had consumed summer chinook. This compares to 17 coho that had consumed fish (9.8%) after the protocol had been violated (Table 11). When all samples are grouped, the incidence of predation was 2.5%.

Table 11. Incidence of Predation on Summer Chinook

Time Period	Number of coho sampled	Number of samples containing fish	Incidence of predation
Release to May 27	663	4	0.0060
May 28 to June 18	174	17	0.0977
Release to June 18	837	21	0.0250

We believe that this study represents the worst case scenario for the 2000 out-migration. The study reach contained the highest density of summer chinook redds in the Wenatchee River basin. All hatchery coho released from the Icicle Creek and Butcher Creek acclimation sites passed through this stretch of river. Additionally, data collected from the trap indicated that approximately 10.2 million summer chinook fry migrated past the trap during 2000 (T. Miller, WDFW pers. comm.), so fry were abundant and available for predation during the study. Researchers measured a random sample of summer chinook fry captured in the trap and compared their lengths to those of summer chinook consumed by coho. Summer chinook fry consumed by coho were significantly smaller than summer chinook fry trapped in the live box. Results also indicated that the chinook fry consumed by coho were significantly smaller than the population of coho migrating past the Monitor smolt trap, implying that only the smallest of the fry, rather than the entire population, are vulnerable to predation by hatchery coho smolts.

Coho Salmon Predation on Sockeye Salmon

The risks of coho predation on sockeye salmon could be similar to spring chinook. Sockeye spawn upstream of most of the proposed release areas in the Wenatchee basin, but a significant number rear in Lake Wenatchee and would be present at times when coho smolts, if released above the lake as proposed, would be migrating through Lake Wenatchee (see Figure 2). Although not listed under ESA, sockeye in this area are considered a vulnerable species because they are one of only two populations remaining in the Columbia River system (the other is in Lake Osoyoos [Okanogan River]) (Ken MacDonald, USFS, personal communication, 1999). Sockeye are considered to be introduced in the Entiat basin (USDA FS 1996), most likely wanderers from the Okanogan (NMFS et al. 1998).

Before significant numbers of coho are released upstream of Lake Wenatchee, YN is investigating the risks. The first task is to determine the spatial and temporal distribution of juvenile sockeye within Lake Wenatchee, in order to assess the potential for interaction with hatchery coho smolts during the coho out-migration. The distribution of sockeye fry within the lake is determined by beach seining, snorkeling in the littoral zone, and tow-netting within the limnetic or pelagic zone. The route hatchery coho take through Lake Wenatchee and the amount of time they take to do so are being analyzed using radio-telemetry. A study of coho smolt predation on sockeye follows these baseline studies.

Studies began in 2001, with limited results. They are expected to continue through 2003. See section 11.1.1.

Coho Salmon Predation on Bull Trout

Potential for coho predation on young-of-the-year bull trout would be limited due to the lack of geographic overlap between bull trout spawning and rearing areas in the Wenatchee and Methow basins and proposed coho acclimation and release sites (Table 82). All proposed acclimation sites in the Wenatchee and Methow are lacustrine-type habitats that generally are not used by juvenile bull trout. In any event, bull trout tend to stay on the spawning grounds until they are large enough not to be a prey-sized item for coho smolts. Significant spatial overlap between the two species may occur in the long term if coho return to spawn upstream of their acclimation sites in significant numbers. Conversely, coho might also benefit bull trout in the long run as coho juveniles probably would become prey for adult bull trout.

Specific coho release sites have not been identified in the Entiat basin and studies are not proposed under this plan. If coho reintroduction is eventually initiated in the Entiat basin, two of the three target rivers (Entiat and Mad) contain bull trout (see section 2.2.1). In particular, the Mad River is considered a stronghold for bull trout by the USFS (USDA FS 1996). In the Entiat, the presumed spawning area for bull trout is within a mile of Entiat Falls (WDFW 1998). Downstream of the falls, which is a barrier to fish, lower gradients, higher temperatures and the presence of rainbow trout and chinook salmon suggest that the habitat may be unsuitable for bull trout spawning and initial rearing. In the Mad River, known spawning occurs in the upper middle reach, most above Cougar Creek (WDFW 1998). At this time, the potential for coho predation on bull trout in the Entiat basin is unknown but expected to be minimal, due to limited micro-habitat overlap and late emergence timing of juvenile bull trout. In fact, because bull trout are better predators than coho, it is much more likely that coho (naturally produced and hatchery) will become prey for bull trout, benefiting the bull trout population, rather than the other way around.

In summary, direct predation by coho smolts on other species is expected to be low either because coho would be actively migrating downstream and therefore be moving quickly away from other species' rearing areas; because habitat overlap is minimal; because fish densities in the habitat are low; or because coho would be too small to prey on other species. While some risk to spring chinook needs to be imposed in order to study the potential for long-term risk to sensitive species, implementing the following mitigation measures as appropriate would minimize that risk:

- working with other fish managers to determine release sites and numbers that minimize risk but that also meet research objectives;
- releasing coho smolts in low densities;
- attempting to release fish that more closely resemble sizes of wild coho, which tend to be smaller than hatchery fish[21] (our target size of 20-25 fpp equates to 110 – 120 mm);
- ensuring smolts are ready to actively migrate before volitionally releasing them from acclimation ponds; and
- monitoring predation and adapting feasibility studies and activities as necessary to minimize risks.

Competition

By definition, competition is a situation where the use of a common and limited environmental resource by two individuals or species causes the growth or survival of one individual or species to be reduced due to the shortage of this resource (Whittaker 1975). Direct competition for food and space between hatchery coho and other species can result in displacement of other fish into less preferred areas, which can potentially affect their growth and survival. For competition to have an adverse effect, the same limited resource must be used by more than one species. However, in some instances, competition for space and food may clearly alter patterns of microhabitat utilization while having no effect on productivity or viability (Spaulding et. al 1989). Indeed, the small-scale shifts in use of habitat niches may represent a significant benefit at the community level because environmental resources are used more efficiently (Nilsson 1966).

Juvenile coho salmon are known to be highly aggressive compared to other juvenile salmonids; thus they may compete with hatchery or naturally produced spring and summer/fall chinook, steelhead or rainbow trout, and resident fishes under certain conditions. For example, in a study conducted by Stein et al. (1972) in an artificial stream, coho socially dominated **fall chinook**, and fall chinook grew faster alone than with coho present. However, Lister and Genoe (1970) suggested that coho and fall chinook do not interact in the natural environment because of size-related differences in microhabitat selection. Coho salmon displaced **summer chinook** from preferred microhabitats in the Wenatchee River drainage but did not measurably affect their growth or survival (Spaulding et al. 1989). YN snorkeling surveys, as discussed under "Predation" above, showed that spring chinook and coho use different microhabitats (Dunnigan and Hubble 1998). Groot and Margolis (1991) also suggest that there is little habitat overlap between chinook and other salmonids including coho and sockeye, and that this habitat segregation provides a possible mechanism for reducing ecological interactions between the species.

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[21] Throughout the geographic range of coho salmon, length at smoltification is relatively consistent. Groot and Margolis (1991) reported that mean smolt size in yearling smolts ranged from 75 (Andersen and Narver 1975) to 122 mm fork length (McHenry 1981), and smolt size in Minter Creek, Washington ranged from 95-106 mm (Salo and Bayliff 1958).

Coho salmon have been shown to displace **cutthroat trout** from pool habitat into riffle habitat (Glova 1984; 1986; 1987; Bisson et al. 1988), even though both species preferred pool habitat in the absence of the other species. Tripp and McCart (1983) observed increasing negative impacts on cutthroat trout growth and survival as coho stocking densities increased.

Coho salmon and **rainbow/steelhead trout** are reported to share habitat along the western coast of North America from California to British Columbia (Frasier 1969; Hartman 1965; Johnston 1967; Burns 1971), with both species residing in freshwater for extended periods (Groot and Margolis 1991). However, the reported impacts of the presence of coho salmon on rainbow/steelhead trout are conflicting. Frasier (1969) observed that the survival rate of steelhead living sympatrically with coho salmon declined slightly as coho salmon densities increased. Coho were shown not to affect steelhead growth or habitat use in the Wenatchee River (steelhead occupied different microhabitats than salmon) (Spaulding et al. 1989), and coho affected steelhead habitat use only to a small extent in another Washington stream (Allee 1974, 1981). However, Hartman (1965) concluded that strong habitat selection occurred in the spring and summer as a result of aggressive behaviors which were differentially directed by coho against steelhead in pools and by steelhead against coho in riffle habitats.

Coho salmon may have a competitive advantage over steelhead when they coexist. Juvenile coho salmon tend to emerge from the gravel earlier than steelhead, which allows them to establish territories and reach larger sizes than steelhead of the same age class (Berejikian 1995). Both laboratory and stream studies indicate that these species use different stream microhabitats. In the absence of coho salmon, steelhead use more of the water column and more pool habitat than when coho salmon are present (Hartman 1965, Allee 1974, Bugert and Bjorn 1991). In the presence of coho salmon, age-0 steelhead generally occupy the shallower, faster water of riffles and pool slopes, while coho salmon occupy the deeper water of pools (Bugert et al. 1991).

The segregation of these species appears to be both actively maintained and adaptive (Nilsson 1966). Their habitat segregation is consistent with inter-specific morphological variation: juvenile steelhead are more fusiform in shape than coho salmon and therefore better able to cope with higher water velocities (Bisson et al. 1988). These differences may reduce competition and facilitate partitioning of stream resources during low summer flows in streams when competition is most intense (Hard 1996). Because of their different morphology and habitat use, it is expected that stream characteristics will be primary determinants of interactions between these species: steelhead are expected to thrive better in the presence of coho salmon in streams with higher gradients and velocities, while steelhead are likely to diminish in streams with lower gradients and velocities (Hard 1996); Stelle 1996).

In 1998, the YN conducted field experiments to address the impacts of coho on the growth, abundance, and broad-scale geographical displacement of cutthroat and rainbow/steelhead trout. Researchers found no evidence that coho salmon influenced the abundance of cutthroat or rainbow trout when they compared the abundance of each species at sites where coho were stocked as well as where coho were not stocked. Coho abundance was largely related to stocking location. In addition, they found no evidence that coho affected the growth of cutthroat or rainbow trout when they compared the condition factor of each species in areas with and without coho (Dunnigan and Hubble 1998). These streams were generally characterized as relatively high gradient (2-5%), and ranged from second- to third-order streams.

Researchers were unable to locate any studies that investigated competitive interactions between **bull trout** and coho salmon. However, Underwood et al. (1992) investigated competitive interactions between hatchery steelhead and spring chinook juveniles and juvenile bull trout and concluded that competition between these species of hatchery fish and bull trout was not affecting abundance of bull trout or their use of microhabitats.

Little competitive interaction is expected between bull trout and coho smolts released in the mid-Columbia tributaries. Bull trout typically spawn in tributaries to the Wenatchee and Methow Rivers, or in the middle to upper reaches of the Entiat and Mad rivers. Spawn timing in these tributaries is most likely similar to general patterns observed for the species, is related to water temperature and generally occurs from September to October (Pratt 1992). Spawning and rearing of bull trout is thought to be primarily restricted to relatively pristine and cold streams, often within the headwater reaches (Rieman and McIntyre 1993). The geographic overlap of the juvenile bull trout rearing habitat and the coho migratory path would be minimal for coho releases because the majority of juvenile bull trout rearing habitat is believed to occur upstream of proposed (or likely, in the case of the Entiat River) coho acclimation sites. Sites proposed in the future for the Mad River would take into account known bull trout spawning locations. Any opportunity for interaction with bull trout juveniles would be further limited due to the migratory behavior of coho smolts.

No published studies were found that demonstrated complete competitive exclusion (species extirpation) by coho of any species.

Rapid out-migration of hatchery fish is believed to decrease the risk of ecological interaction to wild fish (Steward and Bjornn 1990). Recent studies in the Yakima basin found that, on average, actively migrating PIT-tagged coho smolts migrated approximately 30.1 km (18.8 miles) per day. The later the fish were released and the higher the volume of water flowing in the river, the faster the fish moved. Migration rates for coho released in the mid-Columbia tributaries are expected to be similar.

Competition that results directly from the release of hatchery coho smolts would likely be negligible due to the fact that coho would be actively migrating downstream and therefore have limited time to interact with individual fish species. Implementing the following mitigation measures (which are similar to those for minimizing predation) as appropriate would minimize the risk further:

- releasing coho smolts in low densities;
- avoiding or delaying releases in habitat for sensitive species (except when the point of the research is to test interactions with a specific species or when YN and the TWG mutually agree such releases would be appropriate);
- attempting to release fish that more closely resemble sizes of wild coho, and
- ensuring smolts are ready to actively migrate before volitionally releasing them from acclimation ponds.

Coho will be released at levels that meet project goals and that will produce naturalized coho at levels consistent with the carrying capacity of the natural habitat (Table 10). From the one million coho smolts proposed to be released into the Wenatchee River basin in the next few years, approximately 1,000 returning adults are expected. Until 2003, a maximum of 380 coho are expected to spawn naturally near release sites; that number is approximately 6% of the historic population (6,000 - 7,000) in the basin.

Current carrying capacity of tributaries in the mid-Columbia is likely lower than historically for all species of salmonids, and therefore, competition between two species might still be severe at densities below the historic carrying capacity of the habitat. However, while estimating current carrying capacity is imprecise at best, estimates provided in Table 10 suggest that the coho escapement proposed under this plan would not threaten other species in the near term. In fact, in 2001, only three coho redds were found in Nason Creek downstream from the release site. If the project moves beyond feasibility studies and stocking or natural production significantly increases coho densities, the risk of adverse competition effects could increase. Project participants plan studies that will help assess the potential for inter-species competition, beginning with spawning ground surveys in fall 2001; habitat use by sub-yearling coho, spring chinook, and steelhead in summer 2002; and radio-telemetry studies in fall 2002/2003 (see section 11.1.1). It is expected that such studies would inform future decisions on release numbers and escapement goals for the long term. The challenge will be to make competition studies meaningful with the limited numbers of naturally produced coho expected in the near term.

Residualism

The spatial and annual incidence of residualism—the tendency of hatchery smolts to delay or avoid what otherwise would be normal outmigration in the spring—can be variable. When fish residualize, they become a part of the stream-reared fish community; they could potentially compete with resident fish for resources such as food and space and become potential predators (or prey).

To help determine the incidence of coho residualism, YN conducted snorkeling studies in 1999, 2000, and 2001 in Nason Creek; in 2000 in the Wenatchee River; and in 2000 and 2001 in the Methow River. Rates of residualism in Icicle Creek and the Wenatchee and Methow rivers were low. Few residual coho were observed during 1999 snorkel surveys in Nason Creek. During a complete survey (100% sample rate) between Swamp Creek (RM 4.5) and the mouth of Nason Creek, 8 (0.01%) coho were observed (Dunnigan 1999). No coho were observed in Nason Creek in 2000, but it is likely that the numbers of residual coho were too low to be detected with the 20% sample rate used. Similarly, no residual coho were observed in Nason Creek during the 2001 surveys, even though the sample rate was increased to 25%. If the relative abundance of residual coho in Icicle Creek (0.002%) were applied to the 75,000 smolts released into Nason Creek, it would result in approximately 1 to 2 residual coho (Murdoch and Dunnigan 2001). Based on the 1999 observations and the 2000 estimates in Nason Creek, and previously reported rates of coho residualism in the Yakima River (Dunnigan 1999), we believe that the proportion of hatchery coho that do not migrate during the spring is low. Recent experience with mid-Columbia coho releases shows that when researchers remove the barriers at coho acclimation sites, the fish leave quickly. The incidence of coho residualism is expected to be minimized through acclimation and volitional releases. Based on these results, the Technical Work Group deemed further residualism studies unnecessary.

Straying

At the start of feasibility studies, straying of Lower Columbia fish back to their natal hatchery (thus increasing competition with local populations) was not expected to be an issue. Johnson et al. (1990) found that coho smolts acclimated for similar periods used in our study (up to six weeks) strayed back to their natal hatchery at a rate less than 0.001% when released from another river system. Beginning in 2002, 100% of coho smolts released will be marked, thus allowing lower Columbia River hatchery managers to monitor strays of adult project fish to hatcheries where they were reared.

In the mid-Columbia region, returning coho have been observed spawning in tributaries to the Wenatchee where they were not released (Peshastin and Chiwakum), as well as in the Entiat River and Chelan Falls. YN proposes a radio-telemetry evaluation to collect data on stray rates of project fish in the mid-Columbia (see section 11.1.1).

In sum, broad geographical displacement and reduced survival of other salmonid populations is not expected because:

1) coho released during the period covered by this plan are expected to migrate quickly and therefore limit the risk of competition with other species;
2) studies have shown little residualism among hatchery coho smolts;
3) numbers of naturally spawning and rearing coho are expected to be well below the carrying capacity of the target streams;
4) the incidence straying and the numbers of naturally spawning fish would be monitored as carefully as technology allows; and
5) release numbers or rearing practices would be modified if necessary to limit effects on sensitive species.

Transfer of Disease

In general, artificially propagated fish are more prone to suffer from infectious diseases and parasites than their wild counterparts because they live under unnaturally crowded conditions where transmission of infectious agents is more efficient. In addition, hatchery rearing conditions and artificial diets may result in stress or nutritional imbalances that affect the physical condition of hatchery fish and their resistance to disease organisms. Concerns have been raised in the past that such diseases could be transmitted from hatchery-reared coho to wild fish of other species, thus increasing the incidence of infection among wild stocks.

The presumed risk is from two sources: first from hatchery coho smolts released into these locations and later, from adult fish returning to spawn. Upriver salmonids have been documented holding in the lower reaches of lower Columbia River tributaries where they may become exposed to infectious agents in that sub-basin and later show overt disease when they arrive at their upriver “home.” Using genetic “fingerprinting” methods, researchers have documented the movement of strains of infectious agents within the Columbia River basin that are believed to be due to the migration of adult salmonids (Jim Winton, USFS, personal communication, 1999).

Because anadromous fish are already in the subject watersheds and because coho salmon are more resistant than steelhead or chinook salmon to many of the viral and bacterial pathogens of concern, the added risk from this source seems limited. Virtually all of the infectious diseases affecting hatchery coho salmon in the Columbia River basin are thought to occur in wild fish or in the natural environment. Most Columbia basins have or have had the major diseases of concern. For example, BKD is prevalent in essentially all hatchery and wild stocks of salmonids in the Columbia River basin (Jim Winton, USGS, personal communication, 1999).

A literature review by Miller et al. (1990) found that, in spite of the comparatively high incidence of disease among hatchery stocks, there is little evidence that diseases or parasites are routinely transmitted from hatchery to wild fish. This review found a number of studies indicating that bacterial kidney disease was *not* transmitted from infected hatchery outplants.

Among the normal suite of viral, bacterial, fungal and protozoan diseases known to infect salmonids in the Columbia River basin, the most important for coho is coldwater disease. Coldwater disease is a significant risk to coho, particularly in the higher-elevation tributaries of the mid-Columbia basins. Depending on fish life stage and specific rearing conditions, when water temperature in the hatchery cools in the fall and winter, potentially lethal bacterial outbreaks can develop. The disease is treated using antibiotics, but it is not always effective. Because the causative bacterium is already free-living in the watershed, other salmonids in the basin might not be placed at significantly greater risk from this disease due to the presence of coho.

Hatchery-reared fish are prone, through proximity, to contract a variety of fungal, protozoan, and helminth parasites that are relatively easy to diagnose, and chemical treatment of the holding water normally is effective. Any potential risk of transmitting most internal and external parasites of salmonid fish from hatchery to wild situations would be confined to the brief period during outmigration and would therefore be limited.

All phases of broodstock development, fish transfers, and smolt releases would follow the fish health policy documented in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (IHOT 1995(a)). Rigorous sanitation and use of disinfecting procedures combined with optimum husbandry, isolation and quarantine practices and a strong diagnostic and therapeutic program would minimize fish health concerns and reduce any potential for adverse effects from disease transmission by released coho to a low risk.

Migration Corridor/Ocean

Little is known about the effects of hatchery fish on listed fish in the migration corridor and ocean. Studies have shown that a significant portion of all hatchery fish released into the Columbia River basin do not survive the Snake and Columbia River migration corridors, for a variety of possible reasons (NMFS 1999(b)). In an attempt to address potential ecological effects of hatchery fish on listed fish in the migration corridor and ocean, NMFS has recommended an annual production ceiling for the Columbia and Snake rivers. NMFS determined, in its Biological Opinion on the project, that the proposed 1999 coho salmon release was consistent with its Columbia River basin production ceiling and that it would not jeopardize the continued existence of listed salmon and steelhead in migration corridors, the estuary, or the ocean (NMFS 1999(b)). The total release numbers have not changed since 1999, so the 1999 determination is assumed to be still valid.

SECTION 4. WATER SOURCE

To begin to develop a locally adapted coho population, the project is using existing hatcheries that have space available and no conflicts with existing programs. Where possible, these facilities are in mid-Columbia basins. So far, however, capacity in the region is not sufficient to accommodate project needs. Winthrop National Fish Hatchery on the Methow River is being used for part of the broodstock development, but ideally another hatchery in or near the Wenatchee basin is needed to meet broodstock development and egg quality goals. Beginning in 2002, Entiat NFH will be used for adult holding, spawning, and egg eye-up only. Full term rearing is not available at this time but could be an option if resource managers reduce or eliminate Entiat NFH spring chinook production for ESA reasons.

Primary rearing facilities:

Winthrop NFH – Water rights total 29,930 gpm from the Methow River, Spring Branch Spring and two wells. Water use ranges from 8,528 to 27,686 gpm, with the Methow River providing the majority of the flow. All rearing facilities are normally supplied with single-pass water; however, some serial re-use occurs in low-flow years (USDI FWS n.d.). The water supply at Winthrop NFH has frozen in the past. If that were to happen again, any coho at the hatchery would be released into the environment.

Lower Columbia River rearing facilities:

Willard NFH – see USFWS documents for water supply details.

Cascade (ODFW) – see ODFW documents for water supply details.

Adult holding facilities:

Entiat NFH – water rights total 15,340 gpm from three sources: the Entiat River, Packwood Springs, and wells. Approximately 7,786 gpm is available for hatchery use. The Entiat River and wells provide most of this water flow.

Leavenworth NFH – water rights total 25,551 gpm from wells, Icicle Creek, and Snow and Nada lakes. Average flow available to the hatchery is 18,170 gpm. There is insufficient water to operate all rearing facilities. Water from Snow and Nada lakes supplement Icicle Creek during low flow periods.

Chiwawa (WDFW) – see WDFW documents for water supply details.

Approved or proposed acclimation/release sites as of spring 2002:

Dam 5 – Icicle River [not expected to be available after 2003].

Little Wenatchee (Two Rivers) – Pumped ground and/or gravel pit water, discharged to the Little Wenatchee River (revised location since 2001, subject to environmental review).

Butcher Creek – Butcher Creek, tributary to Nason Creek.

Early Pond – Unnamed creek, tributary to Nason Creek.

Whitepine – Unnamed creeks, tributary to Nason Creek (subject to environmental review).

Beaver Creek – Beaver Creek, tributary to the Wenatchee River.

Eightmile Creek – Eightmile Creek, tributary to the Chewuck River.

Biddle Pond – Wolf Creek, tributary to the Methow River.

Other potential sites are being identified and, if proposed, will be subject to various environmental and TWG reviews before being used.

SECTION 5. FACILITIES

Section 1.5 describes the locations of physical facilities required for this feasibility study. No permanent hatchery will be built for these studies. Most facilities proposed for use already exist. The exceptions include some acclimation sites and a potential temporary production facility if existing facilities cannot be used. Impacts of construction and use of currently known acclimation and temporary production facilities are described in the following documents:

- *Mid-Columbia Coho Reintroduction Feasibility Project, Final Environmental Assessment and Finding of No Significant Impact* (USDOE/BPA 1999(b)) and *Supplement Analyses* (USDOE/BPA 2001(b) and USDOE/BPA 2001(d));
- Biological Assessment for Mid-Columbia Coho Reintroduction Feasibility Project, Chelan and Okanogan Counties, Washington (USDOE/BPA 1999(a));
- Biological Assessments prepared for USFWS in March 2001 (USDOE/BPA 2001(a)) and for NMFS and USFWS in August 2001 (USDOE/BPA 2001(c)).

5.1) Broodstock collection facilities (or methods).

Coho returning to the Wenatchee River Basin might be collected at one or more of the following facilities: Dryden Dam, Tumwater Dam, Dam 5 and the ladder at Leavenworth NFH, and Columbia River mainstem dams. For the Methow River, coho will be collected at Wells Dam and at the Winthrop National Fish Hatchery. If insufficient broodstock are trapped in the mid-Columbia sites listed, then Prosser Dam at RM 40 on the Yakima River may be used as an alternative to meet broodstock collection goals, rather than making up deficits with lower Columbia River fish. Prosser Dam is a coho broodstock collection site for the Yakima River coho restoration program. See section 7.2 for more detail.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adult coho are transported in a 930 gallon insulated stainless steel fish transportation tank. The tank is equipped with four microbubble ceramic plate oxygen diffusers and two aerators. In addition to the large transportation tank, a limited number of adult coho may be transported in a 200 gallon insulated fish tote equipped with one or two oxygen diffusers.

Coho smolts typically are hauled from lower Columbia River hatcheries to various acclimation sites in mid-Columbia basins by Oregon Department of Fish and Wildlife (ODFW). Fish are transported in 1,500-5,000 gallon (6,000-19,000 liter) transport tanker trucks. These units are insulated and typically maintain sub-50ºF (<10ºC) hauling temperatures and strive for no more than a 10ºF (6ºC) (<5ºF preferred) variation between tank temperature and release site temperature. Transport tanks are equipped with oxygen injection and water circulation systems. Dissolved oxygen levels are maintained at 9-15 ppm. Oxygen and temperature levels are monitored during transports. Hauling densities are targeted at or below 1 pound of fish per gallon of water. Length of transport ranges from 6-8 hours.

5.3) Broodstock holding and spawning facilities.

All coho collected at Dryden Dam, Tumwater Dam, and on Icicle Creek will be transported by Yakama Nation personnel to Entiat National Fish Hatchery. The adult holding ponds at ENFH will be used as a holding facility until all the fish are spawned. End dates will be determined each year in consultation with facility operators.
Fish collected at Wells Dam will be transported to Winthrop NFH for holding and spawning.

5.4) Incubation facilities.

Leavenworth NFH – Coho eggs are incubated in Marisource stack incubators with 6,000-6,500 eggs per tray. Total incubation capacity for coho at the LNFH is 720,000 eggs. The hatchery uses ground water and effluent is UV-sterilized prior to discharge.
Peshastin incubation facility – Two deep trough incubators were used for brood year 2001. Each trough contained 4 incubation cells. Chilled water was supplied to each incubator. Total incubation capacity at the Peshastin facility (a temporary facility at a former fruit warehouse) was approximately 864,000 eggs.
Entiat NFH – A total of three deep trough incubators supplied with chilled water will incubate coho eggs at the ENFH. Maximum incubation capacity at ENFH will be 1,728,000 green eggs.
Cascade Hatchery (ODFW) – Eyed eggs transported from green egg incubation sites will be hatched in existing facilities.
Willard NFH – Eyed eggs transported from green egg incubation sites will be incubated and hatched in existing facilities.
Winthrop NFH. – Normally eggs are incubated from adults spawned at the hatchery. If there is a shortfall in the target numbers for this hatchery using eggs from adult returns to the Methow, eyed eggs transported from lower river sites will be incubated and hatched here.

5.5) Rearing facilities.

Mid-Columbia brood eyed-eggs not reared in the region will be transported to lower Columbia River fish hatcheries for rearing. These hatcheries may include Cascade FH (ODFW) or Willard NFH. Please refer to HGMPs for these facilities for information on rearing conditions.

5.6) Acclimation/release facilities.

Figures 2 and 3 show locations of existing and known potential acclimation sites, listed below. Currently, coho pre-smolts are acclimated in semi-natural ponds or river side channels behind Dam 5 on Icicle Creek and at Butcher Creek, Beaver Creek, and Early Pond in the Wenatchee basin; and at Winthrop NFH in the Methow basin. Additional sites are proposed in the Wenatchee basin for 2002 and beyond. The program will lose use of the Dam 5 site after 2003. In the Wenatchee basin, specific acclimation and release sites in Chumstick and Brender creeks, a replacement for acclimation at Dam 5, and additional sites in Nason Creek have not been approved, although some options have been identified. Additional sites in the Methow beyond those identified in the 1999 EA have not been proposed. No specific sites in the Entiat basin are currently proposed. Before new, additional, or replacement sites are developed, they would be subject to NEPA and/or ESA review of site-specific impacts.

Wenatchee basin

- Dam 5 – an impoundment formed in the Icicle River channel by a dam. Fish screens added to the dam confine coho during acclimation.

- LNFH – above-ground temporary metal framed ponds or unused Foster/Lucas cement ponds. Potential replacement for Dam 5.
- Little Wenatchee (Two Rivers) – a proposed site at an operating gravel pit that will require construction of an earthen pond and a pumped water supply.
- Butcher Creek – an existing beaver pond with an outlet barrier added.
- Early Pond – an existing pond formed during construction of Highway 2. An outlet screen is fitted to an existing culvert to confine fish.
- Beaver Creek – an existing pond adjacent to Beaver Creek with inlet and outlet screens added to confine fish and regulate water flow.
- Whitepine – two proposed sites near the Whitepine campground. One is an existing pond on private land that would require a net barrier. The other is an existing beaver pond on USFS land that would need minor road improvements and a net barrier.
- Brender – an existing pond that will require the addition of a downstream barrier.
- Coulter Creek – an existing pond in the Nason Creek watershed proposed for use in 2003, requiring installation of an outlet pipe through a beaver dam and barrier nets.
- Mahar Creek Pond – an existing pond in the Nason Creek watershed proposed for use in 2003, requiring installation and removal of barrier nets.

Methow basin

- Eightmile Creek– an existing series of ponds with fish screens in place.
- Biddle Pond – an existing pond with fish screens in place.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Coho reared at Winthrop NFH experienced an unusual botulism problem in 2001, after their rearing location was changed due to the extremely low water that year. The rearing location has been moved to inside the hatchery. There was no reported loss from botulism in natural or hatchery populations of other species. This problem is not expected to recur.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Coho are not listed in these basins.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source

Because coho salmon have been extirpated in the Wenatchee and Methow basins, the research into the feasibility of reintroducing the species relies on development of a coho broodstock from lower Columbia River populations. No wild stock from the mid-Columbia exists to use, and wild stocks from other areas such as British Columbia currently are unavailable. The domesticated Lower Columbia River stock (which originated from the Toutle River stock, with recent infusions of Sandy River stock) is being used as initial broodstock. These fish would come as smolts from Willard or Cascade hatcheries. In 2000, 700,000 smolts came from Cascade and 400,000 from Eagle Creek, but Eagle Creek is no longer used as a source. The numbers from each hatchery are negotiated annually, but the fish are from essentially the same stock regardless of which of the three lower river hatcheries they come from.

Beginning in 1999, adult coho returning to the mid-Columbia from earlier releases in the Methow basin were collected at Wells Dam and Winthrop NFH for use as broodstock. Other collection points were added in later years (see section 1.5). Projected numbers of returning adults to be collected in 2002 are shown in Tables 14 and 15 (section 7.4). Broodstock collection goals are developed annually. As adult returns increase, the project will rely less on the Lower Columbia River stock.

To maximize the potential for genetic variability and naturalization of the returning population, the project would initially use most of the returning coho for broodstock, collected throughout the run. Hatchery fish that return to the mid-Columbia will have gone through a substantial selection process to survive the long migration and the variety of obstacles they encounter in the journey, which is expected to enhance the trend toward local adaptation.

Ideally, adults collected at Wells Dam would be used to develop a Methow basin broodstock, and adults collected at Dryden or Tumwater dams would be used to develop a Wenatchee basin broodstock. However, the number of adults returning is likely to constrain the program from meeting the ideal for much longer than the scope of this plan. For this period, in general, Wenatchee returns are incubated at Entiat NFH and then at lower river hatcheries and returned to the Wenatchee for acclimation. Methow returns are spawned and reared at Winthrop NFH, to the extent of their capacity. The localized stocks are supplemented with progeny of lower Columbia River hatchery stocks if necessary to meet production numbers. Release guidelines are specified in section 10.4.

6.2) Supporting information

6.2.1) History

The Lower Columbia River stock has been essentially a hatchery stock since the 1960s and is considered domesticated. The original source of the Lower River stock was the Toutle River stock. The LCR stock also has had recent infusions of Sandy River stock.

Ninety Years of Salmon Culture at Little White Salmon National Fish Hatchery (Nelson and Bodle, 1990, pp. 12-18), describes the early history of the Lower River stock. Tables 12 and 13 show more recent history.

> *Initial attempts to rear coho salmon with the native, late-running stock were made in 1919 and 1922. Attempts in 1930 and in the 1950s involved early-running stocks native to the Quinault, Quilcene, and Dungeness rivers of Puget Sound, Washington, as well as a native Toutle River stock. The Toutle River stock was considered responsible for establishing a successful run in 1956. In 1957 and 1958, eggs from Little White Salmon*

NFH were shipped to Willard NFH for incubation, after which the fry were returned for rearing. Additional eggs of the Toutle River stock were received from Eagle Creek NFH in 1962 and Bonneville State Fish Hatchery (SFH) in 1963.
Initially, these fish were released in their first summer; later, they were usually released as yearlings in February or March. Fish reared at Little White Salmon NFH were also shipped to Spring Creek, Eagle Creek, Carson, and Willard NFHs for finishing and distribution; others were released in the Columbia, Snake, Klickitat, and John Day rivers…
By 1965, a dependable run of Toutle River coho salmon stock was established… Increasingly larger numbers of eggs were moved to Willard NFH, until finally the Little White Salmon facility began serving its present function as an egg-taking station for Willard NFH. Eggs were also shipped to Entiat, Winthrop, Leavenworth, Carson, and Coleman NFHs; Washougal SFH; and [to other states and countries].

Table 12. Coho Genetic History at Eagle Creek Hatchery

Originally at hatchery beginning:	
BY '57	400,000 from Sandy River 200,000 from Little White Salmon NFH (Toutle)
BY '58	600,000 from Sandy River 467,000 from Big Creek
Since 1987 (released from ECNFH):	
BY '88	325,000 from Sandy River, released April '90
BY '90	292,000 from Sandy River, released April '92
BY '91	196,000 from Sandy River, released April '93
BY '93	579,000 from Toutle River, released May '95

Table 13. Willard NFH Coho Salmon Fish/Eggs Received From Other Hatcheries 1985-1999

Date	Number	Received From
01/28/94	187,556	Speelyai SFH, WA
12/04/94	589,433	Lower Kalama SFH, WA
12/24/96	883,000	Cascade SFH, OR
02/19/97	886,413	Bonneville SFH, OR
03/17/97	948,592	Klaskanine SFH, OR
06/12/97	268,002	Eagle Creek NFH, OR

6.2.2) Annual size

Broodstock collection of mid-Columbia adults began in 1999 at Wells Dam and Winthrop NFH. Table 1 (section 1.11) shows numbers of fish collected in each basin. In 2000, we estimate that 1,113 coho returned to the Wenatchee River Basin; of these, we trapped 919. We observed a pre-spawn mortality rate of 9.5% (87 fish). Based upon 2001 dam counts (Rock Island minus Rocky Reach), 8,555 adult coho returned to the mid-Columbia River and Wenatchee River Basin. This gives us a 0.86% survival rate. Based on numbers of coho collected further upstream at Dryden Dam and in Icicle Creek, Tumwater Dam video counts, redds in Icicle Creek, and coho carcasses collected in the Wenatchee River, 1,730 coho were known to return to the Wenatchee River basin and spawn, providing a minimum smolt-to-adult survival for the Wenatchee River of 0.16%. We collected 1,240 coho for broodstock in the Wenatchee River Basin in 2001.

Based upon Wells Dam counts, 536 coho returned to the Methow River in 2001. This gives us a 0.27% smolt-to-adult survival for the Methow River. Of the 536 coho counted at Wells Dam, 334 coho returned to the Winthrop National Fish Hatchery; 93 were females. Of the 334, 128 males were returned to the river to spawn naturally.

In future years, if too few adults return to maintain an effective population size, their numbers would be supplemented either by adding Lower River adults to the breeding pairs, by supplementing the next year's releases with Lower River smolts, or a combination of both.

6.2.3) Past and proposed level of natural fish in broodstock.

Currently, there is no natural population from which to collect broodstock. Once naturally reproducing coho salmon are re-established in mid-Columbia tributaries, natural fish will be incorporated into the broodstock, initially in their proportion to hatchery fish. As natural production increases, the percentage of naturally produced fish incorporated into the broodstock would be evaluated on an annual basis.

6.2.4) Genetic or ecological differences

There are no natural stocks of coho in the target area. Genetic studies will monitor divergence of natural spawners from hatchery broodstock if the project is successful at improving adult returns (see section 11.1.1).

6.2.5) Reasons for choosing

The primary reason for choosing Lower River broodstock to begin with is that it is the closest stock available geographically, and it is the only early stock in the Columbia River basin. For at least six years, the broodstock selection process would be entirely random, but as large a proportion as possible of the returning adults will be used in order to incorporate the characteristics that allowed the lower Columbia River fish to return to mid-Columbia basins. While the genetics monitoring program would study returning coho for traits associated with survival and adaptability, any proposal to select for certain traits in developing broodstock would be evaluated in future decision-making processes. See also section 6.1.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Because coho are considered extirpated from mid-Columbia basins, introduction of a Lower River stock would not affect a listed population.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults.

7.2) Collection or sampling design.

Include information on the location, time, and method of capture (e.g. weir trap, beach seine, etc.) Describe capture efficiency and measures to reduce sources of bias that could lead to a non-representative sample of the desired broodstock source.

Wenatchee River Basin
To maximize genetic diversity we will collect a representative sample of returning coho from throughout the run. Based on experience in 2000 and 2001, we expect the first coho to arrive at Dryden Dam as early as the first week of September and to continue through early December. Migration peaks in mid-October. Weekly broodstock collection goals will be developed on an annual basis based on the average distribution of returning coho (Table 16 [section 7.4]). If, during any week, the broodstock collection goal is not met, the deficit will be carried over to the following week.
If we are unable to meet our weekly broodstock collection goals through trapping efforts at Dryden Dam, adult coho will be trapped concurrently at Tumwater Dam and Leavenworth NFH Dam 5 or ladders on the Icicle River.

- Dryden Dam: Broodstock collection at Dryden Dam will take place daily in coordination with Eastbank Fish Hatchery Complex personnel. Currently, YN provides two people (fisheries biologist and/or fisheries technicians) each day during the trapping period to assist in trap operations. Number of personnel required for trap operation will be re-evaluated with facility operators on an annual basis. If the weekly coho broodstock collection goals are met prior to the end of the week, YN personnel will continue to assist in the operations and collections at Dryden Dam, to include enumerating and passing coho upstream. YN alone will operate the Dryden Dam fish trap after November 14th.
  The Dryden Dam fish trapping facility is operated by WDFW and Chelan County Public Utility District (CPUD) personnel from July 5 through mid-November to collect steelhead and summer chinook broodstock. The trap normally is operated 24 hours a day, 5 days a

week. BPA has proposed to extend the trapping period to December 7. This will help ensure broodstock are collected throughout the entire run.
To keep transportation stress to a minimum, no more than 65 adult coho will be collected and transported from Dryden Dam on any given day. Any coho in excess of 65 will be passed upstream.

- Tumwater Dam: Trapping efforts at Tumwater Dam will be coordinated with Eastbank Fish Hatchery personnel. Tumwater Dam trap normally is operated 3 days/week, 8 hours/day between July 19 and November 17th (Peterson 2001), although it is permitted to operate up to 16 hours a day. BPA has requested that operations be extended through December 7.

- Leavenworth NFH: If necessary, coho would be trapped at Dam 5 or the fishway, using both the right and left bank ladder traps. The trap could be operated between September 7 and December 7, by either YN or hatchery personnel.

Methow River Basin

Depending on run size, adult coho can either be trapped at Wells Dam and/or allowed to ascend the Methow River on their own. If insufficient numbers return to the Methow River basin, additional broodstock may be taken in the Wenatchee River basin to meet Methow basin project goals.

- Wells Dam: Beginning in fall of 1999, coho adults returning to the Methow basin were trapped at Wells Dam on the Columbia River. The dam is equipped with traps to collect adult fish. The traps are currently being operated by WDFW to collect steelhead adults, which would be returning at the same time as coho. Currently we allow coho adults to swim into Winthrop NFH rather than trap them at Wells. If the runs are predicted to be less than 150 coho for the Methow, we would trap at Wells as often as WDFW's permit (#1094) allows.
- Winthrop NFH: The Winthrop NFH fish ladder is opened on the first of October and allowed to attract and collect fish throughout the run. Coho swim directly into the hatchery. Because this is the only release site for coho smolts in the Methow basin, the coho are expected to be well-imprinted on the hatchery, resulting in good collection rates. Spawning generally begins during the last week of October and continues on a one-day-per-week basis for a period of approximately 5 weeks.

  Sources of bias: The sources of bias are low at Tumwater and Wells dams and at Winthrop and Leavenworth hatcheries. The sources of bias at Dryden are unknown. Potential sources of bias may include fish size and ladder efficiency, particularly with regard to river discharge. Dryden is a low-head dam, so fish can jump over it during high flows.

7.3) Identity.

Describe method for identifying (a) target population if more than one population may be present; and (b) hatchery origin fish from naturally spawned fish.

The project will begin marking all hatchery fish with coded wire tags to distinguish them from any naturally produced fish that may return in future years. See section 11.1.1.

7.4) Proposed number to be collected:

7.4.1) Tables 14 and 15 show program goals for the Wenatchee and Methow basins for 2002. They are based on pre-spawn mortality, eye-up, and hatching rates observed during the 2000 and 2001 brood years. The program goals will be re-evaluated on an annual basis if eye-up, mortality rates, or sex ratios change.

Table 14. Wenatchee River Broodstock Collection Goals: 2002

Program Goal (smolts)	Egg-to-smolt survival rate	Green eggs required	Fecundity	Pre-spawn Mortality rate**	Adult Females Required	Total Broodstock Collection ***
1 million	.60	1.6 million	2750	.10	673	1464

* Based on projected egg-to-smolt survival rates observed in 2000 brood
** Observed pre-spawn mortality rate in 2000 and 2001
*** Assumes 54:46 male to female ratio as observed in 2001

Table 15. Methow River Broodstock Collection Goals: 2002

Program Goal (smolts)	Eyed-egg survival rate*	Eggs required	Fecundity	Pre-spawn Mortality rate**	Adult Females Required	Total Broodstock Collection ***
250,000	.70	357,143	2750	.10	144	497

* Based on projected egg to smolt survival rates observed in 2001

** Observed pre-spawn mortality rate in 2000 and 2001

*** Assumes a 71:29 male to female ratio as observed in 2001

Table 16 shows weekly broodstock collection goals for the Wenatchee basin in 2002. Weekly goals will be developed annually. In the Methow, the project captures all possible fish, but at some point might need to develop weekly goals.

Table 16. Weekly Coho Broodstock Collection Goals for Wenatchee Basin: 2002

Week ending	9/8	9/15	9/22	9/29	10/6	10/13	10/20	10/27	11/3	11/10	11/17	11/24	12/1	12/8	Total
Estimated	0.1	1.6	7.2	10.9	12.3	20.2	10.5	9.9	12.8	6.5	3.7	2.0	1.8	.50	100

% of run															
Broodstock collection goals	2	23	105	160	180	296	154	145	187	95	54	29	27	7	1464

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

See Table 1 (section 1.11) and section 6.2.2.

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Fish collected in excess of broodstock needs at Dryden Dam will be passed upstream.

7.6) Fish transportation and holding methods.

Methow Basin: If adult fish are trapped at Wells Dam, they are transported by a 400-gallon tank truck in groups of 20 or less to the Winthrop NFH adult holding/spawning facility. The trip takes about an hour and a half. Also see section 8.3.
Wenatchee Basin (see tank description in section 5.2): Coho are transported from Dryden to Entiat in a 0.6% salt solution (by weight), and are released directly into the holding pond. The trip takes about 1.25 hours. All broodstock will be treated with a 167 ppm formalin drip as a fungal control measure. Initial treatments begin upon release of fish into the holding pond and will continue for three consecutive days past the last transfer of fish. Thereafter, fish are treated every two to three days or as needed to control fungus.

7.7) Describe fish health maintenance and sanitation procedures applied.

See section 7.6. The fish transportation truck is disinfected weekly.

7.8) Disposition of carcasses.

At Winthrop NFH, spawned carcasses are returned to streams in the upper Methow basin for nutrient enhancement. At Entiat NFH, fish might be injected with an anti-bacterium to keep them disease-free. In those cases, carcasses are buried on the hatchery grounds. Uninjected carcasses are returned to streams.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Any listed fish caught in the traps would be removed and released immediately.

SECTION 8. MATING

8.1) Selection method.
Spawners will be chosen randomly from ripe fish once a week. Returns from mid-Columbia brood may be selected to mate with returns from Lower Columbia River (LCR) transplants or other mid-Columbia brood to eliminate crossing LCR returns with LCR returns.
8.2) Males.
Eggs will be fertilized with one primary male and one back-up male. Jacks (2-year-old males) will be randomly collected during broodstock collection in the relative proportion that they occur in the run and incorporated into the mating schemes.

8.3) Fertilization.
During fertilization procedures, we will follow a 1:1 mating protocol with a back-up male. In the event that five or fewer females are available for spawning on any single spawn date, the eggs from each female will be divided into 5 clutches, a different male fertilizing each clutch.

- **Leavenworth NFH, Entiat NFH and Peshastin incubation facility:** Green eggs will be transported to the incubation facility where fertilization will occur. After fertilization, Iodophor egg treatments will include a minimum of one 30-minute contact period prior to putting the eggs in the incubation trays.
    - **Winthrop NFH:** A minimum of six persons is required to carry out spawning operations at the adult holding/spawning facilities. For actual spawning, two fish killers select and kill males and females from pre-sorted fish. One spawner strips eggs from the females into numbered plastic zip-lock bags, one bucker spawns the males into numbered plastic bags, one egg transporter carries coolers containing gametes to the hatchery building, and one person fertilizes and places the eggs in an Iodophor solution (75ppm) in the isolation incubation buckets. Further details on spawning methods can be found in the Winthrop NFH Fish Culture Manual.

  Personnel from the USFWS Olympia Fish Health Center are present at most or all spawning days to collect viral and bacterial samples from the adults. They coordinate with the spawner and the bucker to get the proper amount of ovarian, blood, kidney, and spleen samples. After spawning, they immediately transport their samples back to the lab.

8.4) Cryopreserved gametes.
The program is cryopreserving gametes for a long-term genetics study. In 5-15 years, the project would use the gametes to determine if changes in genetic characteristics, run timing, or other behaviors result in measurable survival benefits.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.
The mating scheme will not affect listed natural fish, as coho are not listed in these basins.

SECTION 9. INCUBATION AND REARING

At the outset of the feasibility studies, final incubation and rearing of coho to smolts was done only in lower Columbia River hatcheries. The smolts were then trucked to mid-Columbia acclimation sites.

Beginning in 1999, Winthrop NFH began incubation and rearing of eggs and juveniles from adults returning to the mid-Columbia. They have the capacity to rear up to 250,000 smolts per brood year, with two brood years on station at a time. As stated in section 1.5, additional capacity in the region is needed to maximize the potential to meet program goals for broodstock development and smolt quality. In the Wenatchee basin, initial incubation takes place at the LNFH. LNFH does not have space to incubate the program’s entire annual egg requirements; at this time, capacity for coho is limited to approximately 720,000 coho eggs. In 2001, coho eggs in excess of 720,000 were incubated at a temporary facility housed in a fruit warehouse in Peshastin. Beginning in 2002, coho eggs will be incubated at the Entiat NFH and/or at the Peshastin facility, transferred to lower Columbia hatcheries at the eyed egg stage for rearing to pre-smolts, and then returned to mid-Columbia basins for acclimation and release.

Physical characteristics of the rearing environment and fish growth and health in those environments depend on the hatchery. All hatcheries currently involved in this project use appropriate IHOT protocols and standards, including those for health and disease monitoring.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Provide data for the most recent twelve years (1988-99), or for years dependable data are available.

Table 1 in section 1.11 shows eggs taken and survivals since 1999. Tables 14 and 15 in section 7.4 show egg take goals and survival rates expected for 2002. Goals will be adjusted annually (see section 7.4).

9.1.2) Cause for, and disposition of surplus egg takes.

To date, no surplus eggs have been taken.

9.1.3) Loading densities applied during incubation.

Provide egg size data, standard incubator flows, standard loading per Heath tray (or other incubation density parameters).

See 9.1.4 below.

9.1.4) Incubation conditions.

Describe monitoring methods, temperature regimes, minimum dissolved oxygen criteria (influent/effluent), and silt management procedures (if applicable), and any other parameters monitored.

Incubation procedures at all sites will follow IHOT recommendations for flow rates, loading densities, *Saprolegnia* control treatments, and water quality conditions. Incubation will occur at ground water temperatures; however, egg development will be retarded through the use of chillers in some cases. The purpose of this altered temperature regime will be to more closely match natural emergence times and to concentrate the range of time over which fry begin feeding in the hatchery.
Leavenworth NFH: The coho eggs are reared in an isolation unit (10'x 8'x 6') located inside the nursery building. This unit contains 8 Marisource heath incubator stacks with 16 trays per stack. To prevent silt build up, the top tray of each stack is not used, leaving 15 trays per stack for egg rearing. Each tray measures 15.5" x 12.5" x 2". Well water is provided to the incubator trays at a rate of 4 gallons per minute (gpm), with a temperature range of 45-48° F. Loadings are set at 2.5 females per tray, which is approximately 6,000-7,000 eggs. The maximum loading for the isolation unit is 750,000 eggs. Egg development is monitored using Daily Temperature Units (DTUs). The eggs remain in the Heath trays until they reach the eyed stage at approximately 500 DTUs. The eggs are then removed from the trays and shocked by pouring a basket of eggs from a height of 2 to 3 feet into another basket submerged in water. Twenty-four hours after shocking, the

eggs are picked with a Jensorter model H egg-picking machine. The following day the eggs are transported to another facility by Yakama Nation fishery staff.

Throughout the incubation period, the eggs are chemically treated to prevent fungus problems. Using a Masterflex peristaltic pump, a daily 15-minute dose of 1667 ppm formalin is pumped through ½ inch PVC pipe to the Heath incubators. Each Heath incubator stack has one micro-irrigation emitter, which is used to disperse the formalin treatment. Additionally, the isolation unit is equipped with an alarm system and a flow-through Ultra-Violet (UV) effluent treatment. The alarm detects any deleterious fluctuations in flow and/or temperature, and the UV system treats all effluent water from the isolation unit.

The LNFH staff maintain the incubators, temperature regime, and flow volumes and keep records on temperature units and egg numbers (eye-up).

Peshastin (2001): Groundwater is used for incubation. It has a $CaCO_3$ hardness of 73, a pH of 7.7, and an average temperature of 52º F. Water temperature is monitored with an onset temperature recorder, which measures temperatures hourly. Temperatures are maintained at approximately 41ºF with a water chiller. The water is passed over a tote filled with bio-rings to ensure that adequate levels of dissolved oxygen and total dissolved gas are maintained prior to entering the incubators. Water is treated with activated charcoal and oyster shell prior to use in the incubators. Four gpm of flow is used per deep trough and the maximum green egg capacity per trough is 500,000.

Entiat NFH (2002 and beyond): Incubation facilities and conditions will be similar to those used in Peshastin in 2001.

Winthrop NFH: The eggs remain in the isolation incubation buckets until eye-up, which occurs approximately one month after spawning, or at 450-540 DTUs. After eggs are eyed, they are shocked and then picked by hand. Buckets containing a high mortality are picked with a mechanical egg picker.

After picking, and after receiving the Enzyme Linked Immunosorbent Assay (ELISA) results for each numbered bucket, the eggs are weighed and sampled on an electronic scale. A 200-500 egg sample is taken, to estimate the number per pound. Since coho salmon are quite resistant to bacterial kidney disease (BKD), eggs with differing ELISA values (lows, highs, and moderates) are tracked throughout incubation and rearing, but they are not isolated. After enumeration, the eyed eggs are placed in the Marisource stack-type incubator, using the 15.5" x 12.5" x 2" trays, 7 trays per stack.

Each tray is loaded with 4,000 eggs. Water flow is maintained at 3-5 gpm. Ground water is the primary incubation source and temperature remains quite constant in the range of 48 - 50º F. Dissolved oxygen levels are also constant at about 9.5 ppm inflow and not less than 8 ppm outflow.

Since fungus (i.e. Saprolegnia sp.) has not been a problem in the incubation of salmon and steelhead eggs at Winthrop NFH, formalin treatments are not required during incubation. Hatching begins after approximately 975 DTUs. Yolk sac mortality can be avoided by keeping incubation flows below 5 gpm. Significant yolk sac mortality has been observed in incubation units where flows exceed 6 gpm.

9.1.5) Ponding.

Ponding will occur after a majority have buttoned up (approximately 1375 temperature units). At ponding the coho will be approximately 1,100 fish per pound and 4 centimeters in length. Ponding will occur in February (Joe Blodgett, YN, personal communication).

9.1.6) Fish health maintenance and monitoring.

Regular iodophore treatments are the current method used to control fungus. Label regulations and recommendations are followed at all incubation locations. Eggs are shocked and picked after eyeing.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Because coho are not listed, the primary concern would be disease transfer between coho and listed fish in any of the incubation facilities. There are no listed fish raised at Entiat NFH or Leavenworth NFH. At Winthrop, where spring chinook are raised, coho are kept in separate raceways and water used in coho rearing containers is not used for spring chinook.

9.2) Rearing:

The following information applies to the Winthrop NFH. It is representative of the rearing conditions at Willard, Cascade and additional production facilities that may be used in the future.

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.

Experience is limited at this point. Survival rates based on this limited experience are shown in Tables 14 and 15 (section 7.4).

9.2.2) Density and loading criteria (goals and actual levels).

Table 17 shows rearing facilities at Winthrop NFH.

Table 17. Rearing Facilities at Winthrop National Fish Hatchery

Unit Type	Unit Length (ft)	Unit Width (ft)	Unit Depth (ft)	Unit Volume (cu ft)	Number Units	Total Volume (cu ft)	Construction Material
Brood Ponds	80	40	6	19,200	2	38,400	Concrete
Marisource Incubators					42		Fiberglass

Raceways	80	8		1,300	30	39,000	Concrete
Foster Lucas Raceways	76	17		2,200	16	35,200	Concrete
Raceways	102	12		2,200	16	35,200	Concrete
Starter Tanks	16	3		120	34	4,080	Fiberglass
Troughs	16	1.33	1	21	8	168	Concrete

Swim-up fry are expected to be ready to come out of the stacks with full yolk absorption after 1800 DTU. The nursery is presently equipped with 34 fiberglass tanks. Every tank is thoroughly cleaned and then disinfected with approximately 2 ppm Hyamine between year-classes. The tanks have a total capacity of 100 cubic feet; rearing space per tank is approximately 89 cubic feet. The tanks accommodate a flow of approximately 30 gpm. Ideally, 15,000 to 20,000 fry should be started per tank. However, at full production, initial loading of tanks may be closer to 30,000 fish per tank. Initial DI (Density Index) in past years has ranged from 0.05 - 0.41, and the FI (Flow Index) has ranged from 0.28 - 1.22. The target densities are similar to those used in steelhead rearing at this facility. The hatchery tries to keep the DI below .30 during early rearing (fry stage) and below .20 during later rearing (fingerling stage to smolt).
Since fry and fingerlings receive better cleaning and feeding, and treatable diseases are more easily observed in the hatchery building, fingerling spring chinook normally remain in the nursery until they are 200 - 300/lb. Coho salmon fry will also remain in the nursery until that size is reached unless space is not available.

9.2.3) Fish rearing conditions

Pond management strategies (e.g., Density Index and Flow Index) are used to help optimize the quality of the aquatic environment and minimize fish stress which can induce infectious and noninfectious diseases. For example, the Density Index is used to estimate the maximum number of fish (of a given length) that can occupy a rearing unit based on the rearing unit's size. The Flow Index is used to estimate the rearing unit's carrying capacity based on water flows.
The following parameters are currently monitored at Winthrop NFH:

- *Total Suspended Solids (TSS)* — 1 to 2 times per month on composite effluent, maximum effluent and influent samples. Once per month on pollution abatement pond influent and effluent samples.
- *Settleable Solids (SS)* — 1 to 2 times per month on effluent and influent samples. Once per week on pollution abatement influent and effluent samples.
- *In-hatchery Water Temperatures* — maximum and minimum daily.
- *In-hatchery Dissolved Oxygen* — as required by stream flow and weather conditions.

9.2.4) Indicate biweekly or monthly fish growth information (average program performance), including length, weight, and condition factor data collected during rearing, if available.

Table 18. Coho Growth Data (Average 1997-2001), Willard NFH

Month	Length Increase (inches)	Food Conversion	Water Temperature (F)
January	0.074	1.60	40.0
February	0.115	2.89	40.4
March	0.306	1.47	40.9
April	0.323	1.19	41.2
May	0.425	1.00	43.3
June	0.487	0.92	43.4
July	0.508	0.97	44.2
August	0.562	0.95	44.2
September	0.458	0.97	43.6
October	0.228	1.79	43.0
November	0.148	3.55	42.1
December	0.059	4.23	40.7

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Winthrop NFH: At first feeding we generally start out at around 1.5% - 2% body weight per day until most of the fish are actively feeding. Feeding is spread out over 8 feedings each day. Once growth begins accelerating, feeding percentage is gradually decreased. Ground water in the nursery is quite constant at 47-51º F. At these temperatures we expect 50 Monthly TU/inch or about 0.33 inches per month. Once fish leave the nursery and begin rearing in raceways on river water, growth patterns change depending on temperature fluctuations. The following table illustrates average rates of coho growth in the first spring, and in the first and only fall on-station. The table includes averages from brood years 1999 and 2000.

		Average Growth (inches)	Average TUs/inch
Spring	April	0.489	31.0
	May	0.504	31.2
	June	0.341	64.9
Fall	October	0.364	49.3
	November	0.083	223.7
	December	0.057	339.4

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Winthrop NFH: Feeds from Moore-Clark are used throughout rearing. Guidelines for matching size of feed with size of fish come from a combination of the manufacturer's recommendations and trial and error, and are as follows:

swim-up - 570/lb	#0 Nutra Starter
570/lb - 300/lb	#1 Nutra Starter
300/lb - 150/lb	#2 Nutra Starter
150/lb - 100/lb	1.2 mm Nutra Fry
150/lb - 90/lb	1.5 mm Clark Fry
100/lb - 50/lb	2.0 mm Clark Fry
50/lb - 20/lb	2.5 mm Clark Fry

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health is monitored by the Winthrop NFH staff. Monthly fish health checks are conducted by Olympia Fish Health Center personnel. All rearing units are cleaned on a regular basis to help prevent environmental fish health problems.
Health monitoring activities that normally take place at Winthrop NFH include the following:

- On at least a monthly basis, both healthy and clinically diseased fish from each fish lot are given a health exam. The sample includes a minimum of 60 fish per lot.
- At spawning, a minimum of 60 ovarian fluids and 60 kidney/spleens are examined for viral pathogens from each species.

- Prior to transfer or release, fish are given a health exam. This exam may be in conjunction with the routine monthly visit. This sample consists of a minimum of 60 fish per lot.
- Whenever abnormal behavior or mortality is observed, the fish health specialist will examine the affected fish, make a diagnosis and recommend the appropriate remedial or preventative measures.
- Reporting and control of specific fish pathogens are conducted in accordance with the Co-Managers Fish Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

When sampling fish at LNFH and Butcher Creek, we estimate the degree of smoltification by classifying pre-smolts as either parr, transitional, or smolt based on physical appearance. ATPase activity is not measured.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

At Winthrop NFH, final rearing occurs in outside raceways and ponds. Coho are moved out to C-bank 12' x 100' raceways at 150-400 fish per pound in April or May. The fish occupy two ponds until marking or a DI of .20 is reached, at which time the groups are split to occupy 5 ponds until release—approximately one year after they are moved outside. Release is volitional and generally starts the third week of April and ends the first week of May. The target release size is currently 20 to 22 fish per pound.
Water source during final rearing is primarily river water. Ground water is usually available if needed to clear up disease problems or regulate growth rates. River water temperatures fluctuate according to air temperatures, but normally stay in favorable ranges throughout summer and winter months.
On years when egg take goals are not met, fish are often transported from lower Columbia River coho hatcheries to make up the number for a final release of 250,000 smolts. Successful transfers have taken place in late winter and early spring to allow an adequate acclimation period.
Release strategies may be modified by YN, but in recent years have been volitional type releases directly out of the rearing units. The large drains of C-bank lead under the hatchery grounds to a bypass channel which leads to the river.
Natural rearing conditions are emphasized during the acclimation/release phase (see section 10). Camouflage netting is used to provide semi-natural cover during most of the outdoor rearing cycle. Covers are not used during mid-winter months due to snow load problems. Also, temperature and feeding are manipulated to help match hatchery smolt sizes and growth regimes to those of natural smolts. Other hatchery rearing technologies that produce a more natural-like smolt will be tested in the future. Options being considered include rearing in locations closer to acclimation sites, rearing in natural–style ponds, rearing at low densities, extending the acclimation period to include the second winter prior to smolting, and more culture adjustments to include very rapid growth just prior to release.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

No listed fish are propagated in this program.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Yearling	751,500	19.2 (yr 2000)*	Volitional release, Apr 15 – May 30	Icicle Creek
Yearling	248,500	19.5 (yr 2000, at time of transport to site)*	Volitional release, Apr 15 – May 30	Nason Creek
Yearling	250,000	17.0 (yr 2000)*	Volitional release, Apr 25 – May 15	Methow River

* Source: K. Murdoch 2001

10.2) Specific location(s) of proposed release(s).

The following lists potential or approved release sites as of spring 2002. Others might be added in future years, depending on NEPA, ESA, TWG, and other reviews.

Stream, river, or watercourse: Nason Creek

Release point: Butcher Creek acclimation site, RM 8.2

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Nason Creek

Release point: Early Pond acclimation site, RM 8.5

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Nason Creek

Release point: Whitepine acclimation site, RM 11.2

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Beaver Creek

Release point: Beaver Creek acclimation site, RM 0.5

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Icicle Creek

Release point: Leavenworth NFH, Dam 5, RM 2.8

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Little Wenatchee R.

Release point: Two Rivers, RM 0.5

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Wenatchee R.

Release point: Brender, RM 2

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Chumstick Creek

Release point: Uncertain [possible direct stream release]

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Methow River

Release point: Winthrop NFH, RM 50.4

Major watershed: Methow River

Basin or Region: Mid-Columbia

10.3) Actual numbers and sizes of fish released by age class through the program.

Leavenworth NFH

Release year	Yearling	Avg size
1996	N/A	
1997	N/A	
1998	N/A	
1999	450,000	
2000	891,845	19.2
2001	855,167	19.5
Average	732,337	

Nason Creek

Release year	Yearling	Avg size
1996	N/A	
1997	N/A	
1998	N/A	
1999	50,000	
2000	76,893	19.5
2001	142,291	19.5
Average	89,728	

Methow River

Release year	Yearling	Avg size
1996	335,300	
1997	74,200	
1998	341,146	
1999	0.00	
2000	199,763	17.0
2001	260,319	19.0
Average	201,788	

Source: K. Murdoch, 2001.

10.4) Actual dates of release and description of release protocols.

Table 1 (section 1.11) shows release numbers from each release site in the Wenatchee and Methow basins. All fish were volitionally released as smolts. Release dates in the Methow ranged from April 25 – May 15; release dates in the Wenatchee ranged from April 15 – May 30. In the Wenatchee, snorkel surveys confirmed that all fish had left acclimation sites. The date volitional release begins is determined by observing the migratory behavior of the smolts.
The program ideal is to have sufficient numbers of progeny of local returns to allow progeny of returns to the Methow released in the Methow, and progeny of Wenatchee returns released in the Wenatchee. We have not yet reached that ideal. In the interim, because our data show that smolt-adult survivals are much higher for Wenatchee releases than Methow releases, we propose the following release guidelines, as the way to make the best possible use of the fish that have survived to the mid-Columbia:

1) Progeny of Wenatchee returns are released in the Wenatchee.
2) If there are insufficient smolts from Wenatchee returns to meet the 1 million release number in the Wenatchee, they will be supplemented with progeny of Methow returns. This could leave the Methow with a shortfall, so Methow releases would be supplemented, as necessary, with lower Columbia River stocks.
3) If there are still insufficient numbers to meet the 1 million release numbers in the Wenatchee, even with Methow progeny, they will be supplemented with lower Columbia River juveniles, in which case all releases in the Methow would be lower Columbia River stocks.
4) If there is extra production of Wenatchee progeny and a shortfall in the Methow, the extra Wenatchee fish could be used to make up the shortfall in the Methow.

10.5) Fish transportation procedures, if applicable.

Coho smolts are typically hauled by ODFW from lower Columbia River hatcheries to various acclimation ponds in mid-Columbia basins. Fish are transported in 1,500-5,000 gallon (6,000-19,000 liter) transport tanker trucks. These units are insulated and typically maintain sub-50ºF (<10ºC) hauling temperatures and strive for no more than a 10ºF (6ºC) (<5ºF preferred) variation between tank temperature and release site temperature. Transport tanks are equipped with oxygen injection and water circulation systems. Dissolved oxygen levels are maintained at 9-15 ppm. Oxygen and temperature levels are monitored during transports. Hauling densities are targeted at or below 1 pound of fish per gallon of water. Length of transport ranges from 6 to 8 hours.

10.6) Acclimation procedures (*methods applied and length of time*).

To condition them to the wild, coho smolts are acclimated away from the hatchery whenever possible in a semi-natural rearing environment. These sites use surface water supplies that expose fish to cold water early in the acclimation period and a rising temperature as the release time approaches. Ponds usually have earth and rock bottoms, and surrounding natural vegetation provides some cover. A low level of predation by fish, birds, and mammals will be allowed. Juvenile coho are typically acclimated for 4-6 weeks prior to liberation, but depending on experimental objectives, could be acclimated from 2 weeks to 6 months. During that period, fish culturists periodically feed the pre-smolts a predetermined amount of fish food. This amount is calculated based on number and size of fish, and on water temperature. Typical fish culture activities include net and screen maintenance; pond cleaning (if applicable); predator control using such methods as nets, non-lethal live traps, propane and other noise emitters; mortality assessments; and growth and fish health measurements.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

In 2000, 26,394 of the 925,000 coho released from Icicle Creek were coded wire tagged and adipose-fin-clipped; 26,118 were coded wire tagged with no external mark. No Butcher Creek fish were marked or tagged. Of the 200,000 coho smolts released from Winthrop in 2000, 26,470 were coded wire tagged and fin-clipped. By 2002, 100% of the hatchery population will be internally marked with a coded wire tag. The current marking protocol is outlined in Table 19 (section 11.1.1). Fish marked with CWT are not adipose clipped in order to limit their harvest in selective fisheries that target adipose-clipped coho (see section 3.3). Since the program's emphasis during the feasibility studies is development of a localized coho broodstock, the program will attempt to maximize the number of adults collected, thereby allowing the project to estimate relative survival between mark groups by evaluating tags recovered from fish collected for broodstock. We expect natural coho production to be relatively low since we will attempt to collect a large proportion of the return. However, we will attempt to estimate the number of naturally produced fish by estimating the relative proportion of unmarked juvenile and adult fish, thereby providing a means to estimate the smolt-to-adult rates for both hatchery and naturally produced coho.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Not applicable. The program has no surpluses at this time.

10.9) Fish health certification procedures applied pre-release.

Fish health experts check the condition of fish prior to removal from the hatcheries (described in 9.2.7). Health checks are not performed at the acclimation sites unless obvious signs of disease are present.

10.10) Emergency release procedures in response to flooding or water system failure.

In the event of flooding, coho would be released early from acclimation ponds. Sites are designed to allow safe fish migration during floods. High-water exit paths are included near stream channels so that if ponds are overtopped during floods, fish can leave volitionally. Premature releases might reduce coho survival if they were not ready to migrate, but high water likely would move them rapidly downstream in turbid water, providing little opportunity for them to prey on other species or to be preyed upon themselves.

In the past, Winthrop NFH's water system has occasionally frozen in winter, requiring release of fish. The hatchery plans to install a new infiltration gallery, reducing the likelihood that coho would be released prematurely; however, unforeseen disasters such as freezing or pump failures could still result in emergency releases of fish (C. Pasley, personal communication, July 2002).

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Most resident trout and steelhead are not considered to be at risk because these species generally emerge from the gravel after coho have migrated downstream, or spawn in upper reaches of tributaries (i.e., bull trout).

Studies in these basins have shown little evidence of hatchery coho predation on spring chinook, possibly because coho smolts migrate rapidly once they are released. However, because of the nature of the project, biologists need to deliberately create some risk to listed or sensitive fish in order to test the degree to which coho predation on other species might occur if coho are reintroduced. These risks are minimized by implementing the following measures as appropriate:

- working with other fish managers to determine release sites and numbers that minimize risk but that also meet research objectives;
- releasing coho smolts in low densities;
- attempting to release fish that more closely resemble sizes of wild coho, which tend to be smaller than hatchery fish[22] (our target size of 20-25 fpp equates to 110 – 120 mm).
- ensuring smolts are ready to migrate before releasing them volitionally; and

[22] Throughout the geographic range of coho salmon, length at smoltification is relatively consistent. Groot and Margolis (1991) reported that mean smolt size in yearling smolts ranged from 75 (Andersen and Narver 1975) to 122 mm fork length (McHenry 1981), and smolt size in Minter Creek, Washington ranged from 95-106 mm (Salo and Bayliff 1958).

- monitoring predation and adapting feasibility studies and activities as necessary to minimize risks.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

The studies listed below would be conducted in the Wenatchee, Methow and Yakima basins. Currently, direct predation studies are proposed only in the Wenatchee basin, although studies likely would be needed in the future in other basins.

Funding for this feasibility project is being provided by Bonneville Power Administration. The research is being implemented by the Yakama Nation, with assistance from other project participants.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program (section 1.10).

Performance Indicator: Trends in survival of hatchery coho as measured by smolt-to-smolt (PIT tags) and smolt-to-adult (counts at dams/facilities) survival.

The smolt-to-smolt and smolt-to-adult survival rates for hatchery coho released in the Wenatchee and Methow basins would be studied in three ways.

- To estimate smolt-to-smolt survival to McNary Dam and other lower Columbia River mainstem projects, a portion of each release group (at least 8,000 fish annually in the Wenatchee, 8,000 every third year in the Methow) would be PIT-tagged (see "Marking" below).
- Smolt-to-adult survival would be monitored for the Wenatchee basin based on Rock Island minus Rocky Reach and/or Dryden Dam adult fish passage counts and redd counts. They would be based on Wells Dam counts for the Methow basin.
- Coded wire tags would be collected from all coho retained for broodstock and from carcasses collected during spawning ground surveys to allow for a comparison in smolt-adult survival rates between acclimation sites and local vs. lower river stocks.

Marking

The marking protocol to estimate the smolt-to-adult survival rate for coho juveniles released in the Wenatchee system is outlined in Table 19. Three internal-mark groups will be identified: lower Columbia River transfers, Wenatchee progeny and Methow returning progeny. Each mark group will receive a differential CWT code. All CWT marks will be snout tags and potentially alternate body tag locations (for example dorsal, anterior fins, cheek, etc.). Adipose fin clips will not accompany CWT marks. In 2001-2002, an unmarked group (Lower River returns) will be identified by subtraction (total returns collected minus marked returns). Beginning in 2002, all three mark groups of juvenile coho released in the Wenatchee will be marked with CWT. If it is determined that selective mating of in-basin vs. Lower River progeny will occur, then body tag locations will be added in order to non-lethally differentiate mark groups. All marks will be retrieved from spawned broodstock and spawning ground carcasses in order to estimate survival by group.

The project will use PIT-tagged juveniles in order to parse out that portion of the smolt-to-adult mortality that is occurring in the freshwater migrant lifestage. Mark groups identified are lower Columbia River transfers, Wenatchee progeny and Methow returning progeny. PIT-tagged juvenile coho were released in the Methow in 2000 and 2001 (Table 20). This will give us two consecutive years of juvenile survival from the Methow for Lower River smolts. PIT tag releases from that point will occur approximately every third year (Table 20), unless mainstem passage conditions change, or other conditions occur to make us suspect survival rates may have changed.

PIT-tagged juveniles will be released in the Wenatchee River every year until at least 2005 (Table 21). The project PIT tagged and released 8,000 fish in 2000 and 2001 in order to establish a baseline juvenile survival rate for Lower River coho smolts. In 2002, the project released 8,000 coho juveniles from the Leavenworth Dam 5 site, in addition to 8,000 Wenatchee progeny from the natural production areas, in order to assess differences in juvenile survival between the two groups. During the period 2004-2005, the project will release 8,000 PIT-tagged Wenatchee progeny in the natural production areas to monitor changes in juvenile survival potentially related to the local adaptation process.

Marking Protocol for the Mid-Columbia Coho Releases

Table 19. CWT Marking Scheme* for Mid-Columbia Coho Smolt Releases

	Lower River Transfers Methow	Lower River Transfers Wenatchee	Wenatchee Progeny	Methow Progeny
2001	100% (250,000)	0% (826,600 **not** marked)	N/A	100% (146,875)
2002	100% (250,000)	100% (678,524)	N/A	N/A
2003	100% (if used)	100% (if used)	100%**	100%)**
2004	100% (if used)	100% (if used)	100%**	100%**
2005	100% (if used)	100% (if used)	100%**	100**

*   Marks will be differential CWT (snout and potentially cheek) with no adipose fin clip.

** Actual numbers will depend on numbers produced, which is unpredictable at this time.

Table 20. PIT Tag Releases of Juvenile Coho from the Methow Basin

Release Year	Lower River Transfers
2000	8000
2001	8000
2002	0
2003	0
2004	8000*
2005	0

*Numbers depend on funding.

Table 21. PIT Tag Releases of Juvenile Coho from the Wenatchee Basin

Release Year	Lower River Transfers	Wenatchee Progeny	Methow Progeny
2000	8000	N/A	N/A
2001	8000	N/A	0
2002	8000	17,000*	0
2003	0**	24,000*	0
2004	0**	24,000*	0
2005	0**	24,000*	0

* Numbers depend on funding.

**A sample will be PIT tagged, if Lower River fish are used.

Performance Indicator: Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry and foot/boat redd surveys.

Foot/boat redd surveys are conducted in the Wenatchee basin in several areas where adult coho are expected to spawn naturally (Nason Creek, Icicle Creek, and in the Little Wenatchee and Wenatchee rivers. In some of the smaller streams (Chumstick, Beaver, Brender), we might rely on weirs or traps to determine how many fish are returning to these streams. The Methow River is also surveyed.

Beginning in 2001 and continuing in 2002, the Yakama Nation is conducting a radio-telemetry evaluation to estimate the proportion of coho returning to the Wenatchee River that spawn in Beaver and Nason Creeks. Up to 75 adult coho randomly collected at the Tumwater Dam fish trap are anesthetized, gastrically tagged and released upstream of the dam. Fixed monitoring stations near the mouths of Nason and Beaver creeks determine how many of the tagged fish spawned in each creek. Mobile tracking determines the spawning locations of the tagged fish. Data are corroborated with spawning ground surveys. Video counts are used to estimate the total number of fish spawning above Tumwater Dam (Beaver Creek and Nason Creek). In 2004, the study will include adults spawning in the Little Wenatchee River.

The Yakama Nation conducts weekly spawning ground surveys in Nason Creek and bi-weekly surveys in Icicle Creek to identify the location and distribution of coho redds. Surveys began in fall 2001 and are conducted between about October 15th and December 15th. Surveys may extend beyond December 15th if spawning is not complete and river and weather conditions permit.

In Nason Creek, researchers attempt to count all coho redds. The surveys extend from Whitepine Creek (RM 15.4) to the mouth of Nason Creek (RM 0). The entire length of Icicle Creek below the hatchery (2.8 miles) is also surveyed. Elsewhere, surveys are conducted initially in stream reaches close to the smolt release sites, and branch out from these release sites if redds are not located; or researchers use radio telemetry results to guide them to likely spawning locations. Staffing and funding do not allow the entire basin to be searched for every coho redd.

Each redd identified is marked with a piece of surveyors tape. Locations of each redd are identified and mapped with a portable GPS unit. We also collect spawned coho carcasses during the surveys. From each coho carcass found, fork length and post-orbital hypural length are measured to the nearest millimeter. The sex is identified. The percentage of eggs remaining in each female coho carcass is visually estimated.

Physical data are recorded from a random sample of redds in each sub-basin.

Performance Indicator: Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts, redd capping, and smolt production estimates.

Redd count methods are described in the previous section. The smolt production estimate comes from the Monitor smolt trap, operated by WDFW. Redd capping (placing a fine mesh net over the redd and capturing emerging fry in the cod end) is also done in selected areas.

Performance Indicator: Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and recording of such traits as fecundity, body morphometry, maturation timing, and straying/homing rates.

The genetics sampling and adaptation program would study:

- the naturalization of a hatchery fish stock (Lower Columbia River stock);
- allelic frequencies to determine the amount and rate of divergence of the mid-Columbia broodstock from the Lower River stock;

- physical traits and demographic information for introduced coho juveniles and adults and the contribution of those traits and other characteristics to survival.

The main goal driving the genetic and adaptation monitoring and evaluation is to determine the best implementation strategies that result in enhancing the natural production of coho salmon in mid-Columbia rivers. The genetic and adaptation M&E plan focuses on three major categories: 1) are there changes in the frequencies of neutral alleles in the population over time as the program and broodstock develop; 2) is there phenotypic divergence of localized coho and Lower River hatchery coho; and 3) are the introduced fish successful at producing progeny?

The following subsections describe the specific program for each of the genetic and adaptation monitoring studies listed above.

- *Assess changes in out-of-basin stock using genetic monitoring of allelic frequencies.*

The main opportunity of the genetics M&E program is to determine the rate and direction of divergence in neutral allele frequencies of the coho stocks that are used for reintroduction in mid-Columbia rivers.

A sound understanding of the genetic structure of the species of interest is a prerequisite to the assessment of the genetic impacts of human activities such as introductions, transfers or stock enhancement on natural populations. A measure to assess the impact of human activities on natural populations is the degree to which the population structure responds to applied management actions. This can be done by measuring the frequencies of alleles at specific loci through time and in a series of populations (Allendorf and Phelps 1981; Utter 1991; Allendorf 1995). Such a database permits the determination of temporal (and mostly stochastic) and geographic (degree of isolation) variance components. A series of samples will be taken of naturalized coho spawning in the wild (Naches and Upper Yakima Rivers), as well as from the Yakima, Wenatchee, and Methow hatchery broodstocks. An additional number of samples will be used to scale the level of variability within and beyond the Columbia River populations (Umatilla, Clearwater, Klickitat, Lower Columbia, and the Thompson River on the Fraser River system). Microsatellite DNA techniques will be the primary tool. Protein electrophoresis and mtDNA may also be used.

- *Monitor traits such fecundity, body morphometry, and maturation timing.*

Because conditions in the mid-Columbia and Yakima are likely to be different than in the coastal streams and lower Columbia where the coho originate, life history characteristics of the introduced broodstock are likely to change. For one, the migration distance is very much greater into the mid-Columbia than, for example, to Eagle Creek. Optimal maturation rates and timing are likely to be different between these two areas. In order to determine if the stock used has adequate genetic variance and phenotypic plasticity to adapt to local conditions, the life history characteristics of the coho broodstock must be monitored over the length of the program.

An important link to environmental condition is the water temperature profiles in the streams or hatchery setting. The coho stock will be exposed to a water temperature profile that may deviate from the ancestral stream. Although this does not represent a particular problem for controlled conditions (there is generally very little variation in development rate of the eggs, and the genetic variance is additive), it is necessary to determine if the broodstock used has sufficient variance in maturation schedules to match local conditions. A longer-term goal is to select the broodstock from successful wild-spawning fish, thereby enabling the broodstock to progress towards local maturation optima.

For this plan, we will monitor fitness-related phenotypic traits such as fecundity, body morphometry, and maturation timing.

- *Gene flow from program fish into natural populations.*

Monitoring done on mid-Columbia coho will contribute to answering broader questions about the rate of genetic drift when a broodstock is established in a subbasin. A regional sampling effort will collect samples of coho from all reintroduced populations (programs with the intent of establishing wild-spawning, self-recruiting populations) above Bonneville Dam. These samples will be used to extract alleles at a number of nuclear DNA loci. These will be used to estimate parameters of gene flow, diversity, and genetic differentiation.

- *Quantify stray rates and homing to acclimation sites.*

As shown in Table 1b, 1,773 adult coho returned to the Wenatchee basin in 2001. The Fish Passage Center indicates that 10,465 and 1,628 adult coho were counted at Rock Island and Rocky Reach dams, for a difference of 8,837 adults (M. Cooper, USFWS letter, July 1, 2002). Such results raise questions of what happens to the coho between these dams and the smolt release sites to which they would be expected to return.

1) The project will investigate straying and drop-out rates of transferred hatchery coho within the mid-Columbia basin. A sample size of up to 400 adult coho returning to mid-Columbia tributaries will be radio-tagged at Priest Rapid Dam. A combination of fixed sites and mobile tracking will be used to identify spawning areas, drop-out rates, and stray rates. We will also recover CWTs from all carcasses during spawning surveys in order to recover release group information. We will also coordinate with other fisheries agencies within the basin to aid in the recovery of marks to evaluate homing/stray rates.

2) The project also will investigate the rates at which transferred hatchery coho stray back to their natal hatcheries. All fish collected for broodstock at the lower Columbia River hatcheries are examined for the presence of a CWT regardless of the presence or absence of an adipose fin. Spawning surveys conducted by state and federal agencies in the vicinity of lower Columbia River hatcheries also check carcasses for the presence of CWT regardless of the presence of an adipose fin, and enter data into existing regional databases.

Performance Indicator: Predation on other species by program fish as measured by stomach content analyses.

Currently, studies of predation by hatchery coho on sensitive species are planned only for the Wenatchee River basin. Predation studies would not be done in the Methow basin primarily because the opportunities don't exist to study predation on the species of concern—spring chinook, sockeye, and steelhead. All returning spring chinook adults in the Methow are collected and taken to the hatchery to be spawned under an adult-based supplementation program. Studies of hatchery coho predation on steelhead are not planned because steelhead emerge after yearling coho have migrated.

A rotary trap would be placed near two coho acclimation/release sites in the Wenatchee basin to monitor the level of predation on spring chinook and sockeye fry by coho smolts.

The stomach contents of up to 3,000 coho would be examined for each of two studies (one of coho predation on spring chinook, the other of coho predation on sockeye) (6,000 fish total).

- *Predation on spring chinook*

Methods are detailed in Mid-Columbia Coho Reintroduction Feasibility Study 2002/2003 F2 Study Plans (prepared by Keely Murdoch, YN):

Hatchery coho smolts released from acclimation sites on Nason Creek and naturally reared coho smolts scatter planted in Nason Creek approximately 9 months prior to the predation evaluation will be recaptured in a 5-foot rotary screw trap located at RK 1.3 on Nason Creek (Nason creek Campground). The trap will be operated between March 15 and June 15. The naturally reared coho will be marked with an adipose fin clip for quick identification.

The rotary smolt trap will be checked and the live box emptied hourly during the study. The frequent removal of coho from the trap is important in minimizing predation on chinook fry within the live box. Up to 1500 hatchery coho smolts and 1500 naturally reared coho smolts will be collected from throughout the run and retained for stomach content analysis, which will use methods similar to those used in previous years and documented in the 2001 annual report for the project (Murdoch and LaRue 2002).

- *Predation on sockeye*

A brief literature review of the life history of sockeye salmon indicates that they vary substantially in age at out-migration, in growth, and in rearing habitats throughout their geographic range (Groot and Margolis 1991). Such variation makes species-wide generalization difficult. Before attempting a study of coho predation on sockeye, life history information specific to Lake Wenatchee must be collected, in order to determine periods and locations that sockeye salmon in Lake Wenatchee are most susceptible to hatchery coho smolt predation. Sockeye life history collection began in 2001, with limited results; methods will be modified in 2002 as described below.

The YN used radio telemetry to estimate hatchery coho smolt spatial distribution within and travel time through Lake Wenatchee. Due to the short tag life of smolt-sized radio-transmitters (10 days), the data we gathered were limited—many of the tags died before the smolts left the lake. Of the fish we were able to track through the lake, mean travel time was 6.85 days. Telemetry technology is changing rapidly. During the 2002 spring emigration, a smolt-sized radio tag will be available with a tag life of approximately one month. This will allow a more complete data set to be collected.

We used snorkel surveys and beach seining to locate sockeye fry within the littoral zone of Lake Wenatchee. The first fry were observed on May 11 and were observed in the littoral zone from this point through the end of the study. Tow nets were used to capture sockeye fry in the limnetic areas of the lake. Only two fry were captured in the limnetic zone, both on May 16th. The size of the tow net may have been limiting. A larger tow net will be used in 2002 to more accurately assess the locations and distribution of sockeye fry during late April and May.

At the end of the data gathering period (2002), we will assess the information and determine potential risk to sockeye from coho predation and also the potential for monitoring success. If it is considered feasible to continue the study and coho are released upstream of the lake, YN would monitor the impact through a predation study similar to those done for spring chinook, possibly using a WDFW rotary trap at the Lake Wenatchee outfall, or beach seining or trawling in Lake Wenatchee.

Performance Indicator: Superimposition of spring chinook redds by spawning coho as measured by superimposition studies.

Due to concerns regarding the number of adult coho spawners returning to Nason Creek in 2001 and 2002, and possible superimposition effects on incubating spring chinook salmon eggs by later spawning coho salmon, the YN is monitoring the locations of spring chinook redds, identified by CPUD, and coho salmon spawning locations to gauge the potential for redd superimposition and associated adverse effects.

In 2001 we measured the exact locations of up to 50 spring chinook redds in each of two study reaches (100 total) in Nason Creek (Table 22). Each study redd was measured by triangulating from the upstream and downstream ends of the redd tailspill with two fixed points on the bank. The width of each study redd was measured at its widest point.

These measurements enabled us to accurately determine superimposition by spawning coho salmon on spring chinook redds. Each redd was relocated during coho spawning ground surveys and the percent of superimposition was visually estimated (0 through 100%).

During the 2001 coho spawning ground surveys, three coho redds were identified in Nason Creek. None was found to superimpose on spring chinook redds.

The studies will be continued in future years.

Table 22. Redd Superimposition Study Reaches

Reach	**Location**	**River Mile**	**Length**	**% of 2000 chinook spawning**
Butcher Creek	Butcher Creek Pond to Butcher Creek Rd. Bridge	8.3 to 7.1	1.2 RM	14%
Lower Nason	Fishing Pond to Campground	3.4 to 0.8	2.6 RM	16%

Performance Indicator: Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.

To begin to evaluate the potential for naturally produced coho salmon to negatively affect steelhead or spring chinook salmon through competition for space and food, we will assess the distribution, habitat use, growth and abundance of juvenile steelhead and spring chinook in the presence and absence of coho. Potential micro–habitat overlap between sub-yearling coho, spring chinook, and steelhead will be evaluated every two weeks between July 1st and

September 15th, beginning in 2002. For the analysis, Nason Creek will be divided into 4 study reaches. Two reaches will be located upstream of the Butcher Creek acclimation site, and two will be located downstream of the site. This division of reaches was selected because the distribution of spring chinook redds identified during spawning ground surveys in 2000 indicated that 52% of the chinook spawned between the Butcher Creek acclimation site and Whitepine Creek, while 48% spawned downstream from the Butcher Creek acclimation site (Mosey and Murphy 2000). Within the four reaches we will snorkel a stratified random sample of habitat to collect information regarding microhabitat use and distribution of chinook, steelhead and coho.

Due to the low number of coho redds in Nason Creek in 2001, hatchery coho parr from mid-Columbia broodstock will be scatter planted into two of four study reaches in 2002 (treatment reaches). The four study reaches are listed in Table 1. While the scatter-planted coho salmon are not naturally produced, we propose to use them as a surrogate, providing information regarding possible interactions between juvenile coho and species of concern. Prior to scatter planting sub-yearling coho, the current, or baseline, distribution of 0+ spring chinook and steelhead will be evaluated, using the four reaches shown in Table 23. Each reach will be divided into 500 meter sections. We will randomly select 100 meters from each 500-meter section for distribution analysis through underwater observation (20% sample rate). Underwater snorkeling techniques will be conducted as described by Thurow (1994). All salmonids will be enumerated by species and size class. Macrohabitat (pool, riffle, or glide) will be noted and measured. Fish densities and distribution will be reported.

Table 23. Nason Creek Study Reaches

Reach Number	Location	Coho Scatter Plants	River Kilometer
1	Mouth to Kahler Creek Bridge	Yes	0.0 to 6.3
2	Kahler Creek Bridge to Butcher Creek	Yes	6.3 to 13.3
3	Butcher Creek to Merritt Bridge	No	13.3 to 17.9
4	Merritt Bridge to Whitepine Creek	No	17.9 to 24.8

Prior to scatter planting, baseline collections of fish for growth and condition factor information will be collected. Fish growth and condition factor sampling will be repeated once a month for two months.

Within each reach we will collect a sample of up to 25 sub-yearling chinook, steelhead, and coho using a back-pack electrofisher. After collection fish will be anesthetized, measured (fork length in mm), and weighed. Condition factors will be calculated for each fish examined. Micro-habitat variable, abundance and condition factors of spring chinook and steelhead collected in allopatry and sympatry with coho will be compared using analysis of variance.

Comparisons in the change in growth will be made between chinook and steelhead parr in reaches 1 and 2 (sympatric with planted coho [treatment]) with the change in growth and condition factors for chinook and steelhead located in reaches 3 and 4 (allopatric with planted coho [control]).

Performance Indicator: Other potential ecological interactions as indicated by residualism surveys or F2 evaluations.

- *Residualism surveys*

Snorkeling surveys following a stratified random sampling design were done near acclimation/release sites to determine whether and how many coho do not migrate downstream after release. Few residual coho have been found (see section 3.5.3) and no further studies are proposed.

- *Other F2 evaluations*

Additional studies of interactions between naturally produced coho and other fish species—particularly listed fish—are anticipated when and if there are sufficient numbers of coho to allow a meaningful study to be conducted. Methods will be developed in consultation with the TWG.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Project budgets have been approved by NPPC and BPA through 2005.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Some risk to sensitive species needs to be imposed in order to study the potential for long-term risk from coho reintroduction. Sections 3.5.3 and 10.11 list mitigation measures that would minimize the risk to listed species from coho releases.

During all monitoring and evaluation activities, any listed fish incidentally caught or handled will be released immediately to the location from which it was caught. During the operation of a rotary smolt trap, risk to listed fish can be minimized by frequent checking and emptying of the trap's live box. Experience has shown little or no mortality from broodstock collection procedures, as listed fish not subject to collection themselves are released upstream immediately. Risk of mortality from electro-shocking is reduced by using properly trained personnel and following NMFS guidelines for electro-shocking (NMFS 1998(a)) and additional guidance in Fredenberg 1992.

SECTION 12. RESEARCH

Because the Mid-Columbia Coho Reintroduction Feasibility Project is by definition a research project, there are no additional studies or descriptions to add to this section beyond what is covered in section 11.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by______________________________ Date:_____________

APPENDIX A: TAKE TABLES

Listed species affected: Spring Chinook______________ **ESU/Population:**__UCR__________________________________
Activity:__Smolt Trapping____________________

Location of hatchery activity: Nason Creek____________ **Dates of activity:**_3/15 – 6/15____________ **Hatchery program operator:**__________________

Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)** Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	500	1000		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	10	20		
Other Take (specify) h)				

Listed species affected: __Steelhead________________ **ESU/Population:** UCR_________________________________
Activity:_Smolt Trapping____________________

Location of hatchery activity:_Nason Creek_________ **Dates of activity:** 3/15 – 6/15_________________**Hatchery program operator:**_________________

Type of Take	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		500		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		10		
Other Take (specify) h)				

Listed species affected: __Bull Trout ________________ **ESU/Population:** UCR___________________________________ **Activity:**__Smolt Trapping___________________				
Location of hatchery activity: Nason Creek___________ **Dates of activity:** 3/15 –6/15________________ **Hatchery program operator:**__________________				
	Annual Take of Listed Fish By Life Stage ***(Number of Fish)***			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		25		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		1		
Other Take (specify) h)				

Listed species affected: _Spring Chinook ____________ **ESU/Population**:___UCR________________________________
Activity:__Electrofishing____________________

Location of hatchery activity:___Nason Creek____________________ **Dates of activity:**___7/1-9/30__________________
Hatchery program operator:_________________

Type of Take	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		150		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		15		
Other Take (specify) h)				

Listed species affected: __Steelhead__________________ **ESU/Population:** UCR___________________________________
Activity:_Electro-fishing____________________

Location of hatchery activity:___Nason Creek________ **Dates of activity:**__7/1-9/30___________________ **Hatchery program operator:**__________________

	Annual Take of Listed Fish By Life Stage (*Number of Fish*)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		150		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		15		
Other Take (specify) h)				

Listed species affected: __Bull Trout________________ **ESU/Population:** UCR_________________________________
Activity:_Electro-fishing____________________

Location of hatchery activity:__Nason Creek__________ **Dates of activity:**_7/1-9/30____________________**Hatchery program operator:**_________________

Type of Take	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		10	3	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		10	3	
Other Take (specify) h)				

Listed species affected: Steelhead____________________ **ESU/Population**:___UCR_______________________________
Activity:___Broodstock Collection_________________

Location of hatchery activity:_Dryden Dam__________ **Dates of activity**:__9/1-12/7_____________ **Hatchery program operator:**_________________

Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			30	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Bull Trout___________________ **ESU/Population**:___UCR______________________________
Activity:___Broodstock Collection_________________

Location of hatchery activity:_Dryden Dam__________ **Dates of activity:**_9/1-12/7__________________**Hatchery program operator:**_________________

Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)** Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			2	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: _Steelhead__________________ **ESU/Population**: UCR__________________________________ **Activity:**_Trapping – Radio-telemetry and/or broodstock collection___________________				
Location of hatchery activity:___Tumwater Dam______ **Dates of activity:** 9/1/-12/7____________________ **Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			30	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Bull Trout___________________ **ESU/Population**:_UCR________________________________
Activity: Trapping – Radio-telemetry and/or broodstock collection____________________

Location of hatchery activity:_Tumwater Dam_________ **Dates of activity:**___9/15-12/7____________ **Hatchery program operator:**_________________

	Annual Take of Listed Fish By Life Stage (*Number of Fish*)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			2	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead____________________ **ESU/Population**:___UCR________________________________
Activity: Trapping-Radio-telemetry__________________

Location of hatchery activity:_Priest Rapids Dam________ **Dates of activity**:_9/15-12/7____________________ **Hatchery program operator:**__________________

Type of Take	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			50	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: __Bull Trout__________________ **ESU/Population**:___UCR________________________________ **Activity**:___Tow-net sampling_________________				
Location of hatchery activity:_Lake Wenatchee___ **Dates of activity:**_____________________ **Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage *(**Number of Fish**)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Spring Chinook_____________ **ESU/Population:**__UCR_______________________________ **Activity:**__Weir Operation_________________				
Location of hatchery activity: Beaver Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead____________ **ESU/Population:**__UCR________________________________ **Activity:**_Weir Operation_________________				
Location of hatchery activity: Beaver Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	150	15	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				

Listed species affected: Spring Chinook______________ **ESU/Population:**__UCR________________________________
Activity:__Weir Operation__________________

Location of hatchery activity: Brender Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________

	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead ESU/Population: UCR Activity: Weir Operation				
Location of hatchery activity: Brender Creek Dates of activity: 3/15 – 6/1; 9/1 – 12/15 Hatchery program operator:				
	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	200	20	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				

Listed species affected: Spring Chinook_____________ **ESU/Population:**__UCR________________________________
Activity:__Weir Operation_________________

Location of hatchery activity: Chumstick Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage (*Number of Fish*)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead____________ **ESU/Population:**__UCR________________________________
Activity:_Weir Operation_________________

Location of hatchery activity: Chumstick Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________

Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	200	20	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				

Appendix I: Projects in the Methow subbasin by Assessment Unit and Survival Factor

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Yakama Nation	BPA Project #9208200		Eastern Washington Landowners Adopt-Stream Training	Groups were targeted for training in stream and watershed management to enhance habitat for anadromous fish. Six watershed-training meetings were held for target groups of Native Americans, ranchers, and foresters in eastern Washington. Conducted 6 watershed-training meetings for various groups in eastern Washington.		
Yakama Nation	Funding WDOE and BPA	1999 to 2000	Methow Valley Irrigation District, Reorganization to wells.	Lower ditch was shut off and individuals served by the lower ditch were converted to wells.	Middle Methow, Lower Twisp	Flow, Withdrawals, Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Yakama Nation and Methow River Valley Irrigation District	BPA Project # 199603401	ongoing project		Examine the feasibility of alternatives and recommend a project to address water conservation, benefit fish and continue to provide water for irrigation.	All Assessment Units	Flow, Withdrawals, Obstructions
Yakama Nation	BPA Project #199802500		Early Winters Creek Habitat Restoration	Restored historic fish, riparian and floodplain habitat, identified methods to augment instream flow to increase spawner success and juvenile survival. Project was completed the summer of 2000 with some follow-up monitoring in 2001.	Upper Methow	Flow, Habitat Diversity, Key Habitat, Channel Stability
Yakama Nation	BPA Project #9604000	1996 ongoing	Mid-Columbia Coho Feasibility Reintroduction Study	This project was initiated in 1996. The project is designed to gather data and develop and implement plans for coho restoration in the Methow, Entiat, and Wenatchee river basins		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				in concert with various state and federal agencies. The project is centered on the development of a localized broodstock while minimizing potential negative interactions among coho and listed and sensitive species.		
Yakama Nation	BPA Project #23024	2002 ongoing	Hancock Springs Passage and Habitat Restoration Improvements, Yakama Nation	The project is designed to increase juvenile salmonid access to, and enhance the habitat of Hancock Springs, a spring fed off-channel to the upper Methow River. Project objectives are to 1) increase the number of juvenile spring chinook and steelhead utilizing Hancock Springs, and 2) increase the over-winter survival of juvenile spring chinook and steelhead in the Methow River.	Upper Methow	Obstructions, Habitat Diversity, Key Habitat

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Yakama Nation	BPA Project #199802900	Project is ongoing.	Goat Creek Instream Habitat Restoration	Instream habitat restoration work and instream rehabilitation.	Upper Methow	Channel Stability, Habitat Diversity, Key Habitat
Yakama Nation	BPA Project #200103700		Arrowleaf/Methow River Conservation Easement	Purchase prime riparian habitat in the form of a conservation easement.	Upper Methow	Channel Stability, Habitat Diversity, Key Habitat
Yakama Nation	BPA Project #200106300	Project is ongoing.	Methow Basin Screening	Provide fish screen facilities and new fish screen construction at Methow Subbasin irrigation diversions including Foghoorn, Rockview, McKinney Mountain, Kum Holloway. Some equipment upgrades are also included under the project.	Middle Methow	Obstructions
Yakama Nation	Douglas County PUD	Ongoing since 1987	Methow Basin spring chinook spawner surveys	Basin wide spawner surveys have been conducted. This information is summarized each year in an annual report		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				submitted to Douglas County PUD. The data set consists of redd counts by stream reach for each major tributary in which spring chinook spawn, estimated spawner escapement, plus bio-sample data (i.e. scale samples, recovery of CWTs, notation of external marks, sex, body length and extent of gamete retention).		
Yakama Nation	Douglas County PUD	1993 ongoing	Methow Basin Spring Chinook Salmon Supplementation Program (MBSCSP)	The Yakama Nation contracted with Douglas County PUD in 1993 to conduct monitoring and evaluation activities as part of the MBSCSP. The Methow Basin Spring Chinook Supplementation Plan dictates specific monitoring and evaluation tasks associated with the Program. Since 1993 the		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				spawner surveys have been incorporated into the MBSCSP.		
Yakama Nation and Methow Valley Irrigation District				Negotiations to resolve the issue of inadequate instream flows in the lower Twisp River.	Lower Twisp	Flows
Implemented by WDFW	BPA		Methow Watershed Project II	An ongoing $12 million effort to identify and secure more than 5,000 acres of critical riparian/floodplain habitat and linkages to protected upland through fee title acquisition and conservation easements. BPA contributed over $2 million to purchase conservation easements on portions of over 1000 acres of habitat.	Upper Methow	Channel Stability, Key Habitat, Habitat Diversity
USFS	BPA Project #9026,	Project is ongoing	Respect the River	Respect the River is an ongoing interpretive and public contact program		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				that started out with informational/educational signs along the Methow River and its tributaries. The program has been repeatedly expanded to include both media and one-on-one contacts with river users and to include numerous additional drainages within the Methow Subbasin.		
	BPA Project #199803500		Measure Mine Drainage Effects of Alder Creek	The project involved analyzing the leachable metals in the Methow River and Alder Creek drainages resulting from the abandoned Alder Mine. The Alder Creek Mine is on the western slope of McClure Mountain at 3600 feet on private land surrounded by National Forest. While it is clear that Alder Creek has been impaired, the extent of impact has not been	Middle Methow	Chemicals

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				determined.		
	BPA Project #199603450		Methow River Valley NEPA Study	NEPA archaeological and historical studies of the Methow Irrigation District. This contract provided for public involvement, communication and coordination support for the NEPA process.		
	American Bird Conservancy	1997	Conservations Strategy for Landbirds	Program identified important habitats and desired habitat conditions, and provided interim management targets and recommended management actions for land birds and their habitats.		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Methow Conservancy	Funded by State of Washington Interagency Committee for Outdoor Recreation	1997-2001	Methow Conservancy Riparian Habitat Project	For the facilitation or purchase of conservation easements that would protect riparian habitat in the Methow Watershed for perpetuity. By the summer of 2001, nine property owners, representing 526 acres and over $930,000 of donated easement value had completed these voluntary conservation restrictions on their properties. The areas include riparian/agricultural lands on the mainstem Methow River and the Little Cub Creek (Rendezvous) complex, an important, upland watershed of the Chewuch River, a tributary of the Methow. Landowners have created protective buffer zones along the critical riparian	Middle Methow, Upper Methow, Lower Chewuch	Habitat Diversity, Key Habitat, Sediment Load, Channel Stability

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				areas near the river and creeks, have agreed to forest management and land use plans to promote values of watershed and wildlife enhancement, and have agreed that this is to be done for perpetuity.		
Methow Conservancy	Funded by State of Washington Salmon Recovery Funding Board	2001	Methow Watershed Riparian Acquisition	To help protect spring Chinook salmon, bull trout and steelhead trout habitat in the Methow Subbasin. The award to the Conservancy provides financial assistance to landowners who want to assure that their lands along the Twisp, Chewuch and Methow Rivers remain as relatively pristine habitat for fish and wildlife. As of September of 2001, seventeen property owners, representing 870 plus acres and over four	Middle Methow, Upper Methow, Lower Chewuch, Lower Twisp, Upper Twisp	Habitat Diversity, Key Habitat, Sediment Load, Channel Stability

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				miles of riverfront in the areas identified by the Upper Columbia Regional Technical team and Washington State Conservation Commission's Limiting Factors Analysis as of the utmost importance to salmon recovery have signed Letters of Understanding to begin the easement process with the Methow Conservancy.		
Methow Conservancy		November 2000 to October 2001	Partners in Flight Habitat Prioritization	This Songbird Conservation Project brought a land trust (the Methow Conservancy) and several conservation biologists (from the U.S. Forest Service, American Bird Conservatory, and the Washington Department of Fish and Wildlife) together to survey and recommend ways to protect the best	Middle Methow, Upper Methow, Lower Chewuch, Lower Twisp, Upper Twisp	Habitat Diversity, Key Habitat, Sediment Load, Channel Stability

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				privately owned riparian areas in the Methow Valley. The Project allowed for detailed landscape-level mapping and analysis of Methow Valley songbird habitat, along with extensive one-to-one habitat conservation education and many hours of on-the-ground surveys, which formed an important foundation for future conservation easements, research and planning.		
Methow Valley Irrigation District	Funding WDOE and BPA, project is also listed under BPA funded projects	1999 to 2000.	Reorganization to wells	Lower ditch was shut off and individuals served by the lower ditch were converted to wells.	Middle Methow, Lower Twisp	Flow, Obstructions
Methow Valley	Funding WDFW	2001	Remeshing of MVID screens	Screens along both the Methow and Twisp rivers were remeshed to NMFS	Twisp and Methow AU's	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Irrigation District				standard in the spring of 2001.		
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Wolf Creek Channel Restoration	Enhanced fish passage and created additional instream habitat during summer low flow for steelhead and chinook and bull trout in Wolf Creek.	Wolf/ Hancock	Obstructions, Key Habitat, Channel Stability
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Skyline Ditch Pipe Installation	Assisted in piping part of the 6.2 mile Skyline Ditch in high water loss areas. This irrigation diversion is located on the Methow River.	Upper Methow	Flows
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Airey/Risley Ditch Removal	Removed an irrigation diversion structure and reduced the length of conveyance on an irrigation canal on the Twisp River.	Lower Twisp	Flows
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Buttermilk Creek Ditch Fish Screen	Installed a fish screen on the Buttermilk Creek irrigation ditch on the Twisp River.	Lower Twisp	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Skyline Ditch repair	Repaired the headgate at the Skyline Ditch diversion on the Chewuch River and replaced the delivery ditch with pipe in a high water loss area.	Upper Methow	Flows
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Aspen Meadows Ditch Piping	Replaced a portion of the Aspen Meadows irrigation ditch with pipe to prevent water loss on Little Bridge Creek, a tributary to the Twisp River.	Lower Twisp	Flows
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Fulton Ditch Lining Project	Lined a portion of the Fulton irrigation canal to prevent seepage/water loss. The Fulton diversion is located on the Chewuch River.	Lower Chewuch	Flows
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Eagle Creek Ditch Fish Screen	Removed an irrigation ditch and installed a well on Eagle Creek, a tributary to the Twisp River.	Lower Twisp	Flows, Withdrawals
Okanogan	Salmon		Tourangeau Ditch	Abandoned the Tourangeau irrigation	Lower Twisp	Flows, Withdrawals

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
County	Recovery Act RCW 77.85/HB2496		retirement	canal and installed a well on Little Bridge Creek, a tributary to the Twisp River.		
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Early Winters Ditch Diversion Structure	Constructed a fish friendly diversion structure that ensures flow to the Early Winters irrigation canal.	Upper Methow	Obstructions
Okanogan County	Salmon Recovery Act RCW 77.85/HB2496		Little Bridge Creek Culvert passage	Provided engineering & design work to determine alternatives and costs associated with solving a culvert blockage problem on Little Bridge Creek.	Lower Twisp	Obstructions
Okanogan Conservation District	Department of Natural Resources	1997	Pete's Creek planting and fencing	Seeded 65 acres with grass and planted 880 cottonwood and dogwood whips. Also installed 7,745 feet of cross fence to control grazing and protect riparian areas in the upper watershed.		Sediment Load, Habitat Diversity
Okanogan Conservation	Department of Natural	1997	French Creek fencing	Installed 6,792 feet of fence to protect riparian zone.		Sediment Load, Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
District	Resources					
Okanogan Conservation District	Department of Natural Resources	1998	Pete's Creek planting and road deactivation	Project to control access road erosion control. Planted 2,000 cottonwoods, 100 pines, and 100 aspen. Developed spring for stock water outside the riparian zone.		
Okanogan Conservation District	Department of Natural Resources	1998	French Creek fencing & livestock watering	Installed 6,864 feet fence to protect riparian zone. Installed two miles of pipeline and two troughs for livestock water outside the riparian zone. Planted 6,000 cottonwoods and dogwood whips.		Sediment Load, Habitat Diversity
Okanogan Conservation District	Department of Natural Resources	1998	Cow Creek planting and erosion control	Instituted measures to control road erosion on an access road. Planted 2,000 cottonwoods, 6,000 dogwoods, 200 pine and stabilized headcut.	Lower Methow	Sediment Load, Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Okanogan Conservation District	Department of Natural Resources	1998	Texas Creek planting and livestock control	Planted 6000 dogwoods and 2,000 cottonwoods. Created livestock barriers in creek channel by felling trees.	Lower Methow	Sediment Load, Habitat Diversity
Okanogan Conservation District	Department of Natural Resources	1998	Wolf Creek fencing and livestock watering	Built 1.7 miles of fence to exclude livestock from the river. Drilled wells and installed 2,000 feet of pipe and two troughs for stock water outside of riparian zone.	Wolf/ Hancock	Sediment Load, Habitat Diversity
Okanogan Conservation District and the Pacific Watershed Institute	USFW	2000	Methow River, Lehman Site fencing, planting and livestock watering	Drilled a well and installed 500 feet of pipe and one trough for fall stock water outside the riparian zone. Installed 2,640 feet exclusion fence creating a 175-foot riparian buffer. Installed 2,000 feet of pipeline and two troughs for winter stock water outside the riparian zone. Removed corrals from riverbank and rebuild 350 feet away from the		Sediment Load, Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				river. Replanted the old corral site with native trees and shrubs.		
Okanogan Conservation District and the Pacific Watershed Institute	USFW	2000	Methow River, Konrad site planting and livestock watering	Fenced .75 miles of river bank and planted .25 miles of streambank and irrigate riparian plantings. Developed solar stock water system for trough and storage.		Sediment Load, Habitat Diversity
Okanogan Conservation District and the Pacific Watershed Institute	Salmon Recovery Funding Board	ongoing	Beaver Creek Fish Passage Barrier Amelioration	This project will provide fish passage that is compatible with irrigation needs on Beaver Creek in addition to eliminating one diversion dam and replacing it with a well.	Beaver/Bear	Obstructions, Withdrawals
Okanogan Conservation District and the Pacific Watershed Institute	Salmon Recovery Funding Board	ongoing	Okanogan County Fish Passage Barrier Survey	This project will inventory and access all potential fish passage barriers including unscreened diversions in Okanogan County. Identified barriers will be prioritized for correction	All AU's	Obstructions, Withdrawals

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				based on quality and quantity of habitat.		
Pacific Watershed Institute	Jobs for the Environment Program & USFS, USFWS, WDFW and PWI	1996 - 1998	Restored riparian vegetation in a mile long dispersed recreation area near the Chewuch River	Activities included road obliteration, fencing, seeding in meadow areas, stream bank re-grading and re-vegetation with associated large woody debris (LWD) placement in key locations. Construction of a bar apex jam to retain and encourage development of off-channel habitat areas. Placement of non-anchored log complexes within the off-channel area for cover.	Upper Chewuch	Habitat Diversity, Key Habitat, Channel Stability, Sediment Load
Pacific Watershed Institute	Jobs for the Environment Program & USFS, USFWS, WDFW and PWI	1996 - 1998	Enhanced and added road slope protection in a large side channel of Chewuch	Activities included: 1) development of a smaller pilot-channel across and island to deflect flow away from the road slope and provide future side channel development opportunities; 2) construction of lateral bar jams to deflect flow into	Upper Chewuch	Habitat Diversity, Key Habitat, Channel Stability, Sediment Load

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				the new side channel; and 3) construction of a large chaotic crib structure to protect the road slope while providing instream habitat and cover.		
Pacific Watershed Institute	Jobs for the Environment Program & USFS, USFWS, WDFW and PWI	1996 - 1998	Opened .5 mile side channel to increase year-round flow for juvenile rearing and flood refugia habitat	Enhanced the stream channel with 6 LWD complexes to provide summer and winter cover. Investigated ground water relationships to alluvial fan geomorphology as it relates to side channel development and winter habitat availability.	Upper Chewuch	Habitat Diversity, Key Habitat, Channel Stability
Pacific Watershed Institute	Jobs for the Environment Program & USFS, USFWS, WDFW and PWI	1996 - 1998	Restored access to flood channels on a channelized alluvial fan	Activities included the excavation of portions of constructed boulder berms to bankfill level and reshaping connections to the main flow to prevent sub-surface flow during summer.	Upper Chewuch	Habitat Diversity, Key Habitat, Channel Stability
Pacific	Jobs for the	1996 -	Chewuch off	Addition of 6 LWD	Upper	Habitat Diversity, Key

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Watershed Institute	Environment Program & USFS, USFWS, WDFW and PWI	1998	channel restoration	structures to a depositional area of the Chewuch in order to maintain an off–channel area, provide hiding cover and shading. Also, restoration of riparian area in a dispersed campsite.	Chewuch	Habitat, Channel Stability
Pacific Watershed Institute	Jobs for the Environment Program & USFS, USFWS, WDFW and PWI	1996 - 1998	Metho0w River native plant collection and propagation program for re-vegetation projects	Propagation methods include transplants, shrub, tree and forb rooted cuttings, and seed collection and propagation to container stock. Project includes work with local and regional nurseries to propagate plants.		
Pacific Watershed Institute	Jobs for the Environment Program & USFS, USFWS, WDFW and PWI	1998	Monitoring of 6 restoration projects completed in 1996 & 1997	Monitoring includes re-vegetation success, large woody debris structures, channel geometry, sediment, habitat condition, hydrology and fish presence.		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Upper Columbia Regional Fisheries Enhancement Group (UCRFEG)			Fraser Creek Riparian Fence	Installed 1.25 miles of fencing to prevent livestock access to the stream and riparian zone.	Beaver/Bear	Sediment Load, Habitat Diversity
UCRFEG			Black Pine Basin Riparian Fence	Installed 1.1 miles of fencing to prevent livestock access to the stream and riparian zone.	Upper Methow	Sediment Load, Habitat Diversity
UCRFEG			South Fork Beaver Creek Riparian Fence	Installed .1 miles of fencing to prevent livestock access to the stream and riparian zone.	Beaver/Bear	Sediment Load, Habitat Diversity
UCRFEG			Okanogan Fish Passage Inventory	Assisted Okanogan Conservation District with their assessment of barriers to fish migration.	All AU's	Obstructions, Withdrawals
WDFW	WWRP		Methow Corridors Project, Methow Corridors II Project, Methow Corridors Project III, Methow	Over $20 million of Washington Wildlife Recreation Program (WWRP) funding used to secure several thousand acres of critical lower elevation fish and	All AU's	Habitat Diversity, Key Habitat, Sediment Load

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
			Watershed Project	wildlife habitats.		
WDFW	Douglas County Public Utility District as part of the Wells Dam Settlement Agreement	ongoing	Spring chinook artificial supplementation and captive broodstock program	Artificial supplementation and captive broodstock for spring chinook		
WDFW		ongoing	Operation and Management of the Methow Fish Hatchery for the production of ESA-listed upper Columbia River spring chinook salmon	The program is responsible for broodstock collection spawning, rearing and releasing up to 550,000 spring chinook smolts into the Methow River Basin annually.		
WDFW		ongoing	Summer chinook artificial supplementation program	Operation and management of the Carlton Acclimation Pond and Eastbank Hatchery Facility for production of summer chinook (400,000 smolts) as a component of the summer chinook		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				supplementation program associated with mitigation for the construction and operation of Rock Island Dam. The program collects broodstock and spawns, incubates, and releases 400,000 yearling summer chinook into the Methow Subbasin annually.		
WDFW			Summer chinook supplementation program evaluation	The program is funded by Chelan County Public Utility District as part of the Rock Island Project Settlement Agreement. Implementation of the summer chinook supplementation hatchery evaluation program. The program monitors and evaluates the efficacy of supplementation efforts in the enhancement of summer the chinook population in the Methow Subbasin.		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
WDFW	Douglas County Public Utility District	ongoing	Summer steelhead hatchery supplementation program.	Operation and management of the Wells Dam Hatchery for the production of ESA-listed upper Columbia River steelhead in the Methow Subbasin. The program collects broodstock and spawns, incubates and releases approximately 350,000 steelhead smolts in to the Methow Basin annually. It also provides the egg source for the 100,000- steelhead smolts stocked annually in to Methow Subbasin from the Winthrop NFH.		
WDFW	Chelan, Douglas and Grant County PUDs		Adult steelhead migration and spawning disposition	WDFW participated in a steelhead radio telemetry study in the mid-Columbia Region to assess the upstream migration and eventual spawning disposition of Upper Columbia River ESA-listed summer steelhead. The radio tags		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				are applied at Priest Rapids Dam and monitored throughout migration and spawning, and includes the monitoring in Methow Subbasin.		
WDFW	WDFW	ongoing	Upper Columbia River steelhead stock assessment	The stock assessment project occurs at Priest Rapids Dam and collects biological data related to enumeration, origin (hatchery/wild), age (fork-length and scale), and record of marked/tagged steelhead migrating above Priest Rapids Dam, including those destined for the Methow basin.		
WDFW	WDFW	ongoing	Species abundance and distribution	WDFW fisheries personnel conduct annual and periodic species distribution abundance surveys in the Methow Basin.		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
WDFW	WDFW	ongoing	Creel Census Survey Information	Creel census information is gathered annually during the Methow River trout fishery season to assess angler success, angler effort, species assemblage, and population characteristics.		
WDFW	WDFW	ongoing	Methow Wildlife Area Management Plan	Plan developed for WDFW lands in the Methow Subbasin to conserve fish and wildlife resources and maximize wildlife-based recreation. Includes removing fish passage barriers and installing fish friendly irrigation components.	Upper Methow	Obstructions
WDFW	WDFW		Wildlife species management or recovery plans	Developed Sharp-tailed Grouse Recovery Plan, Lynx Recovery Plan, Elk Management Plan, Black Bear Management Plan, Bald Eagle Recovery		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				Plan.		
WDFW	WDFW		Lynx research	Completed ongoing research projects in the 1980s documenting lynx ecology and potential management conflicts.		
WDFW	WDFW & Northwest Ecosystem Alliance	ongoing	North Cascades Rare Carnivore Camera Survey	An ongoing volunteer partnership with Northwest Ecosystem Alliance to survey North Cascades backcountry areas with self-activated cameras for rare carnivores. Multiple occurrences of lynx and wolverine documented to date.		
WDFW & USFS	Trust for Public Lands		Townsend's Big-eared Bat Project	Project involved construction of a "bat house" to replace a currently occupied structure (Rattlesnake House) slated for demolition or relocation and site preparation in anticipation of new funds		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				to move an existing structure.		
WDFW & USFS			Mule Deer Research	Research projects in the 1970s and 1980s collected data on mule deer ecology and habitat needs for the West Okanogan herd.		
WDFW & USFS & National Park Service (NPS)	WDFW & USFS & National Park Service (NPS)		Grizzly Bear/Gray Wolf Investigations Project	Project evaluated the status of grizzly bears and gray wolves in the North Cascades, and the ability of the North Cascades Ecosystem to support a viable grizzly population		
WDFW & USFS & National Fish and Wildlife Foundation	WDFW & USFS & National Fish and Wildlife Foundation		Forest Carnivore Survey	Challenge cost-share project with National Fish and Wildlife Foundation to survey Okanogan National Forest lands for lynx, wolverine, fisher, and marten.		
WDFW & USFS	WDFW & USFS, USFWS &		Wolverine Investigations	Document wolverine distribution and reproductive status.		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
	Skagit Environmental Endowment Commission					
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	1998	Barkley (Methow River)	Fish screen completed summer 1998. On line 1999 irrigation season, tuneup complete spring 2001.	Upper Methow	Obstructions
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	1998	Chewuch (Chewuch River)	Completed fall 1998. Tuneup completed. Contributed 10 cfs to river.	Lower Chewuch	Flows, Obstructions
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	1999	Larson Ditch (Libby Creek)	Completed spring 99, Cap funded, owner cost-share.	Gold/Libby	Flows, Obstructions
WDFW,	WDFW,	1999	WCRD (Wolf Creek)	Completed sprint 1999, did not divert until spring	Wolf/ Hancock	Flows, Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Irrigation Districts, USFS, USFWS, others	Irrigation Districts, USFS, USFWS, others			2000, tuneup complete 5/31/00. Low flow season 10 cfs contributed to river due to Patterson Lake storage. Owner cost share SRFB. EI 75k, NMFS 25k.		
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	1999	Buttermilk (Buttermilk Creek)	Completed summer 1999, tuneup complete 5/31/00, (*) GSRO 17.5K, NMFS 11.5K, owner cost-share, (IAC not used)	Lower Twisp	Flows, Obstructions
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	1999	Eightmile (USFS, Eightmile Creek)	Completed spring 1999, USFS funded 18K. Point of diversion change contributed 8cfs to Chewuch.	Lower Chewuch	Flows, Withdrawals
WDFW, Irrigation Districts, USFS, USFWS,	WDFW, Irrigation Districts, USFS, USFWS,	2000	Twisp Power (Twisp River)	Completed spring 00, tuneup complete by 5/31/00, SRFB EI 80 K, NMFS 40K. WDFW negotiations returned 3 cfs to river.	Lower Twisp	Flows, Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
others	others					
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	2000	Beaver Creek Basin (Beaver, Frazer, Storer)	IAC contract extension to 10/31/00, SRFB EI 100K, Proviso 50K. Will be completed Spring of 1991.	Beaver/Bear	Flows, Obstructions
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	2000	Fulton (Chewuch River)	Completed spring 00, tuneup complete fall 2000, SRFB EI 100K, NMFS 50K, SRFB early 2000 33.5K, NMFS 16.5K. Saved 6 cfs with WDFW negotiations.	Lower Chewuch	Flows, Obstructions
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	2000	Twisp Airey (Twisp River)	Conversion to pump completed spring 2000,GSRO 30K, [Cap Sup 25K, tuneup not yet completed, County has lead] 4 cfs returned to river, change of point of diversion.	Lower Twisp	Flows, Withdrwals
WDFW, Irrigation Districts,	WDFW, Irrigation Districts,	2000	Skyline (Chewuch River)	Completed summer 00, SRFB early 2000 100K, NMFS 40K, Proviso 25K. Lined ditch. Saved	Lower Chewuch	Flows

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
USFS, USFWS, others	USFS, USFWS, others			8 cfs.		
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	2001	Early Winters (Early Winters Creek)	Pre-design, scheduled construction spring 01, funded SRFB early 2000 100K, NMFS 36.5K, Proviso 14.5K. Creek rebuilt by USFW. Point of diversion changes negotiated and completed. Low flow trigger returned to creek. 6cfs.	Upper Methow	Flows, Withdrawals
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	2001	McKinney Mtn. (Methow River)	Re-screened with 3/32 perforated plate 1999. Meets current criteria, scoping stage, flows an issue, scheduled spring 2001. Cap funded 25K.	Upper Methow	Obstructions
WDFW, Irrigation Districts, USFS, USFWS,	WDFW, Irrigation Districts, USFS, USFWS,	2001	Fog Horn (Methow River)	USFWS responsibility, scoping stage, construction scheduled fall 2001. Cap support 65K, USFWS 100K.	Upper Methow	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
others	others					
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	2001	Rockview (Methow River)	Agency screen, re-screened with 3/32 mesh 2000 meeting criteria, pre-design 2001, Proviso 120K	Upper Methow	Obstructions, Withdrawals
WDFW, Irrigation Districts, USFS, USFWS, others	WDFW, Irrigation Districts, USFS, USFWS, others	2001	Kumn Holloway (Methow River)	Re-screened with 3/32 perforated plate 99. meets current criteria, scoping stage, construction scheduled spring 2001, Proviso 20K.	Upper Methow	Obstructions
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2000	Patterson Lake	Modified spillway to allow additional 450 acre-feet of water storage.	Wolf/ Hancock	Flows
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2000	Lower Wolf Creek	Modified creek channel to improve passage opportunities for migrating fish.	Wolf/ Hancock	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2000	WCRD Distribution System	Installed 1,100 feet of new 21” PVC piping. Estimated saving of 500 to 800 acre-feet per year.	Wolf/ Hancock	Flows
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2001	WCRD Distribution System	Installed 5,500 feet of new 18” PVC pipe in WCRD distribution system.	Wolf/ Hancock	Flows
Wolf Creek Reclamation District	SRF Board and National Wildlife Foundation Funds	2001	WCRD Distribution System	Reconstructed existing WCRD structure.	Wolf/ Hancock	Flows
U.S. Forest Service	U.S. Forest Service	1994	Doe Creek	Completed road cut and fill stabilization. Project shifted road further into the hill, seeded, matted, planted, created a drainage ditch and kept sediment laden water from reaching the stream.	Upper Methow	Sediment

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
U.S. Forest Service	U.S. Forest Service	1994	Chewuch Road	21 miles of non-system roads retired.	Upper Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1994	Chewuch	Survey done to identify the dispersed sites along the Chewuch. Modifying sites to reduce their impact on riparian and aquatic resources prioritized.	Upper/ Lower Chewuch	
U.S. Forest Service	U.S. Forest Service	1994	Chewuch	Installed two miles of electric fence, two miles of barbed wire fencing (E. Chewuch). Cattle guard installed to protect main Chewuch River from migrating cattle.	Upper Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1994	Poorman Creek	Completed variety of road obliteration, planting seeding, riparian rehabilitation projects.	Lower Twisp	Sediment, Habitat Diversity, Key Habitat, Channel Stability

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
U.S. Forest Service	U.S. Forest Service	1994	Eightmile Ranch	Pulled the fence line back from the river and planted ponderosa pine.	Lower Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1994	Lake Creek Trail	Rerouted short segments of trail and rehabilitated part that could deliver sediment into the river.	Lower Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1994	Chewuch Trail	Rerouted short segments of trail and rehabilitated part that could deliver sediment into the river.	Upper Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1994	East Chewuch	Completed riparian surveys.	Chewuch AU's	
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Pre-work for large woody debris material for Chewuch, includes low elevation flights, channel cross-sections and design.	Chewuch AU's	
U.S. Forest	U.S. Forest	1995	Chewuch	Dispersed sites. Rehab	Chewuch	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
Service	Service		Campsites	work in 15-20 sites. Minor maintenance on work done previous year.	AU's	
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Contracted with Watershed Restoration Program at Wenatchee Valley College for road/culvert inventory in uplands.	Chewuch AU's	
U.S. Forest Service	U.S. Forest Service	1995	Bromas	Completed road stabilization project.	Upper Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Replaced culverts off East Chewuch.	Chewuch AU's	Obstructions
U.S. Forest Service	U.S. Forest Service	1995	Poorman Creek	Replanted riparian units and obliterated some road.	Lower Twisp	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1995	Falls Creek	Completed seeding and cut/fill of slopes. Tested various approaches to see	Lower Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
				what worked best. Results were variable depending on slope orientation.		Stability
U.S. Forest Service	U.S. Forest Service	1995	Chewuch	Installed 2 miles fencing.	Chewuch AU's	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1995	Chewuch?	Began Proper Functioning Condition survey for riparian areas and instituted appropriate responses.	Chewuch AU's	
U.S. Forest Service	U.S. Forest Service	1996	Chewuch	Implemented large woody material project, two sites included large wood jams in streams and re-vegetation of area.	Chewuch AU's	Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1996	Chewuch	Rehabilitation work on developed sites includes defining river access and moving use further away from shore.	Chewuch AU's	Sediment, Habitat Diversity, Key Habitat, Channel Stability

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
U.S. Forest Service	U.S. Forest Service	1996	Chewuch and others	Many small road fixes, some obliteration of roads, closure, culvert work. Includes Chewuch, Eightmile, Falls, Ortell, Island Mountain, Sherwood, Sweetgrass, War Creek, Little Bridge and Buttermilk.	Chewuch and Twisp AU's	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1996	Long Creek	Moved water troughs in Long Creek and Cub Pass.		Sediment, Habitat Diversity, Channel Stability
U.S. Forest Service	U.S. Forest Service	1996	Reynolds Landing	Rehabilitation work completed.		
U.S. Forest Service	U.S. Forest Service	1996	Rogers Lake	Research Natural Areas designation in process, results in compilation of biological and physical information about Rogers's lake and Chewuch above Andrews Creek.		

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
U.S. Forest Service	U.S. Forest Service	1997	Chewuch River	Site 9 on Chewuch River, added large wood.	Chewuch AU’s	Habitat Diversity, Key Habitat
U.S. Forest Service	U.S. Forest Service	1997	Vanderpool Crossing	Removed culvert, made passage fish friendly and re-vegetated area.		Obstructions
U.S. Forest Service	U.S. Forest Service	1997	Eightmile	Dispersed and developed site rehabilitation.	Lower Chewuch	
U.S. Forest Service	U.S. Forest Service	1997	Blackpine Lake	Beaver Creek fence.	Beaver/Bear	Sediment
U.S. Forest Service	U.S. Forest Service	1997	Chewuch	Rehabilitation and maintenance of Chewuch sites.	Chewuch AU’s	
U.S. Forest Service	U.S. Forest Service	1998	Cub Creek	Road package prepared to determine which roads could be closed in preparation for implementation in 2000.		
U.S. Forest Service	U.S. Forest Service	1998	Twentymile Creek	Road rehabilitation.	Upper Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	Survival Factor Assessed/Restored/ Protected (maintained)
						Stability
U.S. Forest Service	U.S. Forest Service	1999	Throughout	Modifications in campsites and campgrounds are revisited and maintained.	Chewuch AU's	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1999	Chewuch	Closed or obliterated USFS roads in Chewuch area.	Chewuch AU's	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	1999	Barney creek (Falls Creek)	Road obliteration halfway completed.	Upper Chewuch	Sediment, Habitat Diversity, Key Habitat, Channel Stability
U.S. Forest Service	U.S. Forest Service	2000	Throughout	Dispersed campsite maintenance	Chewuch/ Methow AU's	Sediment, Habitat Diversity, Key Habitat, Channel Stability

8 Electronic Appendices

e-Appendix A EDT Attribute Ratings

e-Appendix B EDT Results

e-Appendix C QHA Bull Trout and WCT

e-Appendix D Public Outreach

e-Appendix E Hatchery Information

e-Appendix F Independent Populations and Limiting Factors

e-Appendix G BPA Funding Summary 2001-2003

e-Appendix H 2005 Recovery Plan Drafts

e-Appendix I Methow Limiting Factors Analysis

e-Appendix J 2001 Subbasin Summary

e-Appendix K Supporting Maps

e-Appendix L Wildlife Assessment

e-Appendix M Okanogan County's Prioritization Framework

e-Appendix N Methow Subbasin Plan Supplement to Appendix H

e-Appendix O Listed and Proposed Endangered and Threatened Species, Critical Habitat, and Candidate Species that may occur in the Counties of Eastern Washington as listed by the U.S. Fish and Wildlife Service

e-Appendix P Final Hatchery and Genetics Management Plan for Mid-Columbia Coho Reintroduction Program

e-Appendix Q Projects in the Methow Subbasin by Assessment Unit and Survival Factor