LOWER MID-COLUMBIA MAINSTEM

INCLUDING ROCK CREEK

Subbasin Plan

Prepared for the Northwest Power & Conservation Council

Draft Lower Mid-Columbia Mainstem Subbasin Plan

Includes Rock Creek, Washington

12/08/2004

Prepared for the Northwest Power and Conservation Council

Lower Mid-Columbia Mainstem Subbasin Plan

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1 Contributors

1.1 Lead Organizations

The Yakama Nation, Klickitat County, Washington Department of Fish and Wildlife. The lead entities are supported by the Washington Office of the Northwest Power and Conservation Council and its contractors Normandeau Associates, Laura Berg Consulting, Dick Nason Consulting, and Cogan Owens Cogan.

1.2 Coordinators

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Tom Rien, Oregon Department of Fish and Wildlife

1.3 Participants and Contributors

1.3.1 Rock Creek Working Group Participants

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1.3.2 Rock Creek Information Meeting Participants

Larry Jensen, Dave Whitmore, Keith Jensen, Bob Powers, Sandra Powers, Mike Copenhefer, Harry R. (Dick) Wilson, Larry Seaman, Chrystal Seaman, Miland Walling, Ron Juris, Elwood Brown, Bill Mains, Lynn Mains, Fred Wilkins, Don Slater, Virginia Read, Dean Miller, Marie Miller, Earl Lasley, and Linda Lasley, citizens.

1.3.3 Wildlife Participants and Reviewers

Several people participated in reviewing all or sections of the assessment drafts. These individuals, along with the writers, made up the Wildlife Information Group. For a full list of reviewers see Appendix A. This Washington citizens' committee, made up of concerned citizens of the public, also reviewed all or sections of the document drafts.

1.3.4 Oregon Contributors

Brian Stradley, Oregon Association of Conservation Districts; Rod French, ODFW, The Dalles; Russ Morgan, ODFW Heppner Wildlife District Office; Jimmy Kagan, Oregon Natural Heritage Program Information Center; Howard Browers, U.S. Fish and Wildlife; and Tom Rien, ODFW.

1.3.5 Mainstem Contributors

Tom Rien, ODFW; Mike Matylewich, CRITFC; and for GIS products, Van Hare, Pacific States Marine Fisheries Commission/StreamNet

1.3.6 Technical Writers

Laura Berg Consulting, subcontractor to Normandeau Associates and to Cogan Owens Cogan

1.3.7 Reviewer

Dick Nason, Dick Nason Consulting, subcontractor to Normandeau Associates. (Review of the Washington portion of the subbasin.)

1.4 Subbasin Plan Approach and Public Involvement

This Lower Mid-Columbia Mainstem Subbasin Plan, along with the Klickitat and Big White Salmon subbasins, has no single lead entity but was jointly developed by the Yakama Nation, Washington Department of Fish and Wildlife and Klickitat County, with direct support and involvement of the Washington office of the Northwest Power and Conservation Council and its consultants. The Oregon Department of Fish and Wildlife and the Sherman County Soil and Water Conservation District helped with the Oregon portion of the Lower Mid-Columbia Mainstem Subbasin Plan.

Public involvement is discussed in the Executive Summary. Citizens of the subbasin who participated in the public meetings are named in Section 1.3. and other contributors are named in Appendix A.

The management plan was developed in a relatively short time frame and with a limited budget, as the Klickitat, White Salmon and Lower Mid-Columbia Mainstem were among the last subbasins to get started in the NPCC Subbasin Planning Process. Set by the Northwest Power and Conservation Council, the original boundaries of the Lower Middle Mainstem extended upstream to river km 669 at Wanapum Dam and downstream to river km 308 at The Dalles Dam. Priest Rapids, McNary, John Day, and The Dalles dams and reservoirs were included within the subbasin, as was the free-flowing Hanford Reach immediately downstream from Priest Rapids Dam. The current plan, however, was limited in geographic scope to the north side of the Lower Middle Mainstem segment of the Columbia River from the mouth of the Walla Walla River to the mouth of the White Salmon River. During the response period in late 2004, the Oregon side of the subbasin was addressed as was the mainstem portion of this subbasin. Priest Rapids Dam and the Hanford Reach were not included for the following reasons.

- Unknown management strategies for the Hanford Reach Monument, because the U.S. Fish and Wildlife Service process of developing a management plan for the Reach has not progressed sufficiently to provide guidance to the subbasin planners, and

- Uncertainty about the Federal Energy Regulatory Commission determination in response to Grant County PUD’s application to relicense the Priest Rapids Hydroelectric Project, which was filed on Oct. 29, 2003.

Many mainstem wildlife and particularly fish issues are not covered in this subbasin plan. For the mainstem Columbia, this plan is limited to mostly habitat issues and only an overview of related issues, such as flows, fish passage, hatchery, and harvest. The complex science and proposals for adaptive management associated with hydrodevelopment are largely outside the scope of this LMM Subbasin Plan and often outside the boundaries of the subbasin itself. Critical topics such as the Mainstem Amendments to the Columbia River Basin Fish and Wildlife Program, the Columbia River Treaty with Canada, the Non-Treaty Storage Agreement, the Pacific Northwest Coordination Agreement, and system flood control and mid-hourly coordination agreements are not addressed here, Even aspects of the ESA Biological Opinions, which are now the frequent subjects of litigation, are not covered within these pages. Similarly harvest issues and their ongoing negotiations and resulting regulations are not included in any depth here as they are subject to the U.S.-Canada Pacific Salmon Treaty and the *U.S. v. Oregon* Columbia River Fish Management Plan. Although many anadromous hatchery fish migrate through the lower mid-Columbia mainstem, no hatcheries in the subbasin's currently active planning area are releasing fish into the subbasin. Thus, the scientific research and debates regarding supplement and genetics are not described in this plan, but can be found in other Columbia Plateau Province subbasin plans.

Because wildlife focal habitats and focal species were initially selected by WDFW, Yakama Nation, and Klickitat County for the Washington side of the subbasin, Oregon and mainstem wildlife species information were added later and in many instances remain incomplete and without the aid of GIS products. These gaps should be addressed in future iterations of this subbasin plan. In the Oregon portion of the subbasin, only two of the three focal habitats are present, Interior Riparian Wetlands and Shrub Steppe/Interior Grasslands. The discussion of lower mid-Columbia mainstem wildlife species and wildlife habitat occurs in 3.2 Subbasin Overview/3.2.8 Terrestrial/Wildlife Resources, 4.1.2 Wildlife in the Lower Mid-Columbia Subbasin, and 4.1.3 Wildlife Habitats and Features in the Lower Mid-Columbia Mainstem, and in the discussion of the relevant individual focal species.

For additional information related to subbasin boundaries and what is included in the Lower Mid-Columbia Mainstem Subbasin Plan, see Sections 2.1 and 3.2.

1.4.1 Description Planning Unit

Lead entities for this subbasin plan are the Yakama Nation, Klickitat County, Washington Department of Fish and Wildlife, and the Oregon Department of Fish and Wildlife. The lead entities are supported by the Northwest Power and Conservation Council.

Infrastructure and Organization

Assessment - The subbasin assessment is a technical analysis to determine the biological potential of the subbasin and the opportunities for restoration. It describes the existing and historic resources, conditions and characteristics within the subbasin. The bulk of the assessment work for Washington focused on Rock and Pine Creeks and was done by the Yakama Indian Nation and WDFW with support and involvement of Klickitat County. The assessment for Oregon was done with the assistance of ODFW. Separate teams of fish and wildlife scientists developed the assessment.

Inventory - The inventory includes information on fish and wildlife protection, restoration and artificial production activities and management plans within the subbasin. The inventory work for Washington focused on Rock and Pine Creeks and was done by the Yakama Indian Nation and WDFW with support and involvement of Klickitat County. The Inventory for Oregon was done with the assistance of ODFW.

Management Plan - The management plan is the heart of the subbasin plan-- it includes a vision for the subbasin, biological objectives, and strategies. The management plan embraces a 10-15 year planning horizon. The Yakama Nation, WDFW, ODFW, Klickitat County and a range of stakeholders were contributors to the management plan.

1.4.2 Vision Statement

We envision healthy self-sustaining populations of fish and wildlife indigenous to the Columbia Basin that support harvest and other purposes. Decisions and recommendations will be made in a community based, open and cooperative process that respects different points of view, and will adhere to all rights and statutory responsibilities. These efforts will contribute to a robust and sustainable economy.

2 Executive Summary

2.1 Purpose and Scope

The Lower Mid-Columbia Mainstem Subbasin management plan (including Rock Creek, Washington)—along with the supporting assessment and inventory —is one of 60 management plans currently being developed throughout the Columbia River Basin for the Northwest Power and Conservation Council (NPCC). This subbasin plan was crafted, in part, by the same team that is currently working on the Klickitat and Big White Salmon subbasins, and thus shares many elements in common with those plans, with the main exception that this subbasin encompasses the lower mid-Columbia mainstem river. The plan will be reviewed and adopted as part of the NPCC's Columbia River Basin Fish and Wildlife Program. The plan will help prioritize the spending of Bonneville Power Administration (BPA) funds for projects that protect, mitigate, and enhance fish and wildlife that have been adversely impacted by the development and operation of the Columbia River hydropower system.

The primary goal of subbasin planning in the Columbia Basin is to respond to the Independent Scientific Group's *Return to the River* report to the NPCC. Notable conclusions from that report were:

> Our review constitutes the first independent scientific review of the Fish and Wildlife Program…
>
> The Program's…lack of a process for prioritization provides little guidance for annual implementation…
>
> We recommend incorporation of an integrated approach based on an overall, scientifically credible conceptual foundation…

The NPCC responded to the ISG by creating the subbasin planning process, within the context of the 2000 Fish and Wildlife program. Subbasin plans provide the first basin-wide approach to developing locally informed fish and wildlife protection and restoration priorities.

An important objective of this subbasin plan is to identify management actions that promote compliance of the federal Endangered Species and the Clean Water acts. None of the recommended management strategies are intended nor envisioned to compromise or violate any federal, state or local laws or regulations. The intent of these management strategies is to provide local solutions that will enhance the intent and benefit of these laws and regulations. The NPCC, BPA, NOAA/Fisheries and the U.S. Fish and Wildlife Service (USFWS) intend to use adopted subbasin plans to help meet requirements of the 2000 Federal Columbia River Power System Biological Opinion. NOAA Fisheries and the USFWS have stated their intent to use subbasin plans as a foundation for recovery planning for threatened and endangered species.

The Lower Mid-Columbia Mainstem management plan's purposes include providing benefits to fish and wildlife where that help is most needed. The broad purposes of the plan and of the NPCC program mesh regarding fish and wildlife species.

From the Columbia River Basin Fish and Wildlife Program (NPPC 1994):

> The development of the hydropower system in the Columbia River Basin has affected many species of wildlife as well as fish. Some floodplain and riparian

> habitats important to wildlife were inundated when reservoirs were filled. In some cases, fluctuating water levels caused by dam operations have created barren vegetation zones, which expose wildlife to increased predation. In addition to these reservoir-related effects, a number of other activities associated with hydroelectric development have altered land and stream areas in ways that affect wildlife. These activities include construction of roads and facilities, draining and filling of wetlands, stream channelization and shoreline riprapping (using large rocks or boulders to reduce erosion along streambanks). In some cases, the construction and maintenance of power transmission corridors altered vegetation, increased access to and harassment of wildlife, and increased erosion and sedimentation in the Columbia River and its tributaries.
>
> The habitat that was lost because of the hydropower system was not just land, it was home to many different, interdependent species. In responding to the system's impacts, we should respect the importance of natural ecosystems and species diversity.
>
> Some species, such as some waterfowl species, have seemed to benefit from reservoirs and other hydropower development effects, but for many species, these initial population increases have not been sustained.

NOAA/ Fisheries and the USFWS have stated their intent to use subbasin plans as a foundation for recovery planning for Endangered Species Act (ESA)-listed species.

The Lower Mid-Columbia Mainstem management plan's purposes include providing benefits to fish and wildlife where that help is most needed. The broad purposes of the plan and of the NPCC program mesh regarding fish and wildlife species.

From the Columbia River Basin Fish and Wildlife Program (NPPC 1994):

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system's impacts, we should respect the importance of natural ecosystems and species diversity.

Some species, such as some waterfowl species, have seemed to benefit from reservoirs and other hydropower development effects, but for many species, these initial population increases have not been sustained.

2.2 Public Involvement

The Lower Mid-Columbia Mainstem Subbasin Plan could potentially have a great effect on fish and wildlife resources in the subbasin. It could have significant economic impacts on the communities within the subbasin as well. For these reasons, public involvement is considered a critical component in the development of the subbasin plans. Considerable time and effort was spent from the earliest meetings to craft a statement or "vision" of what the Washington participants would like to see in their subbasin as the result of efforts to restore, protect and enhance fish and wildlife populations and their habitat. The assessment and planning work for the Oregon side of the subbasin and the mainstem occurred in the fall of 2004—after the initial plan was submitted on May 28, 2004 and after ISPR and the public comment period was concluded. During the fall the technical writer and ODFW staff were not able to meet with local citizens about this Oregon area of the subbasin.

An important goal of the subbasin planning process continues to be to bring people together in a collaborative setting to improve communication, reduce conflicts, address problems and, where ever possible, reach consensus on biological objectives and strategies that will improve coordinated natural resource management on private and public lands.

The plan could potentially have a great effect on fish and wildlife resources in the subbasins, and could also have a significant economic impact on the communities within the subbasins. For these reasons, public involvement is considered a critical component in the development of the subbasin plans.

Public involvement in the subbasin planning processes the Washington side of the Lower Mid-Columbia Mainstem Subbasin (including Rock Creek) involved a public mailing, public meetings held at different locations and times in the subbasin (and towns near the subbasin), regular conference calls, use of a ftp site to store draft documents, posting draft subbasin plans on the NPCC website, and development and use of extensive e-mail lists that were intended to keep members of the public informed regarding the status of the subbasin planning process.

The White Salmon, Klickitat, and Lower Mid-Columbia Mainstem subbasin planning team, as a part of its public outreach effort, developed a brochure for the public mailing. The brochure was sent as bulk mail and delivered to all postal customers residing in the three subbasins.

There were also a total of seven public meetings in Washington held as a part of the subbasin planning effort. These meetings were held on March 9 and May 6 in Goldendale, on March 11 and May 4 in White Salmon, on March 10 and May 5 in Bickleton, and on May 3 in Klickitat, and while meetings focused on a particular subbasin, the meetings were open to citizens of the three closely connected subbasins and questions were taken regarding the three areas. Numerous technical and planning meetings, announced and open to the public, were held in many locations throughout the subbasins to facilitate collaboration, information flow and involvement by as diverse a group as possible. Throughout the subbasin planning process, Washington participants worked on a vision statement that reflects their vision of the subbasin in 10 – 20 years. As previously indicated, given the time line, no public meetings were held in Oregon. The extent of Oregon public involvement has been the cooperation and/or contact with local offices of ODFW, USFWS, conservation districts and the Oregon Natural Heritage Program Information Center.

The participating agencies, the Yakama tribe, the citizens in the Washingon portion of the subbasin and ODFW leadership approved the vision statement for the Lower Mid-Columbia Mainstem Columbia River (including Rock Creek, Washington) The vision statement follows.

2.3 Vision Statement

We envision healthy self-sustaining populations of fish and wildlife indigenous to the Columbia Basin that support harvest and other purposes. Decisions and recommendations will be made in a community based, open and cooperative process that respects different points of view, and will adhere to all rights and statutory responsibilities. These efforts will contribute to a robust and sustainable economy.

2.4 Subbasin Goals

- Protect or enhance the structural attributes, ecological function, and resiliency of habitats needed to support healthy populations of fish and wildlife.
- To restore and maintain sustainable naturally producing populations of chinook, steelhead, coho and white sturgeon that support tribal and non-tribal harvest and cultural and economic practices while protecting the biological integrity and the genetic diversity of the subbasin.

2.5 Focal Species and Habitats in the Current Planning Area

While the Lower Mid-Columbia Mainstem Subbasin as defined by the NPCC includes numerous Columbia River reaches, it is in the watersheds that drain into the Columbia where habitat and other restoration initiatives are most likely to be implemented and achieve benefits for fish and wildlife. But for anadromous fish species, in particular, the success of these initiatives also depends on the mitigation and restoration actions taken in the mid-Columbia mainstem, where three dams (in the current configuration of the subbasin) dominant the river environment.The critical tributaries primarily occur on the Washington portion of the subbasin between the mouth of the Walla Walla River and the town of White Salmon and include Rock, Pine, and Glade creeks. In Oregon, the fish-bearing streams in the current planning area of the subbasin are Spanish Hollow and Frank Fulton Canyon creeks, east of the Deschutes River subbasin and west of the John Day River Subbasin. For terrestrial and wildlife species, important shrubsteppe habitat occurs in the northern halves of Sherman and Gilliam counties, parts of Oregon within the Lower Mid-Columbia Mainstem Subbasin.

The assessment and management plan identify strategies that benefit three focal fish species that utilize the Washington, possibly the Oregon tributaries, and the mainstem Columbia, and one, white sturgeon, that inhabitats the mainstem exclusively. In addition to sturgeon, the focal fish species selected are steelhead, fall chinook, and coho. The Pacific lamprey was chosen as a fish species of special interest.

Because this was initially a Washington-driven subbasin planning effort, three focal habitats were chosen, interior riparian wetlands, shrub stepp/interior grasslands, and ponderosa pine/Oregon white oak. Only the interior riparian wetlands and shrubsteppe grasslands occur in the Oregon portion of the subbasin. Agricultural lands and later the mainstem were selected as terrestrial and/or wildlife habitats of concern. Eight wildlife species from the Rock Creek watershed were chosen as focal species: Western gray squirrel, mule/black-tailed deer, grasshopper sparrow, Brewer's sparrow, white-headed woodpecker, Lewis' woodpecker, American beaver, and the yellow warbler.

The current planning area of the subbasin extends upstream from The Dalles Dam only as far as the Walla Walla River mouth. The portion that includes Hanford Reach and lands to the northeast and northwest are not within current planning boundardies. While there were no management plan strategies developed in this subbasin plan for the Hanford Reach area or its healthy and naturally spawning fall chinook, that population's status is addressed in the assessment section of the Lower Mid-Columbia Mainstem Plan because of its importance to the subbasin and the region. Also, Willow Creek and Juniper Canyon do not appear in this iteration of the Lower Mid-Columbia Subbasin Plan, as they were included in the Umatilla Subbasin Plan. See **Figure 1** for original and current subbasin boundaries.

2.6 Key Findings and Limiting Factors

The management plan and parts of the assessment are presented in tables that describe key findings, working hypotheses, and the objectives and strategies to address the findings. Many of the findings constitute the factors that unless dealt with, limit the ability of the subbasin to sustain the particular focal species and/or habitats.

2.6.1 Washington Area of the Subbasin

The terrestrial and wildlife limiting factors are based on IBIS information, the unpublished Ashley/Stovall Wildife Assessment Report, and the first hand knowledge of the Yakama Nation and its wildlife staff. The fish limiting factors for Rock Creek derives from an EDT (Ecosystem Diagnostic and Treatment) analysis and interpretation. The limiting factors for fish in the other Washington watersheds in the subbasin were taken from the Water Resource Inventory Area 31: Habitat Limiting Factors.

Interior Riparian Wetlands and Associated Focal Species

The major limiting factors for the interior riparian wetland and associated focal species, the yellow warbler, American beaver, and Lewis' woodpecker, are:

1. Reduction in overall habitat, including floodplain acreage

2. Loss of riparian vegetation and habitat and displacement of native riparian vegetation by non-native species

3. Fragmentation of habitat

4. Alterations in upper watershed hydrology

5. Incised stream reaches, loss of stream complexity and riparian function

6. For the the yellow warbler and Lewis' woodpecker, a reduced food base is also a limiting factor

7. Information is lacking to identify and prioritize all key areas for application of the appropriate strategies

Shrubsteppe/Interior Grasslands and Associated Focal Species

The major limiting factors for the shrubsteppe/interior grasslands and associated focal species, the Brewers' sparrow, mule/black-tailed deer, and grasshopper sparrow, are:

1. Loss of quality habitat, including soil damage

2. Loss or reduction in the age class native shrubsteppe vegetation and displacement of native vegetation by non-native species

3. Loss of ephermal wetlands

4. Overall loss and fragmentation of shrubsteppe/grassland habitat

5. For mule deer, additional limiting factors are loss of shrubsteppe habitat in winter range and hunting mortality

6. For the brewer's sparrow and grasshopper sparrow, addititional limiting factors are loss of shrubsteppe habitat within their breeding range

7. Information is lacking to identify and prioritize all key areas for application of the appropriate strategies

Ponderosa Pine/Oregon White Oak Habitat and Associated Focal Species

The major limiting factors for the ponderosa pine/Oregon white oak habitat and associated focal species, western gray squirrel and white-headed woodpecker, are:

1. Loss of large tracts of old growth or late seral forests, which has also resulted in the reduction of large diameter trees and snags

2. Increased stand density and decreased average tree diameter

3. Loss of native understory vegetation and composition

4. For the western gray squirrel, increased competition with introduced, non-native squirrels

5. Information is lacking to identify and prioritize all key areas for application of the appropriate strategies

Rock Creek and Focal Fish Species

The fish assessment and management plan for the Washington portion of the subbasin focus on Rock Creek, where an EDT (Ecosystem Diagnostic and Treatment) analysis was made. The limiting factors for Rock Creek and the associated focal species are steelhead, coho, and fall chinook are:

1. Altered thermal regimes have affected fish life histories such as spawn timing, incubation and rearing, and decreased suitable habitat

2. Juveniles redistribute themselves downstream in the summer and fall after emergence, with highest densities in fall being found well below the major spawning areas

3. Steelhead populations have been dramatically reduced from pre-settlement abundance levels

4. Population levels of Pacific lamprey have been dramatically reduced from pre-settlement levels

5. Tributary summer/early fall habitat availability lower in comparison with pre-settlement environment

6. Loss of habitat diversity and thermal refugia because of off-channel habitat losses

7. Hydrology has been altered to increase peak flows; loss of storage

8. In tributaries, lack of habitat diversity (pools with cover) and lack or decrease of large woody debris

9. Food web in lower river has been altered and/or reduced

10 Predation risk to salmonids from native fish (northern pike minnow), from non-native fish (walleye and smallmouth bass), and from birds is elevated

11. Survival of steelhead kelts (mature spawned out fish with the potential to spawn again) migrating out of the Rock Creek watershed and through the mainstem Columbia to the ocean is believed to be at or near zero

12. Hatchery fish compete with natural-origin fish for space and food resources

13. High temperatures in tributaries have resulted in increased susceptibility of native salmonids to pathogens

14. Loss of habitat diversity and thermal refugia because of off-channel habitat losses

15. Population and ecological effect of beavers have been significantly reduced and altered

16. Increased percentages of fine sediment from background levels in spawning gravels and interstitial spaces

Other Washington LMM Watersheds and Focal Fish Species

1. Barrier culverts at SR 14 on Pine Creek preclude access to potential steelhead habitat

2. Low or non-existent flows in all streams during the late summer, fall, and early winter will limit or preclude utilization by fall spawning adults (chinook, coho), and limit mobility of juveniles of all species

3. High stream temperatures in the lower portions of all streams during the summer and early fall limits mobility of juveniles of all salmonid species and can result in mortality due to thermal stress

4. Accelerated channel incision (entrenchment, downcutting) has reduced the quality and amount of available existing or potential fish habitat

5. Channel widening and obliteration of riparian zones

6. Locally poor habitat quality and riparian condition

7. Water quality diminished

8. Removal of or damage to riparian vegetation and compaction and erosion of stream banks and adjacent floodplain areas

9. Low or non-existent flows in all streams during the late summer, fall, and early winter limit or preclude utilization by fall spawning adults (chinook, coho), limit mobility of juveniles of all species, and may be resulting in mortality due to stranding

10. Information available for these findings is limited; additional data is needed on fish utilization and habitat availability and quality; investigation of barriers; more detailed evaluations of the condition of channels, floodplains, wetlands, and riparian areas; identification of sinks and sediments and sediment sources; the causes of high stream temperatures

2.6.2 Oregon Area of the Subbasin

The terrestrial and wildlife key findings and limiting factors are based on information from local ODFW and conservation district sources. Key findings and limiting factors for fish are based on local ODFW sources and the 2004 Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat Consultation on Resource Management Systems for Dry Cropland and Range and Pastureland in Gilliam, Sherman, and Wasco Counties, Oregon. (Oregon and Washintong's terrestrial and wildlife limiting factors and management objectives and strategies are integrated into the same tables.)

Interior Riparian Wetlands and Associated Focal Species

The major limiting factors for the interior riparian wetland and associated focal species, the yellow warbler, American beaver, and Lewis' woodpecker, are:

1. Reduction in overall habitat, including floodplain acreage

2. Loss of riparian vegetation and habitat and displacement of native riparian vegetation by non-native species

3. Fragmentation of habitat

4. Information is lacking to identify and prioritize key areas for application of the appropriate strategies, in particular, information about losses in and changes to riparian and floodplain areas and function, stream complexity, and food base sources for the yellow warbler and Lewis' woodpecker

Shrubsteppe/Interior Grasslands and Associated Focal Species

The major limiting factors for the shrubsteppe/interior grasslands and associated focal species, the Brewers' sparrow, mule/black-tailed deer, and grasshopper sparrow, are:

1. Fragmentation of shrubsteppe/grassland habitat and wildlife populations

2. Loss of habitat, particularly quality habitat

3. Soil damage

4. Loss or reduction in the age class native shrubsteppe vegetation and displacement of native vegetation by non-native species

5. Information is lacking to identify and prioritize key areas for application of the appropriate strategies, in particular, information about loss of ephermal wetlands and existing habitat for and habitat use by the brewer's sparrow and grasshopper sparrow, including the status of subbasin shrubsteppe habitat within their breeding range

Fulton Canyon and Spanish Hollow Watersheds

1. Watershed hydrology is altered

2. Columbia River dams have reduced potential anadromous fish spawners in these watersheds

3. Summer/early fall habitat availability diminished in comparison with pre-settlement environment

4. Increased fine sediment from background levels in spawning gravels and interstitial spaces

5. Altered riparian and wetland structure

6. Steelhead populations have been dramatically reduced from pre-settlement abundance levels

7. Tributary high temperatures have reduced fish mobility and resulted in increased susceptibility of native salmonids to pathogens

8. Information available for these findings is limited; additional data is needed on fish utilization and habitat availability and quality; investigation of barriers and culverts; more detailed evaluation of the condition of channels, floodplains, wetlands, and riparian areas; identification of sediments and sediment sources; high stream temperature occurrences and causes

2.6.3 Mainstem Area of the Subbasin

The key findings limiting are based on information from ODFW, CRITFC, the 2000 Biological Opinion, the Fish Passage Center, the 2001 LMM Subbasin Summary, the fish agency and tribes' Comments on the "All H Paper," and other professional, agency, and technical sources.

Lower Mid-Columbia Mainstem and Focal Species Steelhead, Fall Chinook, and Coho

1. Hydropower system has altered the historic hydrograph, which has a negative impact on juvenile salmon, including steelhead, coho, and fall chinook

2. Downsteam passage conditions at the hydroelectric dams can result in high mortalities

3. Peak demand flows and fluctuations in flow can have a deleterious effect on juvenile salmon migration

4. Fluctuations in flow can delay adult salmon migration

4. Weir technology is new and has been installed only at Lower Granite Dam. Not all dams and reservoirs have the same passage conditions

5. Prolonged exposure to elevated water temperatures is stressful for upstream migrants and can delay migration

6. When monitored, adult fish passage perfomance criteria are often not in compliance

7. Adult steelhead fallback is occurring at the dams

8. Contaminant input from upstream land-use activities are often trapped in the reservoirs behind dams. Dredging suspends contaminants accumulated in sediments

9. Rapid changes in reservoir levels are occur frequently with harmful results to fish and those who harvest fish

10. Irrigation withdrawals contribute to stranding of rearing juveniles

11. Juveniles can be entrained into irrigation pumps

12. Commercial gillnets used in The Dalles and John Day pools may break free, get lost, and trap fish

13. Juvenile salmon are being harvested by bird and fish predators at higher rates than prior to hydro operations

Lower Mid-Columbia Mainstem and Focal Species White Sturgeon

1. Spawning occurs in the mainstem but can be limited by hydrograph and water temperatures

2. Impounded white sturgeon populations incur periodic year-class failures

3. Egg, larval stage, and YOY white sturgeon are susceptible to predation

4. Impounded white sturgeon populations are less productive than the unimpounded lower Columbia River population

5. The health of white sturgeon populations show up in density, condition factor, reproductive potential, age structure, and fish growth rates

6. Reservoir specific intensive harvest management can influence white sturgeon abundance levels

Lower Mid-Columbia Mainstem and Species of Concern Pacific Lamprey

1. Recent counts of Pacific lamprey at The Dalles, John Day and McNary dams indicate a serious decline in abundance. Low abundances limits lamprey populations in upstream tributaries

2. Adult fishways are difficult for lamprey to negotiate

3. Juvenile lamprey suffer from high impingement rates on bypass screens because they are relatively poor swimmers. John Day Dam, in particular, impinges large numbers of lamprey

4. Contaminants input from upstream land-use activities are often trapped in the reservoirs behind dams. Dredging suspends contaminants accumulated in sediments. Dredging can also lead to direct mortalities

5. Rapid changes in reservoir levels can isolate or dewater rearing areas and lead to juvenile mortalities

Habitats of Concern: Mainstem Wildlife Habitat and Agriculture

The lower mid-Columbia mainstem contains some prime wildlife habitat—islands, embayments, and mudflats, primarily—where a diversity of avian species use the area to stop-over, breed, nest, and winter. This section of the assessment lists nearly 40 important wildlife habitat areas in The Dalles, John Day, and McNary reservoirs, including the Umatilla National Wildlife Refuge in the John Day pool. This section discusses the recent invasion of the exotic false indigo that has further degraded riparian areas along the shoreline and on the islands.

Agriculture is briefly discussed as a habitat of important economic significance to the subbasin. This section notes that agriculture is becoming more environmentally friendly. It also mentions that in Oregon’s Sherman, Gilliam, and Wasco counties, successful consultation with NOAA/Fisheries has resulted in plans for conservation-oriented Resource Management Systems for dry cropland and range and pastureland as part of helping to protect ESA threatened and endangered salmon species.

2.7 Management Objectives and Strategies

The fish and wildife species addressed in the 8. Management Plan are affected by many of the same limiting factors. Not surprisingly, subbasin planners have identified some of the same or closely related objectives and strategies to eliminate or reduce threats and to maintain and restore species and habitat viability. The strategic themes that bridge both fish and wildlife include an emphasis on restoring and maintaining native species, including vegetation; eliminating or reducing exotic species and the predator threat they pose; restoring and reducing threats to riparian areas, wetlands, and floodplains; reducing exposure to contaminants; reducing anthropogenic disturbance to water, land, plants, and animals; and acquiring the scientific information that is currently lacking.

Primary strategies in both the fish and wildlife portions of this management plans are proposed acations to restore beaver habitat and, where possible, to prepare for reintroduction of a species whose numbers are greatly reduced from historic levels. Restored habitat would benefit beaver, whose activities would in turn benefit the salmon and steelhead that use the watershed for a portion of their life history. Beaver dams result in the creation of off channel habitat and increased channel stability, which would provide a benefit to the fish focal species that utilize the Rock Creek and other tributary watersheds.

Restoring riparian wetland habitat structure and hydrology increases ecological function, bringing benefits to both fish and wildlife. Rehabilation involves increasing native vegetation and creating adequate hydrological conditions, which together help reconnect habitats in tributary and mainstem floodplain areas.

Other objectives and strategies are specific to wildlife or fish, and they are summarized below.

Generally, the areas and actions identified in the primary tier category of the focal fish and wildlife species management plans could be implemented within the next five years and have a high likelihood of achieving the targeted biological objectives. The geographical areas in the primary tier of the fish and wildlife tables are the most appropriate areas for that strategy to be employed.The white sturgeon table is also ordered according to the confidence level associated with particular strategies.

2.7.1 Wildlife

A general wildlife theme identified across the subbasin is stop the reduction in the quantity and quality of all types of terresterial and riverine habitat that the wildlife focal and other species need to flourish.

Reconnecting currently fragmented wildlife habitats types is a common objective of all three focal habitats. The solutions range from changing silvicultural, grazing practices, and other land use practices to purchasing easements and properties with intact habitats.

Among the causes of the diminution and fragmentation of shrub steppe habitat are agriculture and other human development, altered fire frequencies and invasive weed species. Habitat quality can be improved by controlling the frequency and thus the intensity of fire (restoring more natural fire cycles), encouraging appropriate grazing practices, prioritizing weed control areas, and implementing native plant restoration. Restoration and protection of exisiting habitats are key strategies.

Habitat quality and ecological function in ponderosa pine/Oregon white oak habitat has been reduced because of altered forest species composition and age structure. Harvest practices have resulted in removal of late seral stands and large overstory trees across the landscape. Biological objectives and strategies for the ponderosa pine/white oak habitat include retaining any presented late seral stands and large decadent wildlife trees and managing these stands to restore functional habitat. Such strategies include identifying areas where thinning and/or prescribed burning would help achieve habitat objectives and thinning appropriate stands to decrease stand density.

2.7.2 Fish

Many proposed actions focus on restoring riparian function (reconnect side channels, re-establish or enhance native vegetation, increase channel roughness, artificially introduce large woody debris as well implement practices that allow large woody debris to naturally enter and remain in the system). Such actions would contribute beneficially to lowering stream temperatures, increasing wetted perennial areas in the lower watersheds, improving food availability, filtering fine sediment levels, attenuating peak flows and otherwise improve conditions for fish in the subbasin’s tributaries.

There is significant need for ongoing monitoring and evaluation within the Rock Creek watershed. Although there is a high level of certainty with several key findings and strategies, without concerted monitoring and evaluation there is a margin of uncertainty that the best strategies will achieve the most benefit possible. Therefore, along with the actions suggested in the management plan tables, an extensive monitoring and evaluation effort within Rock Creek is considered a high priority.

This plan urges the supplementation of less productive focal fish populations in the subbasin’s Washington tributaries by capturing juveniles below the lower most dam in the system, Bonneville, then transporting and releasing them in upstream reservoirs. The Rock Creek and mainstem Columbia plans call for strategies to improve the survival of steelhead kelts, which are mature, spawned out fish that have the potential to spawn again.

For Spanish Hollow and Fulton Canyon what is particularly needed and called for is the collection and analyses of base line data about the watershed and fish utilization.

Water quality in the lower mid-Columbia mainstem, in Rock Creek, Spanish Hollow and Fulton Canyon and other watersheds are impacted by excessive sedimentation, which can negatively affect steelhead and salmon rearing and egg incubatio. in the mainstem are Strategies identified in the plan include an assessment of the relative contribution of the various sources of that increased sedimentation and implementation of actions to reduce sedimentation. Those actions include improved road and off-road vehicle management and the implementation of upland management practices that mimic natural runoff and sediment production.

In the mainstem, contaminants are suspended in sediments and accumulate in the reservoirs behind the dams. The recommended strategy for the mainstem includes eventually eliminating dredging. Mainstem strategies targeting contaminants call for the full development of TMDLs, including identifying remedial actions.

Many of the mainstem strategies address the critical limiting factor for anadromous fish: up- and downstream passage of salmonids. Because the mainstem plans are not expected to fully plan the restoration and remedial actions that would make the Columbia River habitat more suitable to anadromous fish, this subbasin plan addresses passage and flow issues in a general way. Nonetheless, the mainstem management plan identifies aggressive actions that acknowledge the strategic location of the lower mid-Columbia River and its three hydroelectric dams. Strategies offered in this document's management plan suggest hydrosystem operational shifts that are expected to increase migration survival and spawning success particularly in the Hanford Reach.The plan recommends actions to restore a more natural hydrograph to improve migration conditions; use flow augmention to increase water velocities during fish critical times; use spill to maximize downstream passasge and spread the risk among several strategies for juvenile migration; minimize fluctuations in flows and rapid changes in reservoir levels; and halt additional water withdrawals.

2.8 Adaptive Management of the Subbasin

It is important to recognize that the Lower Mid-Columbia Mainstem Subbasin Plan reflects current understanding of conditions within the subbasin. The strategies recognize uncertainty and lay out a series of processes for improving the scientific understanding of those conditions, as well as implementing actions that the planners feel certain will succeed in meeting plan goals. The purpose of ongoing research and monitoring is to reduce uncertainty regarding subbasin function and to move from uncertainty to action items. As results of research and monitoring become known, or in some cases as projects are further refined, more specific action strategies are expected to be formulated at points in time which do not precisely coincide with updates to the subbasin plan or project review cycles established by the NPCC.

If adaptive management (i.e. a structured process to actively learn from ongoing management as well as research) is to work and improve our decision-making ability over time, research and monitoring programs must be allowed to occur within each planning cycle. Therefore the agencies that use the subbasin plan as a guide for funding decisions are encouraged to recognize that the specific strategies within the plan may soon be out of date, and that newly developed strategies that are derived from and are consistent with biological objectives are intended as components of the subbasin plan.

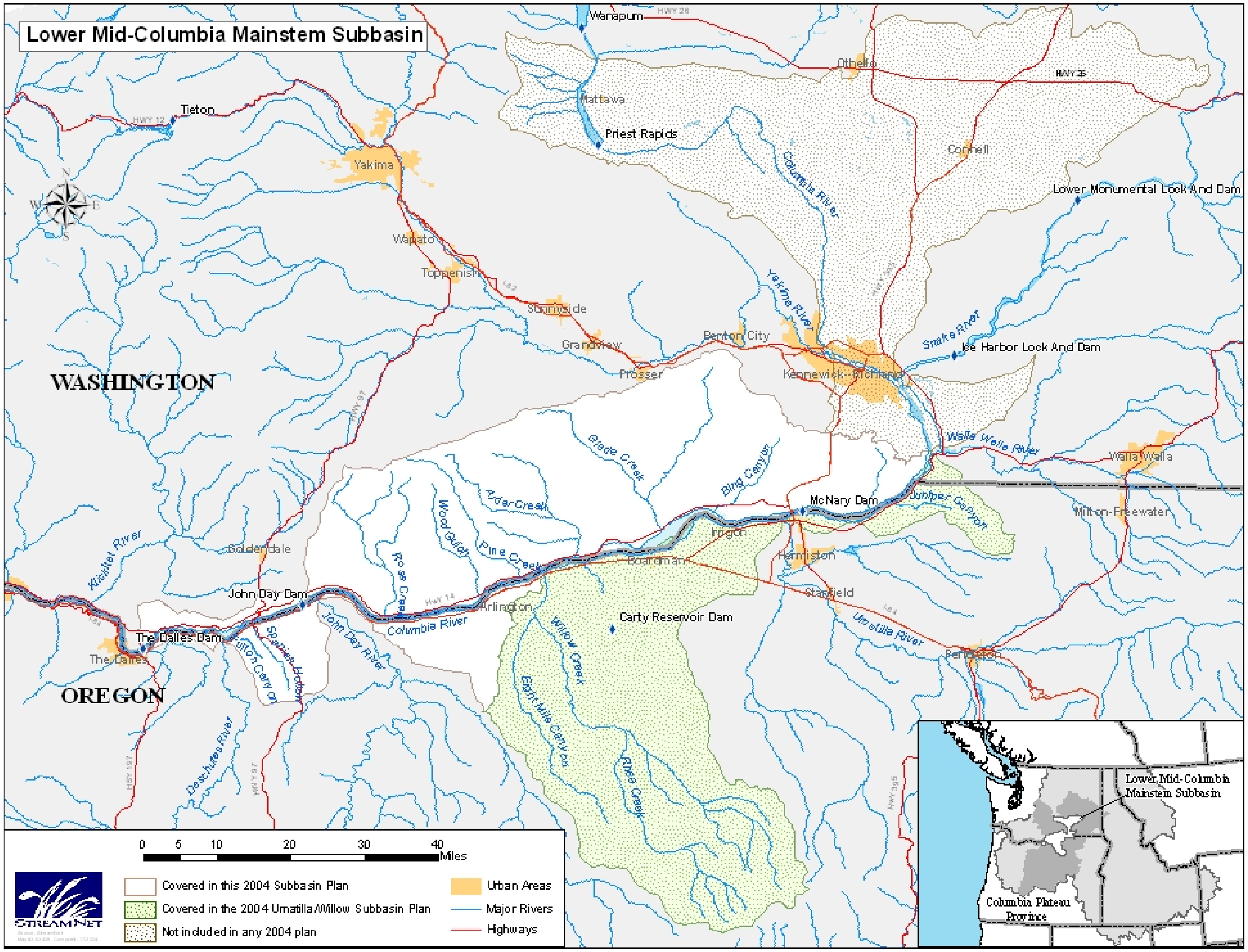


Figure 1 Lower Mid-Columbia Mainstem Subbasin, active planning areas, and location in the Columbia Basin

3 Subbasin Overview

3.1.1 Subbasin in Regional Context

For planning purposes, the Northwest Power and Conservation Council (NPCC) divided the Columbia River Basin south of the Canadian border and its more than 60 subbasins into 11 eco-regions. NPCC is responsible for implementing the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P.L. 96-501) and the Fish and Wildlife Program mandated by the Act.

The 11 provinces, beginning at the mouth of the Columbia River and moving inland, are: Columbia Estuary; Lower Columbia; Columbia Gorge; Columbia Plateau; Columbia Cascade; Inter-Mountain; Mountain Columbia; Blue Mountain; Mountain Snake; Middle Snake; Upper Snake. These 11 eco-regions include the entire Columbia River basin in the United States, and together cover approximately 25,000 sq. mi. in Washington, Oregon, Idaho and Montana.

Each of the 11 provinces will develop its own vision, biological objectives, and strategies consistent with zthose adopted at the subbasin level. NPCC's intent is to adopt these elements into the 2000 Fish and Wildlife Program during later rulemaking. The biological objectives at the province scale will then guide development of the program at the subbasin scale.

The provinces are made up of adjoining groups of ecologically related subbasins, each province distinguished by similar geology, hydrology, and climate. Because physical patterns relate to biological population patterns, fish and wildlife populations within a province are also likely to share life history and other characteristics (Rawding 2000). The Lower Mid-Columbia Mainstem subbasin is in the Columbia Plateau Province.

Columbia Plateau Province

The Columbia Plateau Province is the largest of the ecological provinces and extends over an area of approximately 45,275 sq. mi. It is defined as the Columbia River and associated watersheds between The Dalles and Wanapum dams on the Columbia River and Ice Harbor on the Snake River. This area includes much of southeast and south-central Washington, northcentral and northeast Oregon, and a small portion of Idaho east of Moscow.

The Cascade Mountains form the western border of the Plateau through Oregon and Washington, while the Palouse region along the Washington/Oregon border and Blue Mountains form the eastern edge. The southern border is marked by the divides that separate the upper Deschutes and John Day drainages from the Oregon High Desert and drainages to the south, while the northern border is formed by the Wenatchee Mountains and the divides that separate Crab Creek and Palouse River from the drainages in the Inter-Mountain Province.

The principal rock of the Columbia Plateau is a series of basalt flows, interspersed with sedimentary layers, called the Columbia River Basalt Group. The hydrology of the Plateau is complex; surface water includes numerous small tributaries draining to mainstem rivers, while underlying the region is the Columbia Plateau aquifer system, localized in some areas by series of groundwater subbasins. Temperatures and precipitation vary widely, usually depending on elevation, with cooler and wetter climates in the mountainous areas at the Plateaus' western, eastern and northern boundaries, and warmer and drier climates in the lower areas that make up most of the province. The mountainous regions are predominantly coniferous forests, while the arid regions are characterized by sagebrush steppe and grassland. Many of the same fish and wildlife species are found in each of the 10 Plateau subbasins.

The native people of the Plateau included the Yakama, Wanapum, Palouse, Cayuse, Umatilla, Walla Walla, Nez Perce, Tenino, John Day (Dock-Spus), and Wyam. Today the Plateau province is home to three tribal confederations and parts of four Indian reservations. Most of the Yakama reservation is located within the southwest portion of the Yakima subbasin, while the Warm Springs and Umatilla reservations of Oregon are located within the Deschutes and Umatilla subbasins, respectively. The northwest tip of the Nez Perce reservation in Idaho is located in the Palouse subbasin.

Significant urban centers within the Province include Tri-Cities (Pasco, Richland, and Kennewick), Walla Walla, Pullman, and Yakima, Washington; Moscow, Idaho; and Bend, Redmond, Pendleton and Umatilla, Oregon.

Columbia Plateau is an important agricultural and grazing area and is a major source of hydroelectric power. Four major hydroelectric dams are located in the Plateau province: McNary and John Day dams downstream of the Snake-Columbia confluence, and Priest Rapids and Wanapum dams upstream of the Yakima-Columbia confluence. Downstream of the province on the mainstem Columbia are two more dams, The Dalles and Bonneville, which must be traversed by anadromous fish migrating to and from the province's 10 subbasins.

The Plateau is divided into 10 subbasins: Deschutes; John Day; Lower Mid-Columbia Mainstem, including Rock Creek; Umatilla; Walla Walla; Tucannon; Snake Lower; Palouse; Crab; and Yakima.

Lower Mid-Columbia Mainstem Subbasin Location

The original boundaries of the Lower Mid-Columbia Mainstem Subbasin, set by the Northwest Power and Conservation Council, extended upstream to river Wanapum Dam and included Priest Rapids, McNary, John Day, and The Dalles dams and reservoirs within the subbasin as well as the free-flowing Hanford Reach immediately downstream from Priest Rapids Dam. Although the Mainstem Columbia River Subbasin Summary, prepared in 2001 for the Council, covered this area in addition to Bonneville Dam and reservoir, the geographic scope of the mainstem Columbia segment of the 2004 Lower Mid-Columbia Mainstem Subbasin Plan is limited to the Columbia River from the mouth of the Walla Walla River to the mouth of the White Salmon River. Section 1.2. Subbasin Approach and Public Involvement gives the reasons for this limited geographic scope.

For the purposes of the 2004 subbasin planning effort the Lower Mid-Columbia Mainstem Subbasin of the Columbia River subbasin of the Columbia Gorge Province is bounded upstream from the mouth of the Walla Walla River, downstream by The Dalles Dam, and on the south by the Columbia River. McNary and John Day hydropower projects and reservoirs and The Dalles reservoirs are include within the subbasin. Lands along the Columbia corridor from the Dalles to the Walla Walla River are also included in the LMM Subbasin Plan.

Certain watersheds adjacent to this segment of the mainstem Columbia are within the subbasin boundaries, including Rock Creek, Pine Creek, and other streams which drain into the Columbia River from Washington upstream of John Day Lock and Dam; Frank Fulton Canyon and Spanish Hollow creeks, which drain into the Columbia from Oregon downstream of John Day Dam; and canyon areas east of Arlington to the John Day River subbasin. While the original NPCC boundaries on the Oregon side also included Juniper Canyon, between McNary Dam and the mouth of the Walla Walla River; Willow Creek and its tributaries, west of the Umatilla River watershed, the Umatilla Subbasin Plan has included them with its active planning area. The Lower Mid-Columbia Subbasin references these watersheds when they relate to terrestrial and aquatic habitats, fish and wildlife populations, or anthropogenic conditions there; in other instances, the reader is directed to the Umatilla or the other adjacent subbasins, the John Day, Deschutes, and Columbia Gorge for further information.

Also, the Rock Creek watershed in Washington—although within the original boundaries of the Lower Mid-Columbia Mainstem—was written as a separate subbasin summary, but is now incorporated in the Lower Mid-Columbia Mainstem Subbasin Plan.

Please see **Figure 1** (and also Section 3.2) for the boundaries and current planning areas of the Lower Mid-Columbia Mainstemn Subbasin.

3.1.2 Aquatic/Terrestrial Relationships

Riparian habitat connects aquatic and terrestrial ecosystems providing an important link between fish, wildlife, and their habitat. Riparian areas perform a number of functions vital to the watershed and water quality. These functions are important to salmon habitat and wildlife that are dependent on salmon for food and nutrients.

Anadromous salmon provide a rich, seasonal food and nutrient resource that directly impacts the ecology of both aquatic and terrestrial consumers and the vegetative landscape. There is also an important indirect effect on the entire food-web linking water and land resources (Cederholm et al. 2000). This food-web has likely always included this co-evolutionary relationship between salmon, wildlife and habitat in the Pacific Northwest.

The life stages of salmon (i.e., eggs, fry, smolts, adults, and carcasses) all provide direct or indirect foraging opportunities for terrestrial, freshwater, and marine wildlife (Cederholm et al. 2000). The relationship between Pacific salmon and wildlife was examined by Johnson et al. (2001). A total of 605 species of terrestrial and marine mammals, birds, reptiles, and amphibians currently or historically common to Washington and Oregon were examined for their relationship to pacific salmon. They found a positive relationship between salmon and 137 species of wildlife. See Appendix C,h.s., table C.6.A,h.s. for a full list of the wildlife species in this subbasin identified as having a relationship with salmon.

There are several predators in the Pacific Northwest ecosystem that benefit from the important ecological contribution that pacific salmon make as prey during their anadromous life history. Pacific salmon contribute nutrients during several stages of their life, regardless of whether particular individual salmon complete all life history stages or not (Cederholm et al. 2000). Six wildlife species present in this subbasin are identified as having a strong, consistent relationship with salmon: common merganser (*Mergus merganser*), harlequin duck (*Histrionicus histrionicus*), osprey (*Pandion haliaethus*), bald eagle (*Haliaeetus leucocephalus*), black bear (*Ursus americanus*) and northern river otter (*Lontra canadensis*).

Fish, and their habitat, also benefit from the presence of particular wildlife species. American beavers (*Castor canadensis*) are extremely important in contributing to large woody debris, which is a critical structural component in Pacific Northwest streams. Large woody debris provides important structural complexity as well as vital nutrients to streams. Large woody debris and beaver dams decreases stream velocity and temperature. It also provides refugia to migrating fish.

There are many human activities that have implications to both terrestrial and aquatic species and habitat. Some examples include timber activities, presence of roads and cattle grazing. Timber activities can fragment and decrease quantity and quality of wildlife habitat. It can also decrease woody debris available to streams and increase sedimentation. High amounts of sediment can increase water temperature, making streams unsuitable for fish, amphibian and aquatic macroinvertebrate species. Roads impact terrestrial wildlife by fragmenting habitat, creating barriers to migrating species. Roads can also reduce vegetation, cause sediment increase and edge degradation, and lead to direct mortality. Grazing degrades vegetation and increases sediment and fecal coliform levels in streams, impacting both wildlife and fish.

Three species of anadromous salmon, fall chinook (*Onchorynchus tschawytscha*), coho (*Onchorynchus kisutch*), and steelhead (*Onchorynchus mykiss*), use streams in the Rock Creek assessment unit. One distinct stock, steelhead, has been identified as indigenous to the subbasin. The remaining anadromous use is believed to be a result of straying of other mid-Columbia stocks, or is incidental use associated with upriver migration of adults or downriver migration of juveniles.

A complete list of the common and scientific names used in this plan can be found in Appendix B.

3.2 Subbasin Description

3.2.1 General Location

The current planning boundaries of the Lower Mid-Columbia Mainstem Subbasin in the Columbia Plateau Province are bounded from east to west by the mouth of the Walla Walla River at river mile RM 315 (km 507) and by The Dalles Dam tailgate at approximately RM 192 (km 309). The subbasin mainstem is 123 river miles (km 198) long. McNary Dam and part of its reservoir and the John Day Dam and its reservoir are within the subbasin. On the Washington side across the Columbia from Walla Walla River mouth, the subbasin extends from south from the crest of the Horse Heaven Hills and west encompassing a series of small canyon creeks including Glade, Sixprong, Pine and Rock creeks then along the Columbia shore following the Columbia Hills to The Dalles Dam. This area includes the Rock Creek watershed, among other smaller streams. South on the Oregon side, the subbasin extends west from mouth of the Walla Walla River along the Columbia shore until reaching Arlington, Oregon, where the subbasin then takes in Alkali, Blalock, Philppi and other small canyons. On the east side of the John Day River, the subbasin includes more canyon areas including Spanish Hollow and Fulton Canyon watersheds. See **Figure 1**. These important tributaries flow into the lower mid-Columbia mainstem: the Walla Walla, Umatilla, Willow, Rock, John Day, and Deschutes. (Each of these tributaries, with the exception of Rock Creek, are described in individual subbasin plans.)

3.2.2 Topographic/Physio-geographic Environment

The geology of the subbasin is dominated by extensive basalt flows up to 2 miles thick. The erosion-resistant nature of these flows resulted in the creation of deep (500 to 800 feet) steep-walled canyons with ragged outcrops and in severely constrained floodplain development along substantial portions of the streams within this subbasin (Lautz 2000).

Along John Day reservoir, canyon walls on the Washington side of the river rise abruptly to as much as 150 meters (500 feet), while elevation at The Dalles Dam is 30 m. Mount-ains adjacent to or near the river have elevations as high as 900 m.

The Oregon shore generally rises gradually along a lower terrace extending up to 1.6 km (1 mile) from the river then abruptly to an elevation of approximately 60-70 m (200 feet), forming a higher terrace. High winds have resulted in the deposition of silt and sand and the creation of dunes along these terraces. The huge scale of geologic events produced a landscape of gently rolling lands, deep soil, and cross-cutting rivers, that through time has evolved to account for such features as steep rugged canyons and many breaks, cliffs, and rims (NOAA/Fisheries 2004).

3.2.3 Climate and Weather

The area within the subbasin generally experiences hot dry summers with temperatures that can reach above 380 C (100.40 F) during the day then cool considerably at night. Winters may be wet and cold with strong winds and blowing snow. Summer temperatures are generally highest in July, with highs averaging 31.10 C at Umatilla and The Dalles Dam. Winter lows in January average –3.3 C (-19.60 F) in Umatilla, and –1.10 C at The Dalles Dam. Total annual precipitation averages only 22.9 cm (9 inches) at Umatilla and 35.5 cm (14 inches) at The Dalles Dam. On the Oregon areas of the subbasin, the range is 20.3 cm-25.4 cm (8-10 inches) annually. In many areas about half the precipitation falls in winter as snow. Less than 10% of the total precipitation occurs during the summer months.

Climate is typical of the continental climate that occurs on the east side of the Cascades. Average daily temperatures range from 70˚ F in the summer with maximums commonly above 90° F and 37° F in the winter (Lautz 2000). Annual precipitation ranges from 35 inches in the headwaters of Rock Creek to less than 10 inches in the southern half of the subbasin (Kresch 1998). Generally, about 75-85% of this precipitation occurs between November and May.

3.2.4 Land Cover and Vegetation

Forestlands comprise about 47% of the subbasin, primarily the headwaters of Rock and Pine creeks, and many have active grazing allotments. Forest communities in Rock Creek watershed are dominated by Oregon white oak and ponderosa pine (WDNR 1998) and are typically found on north-facing slopes and in riparian zones.

Outside of the Rock Creek watershed, the subbasin’s plant community is primarily grasslands without many trees. Over the past 150 years, a significant portion of the former sagebrush steppe, grassland, and riparian communities have been converted to agriculture. About 47% of the land in the subbasin (including lands not in the current planning area) are now in agricultural use including for a variety of dryland grains and irrigated crops (Johnson and O’Neil 2001).

Much of this Columbia Plateau region’s natural vegetation is bunchgrass prairie with areas of bitterbrush steppe and western juniper. Riparian vegetation historically was black cottonwood, willows, chokecherry and aspen with wetlands dotting the plateau (Oregon Progress Board 2000.) See 4.2 Discussion of Focal Habitats and their Representative Focal Species and 5.8 Environmental Conditions for more details.

3.2.5 Hydrology and Hydrography

Columbia River Mainstem

The Columbia River travels through about 123 miles of the subbasin. Major tributaries draining into this subbasin include the Walla Walla in Washington and the Umatilla, John Day, and Deschutes in Oregon. Smaller tributaries flowing into the Columbia River include Glade, Six Prong, Pine, and Rock creeks in Washington, and Willow, Spanish Hollow, and Fulton Canyon creeks in Oregon. Numerous other perennial secondary streams and many intermittent and ephemeral streams provide water to the Columbia River. See **Table 1** for the location and drainage area of Columbia River tributaries within the Lower Mid-Columbia Mainstem subbasin.

Table 1 Tributaries of the Columbia River within the Mainstem Subbasin (Location of confluence is given as Columbia River km)

Tributary	Location of confluence	Drainage area (km2)
Walla Walla River	506 km	2,829
Umatilla River	465 km	3,685
Willow Creek	408 km	2,279
Rock Creek	370 km	--
John Day River	352 km	13,033
Deschutes River	330 km	16,894

Within the LMM Subbasin, three mainstem dams impound this lower, middle section of the Columbia River: McNary Dam, John Day Dam, and The Dalles Dam. The dams separate the river into three impoundments.

At normal pool elevations, 100% of the Columbia River within the subbasin is impounded (**Table 2**). Surface area of the impoundments totals approximately 41,000 ha. Discharges at McNary and John Day dams may range from 14,000 m3/s in spring to 2,000 m3/s in autumn.

Table 2 Characteristics of Columbia River dams and associated reservoirs in the Mainstem Subbasin - U.S. Army Corps of Engineers. Pool measurements are at normal pool

Dam	Operator	Year Completed	River km/ RM	Mean discharge (m^3/s)	Pool length (km)	Average pool width (km)	Pool surface area (ha)
McNary	USACE	1953	470/ 292	5,165	98.1[a]	1.6	15,700
John Day	USACE	1971	347/ 216	5,507	122.9	1.8	21,000
The Dalles	USACE	1957	309/ 192	5,536	38.5	1.4	4,500

The U.S. Army Corps of Engineers (USACE) operates McNary, John Day, and The Dalles dams and reservoirs for hydropower production, recreation, navigation, irrigation, anadromous fish passage, and limited flood control. John Day Reservoir is somewhat unique in that it has substantial flood control capabilities. Mainstem reservoirs in the Columbia Plateau Province have relatively little storage capacity, and discharges through dams are run-of-the-river. (See 5.7 Fish Habitat Conditions.)

Riverine and wetland resources

Riverine and riparian habitat along the mainstem Columbia historically functioned as a travel corridor for both fish and wildlife species. Extensive flatlands that existed along the Columbia prior to inundation have formed shallow wetlands and numerous embayments along the shores of McNary, John Day, and The Dalles reservoirs. These serve as holding or resting areas for migrating adults and juveniles (Lautz 2000).

Flatlands that existed prior to inundation by John Day Dam are now shallow wetlands and embayments along the shore near the mouth of Rock Creek, a condition that occurs elsewhere near several river mouths in the LMM Subbasin. However, spring outflow in the immediate vicinity of fish-bearing waters, such as Rock Creek and other rivers, may provide important cool-water refuges during the summer and early fall.

Riparian habitat along the mainstem Columbia historically provided a critical link between drainages for a number of species (i.e., black-tailed/mule deer, western gray squirrels, neotropical birds). Creation of the John Day pool flooded 1,086 acres of riparian tree habitat, effectively isolating species from rich upland areas. This is evident by species extirpation (yellow-billed cuckoo) and current fragmented populations of threatened, endangered, and sensitive species in watersheds along the Columbia River. Other species such as the bald eagle were undoubtedly common along the riparian sections of the mid-Columbia River.

A reduction in the number of beaver and the inundation of wetlands from hydropower development in the subbasin has resulted in the drying and loss of many wetland and riparian habitats. The creation of the John Day pool resulted in the loss of 511 acres of emergent wetland (Rasmussen and Wright 1989).

Remaining locations of mainstem wetlands, empayments, and riparian areas significant to wildlife and fish are described in 3.2.8 Terrestrial/Wildlife Resources and 5.7.2 Lower Mid-Columbia River Mainstem Assessment Unit.

Hydroelectric development has transformed most fast-moving mainstem riverine habitats into slow-moving reservoir impoundments. Construction of McNary, John Day, and The Dalles dams inundated 200 km of fall chinook salmon spawning habitat in the Mainstem Columbia River (Van Hyning 1973). Today, only the Hanford Reach remains unimpounded and provides the majority of mainstem spawning habitat for fall chinook salmon. It is well established that stream flow quantity and timing are critical components of water supply, water quality, and the ecological integrity of river systems (Poff et al. 1997). Flow regimes, geology of surrounding landscapes, and longitudinal slope are important controlling variables in salmon habitats and operate at both the watershed and reach scale (Imhof et al. 1996). Flow regulation for hydropower, navigation, storage, and flood control also affects connections among groundwater, floodplains, and surface water (Stanford et al. 1996), or convergence zones (hyporheic habitats) where biodiversity and bioproduction are frequently high (Stanford and Ward 1993). The relative magnitude and frequency of high flow events also acts to modify channel form within the constraints of existing geological features.

Water quality

The Columbia River mainstem experiences varied and somewhat unique water quality conditions. Within McNary Reservoir, water quality is strongly influenced by the Snake and Yakima rivers. Flow from the Snake, Yakima, and Columbia rivers are not fully mixed until they reach McNary Dam. Below the confluence with the Snake River, the eastern and southeastern portion of the Columbia River is influenced by the Snake River, whereas the western and northwestern portion is influenced by the Yakima River. The Snake River-influenced portion experiences turbidity ranging from 5-10 NTUs during periods of little or no runoff to 200 NTUs during periods of heavy runoff. This portion of the river also experiences a high nutrient load, particularly nitrates from agriculture. The Yakima River-influenced portion experiences lower turbidity, ranging from 1-4 NTUs during periods of little or no runoff to 100 NTUs during periods of heavy runoff.

Throughout McNary, John Day, and The Dalles reservoirs, pH, mercury, arsenic, fecal coliform, and dioxin meet both Washington and Oregon standards. However, standards for dissolved oxygen, sediment bioassay and water temperatures do not meet state standards; and The Dalles, John Day, and McNary pools are listed as impaired [303(d)] waterways. See 5.8.2 Lower Mid-Columbia River Mainstem Assessment Unit, Aquatic Habitat Conditions, and Water Quality.

Tributaries-Oregon and Washington

Hydrologic data for the streams, particularly those other than Rock Creek are limited. For example, there are no snow data collection stations in the Oregon part of the subbasin. Judging from eight snow stations near the border of the Columbia Ecoregion (the subbasin falls in this region designated by the Watershed Professionals Network), minimal snowpack development was estimated below about 3,000 ft on average during January and February. In watersheds below 3,000 ft in elevation, most peak flows were likely produced by winter rainstorms because of the low elevations and maritime influence of the Columbia River (WPN 2001).

No flow regulation occurs on the tributaries within the subbasin. Some diversions for irrigation and stock watering exist. No water diversions exist on Fulton Canyon or Spanish Hollow and relatively intact habitat exists in the lower reaches of these streams (Mid Columbia Salmon and Steelhead Production 1990). Although the town of Wasco and O'Meara Wells in Sherman Count recent applied to draw .91 CFS of groundwater from the Spanish Hollow Creek basin.

Tributary flows in the subbasin can generally be described as having high peaks during the winter or early spring and often extremely low flows in the summer. Many streams in the subbasin can be characterzied as intermittent. Many lose all surface flow during the summer through parts of their length. Such episodic hydrographs are the result of low precipitation—especially in the Oregon and far eastern Washington portion of the subbasin where little snow accumulation is also the norm—steep-sided canyons that are relatively impervious basalt bedrock, and at lower elevations flat surface relief and sandy soils. Basalt rock and diminished vegetation contribute to rapid runoff and poor groundwater recharge Isolated storm events may cause locally high flows for short periods usually during the winter (Watershed Professionals Network 2001).

The watersheds on the Oregon and Washington side of the lower mid-Columbia mainstem subbasin appear to have similar geomorphic characteristics; most of the descriptive information that follows was generalized from information collected on and observations of the Rock Creek watershed. All of the major drainages originate in the Simcoe Mountains or Horse Heaven Hills (which form the northern boundary of the subbasin), and flow in a southerly to southeasterly direction to Lake Umatilla, the portion of the Columbia River impounded by the John Day Lock and Dam. Elevations range from 200 feet at the confluence of Rock Creek and the Columbia River to over 4000 feet in the Horse Heaven Hills (Lautz 2000).

Headwater tributaries flow out of the mountains, in the case of Rock and Glade creek watersheds, and across the relatively flat basalt plateau. Channels are moderately confined to unconfined (although there may be locally confined reaches caused by channel incision) with gradients generally less than 1% on the plateau. Land cover is primarily coniferous forest; land use is managed forest, grazing, and some rural residential. This area is above known anadromous fish use; available fish habitat is used by rainbow trout and non-salmonids such as dace. Fish habitat quality is generally fair to good; however, there are many areas where habitat has been degraded by grazing, road construction, and riparian harvest (Lautz 2000).

Coming off the plateau, streams enter steep-walled canyons. Channels are highly confined, gradients increase to 2 – 4%, and substrate is characterized by a mix of cobbles and boulders. Land cover is conifer forest or mixed conifer-deciduous forest in the vicinity of streams, transitioning to shrub-steppe in the uplands; land use is primarily grazing, which tends to be limited by steep slopes. Fish habitat quality is generally fair to poor, due mostly or entirely to the higher stream power in these reaches. Little suitable spawning gravel occurs, and rearing areas (pools) are minimal in extent and quality and are limited to protected areas behind boulders and along stream margins. Few macroinvertebrates and juvenile fish were observed in surveys conducted by the Bureau of Land Management (1985, 1986), suggesting that these reaches have relatively low productivity (Lautz 2000).

Below the canyon reaches, streams enter alluvial valleys. Channels are moderately confined to unconfined (although there may be locally confined reaches caused by channel incision), with gradients generally between 1% and 2% near the upper end, diminishing to less than 1% as streams approach the Columbia; substrate is variable, with particle sizes ranging from cobble to silt. Land cover is primarily shrub-steppe in the uplands, with riparian areas transitioning downstream from mixed conifer-deciduous forest to deciduous forest to shrub-grassland; land use is primarily grazing, which tends to be concentrated in the riparian zone. Fish habitat is highly variable, ranging from poor where degraded riparian zones and channel widening and incision occurs, to excellent where complex habitat elements (deep pools, suitable spawning gravels, large woody debris, riparian cover) exist in the vicinity of spring inflow or groundwater upwelling areas (Lautz 2000).

Headwater tributaries flow out of the mountains and across the relatively flat basalt plateau at gradients of generally less than 1%; this area is above known anadromous use. Coming off the plateau, streams enter steep-walled canyons; gradients increase to 2 – 4% or more; fish habitat quality is generally fair to poor, with little suitable spawning and rearing habitat. Below the canyon reaches, streams enter alluvial valleys; gradients range between 1% and 2% near the upper end, diminishing to less than 1% as streams approach the Columbia. Fish habitat in these sections is highly variable, ranging from poor to excellent (Lautz 2000).

Riverine and wetland resources

Flatlands that existed prior to inundation by John Day Dam are now shallow wetlands and embayments along the shore near the mouth of Rock Creek. These wetlands and embayments serve as holding or resting areas for migrating fish and are important habitat for a variety of wildlife (beaver, great blue herons, amphibians, and western pond turtle). Other wetland areas are associated with springs occurring further upstream. Many of the spring areas also serve as cattle watering areas, to the detriment or exclusion of wetland vegetation and water quality. Fish habitat within these spring-related wetland areas is unlikely, owing to their small size.

Riparian areas along the subbasin’s tributaries are subject to overgrazing. The major reason for the continued decline in riparian habitat quality in the Rock Creek subbasin is that riparian areas are managed in the same way as upland areas. Because of greater forage production, cover, and water availability relative to surrounding uplands, riparian areas are often subjected to levels of livestock use disproportionately high to their limited area extent (Platts 1990).

Over-grazing has led to loss of vegetative cover, greater summer heating and winter cooling, soil instability, reductions in water quantity and quality, and changes in bank, channel, and instream structure. Additionally, reductions in vegetation across the watershed may also be increasing peak flow discharges, reducing ground water storage, and limiting future recruitment of woody debris to the stream channel.

Floodway and Floodplain Resources

Floodplains in the watershed are relatively narrow along substantial portions of the streams. As such, they limit storage of runoff during the winter for later release in the summer. These factors, combined with the virtual lack of precipitation from July through September, cause some areas to go dry in the summer. At the same time, the lack of storage capacity combined with heavy rains and snowmelt, can result in extremely high stream flows and flooding conditions. The floods of 1996 reduced habitat quality in some areas of the watershed.

Water Quality-Rock Creek Subbasin

All streams in the Rock Creek subbasin are classified as Class A streams, that is, overall excellent water quality for human consumption, but not necessarily for aquatic life. High water temperatures recorded during the summer have been identified as a water quality-limiting factor.

Based on temperature data through 1997, exceedances of the standard at higher elevations (plateau and upper canyon reaches) appear to be relatively minor and of short duration. Some thermal stressing of juvenile salmonids may occur, but may be avoided if there is access to cool water refuges (areas of spring outflow or groundwater upwelling). In lower canyon and alluvial reaches, exceedances extend well into the sub-lethal or lethal ranges for salmonids and are of long duration. It is unknown to what extent cool water refuges exist in these reaches.

Rock Creek became a candidate for the state 303(d) (water quality impaired) list for temperature based on multiple excursions of the standard (18°C/64.4°F) measured in 1990 and 1991 (WDE, 1998). Further monitoring and stream survey work by Ehinger in 1996 concluded that Rock Creek showed "impacts from past grazing activity and episodic flood events, including lack of riparian cover and a shallow, braided stream channel." He also suggested that high stream temperatures observed in upper Rock Creek "may be natural for a small creek in a hot, sunny summer climate," while temperatures in lower Rock Creek were "affected by the exposed rocky substrate (channel bed) and lack of riparian cover."

Based on this assessment, a Memorandum of Agreement between the Washington State Department of Ecology and Eastern Klickitat Conservation District regarding the delisting of Rock Creek from Section 303(d) of the Clean Water Act was signed on July 9, 1996.

The exclusion of Rock Creek from the 303(d) list was subject to a number of conditions to be implemented jointly by the two agencies in cooperation with landowners.

- Identify riparian zones that can be successfully revegetated. Assist landowners to implement Best Management Practices that would enhance canopy cover and encourage channel rehabilitation.
- Monitor grazing and forestry practices.
- Advise landowners in the upper watershed of Best Management Practices for road stability and riparian corridor harvesting.
- Continue water quality monitoring to obtain data for long range planning and for landowners participation with Best Management Practices.
- Seek funds to assist with monitoring and rehabilitation efforts.
- Submit a yearly progress report. Implementation of this agreement is ongoing and will continue at least through 2001.

The MOA expired in 2001 and has not been renewed.

Water Quality-Oregon Tributaries

Neither ODFW or Sherman county Conservation District have habitat surveys of Spanish Hollow and Fulton Canyon Creek watersheds and they do not know of any that have been conducted. In general, habitat conditions in both streams are confined by roads and are affected by sedimentation likely from agricultural practices and, in some places, from livestock grazing (French, pers. comm., 2004; Stradley, pers. comm. 2004).

3.2.6 Jurisdictions and Land Ownership

The Confederated Tribes of the Warm Springs Reservation of Oregon ceded the Oregon portion of the subbasin that is in the current planning area in the June 25, 1855 treaty with the United States. The Warm Springs tribe reserved fishing, hunting and gathering rights among other rights and responsibilities there. In the lower and eastern portions of the Rock Creek watershed, the Yakama Nation and its members own about 749 acres in trust allotments. The Yakama Nation ceded the Rock Creek area in the June 9, 1855 treaty with the United States, reserving fishing, hunting and gathering rights among other rights and responsibilities.

The Warm Springs and Yakama tribes along with the Umatilla and Nez Perce tribes have reserved fishing rights along the mainstem Columbia, including in this subbasin. The largest indigenous fishing place in North America, Celilo Falls, was inundated by The Dalles Dam. For additional information on jurisdictional authority, regulations, plans and projects, see 6. Inventory.

Today over 90% of land base is privately owned (Lautz 2000; Oregon Atlas 2001). Public lands in the Lower Mid-Columbia Mainstem Subbasin make up a small but significant portion of the remaining natural and semi-natural habitats in the subbasin. Most of these lands are held by the U.S. Department of Defense (DoD), U. S. Fish and Wildlife Service (USFWS), with smaller areas managed by the State of Oregon, State of Washington, and U. S. Bureau of Land Management (BLM).

A portion of the Columbia River Gorge National Scenic Area is within subbasin: from the subbasin’s western boundary at the Dalles Dam to the Deschutes River mouth on the Oregon side and to Maryhill Museum on the Washington side.

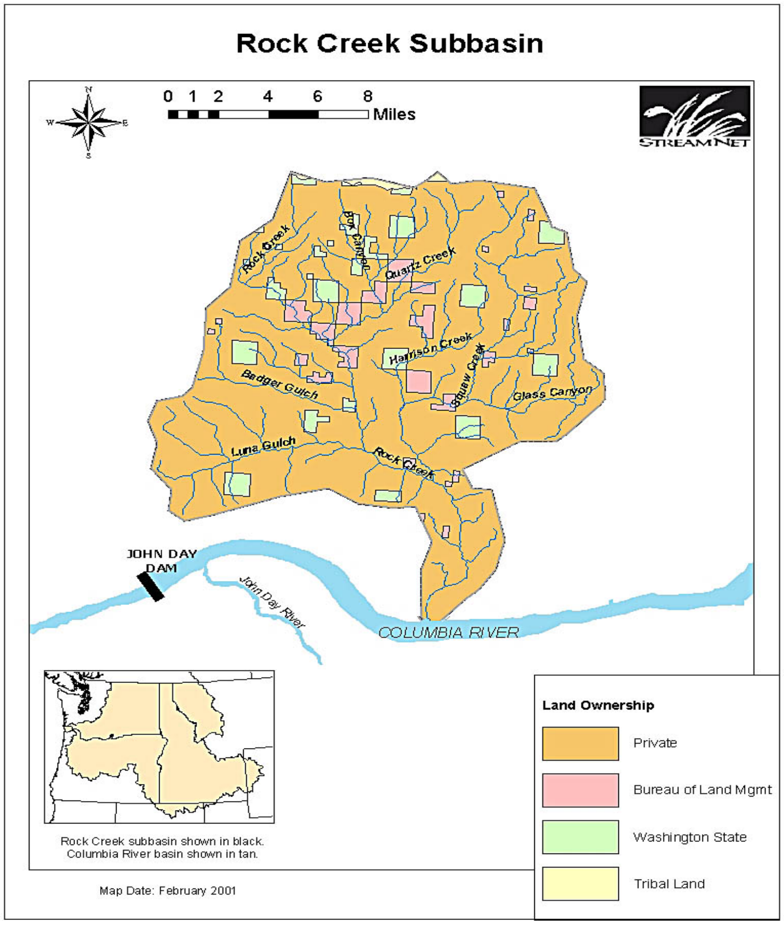


Figure 2 Land ownership in the Rock Creek portion of the Lower Mid-Columbia Mainstem Subbasin

3.2.7 Land Use and Demographics

Land use and ownership in the subbasin have changed dramatically since the arrival of European settlers. Most lands in the Lower Mid-Columbia Mainstem Subbasin are privately owned. About half of the land is used for agriculture. Agriculture and related enterprises are the most important economic activities in the subbasin. High-technology pivot and other irrigation methods are utilized in the subbasin, particularly in Washington and in the northern Oregon portions of the subbasin. In southern Benton County, wheat, grapes, and corn are important crops, and beef and dairy cattle are make an economic contribution. Only 4% of the agricultural land in Rock Creek, which is in Klickitat County, is currently used as cropland. Non-forested rangeland is found in the canyons and other areas unsuitable for agriculture. The rangeland is used for livestock grazing. Wheat, barley, alfalfa, oats, potatoes, poplars, cattle and sheep production, dairies, and food processing (especially potatoes) are important agricultural businesses in this region of Oregon.

The Umatilla National Wildlife Refuge occupies approximately 12,000 ha of marshes, sloughs, open water, cropland, and sagebrush uplands along both sides of John Day Reservoir near Irrigon, Oregon, and Paterson, Washington. The nearby Irrigon Wildlife Area is owned by the USACE and managed under agreement for wildlife habitat and wildlife oriented recreation by the Oregon Department of Fish and Wildlife (ODFW). It includes approximately 380 ha and is immediately adjacent to the Columbia River.

Lands along John Day Reservoir in Oregon include a number of important holdings. The approximately 96,000 (19,000-ha) Boardman Bombing Range is a training facility near Boardman along 12 miles of the Columbia River, bounded on the east and west by irrigated farmland. The Department of Navy owns the eastern half and operates it as an active bombing range or special use airspace (SUA) where jets can frequently be heard overhead. The Army Corps of Engineers owns 13.88 acres located in the northern section. The Morrow Country Port Authority maintains the former airstrip and owns property along the northern boundary.

The State of Oregon owns the western half, which was leased to Boeing in 1963. In the 1970s and 80s, Boeing acquired nine water right permits to irrigate 63,000 acres of the site. In May 2002, the Boeing Agri-Industrial Company sold its lease to agri-business Threemile Canyon Farms. The farm lies just west of the Boardman Bombing Range and is a 225-square-mile mega-dairy, where 6,000 cows are milked to make tons of Tillamook cheese; cow manure is turned into electric power; and enough potatoes are grown to feed 7 million people French fries and hash browns for a year (GlobalSecurity October 2004)

In 2002, the Farm through its wholly owned subsidiary Boeing Agri-Industrial Company purchased the property from the State of Oregon (Federal Register August 27, 2003 [Volume 68, Number 166] wais.access.gpo.gov] [DOCID:fr27auo3-97]). The Portland General Electric Company is a property owner, controlling 3,520 acres within the farm. The Boeing Company leases 2,000 acres as a radar range (Federal Register August 27, 2003 [Volume 68, Number 166]), apparently to support on-going activities such as testing its remote antenna technology (Global Security). Since 1974 most of the property has been used for agricultural purposes. Threemile is developing 10,000 acres of dry land as a wind power site. The farm's remaining 19,000 acres will remain fallow, accommodating Portland General Electric Co.'s coal-fired electric plant, Boeing's radar trial site, and the beef feedlots of Northwest Beef and J.R. Simplot (Global Security). The leased lands contain a small (about 23,000 acres/nearly 10,000 ha) but very high quality remnant of bitterbrush habitat.

After six years of litigation over water withdrawals from the Columbia, water rights, and species conservation, Threemile Canyon Farms agreed to turn over to the Nature Conservancy management of 23,000 acres of farm wetlands as cover for the endangered Washington Ground Squirrel, birds and plants, and to allow public access along the Columbia River. In 2001 the Oregon Department of Fish and Wildlife Commission had listed the Washington ground squirrel, now only inhabiting the Boardman Bombing Range and former leased lands, as an endangered species under Oregon's Endangered Species Act and applied for federal designation.TNC has begun developing long-term management and restoration plans for the property, which had been proposed for agricultural development. R.D. Offutt Co., the Fargo, N.D. agricultural development giant and world's largest potato producer owns Threemile Canyon Farms (Spokesman Review 04/25/2004).

The Umatilla Army Depot was established in 1941 and occupies approximately 20,000 acres (8,000 ha) in Morrow and Umatilla counties of which 2,600 acres have restrictive easements in place. The depot serves as a storage facility for conventional munitions and chemical warfare agents. Department of Defense contractors expect the stockpile of chemical weapons is to be destroyed by 2012.

While these lands occupied by the Umatilla Army Depot, the Boardman Bombing Range, and its lessees are not wholly within the Lower Mid-Columbia Subbasin, their northern portions are along the subbasin's mainstem Columbia River. Their proximity to the rest of the subbasin warrants consideration in the assessment of environment conditions and the formulation of fish and wildlife management plans and projects in the subbasin. (The Umatilla/Willow Creek Subbasin's Management Plan includes references to the significant and relatively rare shrub-steppe plant and wildlife habitat communities on these lands and offers management strategies for these resources).

In Arlington, Oregon, across the river in near Roosevelt, Washington, and at several other locations in Klickitat County are large landfill operations that take garbage, including hazardous wastes, mainly from the Portland, Seattle, and Spokane urban areas. The waste is transported by railroad cars and trucks; much of the route is along the Columbia River. The Environmental Protection Agency (EPA) has fined Waste Management Inc., one of the Arlington operators, for not following the regulations for proper handling of hazardous wastes. About 17 miles south of town Bickelton, in Klickitat County, is the country's 4th largest landfill, which is owned by Allied Waste Industries.

Energy production, a significant feature of the subbasin since hydroelectric dams were built there, has recently begun to diversify. Some five wind projects are operating or under development in the subbasin's current planning area: Klondike Wind Project (25 MW) and Klondike Phase 2 in Sherman County, Oregon; Arlington Columbia Energy Partners (200 MW), Arlington Pacific Power Marketing (200 MW), and Mar-Lu (projected 104 MW) west of Arlington in Gilliam County, Oregon. Two gas-fired projects, Coyote Springs Units 1 and 2 are operating near Boardman, Oregon. A bio-mass project, the H.W. Hill Landfill Gas Project, is operating near Roosevelt Landfill in Klickitat, Washington and Allied Waste Industries' landfill near Bickleton using decomposing waste to create gas used to generate over 8 megawatts of electrical power. A natural gas, combined cycle generation facility (307 MW) is being developed two miles west of Plymouth, Washington. Numerous other gas-fired generating facilities are producing electricity along the Columbia River corridor, of which this subbasin is a part.

Other nearby projects (bordering the inactive planning area of the subbasin) include both phases of the Stateline Wind Projects (300 MV), located near Wallula Junction on both sides of the Oregon and Washington border. Other wind projects are operating or pending in the nearby John Day and Umatilla subbasins. Most of the new energy projects—operating, under construction, or planned—have or will require new transmission interconnections to deliver power from the new generation facilities to the electric transmission grid. Additions and upgrades to the current transmission infrastructure are planned or have recently been completed in the subbasin. The Celilo converter station at the northern end of the direct-curent Intertie to Los Angeles is being retooled increase transmission capacity for future Northwest surpluses. Near Bickleton, Washington, BPA is completing the replacement of 20 steel lattice towers and all wood pole structures and upgrading transmission lines in a larger area of the region. BPA has proposed a new transmission line between McNary and John Day dams that would be about 79 miles long and add about 1250 MW capacity to help integrate new gas and wind energy generated in the area. In recent years, new natural gas pipelines have been constructed in the subbasin and adjacent areas.

The Columbia Aluminum Company, which has been idle since 2001, sits along Columbia near Washington Highway 14 east of the junction with U.S. Highway 97; Boise Cascade Pulp and Paper Mill in Wallula, Washington, operates along the Columbia in the NcNary reservoir area; and numerous other industrial plants upstream of the subbasin use manufacturing processes that depend on a variety of hazardous chemicals.

Roads and railroads now occupy extensive reaches of land bordering the mainstem. The riprap revetments protecting these areas form significant portions of reservoir shorelines. In the subbasin, Interstate 84 and U.S. Highway 730 run along the southern shore of the Columbia. Union Pacific Railroad operates along most of the south shore of the Columbia River runs extending to Wallula Junction. The Union Pacific also operates a line from Arlington to Gilliam, a major waste dump. On the Washington side of the subbasin, Burlington Northern and Washington Highway 14 run along the Columbia shore. On the mainstem itself, barge traffic hauls petroleum, wood, and agriculture products usually bound for the Port of Portland and beyond. Other water traffic consists of small fishing and recreational boats, law enforcement and Coast Guard craft, several small cruise ships, and fish barges transporting juvenile salmon for release below Bonneville Dam.

The human population of the Lower Mid-Columbia Mainstem subbasin is small and growing slowly (**Table 3**). (The area of Benton County where the population has increased significantly is in the Tri-City area, which is not within the current planning boundaries of the subbasin.) The ethnic backround of the subbasin's residents are predominantly European-American, Hispanic, and Native American. In Oregon, the incorporated towns are Arlington, Condon in Gilliam County; Boardman, Irrigon in Morrow; Grass Valley, Moro, Rufus, Wasco and unincorporated Biggs in Sherman County; and Umatilla in Umatilla County. In Washington the towns in the subbasin are unincorporated and include Paterson and Plymouth in Benton County and Wishram, Bickelton, and Roosevelt in Klickitat County.

The Celilo Village, about 10 miles east of The Dalles, Oregon, was relocated (after being flooded by construction of The Dalles Dam) not far from the original site and continues today as small Indian fishing community.

Table 3 Population of major Lower Mid-Columbia Mainstem subbasin counties and percent change, 1990-2000 (Current planning areas are predominately within the shaded counties)

County/State	1990 Population	2000 Population	% Change 1990 - 2000	Area (sq. mi.)	People/sq. mi. of land area in 2000	Population Change 2000 - 2003
Benton/WA.	112,560	142,475	26.6%	1,703	83.7	7.9%
Klickitat/WA.	16,616	19,161	15.3%	1,872	10.2	2.0%
Umatilla/OR	59,249	70,548	19.1%	3,215	21.9	2.1%
Morrow/OR	7,625	10,995	44.2%	2,032	5.4	5.7%
Gilliam/OR	1,717	1,915	11.5%	1,204	1.6	(7.2%)
Sherman/OR	1,918	1,934	0.8%	823	2.3	(9.3%)

U.S. Census Bureau, 1990, 2000

Significant environment pressures directly from population increases are not anticipated; however, the intensification of economic activities in the region, as briefly indicated above and in the following sections, is likely to add to concerns about fish and wildlife and their habitats.

3.2.8 Anthropogenic Disturbances on Aquatic and Terrestrial Environments

Over the past 150 years, the Lower-Mid Columbia Mainstem Subbasin has been one of the most transformed regions in Oregon and Washington (Johnson and O'Neil 2001; NOAA/Fisheries 2004). While the economic and human activities described here are important to the citizens of the region, the focus of this section is to discuss how these activities effect aquatic and terrestrial habitats and the fish and wildlife that also use the land, water, and air in this subbasin.

Agriculture

About half of the land in the subbasin is used for agriculture, which has significantly altered the subbasin. Agricultural activities, such as water withdrawals for irrigation, stream channelization, loss of riparian vegetation and wildlife habitat, increased sediment input, and changes in hydrology associated with land conversion and water uses, have affected fish and wildlife resources.

High-technology pivot and other irrigation methods are utilized in the subbasin, particularly in Washington and in the northern Oregon portions of the subbasin. Most water is being withdrawn from the John Day reservoir into canals on the Washington side, although demand for irrigation water from the Columbia continues to increase in both states. In 2003 the Oregon legislature proposed a bill to lift the virtual moratorium on new water rights on the Columbia River. The Capital Press in Salem, Oregon, reported that, as of 2003, Oregon diverts about 0.3% of the average annual flow of the river, while Idaho diverts 2.7% and Washington, 4%.

Irrigation withdrawals can have extensive effects on instream flows, which can result in fewer pools, stream losses, fewer pools, dewatering and fragmented habitat as well as higher water temperatures. Streams are often channelized in agricultural fields to prevent flooding of fields and natural channel movement into fields (is this happening here? Citation/personal communication). Physical blockages caused by irrigation diversions, push up dams, and warm water can limit access to spawning habitat. All factors decreasing habitat suitability for aquatic species.

Dryland farming has its own set of problems, particularly erosion that stems from traditional winter wheat/summer fallow monoculture cropping. Such agricultural practices, which cause run-off and erosion, result in increased stream sediment loads.

In general, land development for agricultural uses, roads, and other activities that occur near and on low gradient streams and rivers (including the mainstem Columbia) has impacted the productive potential of historic salmon spawning, incubation, and freshwater rearing areas.

The conversion of large areas of native vegetation to croplands and grazing lands has resulted in significant loss of wildlife habitat in the basin. Shrubsteppe and grasslands habitats have been the most heavily affected (Johnson and O'Neill 2001; Kagan et al., 2004).

This conversion has also contributed to alterations in the subbasin's hydrology. For example, with large tracts of land in winter wheat and summer fallow, the result has been slower infiltration of precipitation into the ground and greater runoff into streams (Umatilla/Willow Subbasin Plan 2004).

Farm pesticides, herbicides, fertilizers, and other chemicals often find their way into the food chain and ecosystem more broadly; some with known deleterious effects on aquatic and terrestrial resources. Elevated levels of nitrates have been detected in wells in the area that includes the northern portions of Umatilla, Morrow, and Gilliam counties. Potential sources of the contamination is irrigated agriculture and confined animal feeding operations (DEQ 2003).

Land and water use in this subbasin have caused widespread changes in vegetative cover, soil quality, and hydrologic systems. Agricultural practices, including grazing, have contributed to significant soil loss, gully development, stream channel instability, soil fertility and organic matter, which adversely effect agriculture and fish and wildlife productivity alike (Oregon Progress Board. 2000; NMFS. 2000. Biological Opinion on Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin).

Artificial and Natural Fish Production

Two hatcheries are located on Lower Mid-Columbia River in the current planning area. The Irrigon and Umatilla hatcheries are located on the Columbia River near Irrigon, Oregon, and are operated by ODFW. Neither release fish directly into the Columbia River. The Irrigon Hatchery is funded by the Lower Snake River Compensation Program, and serves as an egg incubation and rearing facility for summer steelhead destined for the Grande Ronde and Imnaha River systems. The hatchery is also used as a final rearing site for legal-sized rainbow trout destined for northeast Oregon waters. The Umatilla Hatchery is funded by BPA, and is used for egg incubation and rearing of spring chinook salmon, fall chinook salmon, and summer steelhead for release into the Umatilla River.

Other upstream artificial production facilities and natural spawning areas on the mainstem Columbia and Snake rivers and on the John Day, Umatilla, Yakima, Wenatchee, Clearwater, Salmon and others contribute to the mix of anadromous fish stocks migrating through this section of the Columbia River. About 80% of the spring chinook and steelhead migrating through the lower mid-Columbia subbasin are hatchery produced, while 20% are wild or naturally spawning. For fall chinook in this subbasin, about 25% are hatchery, while 75% are wild or naturally spawning. For coho in the subbasin, roughly 90% are hatchery and 10% are wild, although it currently remains unknown the extent to which coho supplementation is re-establishing naturally spawning runs (Matylewich, pers. comm. 2004).

Dams

In the Lower Mid-Columbia Mainstem Subbasin, the construction of The Dalles, John Day, and McNary dams and resulting impoundments of the Columbia River have inundated mainstem spawning and rearing areas in the mainstem as well as in the lower reaches of tributaries in this subbasin. The reservoir behind McNary Dam is referred to as Lake Wallula or McNary pool (or reservoir) and extends upstream to about RM 345; however, for this current planning effort, the subbasin boundary terminates at RM 315 where the Walla Walla River enters the Columbia. The reservoir behind John Day Dam, which extends upstream to McNary Dam at RM 292, is referred to as Lake Umatilla or John Day pool (or reservoir). The reservoir behind The Dalles Dam (RM 192), which extends upstream to John Day Dam at RM 216, is referred to as Lake Celilo or The Dalles pool (or reservoir). The three dams are equipped with navigational locks.

Built for hydroelectric power, and variously for navigation, flood control, irrigation and storage, dams (including those constructed upstream of this subbasin) and the resulting impoundments alter water flows. Physical blockages and flow fluctuations caused by large and small dams, tidegates, and warm water can limit access to spawning habitat. Dams and impoundments have scoured vegetation and flooded riparian and flatland areas. The river now exhibits steepshore lines and sparse riparian plant communities.

Fish Passage

Because the hydroelectric dams on the Columbia and Snake rivers block the natural flow of the river and thus the natural migration of anadromous fish, the Federal Columbia River Power System uses several methods to mitigate for the loss of this natural system. The three dams in this subbasin provide upstream and downstream fish passage by various means. Downstream passage is accommodated by fishways, which are discussed in the 5. Fish Assessment section.

Juvenile passage is facilitated by barging or transport, spill, flow augmentation, bypass systems including mechnical screens systems that pass fish away from the generating turbines.

This descrption is taken from BPA Fish, Wildlife, and Environment website:

> McNary Dam in this subbasin and three Snake River dams have fish barging or transport facilities. At these four dams, juvenile fish that go through the bypass systems can be routed either directly back into the river below the dam, or to holding and loading facilities for loading into barges or trucks for transport. The transport barges and trucks carry the fish past the remaining projects for release below Bonneville dam. River water circulates through the barges allowing the fish to imprint the chemicals and smells of the water during the trip downriver. The barges have a closed-circuit recirculation system which can shut off water intake in case of contamination in the river. They also have pumping systems which can help de-gas the water in areas where gas supersaturation is a problem.
>
> The Corps runs the Juvenile Fish Transportation Program in cooperation with National Marine Fisheries Service, and in accordance with the National Marine Fisheries Service hydropower Biological Opinion for salmon. Fifteen to 20 million salmon and steelhead have typically been transported each year over the past several years. The program has come under criticism in recent years from state and tribal fishery agencies and environmental groups, who believe that rather than putting fish in barges, efforts should concentrate on improving in-river migration conditions.

The fish agencies, tribes, and environmental groups generally prefer spill and increased flow to other means of juvenile passage. Based on the preponderance of scientific opinion, increased flow during migration increases survival of juvenile salmonids by decreasing travel times, and mortality over spillways is lower than mortalities through other routes at dams. A spill program during juvenile salmonid migration operates at Columbia and Snake River dams. The timing and amount of spill provided by dam operators and mandated by the federal ESA driven Biological

Opinon continues to change. Spill is a relatively safe route to pass dams and in studies is generally shown to provide increased survival over fish transportation and barging options, except for wild chinook during low flow years (Kiefer 2004). Spill, however, is water not used to generate electricy, which means that hydroelectric dam operators and managers generally prefer other alternatives.

Temperatures

The maximum water temperature established by Washington and Oregon for the Columbia River downstream from Priest Rapids Dam is 20°C (68°F), which is often exceeded during the warmest parts of the summer. Considering the life history of fall chinook, coho, and lamprey and the environmental conditions that exist during their freshwater life cycle, high water temperatures may limit this population by reducing fish performance and long-term survival. Steelhead are known to seek colder water refuges at river mouths and may generally have a tolerance for slightly warm water.

Fish passage

Juvenile and adult fish passage structures operate at McNary and The Dalles Dams. McNary Dam has one of the Columbia River's major fish bypass and collection facilities, which are used in barging and transporting juvenile salmon where they are released downstream of Bonneville Dam. Spill is also used at these dams to facilitate the upstream migration of juvenile salmon.

Predation

Primary predators of juvenile salmonids in the lower mid-Columbia River include northern pikeminnow, smallmouth bass, and walleye. Predator-prey relations have been altered by development of the hydropower system in many ways. Although northern pikeminnow are a native species and have always preyed on juvenile salmonids, development of the hydropower system has increased the level of predation.

Bird predation on juvenile salmonids at the lower mid-Columbia dams may also be a problem. Although estimates for bird predation have been 2% or less of salmonids passing a single dam, the cumulative effect is probably significant. Avian predators include Caspian terns, various gull species, double-crested cormorants, American white pelicans among others. While bird predation on juvenile fish is natural part of the food web, dams have made it easier for the birds to select their prey, e.g., by concentrating juvenile salmon at the dams.

Other ecosystem changes

The transformation of the mainstem Columbia River into a series of reservoirs has altered the food webs that support juvenile salmonids and resident fish. Continued decline in populations of salmon and other fish species results in loss of overall biomass being contributed to the subbasin. This reduction has negative effects on wildlife and fish abundance.

Dairy and Food Processing

Waste water disposal is one of the most significant environmental issues, especially for large scale food processing and manufacturing. Food processing wastewaters are high in organic matter (measured as biochemical oxgen demand) typically contained with high levels of suspended solids, ammonia and protein compounds. Effective ways of eliminating this problem are still in the experimental phases. (Food Manufacturing Coalition for Innovation and Technology Transfer 1997, Great Falls, VA).

Potential sources of the nitrate groundwater contamination in northern Oregon areas of the subbasin include land application of food processing water as well as irrigated agriculture and confined animal feeding operations (DEQ 2003).

Solid waste from thousands of cows is another source pollution. Threemile Canyon attempts to address this by using solid and liquid water from cows to produce methane gas that generates enough electricity to run the farm and some to sell. Leftover manure is is used as crop fertilizer. Potato skins and other crop waste are fed to the cows.

Currently, there is debate about whether Threemile Canyon Farm is a sustainable agricultural enterprise that protects land and water resources or a giant factory farm with confined animal production and industrialized potato production that damages the land it occupies and nearby ecosystems.

Energy

While the development of sources of energy production such as gas-fired, wind, bio-mass generation offer alternatives that have the potential to reduce dependence on the river's hydrosystem, they come with their own potential threats to fish and wildlife and their habitats. Gas-fired generation emits carbon dioxide, a major source of global warming, and other questionable emissions; this technology also requires large quantities of water for cooling. Global warming has long-term implications for the future of viable fish and wildlife resources. More immediate air quality issues are of concern to terrestrial and avian species. Wind power is known to be a more benign source of electric generation. Recent improvements in turbine blade design seem to be less harmful to birds and other avian species (BPA 2002 Avian and Bat study).

Yet even the cleaner wind and, arguably, cleaner bio-mass energy production along with gas-fired electricity have environmental costs. There are construction issues, including access roads, culverts, tree removal, soil damage, and construction debris, and siting concerns when habitats selected for development also have play an important role in the life cycle of wildlife or fish. But possibly more problematic are the need for most new generation facilities to connect to the electric transmission system, which can cause problems in addition to those previously described. Because the access lines are high voltage and may extend for some distance and require additional steel lattice towers, they may have a deleterious effect on habitat generally and on the migratory patterns of large and small animals as well as birds and bats. Transmission system upgrades require extensive infrastructure investments and careful management of hazardous waste disposal from mercury converters and pentachlorophenol- and creosote-treated utility poles.

On the positive side of alternative energy development, these other generation sources could be used to reduce the power system's dependence on hydropower to meet peak demand. Hydropower has been used to serve peak loads because dams can react by quickly putting more water through generating turbines. However, running more water through generating turbines to meet peak demand kills millions of juvenile salmon every year as they are forced through the generators and their turbine blades. During certain times of the year, drawing down so much water has also uncovered (dewatered) salmon redds, killing the salmon eggs (Foley and Lothrop 2003).

Fish and Wildlife Harvest

Tribal ceremonial, subsistence, and commercial fishing, primarily for salmon, occur in the mainstem Columbia portion of the subbasin; tribal commercial fishing usually occurs as far upstream as McNary Dam. Sport fishing and waterfowl hunting occur in the subbasin, particularly on the Columbia River. Tribal and non-tribal hunters also harvest deer and elk in the subbasin.

Forest practices

Forestlands comprise about 47% of the Rock Creek watershed, primarily in the headwaters of Rock and Pine creeks. Most of these lands are in private ownership and many have active grazing allotments (see "Livestock Grazing" below). (Have these lands been logged? Upland land uses such as forestry and grazing can contribute to the sedimentation of spawning gravels in low gradient reaches.

Livestock grazing

Improper livestock grazing practices have reduced the total amount of native vegetation and replaced native plants with others of low forage value and/or non-native and invasive species. The result has been the reduction of surface cover, resulting in increased water amd and wind erosion, which can negatively impact both aquatic and terrestrial wildlife species. Cattle, sheep, and horses can also destroy riparian vegetation and destablilize streambanks when they are allowed to forage in riparian zones (Waters 1995) Waters, T.F. (1995) Sediment in Streams: Sources, Biological Effects and Control. American Fisheries Society Monograph 7. American Fisheries Society, Bethesda, Maryland.).

Non-native, invasive plants are widespread and troublesome in this subbasin as elsewhere in the region and in United States. Whether spread by livestock movement, human travel, or introduction of non-native ornamentals, non-native invasive species are replacing native plants to the detriment of the subbasin's riparian areas, terrestrial wildlife, and ecological processes (e.g. fire regimes, particularly in shrub-steppe habitats).

Military

Although the effects of the Navy's use of the Boardman facility as a bombing range is unknown to the authors of this subbasin report, the one beneficial aspect of the Navy's presence there is that part of the land has been spared some of the development the rest of the basin has experienced. The area, including the portion owned and leased out by the state near Boardman along 12 miles of the Columbia River includes habitat for a number of native declining bird species and is a stronghold for the Washington ground squirrel, *Spermophilus washingtoni*. The Washington ground squirrel was listed in 2001 in Oregon as an Endangered Species and petitioned for listing to the USFWS for federal ESA protection.

The largest remaining habitats of sage brush and bitterbrush shrub-steppe in the subbasin are found on the northern part of the Umatilla Army Depot and the Boeing lease lands, both of which face significant threats (Kagan et al. 2000). The bitterbrush habitat may be the best example of this type of shrub steppe habitat in the world (Umatilla/Willow Subbasin Plan 2004).

The site also provides a connection between large blocks of habitat at the Boardman Bombing Range and habitat to the west.

After some legal challenges to water permits for Boeing leased lands, including a finding of jeopardy to listed salmon stocks under the Endangered Species Act, an agreement was reached to protect important fish and wildlife resources while maintaining the potential to develop additional acres. The Nature Conservancy manages 4,750 acres, the on the Boardman Bombing Range, Boardman Research Natural Area (in the lower Umatilla basin).

Then in 2001, The Nature Conservancy took over management of 22,642 acres of the former Boeing lease lands and has begun developing long-term management and restoration plans for the property.

Recreation

A variety of recreation activities take place in subbasin including angling, windsurfing, boating, water skiing, waterfowl hunting, sightseeing, and birdwatching.

Rural residential

The current planning area of the subbasin is sparsely populated, with small towns and no cities. Small-scale residential developments, primarily in the downstream areas, however, impact fish, wildlife, and their habitats to some degree.

The release of effluents from wastewater, septic tanks, and other wastewater systems can affect water quality by increasing or decreasing temperatures and elevating concentrations of ammonia and chlorine in streams and rivers.

Levees, dikes, and rip-rapped banks constructed to protect roads, rail beds, homes, and farm buildings on floodplains have confined stream channels and reduced riparian vegetation in parts of the subbasin including the mainstem, leading to a decline in available fish and wildlife habitat (Johnson and O'Neill 2001; USGS, unpublished data.)

Transportation

Roads and railroads now occupy extensive reaches of land bordering the mainstem. The riprap revetments protecting these areas form significant portions of reservoir shorelines, but resulting in a pervasive loss of riparian vegetation.

Roads are a primary contributor of fine sediment and a number of roads in the headwaters are built primarily of native material with a high fine sediment component. Some of these roads parallel or are in close proximity to streams and many have had infrequent maintenance. In-channel fine sediment is a problem in some areas of the subbasin, particularly in the headwaters and lower alluvial reaches. Being impervious to water, many transportation surfaces increase surface run-off, making streams more likely to flood and washing oil and other chemicals into streams.

Both paved and gravel roads are often constructed along waterways in the subbasin. Transportation corridors can significantly impact hydrology and ecology by increasing the loss of riparian vegetation, stream water temperatures, surface water run-off into stream channels, and flashiness in stream flow.

Chemical contaminants enter the river from spills along the rail and road transportation corridors and at the locks (and other dam locations). Hydraulic connections beneath portions of the transportation corridor between embayments, mouths of streams, and mainstem is accomplished through bridges, culverts, and trestles, sometimes limiting access to spawning habitat or other tributary habitats or hatchery weirs.

Waste disposal

Several dangers to environment are presented by the transport and disposal of large quanities of waste, including hazardous wastes, in the subbasin. The entire stretch of highway and Trucks and railroads transporting the waste along this subbasin's major waterway, the Columbia River, are subject to accidents and spills. Although new liner technology is used to contain the garbage during disposal, the danger of ground water contamination from improper practices or faulty equipment is real. The Environmental Protection Agency (EPA) has fined at least one of the Arlington operators, Waste Management Inc., for not following regulations for the proper handling of hazardous wastes.

Water withdrawals

Flow objectives of NOAA/Fisheries' Biological Opinions for the mainstem Columbia River are rarely met during the summer, especially in moderate to low water years. The summer is a critcal time for migrating salmon, for steelhead and especially fall chinook. Diversion of water for agricultural production, also at its peak during the summer, contributes significantly to this shortage. Low flows, resulting in part from water withdrawals contribute to higher water temperatures and delays in salmon migration, both harmful to fish.

As of 2003, only two new Oregon water rights were issued since 1994 for Columbia River withdrawals for irrigation (Lies 2003). In 2004 the National Academy of Sciences, working on behalf of the State of Washington, released a report recommending no additional permits be issued for water withdrawals on the Columbia River during the samon critical months of July and August (2004).

3.2.9 Terrestrial/Wildlife Resources

Vegetation

The region's extremes in temperature and low level of precipitation result in sharp contrasts between riparian and upland vegetation. Riparian vegetation generally consists of a variety of deciduous trees, shrubs, grasses, and forbs that grow along the shoreline of rivers and streams. In John Day Reservoir, riparian habitats have been broken into three categories (Rasmussen and Wright 1990, ODFW 1993): trees, shrub, and herb. In the hardwood community, black cottonwood *Populus trichocarpa* is the dominant species, with willow *Salix* sp., white alder *Alnus rhombifolia*, Russian olive *Elaegonus angustifolia*, Russian mulberry *Morus alba,* black hawthorn *Crataegus douglasii,* northwestern paper birch *Betula papyrifera* and hackberry *Celtis reticulata* comprising a smaller component. Locations inhabited by people may also include Lombardy poplar *Populus nigra*, black locust *Robina pseudoacacia,* and Siberian Elm *Ulmus sinuate,* while Russian Olive is found around the reservoirs and the Columbia River. Shrub habitat includes willows, young hardwoods, false indigo *Amorpha* spp., chokecherry prunus virginiana, Saskatoon serviceberry *Amelanchier alnifolia*, rose *Rosa spp.*, and other shrubs. Herb communities are generally found on sand, mud, or gravel bars. They are typically dominated by non-native mustard Brassicaceae, dock *Rumex* spp., pigweed *Chenopodium* spp., and Russian thistle *Salsola tragus*..

Most natural vegetation in upland areas of the subbasin is classified as steppe or shrub-steppe. The steppe, or grasslands, can be broken into three climatic, climax vegetation zones: *Artemisia-Agropyron*, *Agropyron-Poa,* and the *Festuca-Koeleria* zone (Poulton 1955). The *Artemisia-Agropyron* zone occupies the driest lower reaches of the subbasin and is dominated by big sagebrush *Artemisia tridentata*, bluebunch wheatgrass *Pseudoregnia spicatum*, and bluegrass *Poa secunda*. Epigeous cryptogams made up 13% of the groundcover in this association, the second highest percentage after bluebunch wheatgrass. The combined stress of grazing and fire have allowed rabbitbrush *Chrysothamnus nauseosus* and cheatgrass *Bromus tectorum* to invade and dominate this association, rapidly reducing the cryptogam crust.

The Agropyron-*Poa* zone is slightly wetter than the *Artemisia-Agropyron* zone (Poulton 1955). Bluebunch wheatgrass, bluegrass, and rabbitbrush dominate the *Agropyron-Poa* zone with an epigeal layer of mosses and lichens. This zone receives an average annual precipitation of approximately 37 cm, approximately 15 cm more than the *Artemisia-Agropyron* zone. Disturbance leads to increased rabbitbush and cheatgrass through the *Agropyron-Poa* zone. Agriculture is prevalent in this zone, marking the driest site in the annual cropping area of the Columbia basin (Poulton 1955).

The *Festuca*-Koeleria zone is wetter still, with prairie junegrass *Koeleria cristata*, Idaho fescue *Festuca idahoensis*, and bluebunch wheatgrass dominating the grassland areas (Poulton 1955). Black hawthorn *Crataegus douglasii* and common snowberry *Symphoricarpos albus* occur along streams and in concave areas on north-facing slopes. Cryptograms comprise 28% of the groundcover in this zone. Grazing disturbance results in an increase in Kentucky bluegrass *Poa pratensis*, brome *Bromus commutatus and B. brizaeformis*, mule’s ear *Wyethia amplexicaulis*, and St. John’s wort *Hypericum perforatum*.

The Rock Creek subbasin lies within a vegetation zone in transition from arid shrub-steppe to the south and forest vegetation to the north. Within the zone, there is a mosaic of meadow-steppe communities and forest communities dominated by Oregon white oak and ponderosa pine (WDNR 1998). The forest communities are generally found on north-facing slopes and in riparian zones, while the steppe communities populate drier areas. The meadow steppe communities also occupy drier areas in the subbasin. Bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg's bluegrass (*Poa suandbergii*) generally dominate this plant community type (WDNR 1998). Also present are a variety of forbs indicative of lithic soils. In the south central Klickitat area, heavily grazed stands are dominated by cheatgrass (*Bromus tectorum*), gray rabbitbrush (*Chrysothamnus nauseosus*), broom snakeweed (*Gutierrezia sarothrae*), and/or lupines (*Lupinus* sp.). In headwaters, land cover is primarily coniferous forest; this area is mostly above known anadromous fish use, although rainbow trout and non-salmonids such as dace use available fish habitat. Coming off the plateau, land cover is conifer forest or mixed conifer-deciduous forest in the vicinity of streams, transitioning to shrub-steppe in the uplands. Below the canyon reaches, land cover is primarily shrub-steppe in the uplands, with riparian areas transitioning downstream from mixed conifer-deciduous forest to deciduous forest to shrub-grassland. The riparian zones are made up of primarily the white alder plant community. The subbasin contains some of the few known high-quality occurrences of the white alder community type within Washington, where it is limited to riparian zones in the eastern portion of the state.

Most of the riparian zone community has an overstory of Oregon white oak (*Quercus garryana*), bigleaf maple (*Acer macrophyllum*), white alder (*Alnus rhombifolia*), black cottonwood (*Populus trichocarpa*), and water birch (*Betula occidentalis*), while shrubs are dense in places and include mock orange (*Philadelphus lewisii*), ocean spray (*Holodiscus discolor*), currant (*Ribes aureum*), and occasionally willow (*Salix* sp.) (WDNR 1998).

The Oregon side of the subbasin originally supported vast natural grasslands broken by brushy draws and tree and rimrock-bordered streams. Wheat fields and various irrigated crops, such as alfalfa, pasture grasses, and mint, have since replaced the grasslands. Corn, melons, peas, and a variety of other crops, are grown near the Columbia River. The area remains largely treeless, aside from riparian sites, farmsteads, and towns.

This area of Oregon is one of the most heavily modified by human activities. Only remnanats of the original grass steppe remain, and some of these are dominated by exotic species. The original grass steppe was dominated by bluebunch wheatgrass, Idaho fescue and Sandberg's bluegrass. There are some areas near the Columbia River, and along the western edge of the province, that are dominated by bitterbrush, but they are now smaller, isolated, and fragmented patches.

A list of of the rare plants and plant communities found in this subbasin are included in Appendix D.

Wildlife

The Lower Mid-Columbia Mainstem subbasin supports 435 species of wildlife, 35 which are federal and state listed species (IBIS 2003). Riparian and wetland habitats directly influenced by the Columbia River and upland habitats along the river are important to many species of wildlife. Species assemblages vary among habitats, which include open water, wetland, riparian, and upland. Assemblages also differ among reaches of the Columbia River.

In ODFW's Wildlife Diversity Plan (1993), Oregon is divided into 10 physiographic provinces based on geologic and vegetative patterns. The Oregon side of the Lower Mid-Columbia Mainstem subbasin is located within the western half of the Columbia Plateau Province, which lies immediately south of the Columbia River between the Cascade Range to the west and the Blue Mountains to the east.. According to the Plan, this province is below average in vertebrate diversity in all taxonomic groups because of the absence of true coniferous forest types.

A number of mammals, birds, reptiles and amphibians known to occur in the subbasin are state or federally listed as threatened or endangered. Numerous additional species are candidates for listing, or are considered sensitive or species of concern. See Appendix C, Table C.2. for a list of federal and state listed species of the Lower Mid-Columbia Mainstem subbasin.

Birds

This subbasin supports 280 species of birds. Asherin and Claar (1976) found 114 species of birds associated with McNary Reservoir. Tabor (1976) found 145 species of birds associated with John Day Resevoir and 79 species associated with The Dalles Reservoir. Avian species such as the bald and golden eagles were historically more common along the riparian sections of the Columbia River. Although numbers of bald eagles have increased in the Columbia River Gorge in the past 10 years, current numbers are considered a small remnant of past population levels.

Peregrine falcons have recently been seen at the mouth of Rock Creek during the breeding season but no nest sites have been located to date.

Agricultural production of cereal grains, as well as the increase in open water since development of the hydropower system have contributed to a significant increase in breeding and migrant/wintering waterfowl numbers. All reservoirs in the subbasin support colonies of colonial nesting birds, such as herons and gulls, that are primarily dependent on fish. This subbasin also supports one of the largest Northwest concentrations of wintering waterfowl, particularly Canada geese *Branta canadensis* and mallards *Anas platyrhynchos* (ODFW 1993).

The Northwest Area Committee, a multi-agency spill response planning group, identified a number of areas in Columbia River mainstem, including the Dalles, John Day, and McNary pools, where habitat resources and concentrations of waterfowl and shorebirds nest, breed, and winter. Within the Dalles Pool these areas include: 1) mouth of Deschutes River; 2) between Maryhill, WA and Rufus, OR; 3) mouth of Spanish Hollow Creek at Biggs Junction OR; 4) NE of Miller Island in the Columbia River Mainstem - sensitive nesting species, gull and tern nesting area; and 5) islands south and southeast of Brown's Island (includes concentration of diving ducks) (Northwest Area Committee 2004a).

The John Day pool includes the following waterfowl and shorebird habitats: 1) NE of I-82 bridge, near Plymouth WA; 2) second inlet west of Plymouth; 3) island between Irrigon and Umatilla, east and north entrances; 4) shallow water area, WA side, north of Irrigon, OR; 5) Paterson Slough; 6) WA side, east end of abandoned railroad tracks; 7) Big Blalock Island and two islands sw of Big Blalock; 8) Glade, Willow, and Alder creeks; 9) first set of small islands east of Long Walk Island, south end and se point of island, and area between Sand Island and island to the west; inlet east of Messner; 10) northeast corner and west end of Whitcomb Island; 11) Crow Butte Island; 12) inlet entrances to Threemile Canyon; 13) shallow water habitat, RM 255.8; 14) Jones Canyon and Sundale; 15) John Day River mouth and inlet just northwest of John Day Dam (Northwest Area Committee 2004b).

McNary Pool also has many habitat areas that attract large numbers of waterfowl and shorebirds: 1) Strawberry Island - Canada goose nesting habitat and wildlife refuge; 2) Sacajawea State Park shores; 3) inlet west of Highway 410 and inlet just east of Snake River railroad trestle (south end) - sensitive marsh habitat, Hood and Sacajawea Park; 4) inlet just west of Snake River railroad trestle, and inlet mouths south of Snake River railroad trestle (south end); 5) entrance to Villard Pond; 6) point south of and east end of Columbia River railroad trestle; 7) Foundation Island – geese, cormorants, shorebirds, herons; 8) entrance to Casey Pond; 9) south tip of Corps of Engineers habitat management area; 10)Badger Island; 11) mouth of Walla Walla River (various wildlife resources); 12) Juniper Canyon – marsh, Corps of Engineers habitat management area, shallow water habitat; 13) point on south shore opporsite Spukshowski Canyon; 14) point northeast of Cold Spring Juntion; 15) first island north of Cold Springs Junction; (16) northeast point of peninsula jutting out, north of Cold Springs Junction; 17) two largest islands east of Hat Rock State Park and passageways between the two islands (Northwest Area Committee 2004c).

Riparian forest and cliffs provide nesting opportunities for several species of raptors (e.g. red-tailed hawks *Buteo jamaicensis*, Swainson's hawks *B. swainsoni*, prairie falcons *Falco mexicanus,* and American kestrels *Falco sparverius)* and are used by other species (sharp-shinned hawks *Accipiter striatus* and Cooper's hawks *A. cooperii)* during migration. Owls, game-birds, passerines, and shorebirds also inhabit the subbasin. A significant population of curlew breed in the Umatilla-Boardman area, including the Boardman Bombing Range and the Umatilla Army Depot. Long-eared owls nest in junipers on the Boardman Bombing Range and burrowing owls many reach the peak of their state abundance in grasslands associated with the bombing range (ODFW 1993).

Riparian areas of the province, while heavily disturbed by livestock, still support numerous songbirds. This province may have more bank swallows than any other. This sensitive species nests in scattered colonies, using burrows in vertical sand banks. Native grassland communities in the Boardman area of Morrow county support sparse populations of grasshopper sparrows (ODFW 1993).

Mammals

IBIS lists 108 species of mammals in this subbasin, including aquatic and terrestrial furbearers, small mammals, and big game. Blalock and Philippi Canyons, just east of the John Day River in the northwest corner of Gilliam County, support a resident herd of California bighorn sheep numbering approximately 70 animals (Russ Morgan, pers. comm., 2004). Historically, California bighorns were the most abundant wild, native sheep in Oregon (Toweill and Geist 1999). They were found throughout the steeper terrain of southeast Oregon, and the non-timbered portions of the Deschutes and John Day River drainages. California bighorns were extirpated from Oregon by 1915 because of indiscriminate hunting, unregulated grazing by domestic livestock, and parasites and diseases carried by domestic livestock. Between 1954 and 1985, efforts were made to restore California bighorn sheep to Oregon with transplants from British Columbia and other states as animals and funding ware available. Oregon now supports 3,700 California bighorn in 32 herds (ODFW 2003b).

Overall, most established California bighorn herds are stable to increasing in number, although it will take a few years to evaluate the success of recent transplants. The annual rate of increase in all populations tends to decrease as total population size increases. The exact cause for this drop in productivity or survival is not yet known. Biologists think that as bighorn density increases, parasite levels and possibly stress have a depressing effect on overall herd productivity and survival (ODFW 2004g).

Numerous species of small rodents are also present, including the Washington ground squirrel (recently listed as endangered in Oregon, and has been petitioned for federal listing across its entire range), which is associated with native shrub-steppe and grassland habitats. It has a very limited distribution and occurs only in portions of the Columbia basin, including the BAIC tract and Boardman Bombing Range (TNC 1999).

Reptiles and Amphibians

Twenty-three species of amphibians and 24 species of reptiles are known to inhabit this subbasin. Amphibians and reptiles often reveal important information about the ecological condition of an area because, they are predators, often rely on specific habitats, and are sensitive to environmental degradation. Furthermore, there is global concern that amphibians are declining as the result of climate change and habitat alteration (Wake and Morowitz 1991; Stebbins and Cohen 1995).

Before inundation by hydroelectric dams, the natural hydrological flooding and seasonal drying of lowland backwater areas along the Columbia created environments that would have been especially rich in amphibian species, such as spotted frog *Rana sp*. and western toad *Bufo boreas*. Now these species are primarily missing from the Columbia River lowlands. The western painted turtle *Chrysemys picta belli* is abundant in the Irrigon Wildlife Management Area, supported by the complex of emergent marsh and open water.

3.2.10 Aquatic/Fish Resources

At least 51 species of fish from 14 families have been reported from the mainstem Columbia River between Wanapum and The Dalles dams (Appendix C, Table C.8). Thirty of these species are native. Thirty-three species were found just in backwaters between McNary and Bonneville dams (USFWS 1980). Most of the species observed remain in the subbasin throughout their life naturally or because they are largely constrained within the barriers presented by the dams (e.g., white sturgeon). See **Table 4.**

Anadromous Fish

At least five anadromous fish species are found in the Lower Mid-Columbia Mainstem Subbasin, including spring, summer/fall chinook (*Oncorhynchus tshawytscha*), summer steelhead (*O. mykiss*), sockeye salmon *(O. nerka*), coho salmon (*O. kisutch),* and Pacific lamprey (*Lampetra tridentata*). Counts of adult salmonids passing The Dalles Dam have averaged nearly a half million fish in recent years.

Areas of the lower mid-Columbia River historically served as spawning grounds for fall chinook and steelhead. Today the lower mid-Columbia is mostly a migration corridor to and from the Pacific Ocean for adult and juvenile salmonids. Although Pacific lamprey, American shad, bull trout, ocean-type Chinook salmon, coho salmon, and rainbow trout (steelhead) may use the subbasin for significant portions of their life history. Salmon spawning has been observed in limited areas in the Columbia River. Most fish species spawn and rear in tributary streams away from the Columbia River. Anadromous fish that primarily use the subbasin as a migration corridor include stream-type chinook and sockeye salmon. In the mainstem Columbia River, salmonid concentrations and habitat are found in shallow water, inlet, and island locations. See 5.7.2 Lower Mid-Columbia Mainstem Assessment Unit.

Seven watersheds in the subbasin are known to have anadromous fish use, five on the Washington side: Rock Creek, Pine Creek, Wood Gulch, Alder Creek, and Grade Creek; and two on the Oregon side, Frank Fulton Canyon and Spanish Hollow. Three species of anadromous salmon, fall chinook, coho (*Onchorynchus kisutch*), and steelhead (*Onchorynchus mykiss*), use streams in the Rock Creek assessment unit. Steelhead have been identified as indigenous to the subbasin. The remaining anadromous use is believed to be a result of straying of other mid-Columbia stocks, or is incidental use associated with upriver migration of adults or downriver migration of juveniles. Pacific lamprey have also been observed in Rock Creek (Jim Matthews, YN, pers. communication 2001).

Historically summer steelhead used Spanish Hollow and Fulton Canyon. Currently, they use Fulton Canyon when water conditions permit, but there is some uncertainly as to the exent to which summer steelhead to use Spanish Hollow, including for spawning (French, pers. comm., 2004).

Chum salmon are reported to have once migrated up the Columbia River as far as the Walla Walla River, a distance over 300 miles from the ocean (Nehlsen et al. 1991) and were productive in many lower Columbia River tributaries. Runs of nearly 1.4 million fish are believed to have returned annually to the Columbia River. After Bonneville Dam was completed, passage counts were variable ranging from over 5,000 adults in 1941 to less than 100 by 1968. Since 1970, counts have been as low as one.

Historical distribution of chum upstream of Bonneville Dam is not well known. Few fish were observed passing The Dalles Dam upon its completion and since adult passage counts began in 1957. Recent production is generally limited to areas downstream of Bonneville Dam although adults continue to be observed ascending Bonneville Dam. All naturally produced chum salmon populations in the Columbia River Basin were listed as threatened under federal ESA August, 1999.

Hanford Reach

This subbasin plan covers only a portion of the Lower Mid-Columbia Mainstem subbasin and its management plan does not include strategies for the Hanford Reach. However, WDFW biologists thought the Hanford Reach's naturally spawning fall chinook population to be important enough to deserve mention in the Lower Mid-Columbia Mainstem subbasin document.

Gray and Dauble (1977) list 43 fish species (i.e. anadromous and resident) in just the Hanford Reach. Beach seine catches from April-June in the Hanford Reach are dominated by subyearling fall chinook salmon (U.S. Geological Survey, USGS, unpublished data).

Hanford Bright Fall Chinook

Most of the salmon migrating through the Lower Mid-Columbia Mainstem Columbia River are from the Hanford Reach, which remains the most important natural spawning area for fall chinook salmon in the mainstem Columbia River. The salmon in the Hanford Reach area are classified as the upriver bright stock of fall chinook. These bright fall chinook migrate upstream to spawning areas in the Hanford Reach from mid-August through October, dig redds and deposit eggs from late October to late November. The Hanford Reach is a 50-mile segment of the Columbia River extending from the upper end of McNary Dam Reservoir (near the downstream border of the Hanford Nuclear Reservation) to Priest Rapids Dam.

The number of fall chinook salmon redds observed in the Hanford Reach increased through the decades of the 1960s, 1970s and 1980s until reaching a high in 1989 of nearly 9,000 (see**Figure 30**). In the early 1990s, redd counts declined to approximately one-third, but rebounded in the late 1990s. Redd survey data generally agree well with adult escapement figures obtained by counting migrating adult fish at fish ladders on the Columbia River.

The Priest Rapids Hatchery contributes significantly to the Hanford bright fall chinook run. In 2003 nearly 100,000 fall chinook salmon returned to the Hanford Reach to spawn, and recent years have seen some of the highest returns in over 40 years of record-keeping. A recent CRITFC study (Hatch and Talbot 2002) found that the proportion of Priest Rapids Hatchery fish returning to the natural production areas in the Hanford Reach to spawn ranged from 4.64%to 60.57%—an average of 29.83%—between 1979 and 2000. The proportion of Hanford Reach returns attributable to Priest Rapids Hatchery ranged from 1.33%to 33.0 %, with an average of 8.63%.

Resident Fish

Whitefish, sturgeon, trout, and char were the dominant resident species in the mid-Columbia before reservoir inundation. Hydropower development and production in the mid-Columbia created a subsequent shift in resident species composition. Today, bull trout, rainbow, whitefish and white sturgeon are present in the reservoirs along with numerous non-native (e.g. American shad, bass, bulleye, carp, crappie, perch, walleye) and cool water, non-game species (e.g. northern pikeminnow, shiners, and suckers). Burbot, chiselmouth, dace, peamouth, sculpin, and three-spine stickleback are also found in this subbasin.

A number of areas in the Dalles, John Day, and McNary pools are identifed where habitat resources (includes warm water nurseries) and concentrations of resident fish species exist. See 5.7.2 Lower Mid-Columbia Mainstem Assessment Unit.

Rainbow trout are currently present in the mid-Columbia reservoirs, however they are likely the result of hatchery steelhead and resident rainbow trout production programs in nearby tributaries. Resident rainbow trout do not appear to be self-sustaining in the reservoirs, though self-sustaining populations of rainbow, cutthroat, and brook trout are maintained in the tributaries (Chelan County PUD 1998; Zook 1983). Resident rainbow trout have been found in many of the streams in the Rock Creek subbasin, particularly in the headwaters. They have also been observed in upper Rock Creek, Quartz Creek, Squaw Creek and Box Canyon. Suckers (*Catostomus spp*), dace (*Rhinicchthys spp*) and other non-game fish species have also been observed in Rock Creek (Jim Matthews, YN, pers. communication 2001).

In Spanish Hollow and Fulton Canyon, redband trout, longnose dace, reside shiner, and largescale sucker were historically and are currently present. However, redband trout in Spanish Hollow have not been recently observed (Rod French, pers. comm., 2004).

Smallmouth bass are abundant in the Hanford Reach and mountain whitefish are common and support a recreational fishery. Beach seine catches at Hanford from April-June were dominated by redside shiners, carp, largescale suckers, northern pikeminnow, and peamouth (U.S. Geological Survey, USGS, unpublished data). Tench, threespine sticklebacks, and mountain whitefish are rarely captured in Hanford beach seining activities.

Bull trout are rarely observed in the Columbia River; however, Gray and Dauble (1977) reported collecting bull trout at two sites within the Hanford Reach. In recent years very few bull trout have been collected during sampling in McNary Reservoir (ODFW, unpublished data). Extensive multi-gear, multi-season sampling (beach-seining, electrofishing, gill-netting, and minnow trapping) in the Priest Rapids and Wanapum tailraces, reservoirs, and forebays during 1999 resulted in the capture of only 2 bull trout (Pfeifer et al. 2000). A bull trout was observed in the Smolt Monitoring Program collection facility at John Day Dam, 5/18/2002 (Martinson et al. 2003).

Resident Predators

Primary predators of juvenile salmonids in the Columbia River include northern pikeminnow, smallmouth bass, and walleye. Northern pikeminnow are a native cyprinid that is widely distributed throughout the Columbia River Basin. They are the subject of an extensive predator control effort. Smallmouth bass and walleye support popular recreational fisheries and walleye are also harvested in commercial fisheries.

Beamesderfer and Rieman (1991) estimated abundance in John Day Reservoir to be approximately 85,000 northern pikeminnow and 15,000 walleye longer than 250 mm fork length, and 35,000 smallmouth bass longer than 200 mm fork length. Ward et al. (1995) estimated abundance of northern pikeminnow relative to that in John Day Reservoir to be approximately 138% in The Dalles Reservoir and 68% in McNary Reservoir (excluding the Hanford Reach). Zimmerman and Parker (1995) estimated abundance of smallmouth bass relative to that in John Day Reservoir to be approximately 10% in The Dalles Reservoir and 45% in McNary Reservoir.

Petersen (1994) estimated the annual loss of juvenile salmonids to predation by northern pikeminnow in John Day Reservoir to be 1.4 million, approximately 7.3% of all juvenile salmonids entering the reservoir. Rieman et al. (1991) determined that northern pikeminnow accounted for 78% of the loss of juvenile salmonids to fish predators. Ward et al. (1995) estimated predation on juvenile salmonids by northern pikeminnow relative to that in John Day Reservoir to be approximately 190% in The Dalles Reservoir and 50% in McNary Reservoir.

Predation on juvenile salmonids by northern pikeminnow has decreased since implementation of the Northern Pikeminnow Management Program in 1990 (Beamesderfer et al. 1996; Friesen and Ward 1999). From 1992 through 1999, annual exploitation rate of northern pikeminnow longer than 250 mm fork length has averaged approximately 11.4% in The Dalles Reservoir, 5.2% in John Day Reservoir, and 15.3% in McNary Reservoir and the Hanford Reach combined. Annual exploitation rate throughout the lower Columbia River Basin has averaged about 12%, resulting in an estimated 25% reduction in predation on juvenile salmonids (Friesen and Ward 1999).

Smallmouth bass are introduced and are also widely distributed throughout the Columbia River basin. Crayfish and fish each constitute nearly 50% of the diet (by weight) of smallmouth bass in lower Columbia River reservoirs (Zimmerman 1999). Sculpins are the primary fish prey, with salmonids comprising about 10-25% of the fish consumed by weight, and about 14% by number. Individually, smallmouth bass consume fewer juvenile salmonids than northern pikeminnow[TR1]. But in areas where smallmouth bass are more abundant than northern pikeminnow, they likely consume more salmonids. Density of smallmouth bass is generally higher in upstream reservoirs and abundance of smallmouth bass is especially high in John Day Reservoir (Zimmerman and Parker 1995).

Introduced walleye are generally less abundant in lower Columbia Reservoirs than either northern pikeminnow or smallmouth bass, although fluctuations in walleye abundance are common (Tinus and Beamesderfer 1994; Friesen and Ward 2000). Walleye year-class strengths are highly variable, with occasional dominant years (Rieman and Beamesderfer 1990; Friesen and Ward 2000). Walleye may consume as many salmonids per individual as northern pikeminnow (Vigg et al. 1991), but low predator numbers usually preclude extensive losses of juvenile salmonids. Fish comprise almost 100% of the diet in lower Columbia River reservoirs, with salmonids constituting about 14% of the fish by number (Zimmerman 1999). Predation may be much higher in spring, when salmonids constitute almost 60% of the fish by weight.

Table 4 Fish species reported from the Columbia River between Wanapum and The Dalles dams

Tolerance refers to physiological resistance to organic pollution, warm water, sedimentation, and low dissolved oxygen (Zaroban et al. 1999). Status refers to listing as threatened or endangered: FE = federal endangered, FT = federal threatened, FSC = federal species of concern, OT = Oregon threatened, WC = Washington candidate.

Family, species	Origin	Tolerance	Status
Petromyzontidae			
Western brook lamprey Lampetra richardsoni	Native	Intermediate	--
River lamprey L. ayresi	Native	Intermediate	FSC
Pacific lamprey L. tridentata	Native	Intermediate	FSC
Acipenseridae			
White sturgeon Acipenser transmontanus	Native	Intermediate	--
Clupeidae			
American shad Alosa sapidissima	Exotic	Intermediate	--
Salmonidae			
Rainbow trout/steelhead Oncorhynchus mykiss	Native	Sensitive	FE, FTa,WC
Cutthroat trout O. clarki	Native	Sensitive	--
Chinook salmon O. tshawytscha	Native	Sensitive	FE, FTb, OT, WC
Coho salmon O. kisutch	Native	Sensitive	--
Sockeye salmon O. nerka	Native	Sensitive	FEc, WC
Bull trout Salvelinus confluentus	Native	Sensitive	FT, WC
Brown trout Salmo trutta	Exotic	Intermediate	--
Mountain whitefish Prosopium williamsoni	Native	Intermediate	--
Lake whitefish Coregonus clupeaformis	Exotic	Intermediate	--
Cyprinidae			
Carp Cyprinus carpio	Exotic	Tolerant	--
Grass carp Ctenopharyngodon idella	Exotic	Tolerant	--
Goldfish Carrassius auratus	Exotic	Tolerant	--
Chiselmouth Acrocheilus alutaceus	Native	Intermediate	--

Family, species	Origin	Tolerance	Status
Redside shiner Richardsonius balteatus	Native	Intermediate	--
Northern pikeminnow Ptychocheilus oregonensis	Native	Intermediate	--
Peamouth Mylocheilus caurinus	Native	Intermediate	--
Longnose dace Rhinichthys cataractae	Native	Intermediate	--
Leopard dace R. falcatus	Native	Intermediate	WC
Speckled dace R. osculus	Native	Intermediate	--
Tench Tinca tinca	Exotic	Intermediate	--
Catostomidae			
Largescale sucker Catostomus macrocheilus	Native	Tolerant	--
Bridgelip sucker C. columbianus	Native	Tolerant	--
Mountain sucker C. platyrhynchus	Native	Intermediate	WC
Longnose sucker C. catostomus	Native	Intermediate	--
Ictaluridae			
Channel catfish Ictalurus punctatus	Exotic	Tolerant	--
Black bullhead Ameiurus melas	Exotic	Tolerant	--
Brown bullhead A. nebulosas	Exotic	Tolerant	--
Yellow bullhead A. natalis	Exotic	Tolerant	--
Poeciliidae			
Mosquitofish Gambusia affinis	Exotic	Tolerant	--
Gadidae			
Burbot Lota lota	Native	Intermediate	--
Gasterosteidae			
Three-spine stickleback Gasterosteus aculeatus	Native	Tolerant	--
Percopsidae			
Sandroller Percopsis transmontana	Native	Intermediate	--
Centrarchidae			
Largemouth bass Micropterus salmoides	Exotic	Tolerant	--

Family, species	Origin	Tolerance	Status
Smallmouth bass M. dolomieui	Exotic	Intermediate	--
Black crappie Pomoxis nigromaculatus	Exotic	Tolerant	--
White crappie P. annularis	Exotic	Tolerant	--
Warmouth Lepomis gulosis	Exotic	Tolerant	--
Bluegill L. macrochirus	Exotic	Tolerant	--
Pumpkinseed L. gibbosus	Exotic	Tolerant	--
Percidae			
Walleye Stizostedion vitreum	Exotic	Intermediate	--
Yellow perch Perca flavescens	Exotic	Intermediate	--
Cottidae			
Paiute sculpin Cottus beldingi	Native	Intermediate	--
Torrent sculpin C. rhotheus	Native	Intermediate	--
Prickly sculpin C. asper	Native	Intermediate	--
Reticulate sculpin C. perplexus	Native	Intermediate	--
Mottled sculpin C. bairdi	Native	Intermediate	--

a Middle Columbia River and Snake Basin Steelhead ESUs listed as threatened; Upper Columbia River ESU listed as endangered. b Snake River Chinook Salmon ESUs listed as threatened; Upper Columbia River Spring-run ESU listed as endangered. c Only the Snake River ESU is federally listed (endangered)

4 Wildlife Assessment

4.1.1 Introduction

The subbasin wildlife assessment is a technical analysis to determine the biological potential of the subbasin and the opportunities for restoration. It describes the existing and historic resources, conditions and characteristics within the subbasin. Separate teams of wildlife scientists developed the assessment. The bulk of the Washington assessment work was done by the Yakama Nation and WDFW with support and involvement of Klickitat County. ODFW guided the Oregon assessment draft and, under the circumstances of time, agreed to the focal habitats and species.

The initial subbasin planners from Washington chose a set of focal wildife species, and habitats, on which to focus their assessment. A focal species has special ecological, cultural, or legal status and is used to evaluate the health of the ecosystem and the effectiveness of management actions. Criteria used in selecting the focal species include a) designation as federal endangered or threatened species, b) cultural significance, c) local significance and d) ecological significance, or ability to serve as indicators of environmental health for other species. Each of the focal wildlife species for the Lower Mid-Columbia Mainstem Subbasin is described below.

Focal Wildlife Species and Representative Habitats

Wildlife

Eight wildlife species found in the Lower Mid-Columbia Mainstem Subbasin have been chosen as focal species for this planning effort: Western gray squirrel, mule/black-tailed deer, grasshopper sparrow (*Ammodramus savannarum*), Brewer's sparrow (*Spizella breweri*), white-headed woodpecker, Lewis' woodpecker (*Melanerpes lewis*), American beaver (*Castor canadensis*), and the yellow warbler (*Dendroica petechia*).

Table 5 Wildlife focal species and their distribution within the Lower Mid-Columbia Mainstem subbasin

Wildlife Focal Species	Habitat Represented
Western Gray Squirrel	Ponderosa Pine/Oregon White Oak
Mule/Black-Tailed Deer	Shrub Steppe/Interior Grasslands
Grasshopper Sparrow	Shrub Steppe/Interior Grasslands
Brewer's Sparrow	Shrub Steppe/Interior Grasslands
White-Headed Woodpecker	Ponderosa Pine/Oregon White Oak
Lewis' Woodpecker	Interior Riparian Wetlands
American Beaver	Interior Riparian Wetlands
Yellow Warbler	Interior Riparian Wetlands

4.1.2 Wildlife Assessment Methodology

This section briefly describes the framework used to develop the subbasin wildlife assessment for the Lower Mid-Columbia Mainstem subbasin plan. A number of state and local wildlife /land management agencies provided data and information to complete the subbasin plan: The Yakama

Nation Wildlife Department, WDFW, ODFW, Klickitat County, Washington, and Sherman and Gilliam counties, Oregon. The Yakama Nation Wildlife Department is the lead wildlife agency in the Lower Mid-Columbia Mainstem subbasin compiling wildlife assessment, inventory, and management information for the subbasin.

The wildlife assessment was developed from a variety of "tools" including the Mainstem Columbia Subbasin Summary (Ward 2001), Rock Creek Subbasin Summary (NPPC 2001), Umatilla and John Day Subbasin Plans (i.e. some watersheds within the Oregon portion of the subbasin, border the Umatilla and John Day subbasins and were included in these plans), the Interactive Biodiversity Information System (IBIS), the WDFW Priority Habitats and Species (PHS) database, the ODFW Sensitive Species List and Oregon Administrative Rules, the Washington Gap Analysis Project (GAP) database, Partners in Flight (PIF) information, National Wetland Inventory maps, and input from local, state, federal, and tribal wildlife managers.

Although IBIS is a useful assessment tool, it should be noted that IBIS-generated historic habitat maps have a minimum polygon size of 1 km^2 while current IBIS habitat type maps have a minimum polygon size of 100 ha or 250 acres (O'Neil, pers. comm., 2003). In either case, linear aquatic, riparian, wetland, subalpine, and alpine habitats are under represented, as are small patchy habitats that occur at or near the canopy edge of forested habitats. It is also likely that microhabitats located in small patches or narrow corridors were not mapped at all. Another limitation of IBIS data is that they do not specifically rate habitat quality nor do they associate key ecological correlates (KEC) with specific areas. As a result, a given habitat type may be accurately depicted on IBIS maps, but may be lacking in functionality and quality. For example, IBIS data do not distinguish between shrub steppe habitat dominated by introduced weed species and pristine shrub steppe habitat.

Washington State GAP data was also used extensively throughout the wildlife assessment. The GAP generated acreage figures may differ from IBIS acreage figures as an artifact of using two different data sources. The differences, however, are relatively small (less than 5%) and will not impact planning and/or management decisions.

The WDFW has created the Priority Habitats and Species (PHS) List, which is a catalog of species and habitat types that were identified as priorities for management and preservation. For many of these species and habitat types, documents have been created that include, in the case of species, habitat need and use descriptions, basic life history information, population status and trends, and in the case of both species and habitats, provide factors limiting presence and make management recommendations. Available documents were used for species and habitat write-ups as well as for the creation of key findings, limiting factors and working hypotheses to be used in the creation of a management plan.

Wildlife in the Lower Mid-Columbia Mainstem Subbasin

Using IBIS (2003), 435 wildlife species have been identified to currently occur within the Lower Mid-Columbia Mainstem subbasin. For a full list of species and breeding status in this subbasin, see Appendix C, table C.1.

Species richness for the Lower Mid-Columbia Mainstem subbasin is given in **Table 6**. Differences in species richness between subbasins can partially be explained as variation in biological potential and quality of habitats, amount/type and juxtaposition of remaining habitats, and robustness of databases used to establish the species lists.

Table 6 Species richness of the Lower Mid-Columbia Mainstem subbasin, Washington and Oregon (IBIS 2003)

Class	Number
Amphibians	23
Birds	280
Mammals	108
Reptiles	24
Total	435

Many of the wildlife species found in this subbasin can be listed in several different categories. These categories include: federal and state listed species, game species, Washington state Partners In Flight species, species used in the Habitat Evaluation Procedure (HEP), and species that have documented relationships with salmon. These groups were compiled by IBIS (2003) and are discussed next. These categories were some of the criteria used in choosing focal species later.

Federal and State Listed Species

Of the 435 wildlife species listed above, 54 are either federally (threatened, candidate, or concern) or state (endangered, threatened, sensitive, or candidate) listed. See Appendix C., table C.2.A for a full list, and table C.2.B for definitions of listings.

Game Species

Of the 435 wildlife species identified in the subbasin, 65 species are listed in IBIS (2003) as game animals. Of these, 1 is an amphibian, 41 are birds and 23 are mammals. For a detailed list of game species in the subbasin, see Appendix C, table C.3.

Oregon and Washington Partners in Flight

The goal of Partners in Flight (PIF) is to focus resources on the improvement of monitoring and inventory, research, management, and education programs involving birds and their habitats. The PIF strategy is to stimulate cooperative public and private sector efforts in North America and the Neotropics to meet these goals. Of the 435 wildlife species in the subbasin, there are 280 bird species. Of these, 111 are listed in Partners in Flight for this subbasin. See Appendix C, table C.4 for a full list of species.

Habitat Evaluation Procedure

The wildlife species listed under the Habitat Evaluation Procedure (HEP) are used to assess habitat losses associated with federal hydroelectric facilities on the Lower Snake and Columbia Rivers. Of the 435 wildlife species in the subbasin, 26 are used under HEP, 20 birds and 6 mammals (IBIS 2003). See Appendix C table C.5 for a full list.

Salmonid Associations

Anadramous salmon provide a rich, seasonal food resource that directly affects the ecology of both aquatic and terrestrial consumers, and indirectly affects the entire food web that knits the water and land together. Wildlife species and salmon have likely had a very long, and co-evolutionary relationship with salmon in the Pacific Northwest. Of the 435 species in the subbasin, 92 are classified as having a routine relationship with salmon (combination of species with Strong and Consistent, Recurrent, Indirect and Rare relationships, see Appendix C, table C.6.B for definitions). See Appendix C., table C.6.A for entire list (IBIS 2003).

Priority Habitat and Species (PHS)

The PHS list is a catalog of habitats and species considered to be priorities for conservation and management. Priority species may warrant management measures for their perpetuation at target population levels due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Priority species include State Endangered, Threatened, Sensitive, and Candidate species; animal aggregations considered vulnerable; and those species of recreational, commercial, or tribal importance that are vulnerable.

In this subbasin there are 77 wildlife species listed on the PHS list for Washington State. Internet access to the PHS List is available via the World Wide Web at: http://www.wa.gov/wdfw/hab/phslist.htm.

4.1.3 Wildlife Habitats and Features in the Lower Mid-Columbia Mainstem Subbasin

Wildlife Habitats

The Lower Mid-Columbia Mainstem subbasin consists of 12 wildlife habitat types as identified by IBIS (2003). These are briefly described in **Table 7**. Historic and current wildlife habitat distribution is illustrated in **Figure 3** and **Figure 4**. However, not all areas shown on the maps or all current habitat types occur in the present planning area of the subbasin.

Table 7 Current wildlife habitat types within the Lower Mid-Columbia Mainstem subbasin, Washington (IBIS 2003); only shaded areas occur in Oregon part of the subbasin

Habitat Type	Brief Description
Montane Mixed Conifer Forest	Coniferous forest of mid-to upper montane sites with persistent snowpack; several species of conifer; understory typically shrub-dominated
Interior Mixed Conifer Forest	Coniferous forests and woodlands; Douglas-fir commonly present, up to eight other conifer species present; understory shrub and grass/forb layers typical; mid-montane.
Ponderosa Pine & Interior White Oak Forest and Woodlands	Ponderosa pine dominated woodland or savannah, often with Douglas-fir; shrub, forb, or grass understory; lower elevation forest above steppe, shrubsteppe.
Western Juniper and Mountain Mahogany Woodlands	Not found in Rock Creek
Interior Canyon Shrublands	Chokecherry, oceanspray, and Rocky Mtn. maple with shrubs and grasses dominated the understory.
Interior Grasslands	Dominated by short to medium height native bunchgrass with forbs, cryptogam crust.

Habitat Type	Brief Description
Shrub steppe	Sagebrush and/or bitterbrush dominated; bunchgrass understory with forbs, cryptogam crust.
Agriculture, Pastures, 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% 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.
Interior Riparian-Wetlands	Shrublands, woodlands and forest, less commonly grasslands; often multilayered canopy with shrubs, graminoids, forbs below.

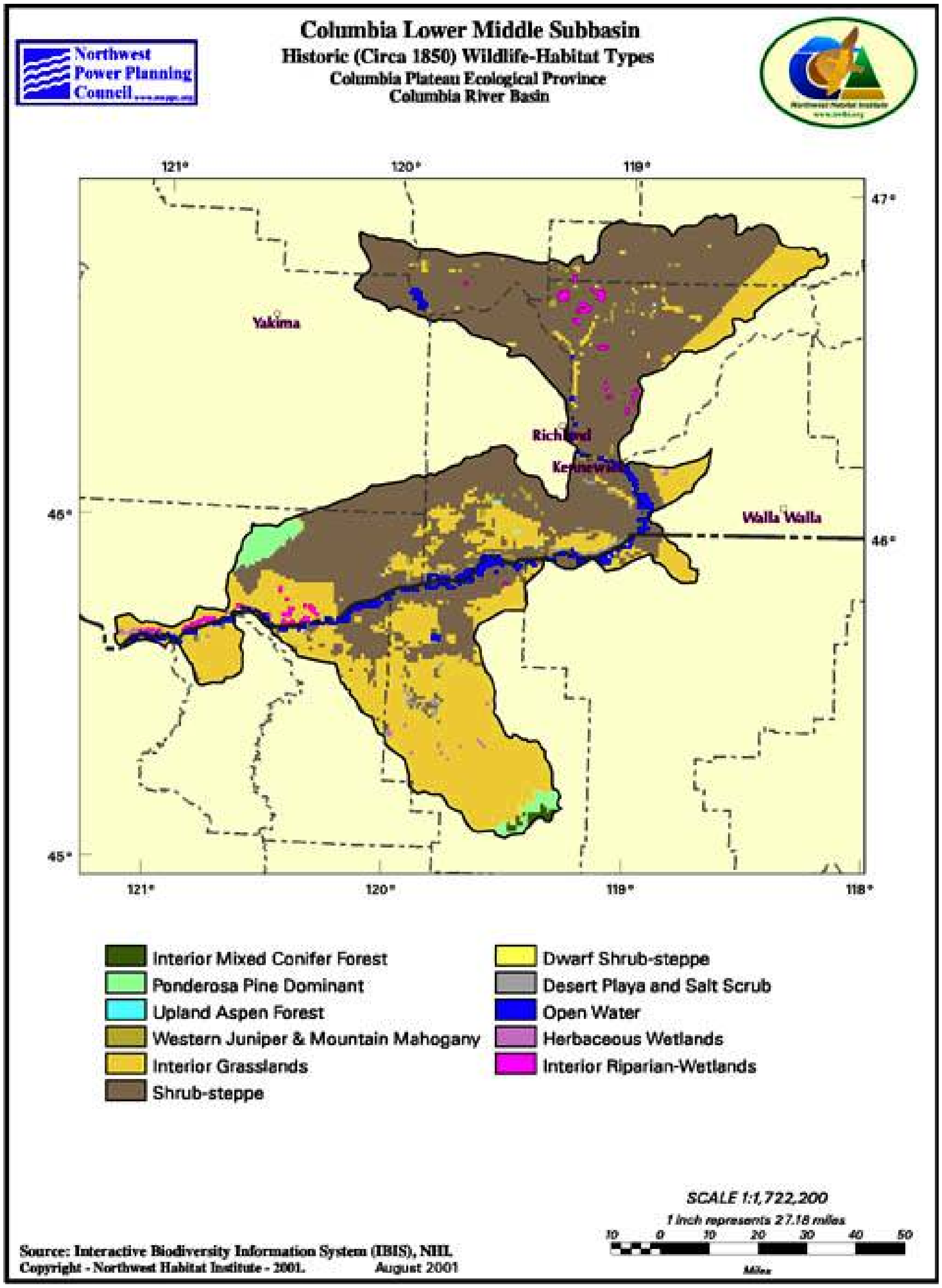


Figure 3 Historic wildlife habitat types of the Lower Mid-Columbia Mainstem Subbasin (IBIS 2003)

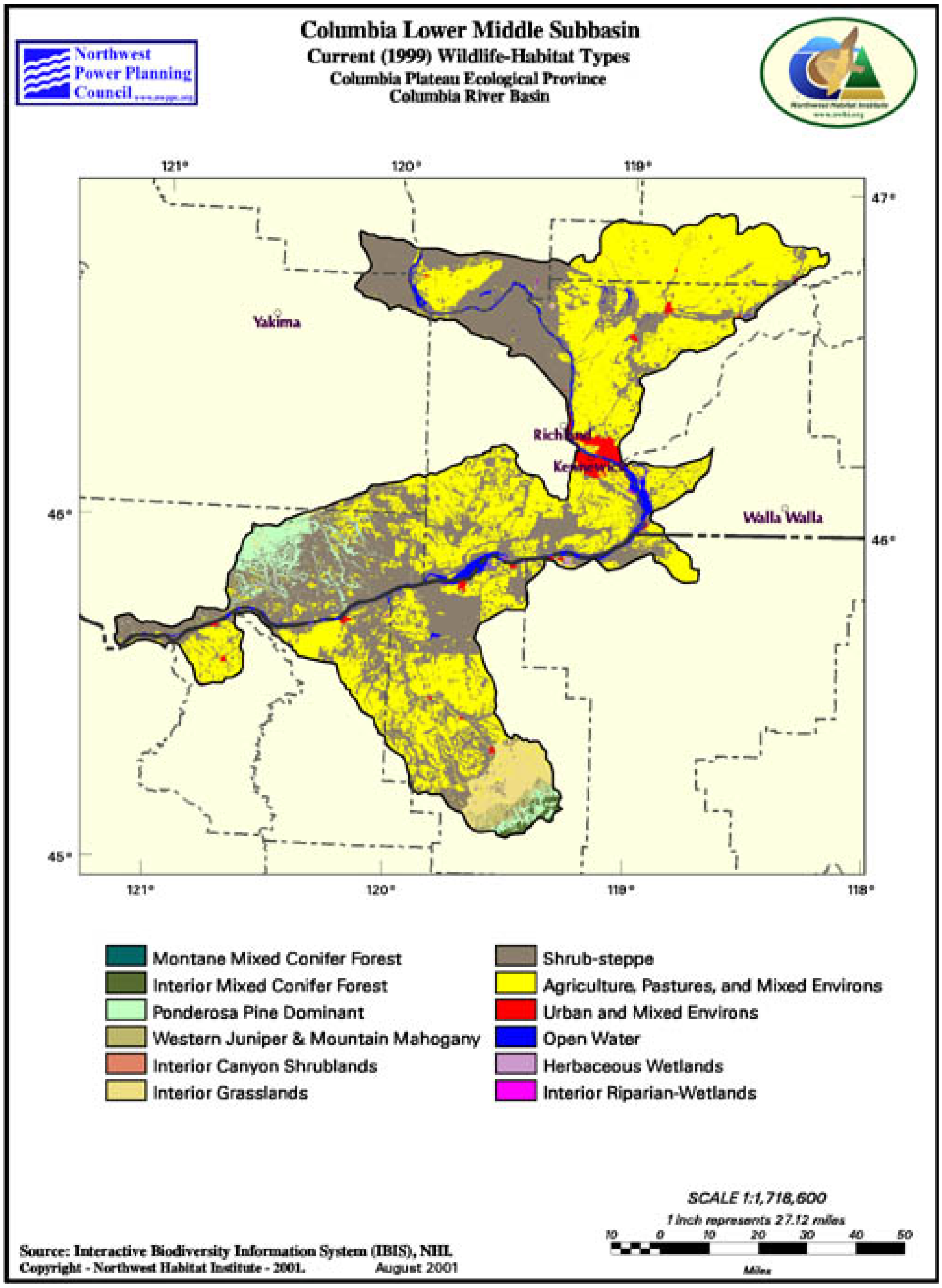


Figure 4 Current wildlife habitat types of the Lower Mid-Columbia Mainstem Subbasin (IBIS 2003)

Rare Plants and Plant Communities

The Washington and Oregon Natural Heritage Programs (2003, 2004) list 76 rare, endangered, and threatened plants in Klickitat County, Washington, and Sherman, Gilliam, and Morrow counties, Oregon (part of which make up the Lower Mid-Columbia Mainstem subbasin). The Oregon Natural Heritage Program (2004) does not track plant communities, but Klickitat County has 23 rare or high-quality plant communities (WNHP 2004). Complete listings are in Appendix D, tables D.1.A and D.2

Priority Habitat and Species (PHS)

The PHS list is a catalog of habitats and species considered to be priorities for conservation and management. 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.

In this subbasin there are 17 habitats or habitat elements listed within the PHS list for southwest Washington (Region 5) (see Appendix D, table D.3). Internet access to the PHS List is available via the World Wide Web at: http://www.wa.gov/wdfw/hab/phslist.htm.

Plant Species of Importance to the people of the Yakama Nation

There are many species of native plants that have traditional and modern cultural importance to the Yakama Nation. When looking for focal habitats, habitats that supported culturally important, and often imperiled, plants were considered. For a short list of some of these plant species that have already been published in other literature, refer to Appendix D, table D.5

Noxious Weeds

To help protect the state's resources, the Washington State Noxious Weed Control Board (WD NWCB) adopts a State Noxious Weed List each year (WS NWCB 2004). This list categorizes weeds into three major classes – A, B & C - according to the seriousness of the threat they pose to the state or a region of the state. The Rock Creek watershed has 22 classified weed species. One is Class A, 19 are Class B, and two are Class C.

The governing agency in Oregon is the Oregon Department of Agriculture's Plant Division. The classification system for their Noxious Weed Control Program categorizes weeds into three major classes – A, B, & T - according to the seriousness of the threat they pose to the state, or a region of the state, and the quantity of the invasive plant. Gilliam County renews their noxious weed list once a year. It was last renewed in July 2004 and has 39 classified weed species: Class A = 17, Class B = 15 and Class T = 7 (Farrar, pers. comm., 2004). Sherman County also classifies invasive weeds based on the seriousness of threat and quantity, but they use an A, B, & C system. They review their weed list annually, and currently have 48 weed species: Class A= 20, Class B=11, Class C=17 (Asher, pers. comm.,2004).

Noxious weeds have one of the most degrading impacts on our native wetland and terrestrial habitats. They often out-compete native plant species and degrade wildlife habitat. They can also decrease the recreational and economic value of land. The focal habitats chosen all have noxious weeds that have already degraded or currently threaten what remains of these habitats. See Appendix D, table D.4.A and D.4.B C, D, E, & F for a complete list of weeds and class definitions for the Rock Creek watershed (WA.) and Sherman and Gilliam counties (OR.).

4.1.4 Focal Terrestrial/Wildlife Habitat Selection and Rationale

Subbasin wildlife planners emphasize an ecosystem approach to management through use of focal habitat types while including components of single-species, guild, or indicator species assemblages. This approach is based on the following assumption: a conservation strategy that emphasizes focal habitats at the subbasin scale is more desirable than one that emphasizes individual species.

By combining the “course filter” (focal habitats) with the “fine filter” (focal wildlife species assemblage) approach, subbasin planners believe there is a much greater likelihood of maintaining, protecting and/or enhancing key focal habitat attributes and providing functioning ecosystems for wildlife. This approach not only identifies focal habitats, but also describes the most important habitat conditions and attributes needed to sustain obligate wildlife populations within these focal habitats. Although conservation and management is directed towards focal species, establishment of conditions favorable to focal species also will benefit a wider group of species with similar habitat requirements.

To ensure that species dependent on given habitats remain viable, Haufler (2002) advocated comparing the current availability of the habitat against its historic availability (see**Table 8**). According to Haufler, this “coarse filter” habitat assessment can be used to quickly evaluate the relative status of a given habitat and its suite of obligate species. To ensure that “nothing drops through the cracks,” Haufler also advocated combining the coarse filter habitat analysis with a single species or “fine filter” analysis of one or more obligate species to further ensure that species viability for the suite of species is maintained.

The following rationale was used to guide selection of focal habitats (see **Figure 5** for an illustration of the focal habitat/species selection process):

- Identification of habitats that can be used to evaluate ecosystem health and establish management priorities at the subbasin level (course filter);
- Habitats that have experienced a dramatic reduction in acreage or quality within the subbasin (**Table 8** and **Table 9**).
- Habitats that are naturally sensitive and have likely undergone reduction in quantity and quality, although historical records may be lacking (riparian habitats).
- Other considerations included cultural, economical, ecological and special factors.

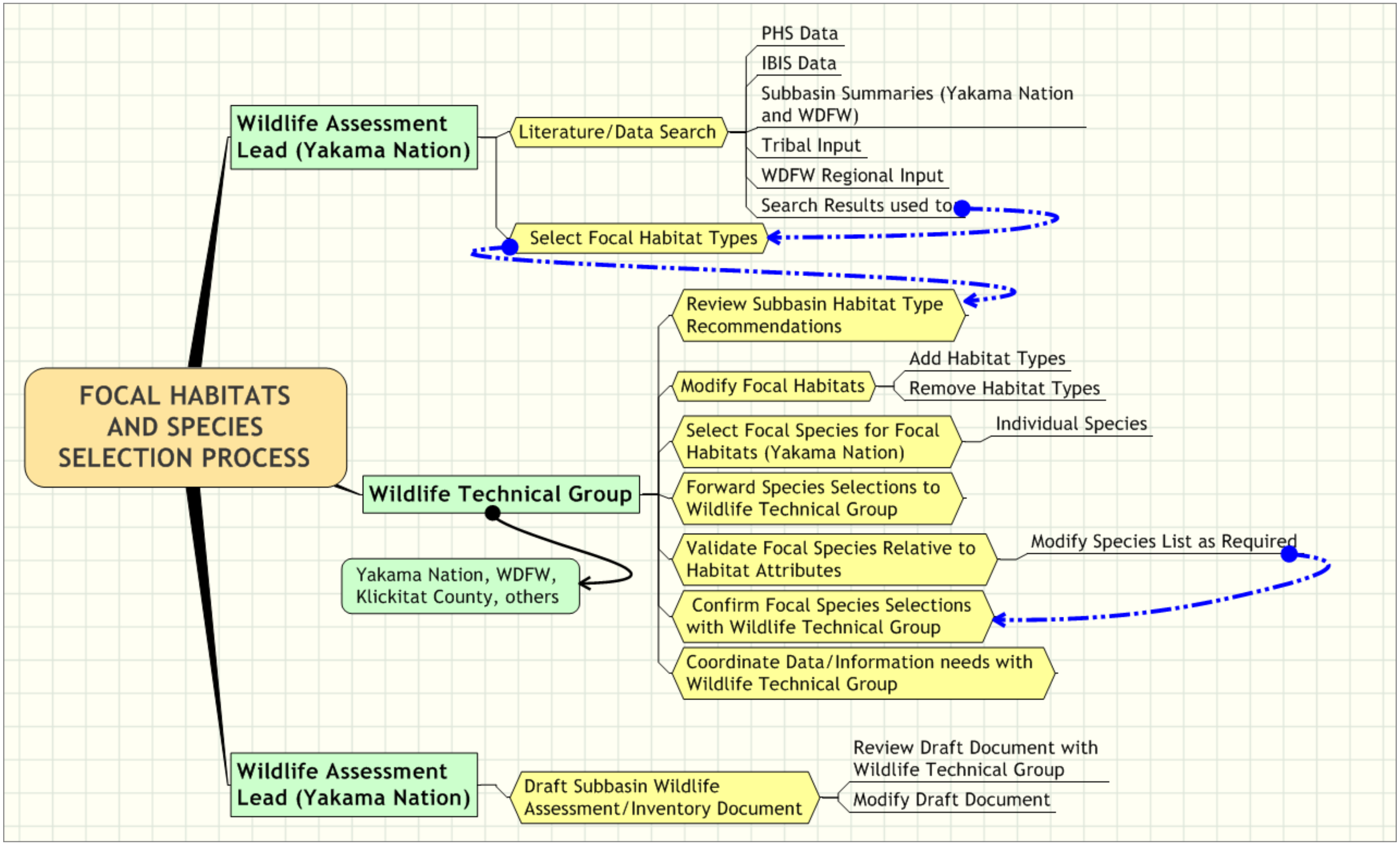


Figure 5 Washington and Yakama Nation focal habitat and species selection process summary (prepared by Paul Ashley, 2004)

Table 8 Changes in wildlife habitat types in the Lower Mid-Columbia Mainstem Subbasin from circa 1850 (historic) to 1999 (current) (IBIS 2003)

	STATUS (Acres)			
HABITAT TYPE	**Historic**	**Current**	**Change**	**Change (%)**
Montane Mixed Conifer Forest	unknown	5	N/A	N/A
Interior Mixed Conifer Forest	9,349	20,034	-10,685	114
Upland Aspen Forest	1,236	unknown	N/A	NA
Ponderosa Pine & Oregon White Oak Forest and Woodlands	67,856	120,017	+52,161	77
Western Juniper and Mountain Mahogany Woodlands	31,290	25,670	-5,620	18
Interior Canyon Shrublands	Unknown	437	N/A	N/A
Interior Grasslands	1,238,342	103,136	-1,135,206	92
Shrub Steppe	2,162,965	1,518,558	-644,407	30
Dwarf Shrub Steppe	741	unknown	N/A	N/A
Desert Playa and Salt Scrub Shrublands	17,795	unknown	N/A	N/A
Agriculture, Pastures	unknown	1,697,796	N/A	N/A
Urban	0	46,551	+46,551	999
Open Water - Lakes, Rivers, and Streams	94,005	112,125	+18,120	19
Herbaceous Wetlands	6,838	6,771	-67	1
Interior Riparian Wetlands	22,733	2,021	-20,712	91
Totals	3,653,150	3,653,121		

Note: A percent change value of 999 indicates a positive change from a historic value of 0 (habitat not believed to be present historically); N/A indicates change is unknown due to lack of historical data.

The IBIS riparian habitat data are incomplete. Therefore, riparian floodplain habitats are not well represented on IBIS maps (accurate habitat type maps, especially those detailing riparian wetland habitats, are needed to improve assessment quality and support management strategies/actions).

4.1.5 Focal Terrestrial/Wildlife Habitats for the Lower Mid-Columbia Mainstem Subbasin

Subbasin planners selected three focal wildlife habitat types from the 12 identified by Interactive Biodiversity Information System (IBIS) in for the subbasin. Subbasin focal habitats include: Interior Riparian Wetlands, Shrub Steppe/Interior Grasslands and Ponderosa Pine/Oregon White Oak. In the Oregon portion of the subbasin, only two habitat types are represented in the plan: Interior Riparian Wetlands and Shrub Steppe/Interior Grasslands. See **Figure 4** for an alternative GAP habitat map of the focal habitats. As with IBIS, riparian habitat is not mapped well.

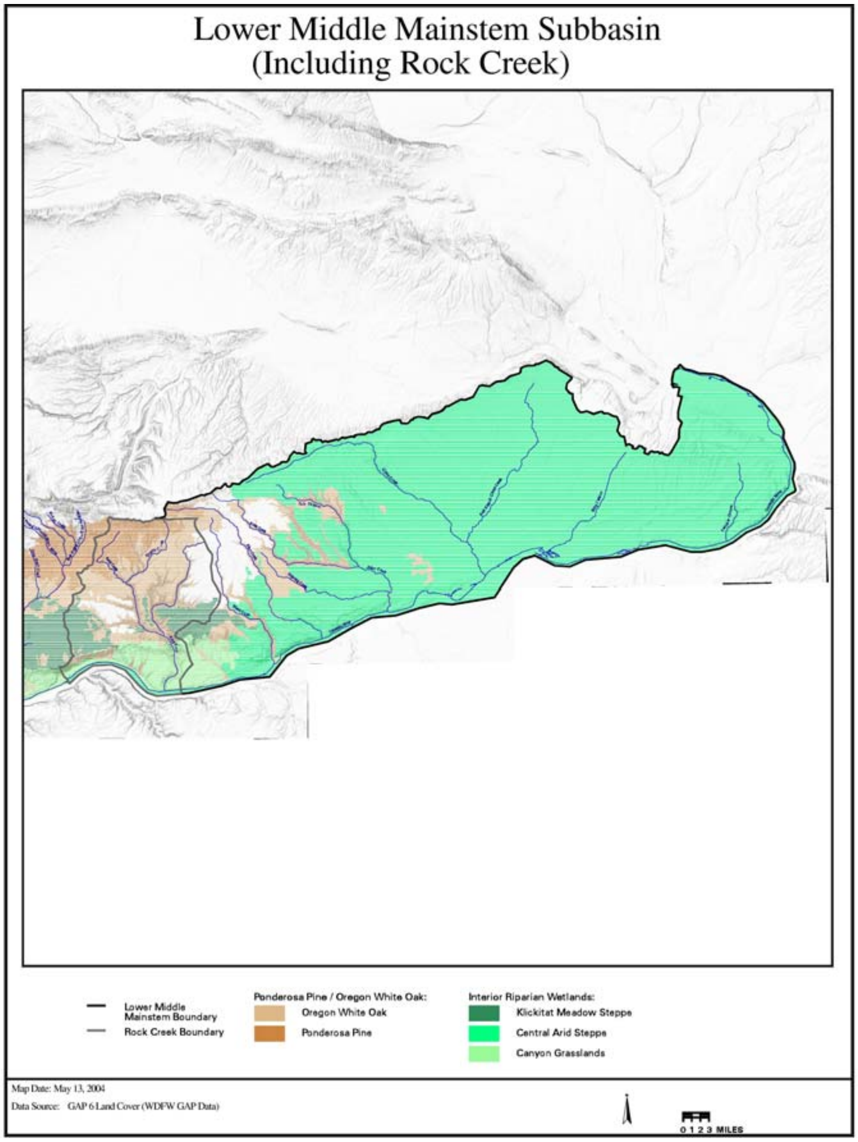


Figure 6 Range of two focal habitats (Ponderosa Pine/Oregon White Oak and Shrub Steppe/Interior Grasslands) in the Washington portion of lower mid-Columbia mainstem subbasin (Cassidy 1997)

Table 9 Focal habitat selection matrix for the Lower Mid-Columbia Mainstem subbasin

Habitat Type	Criteria						
	PHS Data	**ECA Data**	**IBIS Data**	**Considerable loss in quantity**	**Considerable loss in quality**	**Listed in subbasin summary**	**Historically present in macro quantities[1]**
Interior Riparian Wetlands	Yes	Yes	Yes	Likely, not mapped well	Yes	Yes	No
Shrub Steppe/Interior Grasslands	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ponderosa Pine/Oregon White Oak	No	No	Yes	Yes	Yes	Yes	No
Agriculture[2]	No	No	Yes	-	-	Yes	No

[1] Habitat types historically comprising more than 5% of the subbasin land base. This does not diminish the importance of various micro habitats.

[2] Agriculture is not a focal habitat; it is a habitat of concern. Focal species were not selected to represent this habitat type.

4.1.6 Focal Wildlife Species Selection and Rationale

The term focal species was defined by Lambeck (1997) as a suite of species whose requirements for persistence define the habitat attributes that must be present if a landscape is to meet the requirements for all species that occur there. The key characteristic of a focal species is that its status and trend provide insights to the integrity of the larger ecological system to which it belongs (USDA Forest Service 2000).

Subbasin planners refer to these species as "focal species" because they are the focus for describing desired habitat conditions, attributes and needed management strategies and/or actions. The rationale for using focal species 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 those factors, which affect habitat quality and integrity within the subbasin, also impact the species, hence, the decision to focus on habitat with focal species in a supporting role.

Subbasin planners consider focal species' life requirements representative of wildlife habitat conditions or features that are important within a properly functioning focal habitat type.

Subbasin planners selected focal species using a combination of several factors including:

- Primary association with riparian or wildlife habitats for breeding;
- Specialist species that are obligate or highly associated with key habitat elements/conditions important in functioning ecosystems;
- Declining population trends or reduction in their historic breeding range (may include extirpated species);

- Cultural significance of the species, from a tribal and non-tribal perspective;
- Special management concern or conservation status such as threatened, endangered, species of concern, management indicator species, etc.; and
- Professional knowledge on species of local interest.

Subbasin planners identified a focal species assemblage and combined life requisite habitat attributes for each species assemblage to form a recommended "range of management conditions." Fisheries and wildlife habitat managers will use the recommended range of riparian and wildlife habitat conditions to identify and prioritize future habitat restoration and protection strategies and to develop specific habitat management actions/measures for focal habitats.

Focal species can also serve as performance measures to evaluate ecological sustainability and processes, species/ecosystem diversity, and results of management actions (USDA Forest Service 2000). Monitoring of habitat attributes and focal species will provide a means of tracking progress towards conservation. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in this approach.

4.1.7 Focal Wildlife in the Lower Mid-Columbia Mainstem Subbasin

A total of five bird species and three mammalian species were chosen as focal or indicator species to represent three priority habitats in the Lower Mid-Columbia Mainstem Subbasin (table 7). See Appendix C, table C.7 for an entire list of species associated with the focal habitats. Focal species selection rationale and important habitat attributes for each species are described in further detail in **Table 11**.

A number of watersheds on the Oregon side of the Lower Mid-Columbia Mainstem Subbasin border the John Day (Rock Creek) and Umatilla (Willow Creek, Eightmile Canyon, Six-mile Canyon, Juniper Grove, and their tributaries) subbasins and were included in these subbasin plans. Although some general information on focal wildlife habitats and species in Oregon were taken from the John Day and Umatilla subbasin plans, detailed information is included in these plans and is not replicated here.

It is important to note some differences in the selection of wildlife focal species for this plan and those selected for the Umatilla and John Day subbasin. Both the John Day and Umatilla plans include the sage sparrow and great blue heron as focal species to represent shrub-steppe and interior riparian wetlands, respectively. Although they were not selected as focal species for the Lower Mid-Columbia Mainstem Subbasin, they do occur here and detailed information on their life-history, distribution, status, and trends within the Columbia Plateau can be found in the John Day and Umatilla subbasin plans.

Table 10 Focal species selection matrix for the Lower Mid-Columbia Mainstem subbasin, Washington and Oregon

Focal Species (Common Name)	Focal Habitat	Priority Habitat Species	Partners in Flight Species	Game Species	Status[1]	
					Federal	State
Yellow Warbler	Interior Riparian Wetland	No	No	No	-	-
Lewis' Woodpecker		Yes	Yes	No	-	WC, OS
American Beaver		No	No	Yes	-	-
Mule/Black-Tailed Deer	Shrub Steppe/Interior Grassland	Yes	No	Yes	-	-
Grasshopper Sparrow		Yes	Yes	No	-	-
Brewer's Sparrow		No	Yes	No	-	-
White-Headed Woodpecker	Ponderosa Pine/Oregon White Oak	Yes	Yes	No	-	WC, OS
Western Gray Squirrel		Yes	No	No	-	WT, OE

[1]FC = Federal Candidate; WE = Washington Endangered; WT = Washington Threatened; WC = Washington Candidate; OE = Oregon Endangered; OT = Oregon Threatened; and OS = Oregon Sensitive,

Table 11 Focal species selection rationale and habitat attributes for the Lower Mid-Columbia Mainstem subbasin, Washington and Oregon

Focal Species	Focal Habitat	Life/Habitat Requisite	Conservation Focus	Habitat Attribute (Vegetative Structure)	Comments	Habitat Criteria for Selection
Yellow Warbler	Interior Riparian Wetlands	Reproduction	Subcanopy foliage, riparian habitat	> 70% cover in shrub and subcanopy w/ subcanopy > 40% of that, > 70% cover native species	Highly vulnerable to cowbird parasitism; grazing reduces understory structure	Riparian obligate, reproduces in riparian shrub habitat and makes extensive use of adjacent wetlands
Lewis' Woodpecker		Reproduction	Large cottonwood trees/snags	> .8 trees/acre > 21" dbh, canopy closure ≤ 30%, shrub cover ≥50%	Dependent on insect food supply, mast; competition from E. starlings detrimental	Dependent on insect food supply, mast
American Beaver		Food	Canopy closure	40-60% tree/shrub canopy closure trees, < 6" dbh; shrub height 6.6 ft.	Wetland and riparian shrub/forest habitat	Indicator of healthy regenerating cottonwood stands; important habitat manipulator
		Water (cover for food and reproductive requirements)	Permanent water	Stream channel gradient 6% with little to no fluctuation	Keystone species creating pools and standing water used by many species	
		Food	Shoreline development	Woody vegetation 328 ft. from water	Important tool in watershed and wetland restoration	
Brewer's Sparrow	Shrub Steppe /Interior Grasslands	Breeding	Sagebrush cover, low exotic plant presence	Sagebrush cover 10-30%, sagebrush height > 64 cm, herbaceous cover > 10%, bare ground > 20%, non-native herbaceous cover < 10%	More abundant in areas of loamy soil than areas of sandy or shallow soil	Indicator of healthy sagebrush dominated shrub steppe w/ native cover, PIF species
Mule/Black-Tailed Deer		Winter forage	Ceanothus, Big sagebrush, antelope bitterbrush	30-60% canopy cover of preferred shrubs < 5 ft., number of preferred shrub species > 3, mean height of shrubs > 3 ft., 30-70% canopy cover of all shrubs < 5 ft.	Deer are important food source for predators and scavengers, agric. important suppl. food source	South facing slopes important in winter
Grasshopper Sparrow		Breeding	Vegetative complexity, large unbroken patches	Bunchgrass cover > 15% and > 25 cm tall, > 60% total grass cover and shrub cover < 10%	Vegetation type not as important as percent cover, require some bare ground	Indicator of healthy, native grasslands, Washington state candidate

Focal Species	Focal Habitat	Life/Habitat Requisite	Conservation Focus	Habitat Attribute (Vegetative Structure)	Comments	Habitat Criteria for Selection
White-Headed woodpecker	Ponderosa Pine/Oak Woodlands (Not present in Oregon part of subbasin)	All life stages, non migratory	Large patches of late seral forest with large trees and snags	> 10 trees/ac, > 21” dbh w/ > 2 trees > 31” dbh, 10-40% canopy closure, > 1.4 snags/ac > 8” dbh w/ > 50% > 25”, 250-500 acres suitable, unfragmented habitat	Weak primary excavator, needs well decayed snags for nesting. Needs open stand, canopy closure 30-50%	Obligate for large patches of healthy late seral ponderosa pine forest
Western Gray Squirrel		All life stages, non migratory	Oak and ponderosa pine forests	Acorns and other mast producing plants, important in winter, pine cones and seeds in summer	The core population of the western gray squirrel is currently found in the lower Klickitat drainage	Obligate for oak pine woodlands habitat. Mixed stands of oak and ponderosa pine preferred for nesting

4.2 Discussion of Focal Habitats and their Representative Focal Species

4.3 Interior Riparian Wetlands

Rationale For Selection

The Interior Riparian Wetlands wildlife habitat type was selected as a focal habitat because its protection, compared to other habitat types, may yield the greatest gains for fish and wildlife while involving the least amount of area (Knutson and Naef 1997). Riparian habitat covers a relatively small area yet it supports a higher diversity and abundance of fish and wildlife than any other habitat: it provides important fish and wildlife breeding habitat, seasonal ranges, and movement corridors; it is highly vulnerable to alteration; it has important social values, including water purification, flood control, recreation, and aesthetics; and, many species that primarily dwell in other habitat types, such as shrub steppe, depend on riparian areas during key portions of their life history. Interior Riparian Wetlands have suffered degradation and losses to hydrological function as well as fragmentation of habitat, which also fragments movement corridors for wildlife.

Description of Habitat

Historic

Since the arrival of settlers in the early 1800s, 50 to 90% of riparian wetland habitat in Washington State has been lost or extensively modified (Buss 1965). Prior to 1850, riparian habitats were found at all elevations and on all stream gradients; they were the lifeblood for most wildlife species with up to 80%of all wildlife species dependent upon these areas at some time in their lifecycle (Thomas 1979a).

These habitats are strongly influenced by stream dynamics and hydrology. Riparian forests require various flooding regimes and specific substrate conditions for reestablishment. Annual flood cycles occurred in most riparian wetland areas, although flood regimes varied among stream types. Hyporheic hydrology supported riparian wetland conditions considerable distances from perennial creek and river channels. Upwelling and downwelling groundwater dynamics created thermal conditions in wetland and spring brook areas conducive to wildlife use throughout the seasons. Fire typically influenced habitat structure in most areas, but was nearly absent in colder regions or on topographically protected streams. River meander patterns, ice and log jams, sediment dynamics and flood debris deposits provided spatial and temporal changes in habitat condition. Abundant beaver activity cropped younger cottonwoods (Black cottonwood, Populus balsamifera ssp. trichocarpa) and willows (Salix spp.), damming side channels. This activity influenced the vegetative, sediment, hyporheic and surface water dynamics creating diverse and complex habitat interactions.

In this subbasin, the density and diversity of wildlife in riparian wetland areas is also high relative to other habitat types. Riparian forest habitats are critical to the structure and function of rivers and to the fish and wildlife populations dependent upon them (Rood and Mahoney 1990). Healthy forested riparian wetland habitat has an abundance of snags and downed logs that are critical to many cavity nesting birds, mammals, reptiles and amphibians. Cottonwood, alder (Alnus spp.) and willow are commonly dominant tree species in riparian wetland areas from the

Cascades down through the valley portion of the sub basin. This habitat is often characterized by relatively dense understory and overstory vegetation. Riparian wetland habitats also function as travel corridors between, and provide connectivity to, other essential habitats (e.g., breeding, feeding, seasonal ranges).

Though riparian wetland habitats are often forested, they also contain important sub-components such as marshes and ponds that provide critical habitat for a number of wildlife species. Broad floodplain mosaics consisting of cottonwood gallery forests, shrub lands, marshes, side channels, and upland grass areas contain diverse wildlife assemblages. The importance of riparian wetland habitats is increased when adjacent habitats are of sufficient quality and quantity to provide cover for nesting, roosting, and foraging.

Riparian vegetation was restricted in the arid Intermountain West, but was nonetheless diverse. It was characterized by a mosaic of plant communities occurring at irregular intervals along streams and dominated singularly or in some combination by marshes, side channels, grass-forb associations, shrub thickets, and mature forests with tall deciduous trees. Common shrubs and trees in riparian zones included several species of willows, red-osier dogwood (*Cornus stolonifera*), alder, Wood's rose (*Rosa woodsii*), snowberry (*Symphoricarpos* spp.), currant (*Ribes* spp.), black cottonwood, water birch (*Betula occidentalis*), trembling aspen (*Populus tremuloides*), and peach-leaf willow (*Salix amygdaloides*). Herbaceous understories were very diverse, but typically included several species of sedges (*Carex* spp.) along with many dicot species. Marsh habitats contained tule (*Scirpus* spp.), common cattail (*Typha latifolia*), narrow-leaved bur-reed (*Sparganium angustifolium*), wapato (*Sagittaria latifolia*), water-plantain (*Alisma plantago-aquatica*), many species of submersed macrophytes (including sago pondweed (*Stuckenia pectinatus*), common hornwort (*Ceratophyllum demersum*), and greater bladderwort (*Utricularia vulgaris*), yellow waterlily (*Nuphar polysepalum*), and common watercress (Nasturtium officinale). Lower elevation wet meadows contained much of the vegetation found in their montane counterparts; including sedges, smartweeds (*Polygonum* spp.), spike rushes (*Scirpus* sp.), common camas (*Camassia quamash*), and wild onion (*Allium* spp.). Floodplain grasslands were dominated by great basin wild rye (*Elymus cinereus*), greasewood (*Sarcobatus vermiculatus*), and dogbane (*Apocnum* spp.).

Riparian areas have been extensively impacted within the Columbia Basin such that undisturbed riparian systems are rare (Knutson and Naef 1997). Losses in lower elevations include large areas once dominated by cottonwoods that contributed considerable structure to riparian habitats. In higher elevations, stream degradation occurred with the trapping of beaver in the early 1800s, which began the gradual unraveling of stream function that was greatly accelerated with the introduction of livestock grazing. Woody vegetation has been extensively suppressed by grazing in some areas, many of which continue to be grazed. The implications of riparian area degradation and alteration are wide ranging for bird populations, which utilize these habitats for nesting, foraging and resting. Secondary effects that have affected insect fauna have reduced or altered potential foods for birds as well.

Historic wetland acreage in this subbasin is difficult to measure. The IBIS riparian habitat data are incomplete; therefore riparian floodplain habitats are not well represented on IBIS maps. Landscape information such as that contained in floodplain maps can be consulted but was not done so for this assessment due to time constraints.

Current

Quigley and Arbelbide (1997) concluded that the cottonwood-willow cover type covers significantly less in area now than before 1900 in the Inland Pacific Northwest. The authors concluded that although riparian shrub land occupied only 2%of the landscape, they estimated it to have declined to 0.5%of the landscape. Approximately 40%of riparian shrublands occurred above 3,280 ft. in elevation pre-1900; now nearly 80%is found above that elevation.

Riparian and wetland conditions in this subbasin range from severely degraded to high quality. Roadway and development projects have constricted floodplains in some areas of the subbasin and reduced riparian wetland habitats. Riparian habitats are degraded in some places because of historical timber practices, removal of beaver, road construction, and inappropriate livestock grazing. Within the past 100 years, a large amount of this subbasin riparian wetland habitat has been altered, degraded, or destroyed. As in other areas of the Columbia Basin, impacts have been greatest at low elevations and in valleys where, agricultural conversion, road development, altered stream channel morphology, and water withdrawal have played significant roles in changing the character of streams and associated riparian areas.

Stresses

Natural systems evolve and become adapted to a particular rate of natural disturbances over long periods. Land uses alter stream channel processes and disturbance regimes that affect aquatic and riparian habitat (Montgomery and Buffington 1993). Anthropogenic-induced disturbances are often of greater magnitude and/or frequency compared to natural disturbances. These higher rates may reduce the ability of riparian and stream systems and the fish and wildlife populations to sustain themselves at the same productive level as in areas with natural rates of disturbance.

Other characteristics also make riparian wetland habitats vulnerable to degradation by human-induced disturbances. Their small size, topographic location, and linear shape make them prone to disturbances when adjacent uplands are altered. The unique microclimate of riparian and associated aquatic areas supports some vegetation, fish, and wildlife that have relatively narrow environmental tolerances. This microclimate is easily affected by vegetation removal within or adjacent to the riparian area, thereby changing the habitat suitability for sensitive species (Thomas et al. 1979a, O’Connell et al. 1993).

Factors affecting riparian wetlands in this subbasin are summarized in the paragraphs below, as well as in

Table 12. One or all of these factors has influenced riparian wetland habitat conditions throughout the subbasin in different ways depending on their location. Restoration plans for these habitats must take in to consideration the location of the habitats, the historic conditions under which they operated, the alterations that have occurred to impact their function, and the possibilities that currently exist to adequately address the stresses in a cost-effective manner.

Exclusion of the River from its Floodplain

Transportation ways (road and railroad) and levee development has restricted the floodplain in some areas. Land conversion from riparian wetland habitat to agricultural, residential, gravel mining, or recreational uses has also occurred behind the levees and roads. Riparian wetland restoration must take in to consideration the effects of restoration on lands that have been converted away from flooded habitats. Restoration priority should be given to protecting those areas that have not experienced floodplain exclusion and to areas within which floodplain reconnection is economically and culturally possible.

Alteration of Sediment Dynamics

Riparian wetland habitats are spatially and temporally dynamic. Floodplain processes creating and altering these habitats are largely dependent on cut and fill alluviation. The activities creating the altered hydrograph, the floodplain restrictions, the agricultural drainage of sediment-laden water into the waterways, the loss of green vegetation, and the reduction in woody debris have disrupted the sediment processes necessary for healthy riparian wetland conditions. Certain watersheds are experiencing increased sedimentation. Management actions often can correct alterations in sediment dynamics in localized areas. Priority should be given to projects that include the restoration of sediment processes.

Loss or Alteration of Riparian Wetland Vegetation

Vegetation loss and alteration is caused by multiple factors. All of the impacts listed above result in loss and alteration of riparian wetland vegetation communities. In areas unaffected or receiving little alteration by the factors listed above, vegetation alteration can also occur through heavy grazing or clearing. In areas that have experienced little hydrologic and landscape alteration, vegetation restoration may be as simple as reducing the grazing or vegetation removal practices. In situations where the hydrology or landscape has been altered in a significant manner, these impacts must be addressed if vegetation restoration is to be successful. Many riparian wetland vegetation reintroduction projects fail because the hydrologic impacts have not adequately been addressed. Priority should be given to projects that adequately address the reasons for vegetation loss or alteration.

Reduction in Large Woody Debris

Healthy riparian wetland habitats create large amounts of dead woody materials. Cottonwood gallery forests are famous for their ability to provide standing and downed snags. The processes mentioned above interact with this dead woody material to supply nesting and feeding opportunities for many fish and wildlife species. This material is responsible, as well, for influencing the floodplain dynamics, especially cut and fill alluviation, necessary for riparian wetland and cottonwood forest health. As cottonwood stands age, the large dead material produced will collect sediment, block side channels, and force the establishment of new channels. The new channels will create exposed gravel and sediment conditions upon which new cottonwood trees will become established. The result is a diverse mosaic of cottonwood stands of different ages within a floodplain area. Restoration of large woody debris, then, is dependent on the restoration of healthy cottonwood stands. This activity requires floodplain areas large enough to provide space for cottonwood stands of various ages. Restoration areas too small may experience declines in the health of the cottonwood forests as they age and are not replaced with new stands. Restoration priority should be given to projects large enough to provide sufficient floodplain conditions conducive to the continued development of healthy cottonwood forests.

Reduction of Beaver Activity

American beaver were central to the maintenance of healthy riparian wetland habitats. Their abundant activity created flooded conditions throughout the subbasin. A testimony to their abundance is reflected in the fact that the Pacific Northwest was revered for its fur trade. Extensive trapping is routinely listed as a major factor in their decline. Healthy beaver populations, however, are returning to many restoration areas in the lower portions of this subbasin. Beaver damage complaints often will increase in areas adjacent to restoration projects. Restoration managers must be prepared to address these affects if projects are to succeed in the long term. Priority should be given to projects that address the factors necessary to support healthy populations of beavers and to address the unintended impacts to adjacent lands.

Increase in Invasive Non-Native Vegetation

This subbasin is in no means an isolated area. Global markets and economies cause human interactions unheard of a century ago. Because of this, the introduction of vegetation from exotic locals increases every year. Habitat conversion in the intensively developed irrigated agricultural portions of the subbasin compounds the effects of these introductions. Weed management is becoming an increasingly important component of riparian wetland restoration and management. A list of noxious weed species occurring in this subbasin is included in Appendix D, table D.4.

To combat these invasive species, techniques must be used that fit the situation within which they are arising. A comprehensive, integrated approach to pest management involves many tools. One such tool is to restore current habitat conditions as close as possible to historic conditions. Restoring native plant species and habitat conditions often provides the best defense against infestation by exotic vegetation. Intensive weed control may be necessary to reestablish these native communities. Weeds are much more pervasive in the lower portions of the subbasin, but are increasing in the upper basin as well. Restoration projects should include, and give priority to activities that include credible, integrated plans to address exotic vegetation issues.

Human Disturbance

Fish and wildlife populations need habitats relatively free of human activity. The best habitat will not provide the needs of wildlife if the level of human disturbance is high. Restoration areas must balance the needs of the fish and wildlife with the needs of the local communities. Priority should be given to projects adequately addressing human disturbance issues.

Reduction in Anadromous Fish Populations

Many native wildlife species and habitats in this subbasin were dependent on the constant energy sources brought up from the ocean by the large anadromous fish runs. The loss of these fish runs caused a large reduction in energy entering the system, altering wildlife population dynamics.

Priority should be given to riparian wetland restoration activities that emphasize anadromous fish as well as wildlife benefits that promote an increase in the inter-specific interactions.

Table 12 Summary of potential effects of various land uses on riparian wetland habitat elements needed by fish and wildlife (Knutson and Naef 1997)

Potential Changes in Riparian Elements Needed by Fish and Wildlife	**Land Use**						
	Forest Practices	**Agri-culture**	**Unmanaged Grazing**	**Urban-ization**	**Dams**	**Recreation**	**Roads**
Riparian Habitat							
Altered microclimate	X	X	X	X		X	X
Reduction of large woody debris	X	X	X	X	X	X	X
Habitat loss/fragmentation	X	X	X	X	X	X	X
Removal of riparian vegetation	X	X	X	X	X	X	X
Reduction of vegetation regeneration	X	X	X	X	X	X	X
Soil compaction/ deformation	X	X	X	X		X	X
Loss of habitat connectivity	X	X	X	X		X	X
Reduction of structural and functional diversity	X	X	X	X		X	X
Stream Banks and Channel							
Stream channel scouring	X	X	X	X		X	X
Increased stream bank erosion	X	X	X	X	X	X	X
Stream channel changes (e.g., width and depth)	X	X	X	X	X	X	X
Stream channelization (straightening)	X	X		X			
Loss of fish passage	X	X	X	X	X		X
Loss of large woody debris	X	X	X	X	X	X	X
Reduction of structural and functional diversity	X	X	X	X	X		X
Hydrology and Water Quality							
Changes in basin hydrology	X	X		X	X		X
Reduced water velocity	X	X	X	X	X		
Increased surface water flows	X	X	X	X		X	X
Reduction of water storage capacity	X	X	X	X			X
Water withdrawal		X		X	X	X	
Increased sedimentation	X	X	X	X	X	X	X
Increased stream temperatures	X	X	X	X	X	X	X
Water contamination	X	X	X	X		X	X

4.3.1 Yellow Warbler (*Dendroica petechia*)

Rationale for Selection

The yellow warbler is a common native species strongly associated with riparian and wet deciduous habitats. The yellow warbler is a good indicator of functional subcanopy/shrub habitats in riparian areas. It is a locally common breeder along rivers and creeks in the Columbia Basin, where it is declining in some areas. Yellow Warblers are HEP species and occur on the Oregon PIF list. For these reasons, they were chosen as a focal species for the Interior Riparian Wetlands wildlife habitat.

Key Life History Strategies: Relationship to Habitat

Summary

Partners in Flight (PIF) established the following biological objectives for this species in the lowlands of eastern Oregon and eastern Washington (Altman 2001):

- >70%cover in total cover {shrub (<3 m, 10 ft) and subcanopy (>3m, 10 ft) layers};
- Subcanopy layer contributing >40%of the total cover;
- Shrub layer cover 30-60%of total cover (includes shrubs and small saplings), height > 2m (6.5 ft;
- >70% cover should be native species, and
- Edge and small patch size (heterogeneity)

General

The yellow warbler is a riparian obligate species most strongly associated with wetland habitats and deciduous tree cover and is a good indicator of functional subcanopy/shrub habitats in riparian areas.

Yellow warbler abundance is positively associated with deciduous tree basal area, and bare ground. Abundance is negatively associated with mean canopy cover of Douglas-fir (Pseudotsuga menziesii), Oregon grape (*Berberis nervosa*), swordfern (*Polystuchum munitum*), blackberry (*Rubus discolor*), hazel (*Corylus cornuta*), and oceanspray (*Holodiscus discolor*) (Rolph 1998).

At the landscape level, the biological objectives for habitat included high degree of deciduous riparian heterogeneity within or among wetland, shrub, and woodland patches, and a low %age of agricultural land use (Altman 2001). Their habitat suitability index strongly associates them with a dense deciduous shrub layer 1.5-4 m. (5-13.3 feet), with edge, and small patch size (heterogeneity). Other suitability index associations include percent of deciduous shrub canopy comprised of hydrophytic shrubs (wetlands dominated by shrubs had the highest average of breeding densities of 2males/ha) and deciduous tree basal area (abundance is positively associated).

Negative associations are closed canopy and cottonwood proximity. Some nests have been found in cottonwood, but more often in shrubs with an average nest height of 0.9-2.4 m., maximum being 9-12 m. (Schroeder 1982).

Nesting

They are a common breeder in hardwood trees throughout Washington and Oregon at lower elevations. Breeding yellow warblers are closely associated with riparian trees, specifically willows, alders, aspen, or cottonwoods (Marshall et al. 2003). In Klickitat County, they are mostly confined to relatively dense riparian vegetation (Manuwal 1989). Optimal nesting habitat for the yellow warbler is provided in wet areas with dense, moderately tall stand of hydrophytic deciduous shrubs (Schroeder 1982).

Diet and foraging

The yellow warbler feeds mainly on insects. They are known to eat caterpillars, cankerworms, gypsy moths, bettles, and aphids, but the type and proportion of insects varies depending on location (Stokes 1996, Marshall et al. 2003).

Population Status and Trend

Core zones of distribution in Washington are the forested zones below the subalpine fir (*Abies lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*) zones, plus steppe zones other than the central arid steppe and canyon grassland zones, which are peripheral. In Oregon, the yellow warbler is a common to abundant breeder on the east slope of the Cascades and in the Blue and Wallowa mountains below 5,000 feet (1,524 m). In other areas east of the Cascades, including the Columbia Plateau, they are common along watercourses, or to a lesser extent, in residential areas (Marshall et al. 2003).

Within the Washington State, yellow warblers are apparently secure and are not of conservation concern (figure 9). Information from Breeding Bird Surveys indicates that the population is stable in most areas. However, yellow warblers have shown population declines in various regions during well-defined time periods. Because the Breeding Bird Survey dates back only about 30 years, population declines in Washington resulting from habitat loss prior to the survey would not be accounted for by that effort.

In Oregon, Gabrielson and Jewett (1940) listed the yellow warbler as an “abundant summer resident throughout state” and common in every county. More recent Breeding Bird Surveys confirm an average population decline of 1.7% statewide between 1966-2000. A likely cause is the loss of riparian habitat to grazing and conversion to agriculture (Marshall et al. 2003). Most (>94%) of the riparian wetland habitat in the Umatilla/Willow subbasin is estimated to be under no or low protected status. Strategies aimed at increasing protection and enhancement by working with private landowners should be emphasized.

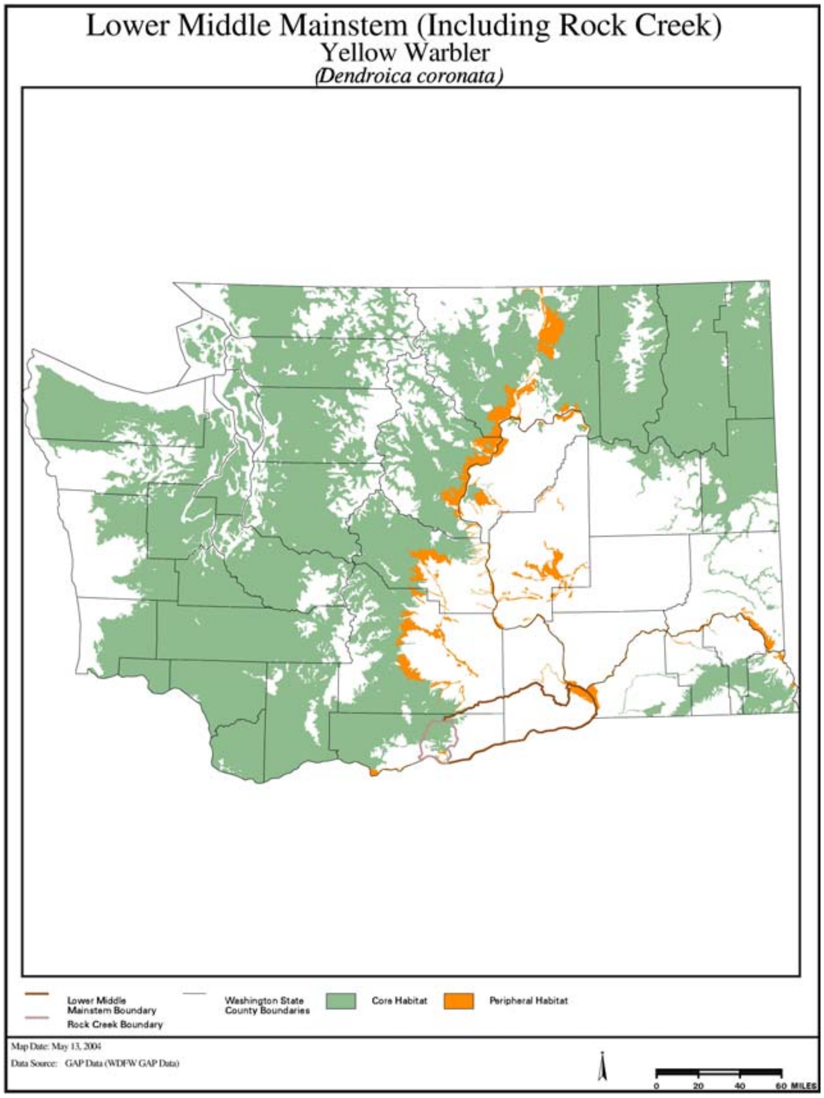


Figure 7 Potential habitat for yellow warblers in the Lower Mid-Columbia Mainstem (including Rock Creek) and Washington State (Smith et al. 1997)

They are most abundant in riparian areas in the lowlands of eastern Washington and Oregon. Numbers decline in the center of the Columbia Basin, but this species can be found commonly along most rivers and creeks at the margins of the Basin.

Management Issues

No specific yellow warbler management issues were identified in this subbasin.

Out-of-Subbasin Effects and Assumptions

The yellow warbler is a long-distance Neotropical migrant. Spring migrants begin to arrive in the Columbia River Basin in April; dates of 2 April and 10 April have been reported from Oregon and British Columbia, respectively (Gilligan et al. 1994, Campbell et al. in press). The peak of spring migration in the Lower Mid-Columbia mainstem occurs in mid- to late May (Marshall et al. 2003, Gilligan et al. 1994).

Fall migration is somewhat inconspicuous for the yellow warbler. Southward migration begins in late July (Oregon) and early August (Washington), and peaks in late August to early September; very few migrants remain in the region by late September and October (Marshall et al. 2003, Lowther et al. 1999). The yellow warbler winters from southern California, southwest Arizona, northern Mexico and the Bahamas south through Middle and South America to Peru, Bolivia and Brazil (Marshall et al. 2003).

In Yakima County, earliest arrival dates are in late April with most breeders present by mid- to late-May; by late July/early August numbers begin to decline and by early September most yellow warblers have migrated out of the county (Stepniewski 1998).

Poor riparian habitat and increased pesticide use are two negative effects Yellow Warblers may encounter as they migrate. Increased pesticide use in the metropolitan areas, especially with the outbreak of mosquito born viruses like West Nile Virus, may impact food availability.

Relationship with Riparian/Fisheries Issues

Healthy riparian vegetation is important to yellow warbler, and to other terrestrial and aquatic species as well. Riparian vegetation helps stabilize stream banks, reducing sedimentation input in the stream. Riparian vegetation also shades the stream keeping stream temperatures stable. The trees that yellow warbler need for nesting provide large woody debris when they die, increasing refugia for fish and other aquatic vertebrates and invertebrates. Riparian restoration that improves habitat for yellow warblers will also improve riparian aquatic and terrestrial habitat for other species including fish.

Factors Affecting Population

Habitat loss

Hydrological diversions and control of natural flooding regimes (e.g., dams), inundation from impoundments, cutting and spraying riparian woody vegetation for water access, gravel mining, and urban development have negatively affected yellow warblers in the subbasin.

Vegetation and Habitat degradation

Degradation of riparian habitat includes: loss of vertical stratification of riparian vegetation, lack of recruitment of young cottonwoods, ash (Sorbus spp.), willows, and other subcanopy species; stream bank stabilization which narrows stream channels, reduces the flood zone, and reduces extent of riparian vegetation; invasion of exotic species such as reed canary grass (Phalaris arundinacea) and blackberry; inappropriate grazing which can reduce understory cover; reductions in riparian corridor widths which may decrease suitability of the habitat and may increase encroachment of nest predators and nest parasites.

Presence of Development

Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird, *Molothrus ater*) and domestic predators (cats), and be subject to high levels of human disturbance.

Recreational Disturbance

Recreational disturbances during nesting season, particularly in high-use recreation areas, may contribute towards nest abandonment.

Pesticide and Herbicide Use

The use of pesticides and herbicides associated with agricultural practices may reduce the warbler's insect food base.

4.3.2 American Beaver (*Castor canadensis*)

Rationale for Selection

American Beavers are an indicator of healthy riparian systems. Beavers are dependent on permanent riparian systems with consistent year round stream flow rates, adequate stream-side an in-stream vegetation and presence of in-stream downed woody debris. Beavers are also an important tool in maintaining and repairing properly functioning riparian systems. Because of their strong relationship with healthy riparian systems, they were chosen as a focal species for the Interior Riparian Wetlands wildlife habitat.

Summary

Recommended habitat objectives include the following:

- Permanent source of water (Slough and Sadleir 1977).
- Ability to build lodges:
- Mild or no annual or seasonal water level fluctuations (Murray 1961, Slough and Sadleir 1977),
- Slow water flow (Collins 1976b),
- Low stream channel gradient (Slough and Sadleir 1977, Williams 1965):
- Stream channel gradients of 6%or less have optimum value as beaver habitat; streams of 15%or more are uninhabitable (Retzer et al. 1956).
- Presence of food source:
- Herbaceous plants include aspen, willow, cottonwood, alder) (Denney 1952) and aquatic vegetation (Collins 1976a),
- Woody stems cut by beavers are usually less than 7.6 to 10.1 cm (3 to 4 inches) dbh (Bradt 1947, Hodgdon and Hunt 1953, Longley and Moyle 1963, Nixon and Ely 1969).

General

All wetland cover types (e.g., herbaceous wetland and deciduous forested wetland) must have a permanent source of surface water with little or no fluctuation in order to provide suitable beaver habitat (Slough and Sadleir 1977). Water provides cover for the feeding and reproductive activities of the beaver.

Lodge Building

Lodges and/ or burrows are built by beavers for cover (Rue 1964). Lodges may be surrounded by water or constructed against a bank or over the entrance to a bank burrow. Water protects the lodges from predators and provides concealment for the beaver when traveling to and from food gathering areas and caches.

The lodge is the major source of escape, resting, thermal, and reproductive cover (Jenkins and Busher 1979). Mud and debarked tree stems and limbs are the major materials used in lodge construction although lesser amounts of other woody, as well as herbaceous vegetation, may be used (Rue 1964). On lakes and ponds, lodges are frequently situated in areas that provide shelter from wind, wave, and ice action.

For beavers to build dams, there must be a low seasonal and annual water level fluctuations, slow water flow and a low stream channel gradient. In the lower mid-Columbia mainstem embayments are of special importance to beaver (and muskrats) because of the reduced water fluctuations. (Embayments are shallow water habitats typically connected to the mainstem Columbia River via culverts or small channels; water fluctuates less in most empayments than in the river because of culvert or inlet channel elevations. The magnitude of waves is also relatively low.)

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 14%or more, will have little year-round value as beaver habitat.

Diet and Foraging

Assuming that there is an adequate food source available, small lakes [< 8 ha (20 acres) in surface area] are assumed to provide suitable habitat. Large lakes and reservoirs [> 8 ha (20 acres) in surface area] must have irregular shorelines (e.g., bays, coves, and inlets) in order to provide optimum habitat for beaver.

Various factors, including the poor placement, construction and maintenance of road systems in the subbasin, have contributed to changes in stream channel morphology. Stream channels have become incised, secondary channels have been lost, and beaver access to floodplains has been reduced. These factors contribute and relate to a decline in the recruitment of aspen and cottonwood, both food sources for beaver. The loss of wetlands is an additional factor limiting beaver populations.

An adequate and accessible supply of food must be present for the establishment of a beaver colony (Slough and Sadleir 1977). The actual biomass of herbaceous vegetation will probably not limit the potential of an area to support a beaver colony (Boyce 1981). However, total biomass of winter food cache plants (woody plants) may be limiting. Low marshy areas and streams flowing in and out of lakes allow the channelization and damming of water, allowing access to, and transportation of, food materials. Steep topography prevents the establishment of a food transportation system (Williams 1965, Slough and Sadleir 1977).

Population Status and Trend

The American beaver is widespread in the Columbia Basin and can be found in suitable habitats throughout Washington (Verts and Carraway 1998) and Oregon (Johnson and O'Neill 2001). It is almost always associated with riparian or lacustrine habitats bordered by a zone of trees, especially cottonwood and aspen (*Populus*), willow (*Salix*), alder (*Alnus*), and maple (*Acer*) (Verts and Carraway 1998). Small streams with a constant flow of water that meander through relatively flat terrain in fertile valleys and are subject to being dammed seem especially productive of beavers (Hill 1982). Beaver distribution occurs from the Columbia River to mid-elevation forested regions (Kirsch, pers. comm., 2001).

Because of the high commercial value of their pelts, beavers figured importantly in the early exploration and settlement of western North America. Thousands of their pelts were harvested annually, and it was not many years before beavers were either exterminated entirely or reduced to very low populations over a considerable part of their former range. By 1910 their populations were so low everywhere in the United States that strict regulation of the harvest or complete protection became imperative. In the 1930s live trapping and restocking of depleted areas became a widespread practice which, when coupled with adequate protection, has made it possible for the animals to make a remarkable comeback in many sections (see map of current habitat and locations,**Figure 4**). Currently, the American beaver is a managed game species.

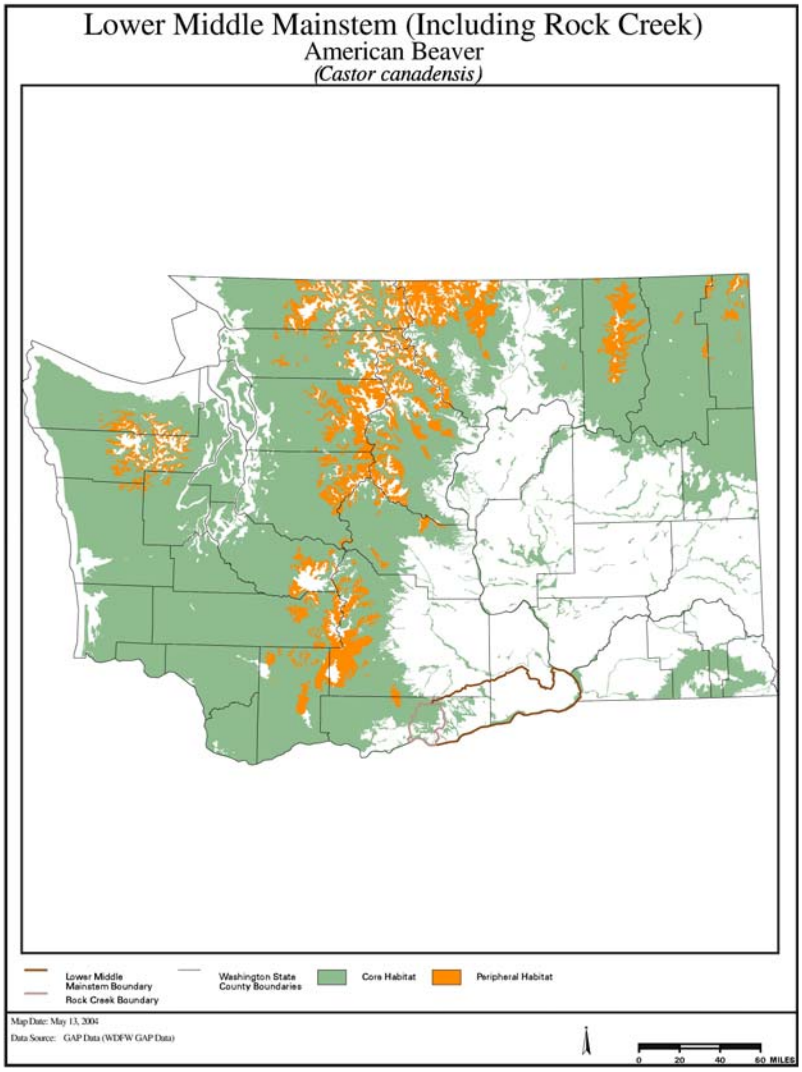


Figure 8 Potential habitat for American beavers in the lower mid-Columbia mainstem (including Rock Creek) and Washington (Johnson and Cassidy 1997)

Management Issues

Trapping removed almost all of the beaver from the subbasin. Once this happened, they were no longer available to provide activities necessary to maintain the early-successional habitats on which they depend. Without beaver, a cycle is broken and important ecosystem and riparian/wetland functions are lost. In upland riparian habitats, beavers are unable to re-colonize the area with restoration and management efforts.

Transplants do occur of “problem” beaver from lower elevation riparian areas to higher elevation riparian areas. Little documentation is available on when this occurs and whether transplanted beaver have been successful in living in their new locations. Research and organization of these transplants would be valuable. Transplanting beaver could also be used to assess the quality of riparian restoration efforts, as well as act as a tool in speeding up restoration efforts.

There are many other human activities that have implications to both beavers and their habitat (Cederholm et al. 2000). Some examples include timber activities, presence of roads and cattle grazing. Timber activities can fragment wildlife habitat. It can also decrease woody debris available to streams and increase sedimentation. High amounts of sediment can increase water temperature, making streams unsuitable for fish, amphibian and aquatic macroinvertebrate species. Roads fragment habitat and creating barriers to migrating species. Roads can also cause sediment increase and edge degradation. Grazing both degrades terrestrial and aquatic vegetation, impacting both wildlife and fish.

The American Beaver is a managed fur-bearing species in Oregon. ODFW’s American Beaver Management Plan provides guidance for managing this species in the subbasin.

Relationship with Riparian/Fisheries Issues

Beavers have long co-existed with salmon (*Oncorhynchus* spp.) in the Pacific Northwest, and have had an important ecological relationship with salmon populations (Cederholm et al. 2000). The beaver created and maintained a series of beneficial aquatic conditions in many headwater streams, wetland, and riparian systems, which serves as juvenile salmon rearing habitat. Beavers have multiple effects on water bodies and riparian ecosystems that include altering hydrology, channel morphology, biochemical pathways, and stream productivity. This function, however, has been severely altered by people. It is difficult to imagine the amount of influence beavers have had on the landscapes, most Pacific Northwest streams had been void of beaver activity for many decades before ecologists had the opportunity to study them.

Beavers are extremely important in contributing to large woody debris, which is a critical structural component in streams. Large woody debris provides important structural complexity as well as vital nutrients to streams. Large woody debris and beaver dams decreases stream velocity and temperature. It also provides refugia to migrating fish.

Beaver dams can obstruct channels and redirect channel flow and the flooding of stream banks and side channels (Cederholm et al. 2000). Damming streams and creating ponds, beavers create habitats for aquatic species and raise water tables, resulting in wetlands (Johnson and O’Neill 2001). By ponding water, beaver dams create enhanced rearing and over-wintering habitat that protect juvenile salmon during high flow conditions. Beaver dams are often found associated with riverine ponds called “wall-base channels” along main river flood plains, and these habitats are used heavily by juvenile coho salmon (*Oncorhynchus kisutch*) and cutthroat trout (*Oncorhynchus clarki*) during the winter.

Factors Affecting the Population

Habitat Loss and Fragmentation

The lack of habitat and the loss of proper ecosystem and riparian functioning have hindered the natural re-colonization of beaver in this subbasin. Multiple factors have influenced the loss of habitat and riparian processes. The poor placement, construction, and maintenance of road systems in the subbasin, have contributed to changes in stream channel morphology. Stream channels have become incised, secondary channels have been lost, and beaver access to floodplains has been reduced. Beaver have also suffered high mortaliy from being hit by trains and cars because of the proximity of highways and railroads to the shoreline of the Columbia River.

Water fluctuations, waves, the inundation of habitat, and the alternating flooding and exposing of dens from hydropower development and operation also decreases beaver production. Only 19 of 43 den sites surveyed by Tabor et al. (1981) between The Dalles and Priest Rapids dams were considered suitable if predicted dam operations were achieved.

Food availability

Availability of food is a limiting factor. Degradation of streams contributes and relates to a decline in the recruitment of aspen and cottonwood. In winter, the amount of available winter food cache plants (woody plants) may be limiting (Boyce 1981). At lower elevations, riparian habitat along some waterways has been removed to plant agricultural crops, which removes important habitat and food sources for beaver.

Dam removal

Beavers create dams that restrict fish passage. These dams are then removed to restore fish passage.

Trapping

Historically, trapping removed beavers from the subbasin, resulting in the alteration of their riparian/wetland habitats. Currently, the American beaver is a managed game species.

4.3.3 Lewis' Woodpecker (*Melanerpes lewis*)

Rationale for Selection

The Lewis' woodpecker is listed as a species of concern in Washington State, a sensitive species in the state of Oregon, and is on the Oregon Partners in Flight list. They are considered to be an indicator of healthy cottonwood forest systems, and therefore are a focal species for the Interior Riparian Wetland wildlife focal habitat.

Key Life History Strategies: Relationship to Habitat

Summary

Recommended habitat objectives for Lewis' woodpecker in Interior Riparian Wetland habitat include the following:

- Adequate numbers of snags (1 or more of adequate size);
- Diameter at breast height (dbh) ≥ 30 cm (Thomas et al. 1979b);
- Optimal height ≥ 9.1 m (Thomas et al. 1979b), range used 1.5-51 m (Bock 1970);
- Tree canopy closure ≤ 30%(closure exceeding 75%is unsuitable), and
- Understory cover ≥ 50 %, not as vital in riparian habitats.

General

Lewis' Woodpecker typically inhabits dry open woods, orchards, farmlands, and foothills (Stokes 1996). Drought and overgrazing pose continued threats to riparian habitats in arid regions (Stokes 1996, Ehrlich et al. 1992).

Nesting

Lewis' woodpeckers prefer an open woodland canopy and large-diameter dead or dying trees. Tree species often used include ponderosa pine, cottonwood, Oregon white oak, juniper (*Juniperus* spp.), willow, and paper birch (*Betula papyrifera*). Of 53 nests found on the eastern edge of Mt. Hood, Oregon in 1989, the mean dbh of nest trees was 26 in (66cm) with a range of 12.5-43 in (31.8-109 cm), and the mean height of nest trees was 41 ft. (12.5 m) with a range of 10-100 ft (3-30 m) (Galen 1989).

At lower elevations, breeding habitat is provided by riparian cottonwood groves (Bock, pers. comm.). Riparian woodlands have been identified as important nesting habitat for Lewis' woodpeckers (Saab and Vierling 2001). Suitable conditions for breeding in these habitats are provided by the same structural features important in ponderosa pine forests, except that shrub cover is apparently not a critical habitat feature. Vierling (1997) found that Lewis' woodpecker nest in dead or decaying cottonwoods (*Populus deltoids*, not found in Washington) and located their nest holes an average of 11.1 m high in riparian habitat in Colorado. Nest trees selected are often taller and larger in diameter than surrounding trees not used for nesting (Vierling 1997).

Lewis' woodpeckers are considered weak excavators and rarely excavate their own nest cavity. They prefer to use nest holes previously excavated by other woodpeckers (Marshall et al. 2003) or to excavate nest cavities in soft snags or dead trees (Lewis et al. 2002).

Diet and Foraging

Lewis' Woodpeckers feed opportunistically on bountiful, convenient supplies of insects during spring and summer and on acorns and fruits during fall and winter. Their diet inclues crickets, ants, grasshoppers, flies, wasps, beetles, nuts, berries and orchard fruits (Marshall et al. 2003, Stokes 1996).

In deciduous cover types, the presence of shrubs is considered to add to the food value, but will not be limiting to food suitability. Although the reasons for such a difference in the importance of shrubs is unclear, it may be due to different feeding strategies in coniferous and burned habitats compared to riparian and oak habitats.

Population Status and Trend

Status

The current overall distribution in Oregon has not changed from historical patterns, but has become more spotty due to habitat deterioration. It is only common year round in the white oak-ponderosa pine belt east of Mt. Hood. It also breeds in low numbers in open habitat along eastern Oregon river and stream valleys (Marsahll et al. 2003). Lewis' woodpecker is present year round in the Columbia Basin, but is uncommon (ODFW 1993). It is a confirmed breeder in the southwest corners of Sherman and Gilliam counties and is possibly breeding in other portions of these counties (Marshall et al. 2003).

The Lewis' woodpecker has been included in the Audubon Society's Blue List since 1975 (Tate 1981). The list is intended as an early warning list of species exhibiting noncyclical population declines or range contractions. Competition for nest sites from starlings (*Sturnus vulgaris*) may be a possible cause of the decline. Along the Klickitat River, a nesting pair was found near milepost 11 on SR 142 just west of the river (Manuwal 1989).

Trends

According to the Interior Columbia Basin Ecosystem Management Project (ICBEMP), terrestrial vertebrate habitat analyses, historical source habitats for Lewis' woodpecker occurred in most watersheds of the three ERUs within our planning unit (Wisdom et al. in press). Within this core of historical habitat, declines in source habitats have been strongly reduced from historical levels, including 97% in the Columbia Plateau. Within the entire Interior Columbia Basin, overall decline in source habitats for this species was the greatest among 91 species of vertebrates analyzed (Wisdom et al. in press).

Lewis' woodpecker populations tend to be scattered and irregular and are considered rare, uncommon, or irregularly common throughout their range (see **Figure 9** for range in Washington State); local abundance may be cyclical or irregular (Tobalske 1997). Based on North American Breeding Bird Survey (BBS) data, numbers in the U.S. may have declined more than 60%overall between the 1960s and mid-1990s (Tobalske 1997). BBS data indicate a significant decline in the United States for the period 1966-1996 (-3.3%average annual decrease; P = 0.01; N = 62 survey routes) and a nonsignificant declining trend between 1980 and 1996 (-1.7 %; P = 0.22; N = 53). Thirty-year trends were negative but not statistically significant survey-wide and for the Western BBS Region and California; likewise trends were positive but not statistically significant for these analysis areas from 1980 to 1996. Mapped trends for 1966-1996 show steep declines throughout the range. Overall, however, BBS sample sizes are relatively low for robust trend analysis (Sauer et al. 1997).

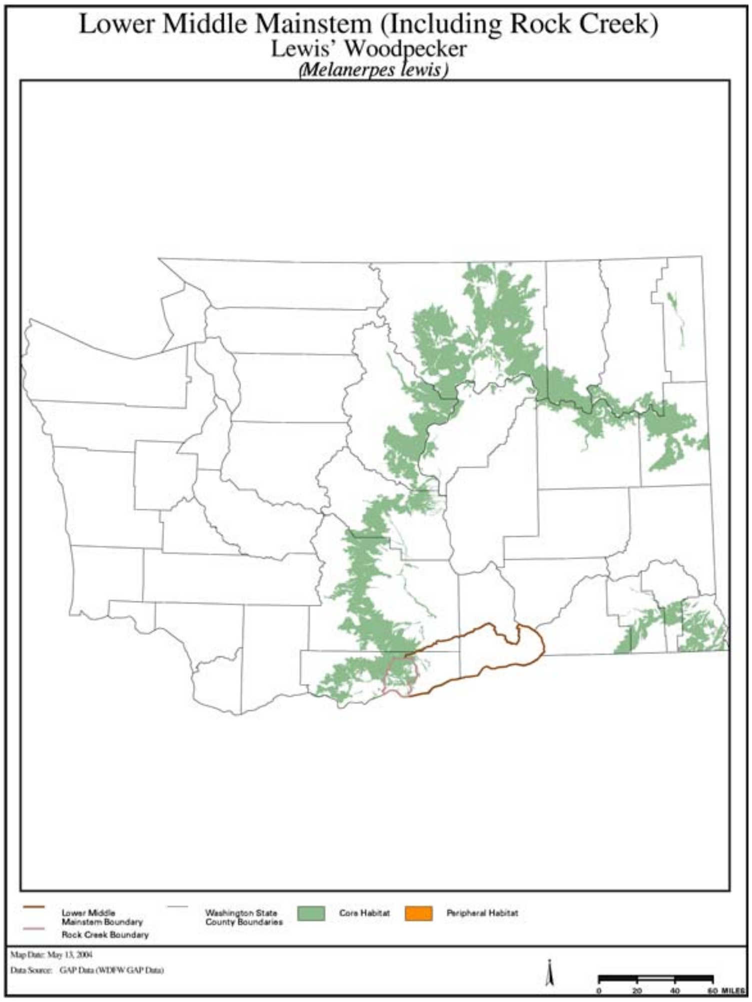


Figure 9 Potential habitat for Lewis' woodpecker in the Lower Mid-Columbia Mainstem subbasin and Washington (including Rock Creek) (Smith et al. 1997)

Oregon has also experienced a substantial decrease in Lewis' woodpecker since the mid-1960s. The decrease has been attributed to the destruction of lowland oak habitat and competition with the European Starling (Marshall et al. 2003).

Lewis's woodpeckers appear to be common near Lyle, Washington, based on annual Christmas Bird Counts (CBCs) of 61 birds from 1997 to 2001. In the Columbia Hills-Klickitat Valley CBC circle, a mean of 19/year were counted between 1996 and 2001. Although numbers were highly variable in both counts, there were no apparent decreases in populations during the time period that surveys were conducted (Hansen 2002).

Relationship with Riparian/Fisheries Issues

Healthy riparian vegetation is important to Lewis' woodpecker, and to other terrestrial and aquatic species as well. Riparian vegetation helps stabilize stream banks, reducing sedimentation input in the stream. Riparian vegetation also shades the stream keeping stream temperatures stable. The trees that Lewis' woodpecker need for nesting provide large woody debris when they die, increasing refugia for fish and other aquatic vertebrates and invertebrates. Riparian restoration that improves habitat for Lewis' woodpecker will also improve riparian aquatic and terrestrial habitat for other species including fish.

Out-of-Subbasin Effects and Assumptions

The Lewis's woodpecker is highly migratory during the non-breeding season. The bird winters in milder locations extending from northern Oregon south to northern Mexico and west Texas. In Oregon, it winters in oak savannah east of Mt. Hood, the upper Rogue River valley, and along Bear Creek near Medford. Winter populations are highly dependent on acorns and often migrate in large numbers to locations with acorn crops (Marshall et al. 2003).

Large mature cottonwoods, as for breeding habitat, are important for winter activities (Vierling 1997). Because the habitat needs of Lewis' woodpeckers are more specialized in winter than during the breeding season, destruction of winter range represents a greater potential threat to the species than loss of breeding habitat (Bock, pers. comm.).

Factors Limiting Population

Alteration of Hydrology

Alteration of stream flows from their natural state has virtually eliminated the natural reproduction of cottonwoods in eastern Washington. Cottonwoods require just the right combination of exposed streambed and moisture conditions for their seeds to germinate. Regulation of water levels for irrigation, fish production, and flood control limits these conditions, thereby almost eliminating germination. Without the incorporation of new trees, many cottonwoods continue to age and die with little or no recruitment to replace them. Thus, nest sites for Lewis' woodpeckers within low elevation riparian habitat will continue to decline overtime.

Land Conversion and Development

Lewis woodpecker habitat continues to be lost to ongoing urban, rural, and agriculture development which often occurs in or near riparian areas. Human development also favors the proliferation of exotic species and aggravates inter-species relationships. The Lewis woodpecker experiences heavy competition for nest sites with European Starlings. In the Columbia Basin, over 50% of the land inhabited by Lewis' woodpecker is privately owned (ODFW 1993), suggesting that strategies should emphasize increased protection and enhancement by working with private landowners.

Inappropriate Grazing

Grazing, although historically common within riparian areas of the intermountain west, may reduce the grass and forb components of riparian habitats. This may reduce populations of insect prey depended on by Lewis' woodpeckers during the breeding season.

4.3.4 Interior Riparian Wetlands Key Findings, Limiting Factors, and Working Hypotheses

Table 13 Key findings, limiting factors and working hypotheses for the Interior Riparian Wetlands focal habitat and its representative focal species

INTERIOR RIPARIAN WETLANDS HABITAT		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Habitat has suffered degradation and loss of hydrological function.	Overall Loss of Riparian Vegetation	Properly managed grazing in riparian areas will help reduce the damage to riparian understory vegetation, which will in turn avoid the narrowing of stream channels and reverse increases in water temperature.
	Reduction in Floodplain Acreage	In riparian habitat, restoring habitat on abandoned roads or railroads and relocating problematic roads would allow for wider floodplain zones, decrease stream bank erosion, decrease sediment, and decrease disturbance to nesting species.
	Displacement of Native Riparian Vegetation with Non-native Vegetation	Reduction of acres dominated by invasive non-native plant species will help improve riparian habitat conditions for focal species and overall riparian habitat viability.
	Incised Stream Reaches	Restoring stream channels in selected reaches will allow for hydrologic reconnection into wetland habitats.
	Upper Watershed Hydrologic Alteration	Appropriate silvicultural practices that maintain and enhance riparian habitat will decrease sediment discharge and maintain bank stabilization.
	Loss of Stream Complexity and Increased Flows	Appropriate silvicultural practices that maintain and enhance riparian habitat will increase presence of large woody debris in streams. This will increase both fish and wildlife focal species presence and population sizes.
Habitat has suffered loss and fragmentation, removing corridors necessary for wildlife movement.	Loss of Riparian Habitat and Function	Restoring and maintaining riparian habitat will provide corridors used by wildlife as well as habitat and forage. This will also retain water storage availability of riparian terrestrial habitat for release in drier seasons.
	Fragmentation of Habitat	
INTERIOR RIPARIAN WETLANDS FOCAL SPECIES		
Yellow Warbler		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Habitat loss and degradation has negatively affected yellow warblers in the subbasin.	Reduction in Floodplain Acreage	Identifying critical habitat, inventorying habitat remaining in Washington and Oregon, and monitoring habitat changes, both locally and at a landscape level, will increase the

INTERIOR RIPARIAN WETLANDS HABITAT		
Key Findings	**Limiting Factors**	**Working Hypotheses**
	Overall Habitat Loss	effectiveness future management and protection of yellow warblers and reduce loss of habitat due to limiting factors.
	Fragmentation of Habitat	
	Reduced Base	Decrease misuse of herbicides and pesticides in riparian areas will decrease mortality of food base of key species.
American Beaver		
Key Findings	**Limiting Factors**	**Working Hypotheses**
American Beavers are unable to reestablish into many historical locations due to habitat fragmentation, loss and degradation.	Fragmentation of Habitat	Reestablishing corridors of movement would help enable beaver to reestablish themselves in historical locations.
	Overall Loss of Riparian Vegetation	Restoration of riparian vegetation would increase food availability and quality for beaver, increasing survivorship and reestablishment efforts.
American Beavers have disappeared throughout many riparian systems they were once found in due to historical trapping for their pelts.	Reduction in Floodplain Acreage	Increasing beaver presence to historic level would help restore hydrological function to floodplains.
Lewis' Woodpecker		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Loss of large cottonwoods and cottonwood recruitment along riparian edges has decreased nesting sites for Lewis' woodpecker	Reduction in Floodplain Acreage	Restoration efforts that repair natural stream hydrology will increase recruitment of cottonwoods in riparian habitat and increase available breeding locations for Lewis' woodpecker.
Riparian habitat degradation and fragmentation has decreased presence and numbers of Lewis' woodpeckers in their historical range.	Fragmentation of Habitat	Decreasing fragmentation of riparian habitat by decreasing future conversion of riparian habitat will preserve habitat currently used by Lewis' woodpecker.
	Overall Loss of Riparian Vegetation	Properly managed grazing will decrease loss of native understory and prey base for Lewis' woodpecker increasing breeding success and hatchling survivorship.
	Reduced Food Base	Decrease misuse of herbicides and pesticides in riparian areas will decrease mortality of food base of key species.

4.4 Shrub Steppe/Interior Grasslands

Rationale for Selection

Shrub steppe and interior grasslands were selected as a focal habitat because changes in land use over the past century have resulted in the loss of over half of these once expansive habitat types in eastern Washington and Oregon. Adequate mapping data illustrating where these two types exist within the subbasin does not exist. Therefore, the interior grassland type was combined with the shrub steppe type into the Shrub Steppe/Interior Grassland wildlife focal habitat for this plan.

Shrub Steppe

Shrub-steppe habitats are common across the Columbia Plateau of Washington and Oregon. It extends up into the cold, dry environments of surrounding mountains. Basin big sagebrush shrub-steppe occurs along stream channels, in valley bottoms and flats throughout eastern Oregon and Washington. Wyoming sagebrush shrub-steppe is the most widespread habitat in eastern Oregon and Washington, occurring throughout the Columbia Plateau and the northern Great Basin. Mountain big sagebrush shrub-steppe habitat occurs throughout the mountains of the eastern Oregon and Washington. Interior shrub dunes and sandy steppe and shrub-steppe habitat is concentrated at low elevations near the Columbia River (Crawford and Kagan 1998-2003).

Shrub-steppe habitat defines a biogeographic region and is the major vegetation on average sites in the Columbia Plateau, usually below Ponderosa Pine Forest and Woodlands, and Western Juniper and Mountain Mahogany Woodlands habitats. It forms mosaic landscapes with these woodland habitats and Eastside Grasslands, Dwarf Shrub-steppe, and Desert Playa and Salt Scrub habitats. Livestock grazing is the primary land use in the shrub-steppe although much has been converted to irrigation or dry land agriculture. Elevation range is wide (300-9,000 ft [91-2,743 m]) with most habitat occurring between 2,000 and 6,000 ft (610-1,830 m). Habitat occurs on deep alluvial, loess, silty or sandy-silty soils, stony flats, ridges, mountain slopes, and slopes of lake beds with ash or pumice soils (Crawford and Kagan 1998-2003).

Much of the shrub-steppe habitat has been eliminated or fragmented since the arrival of European settlers. Homesteads, livestock grazing, and conversion to farmland have eliminated native vegetation and facilitated invasion of non-native species such as cheatgrass, Russian thistle, and Jim Hill mustard *Sisymbrium altissimum*. Poor land use practices exacerbated problems with soil erosion as well, further reducing native vegetation. Approximately 55% of grassland habitat and 87% of shrub-steppe habitat have been lost due to irrigated and dryland agricultural conversion, or to inundation of the Columbia River and associated urban expansion (Ward 2001). In the Washington portion of the basin, over 60% of the native shrub-steppe has been lost or highly fragmented (Washington Department of Fish & Wildlife, WDFW, unpublished data).

The Boardman/BAIC/Horn Butte site in Oregon contains the best remaining examples of sandy bunchgrass habitats and open sand dune habitats in the Columbia River Basin. It also has the best quality remnants of sagebrush / bluebunch wheatgrass, Palouse bunchgrass steppe, as well as the only high quality remnant of bitterbrush / bunchgrass steppe habitat in Oregon. It includes most of the habitat in Oregon for the Washington ground squirrel and several endemic plants.

Collectively, the site includes approximately 36,000 ha of native steppe and shrub-steppe habitat Ward 2001).

The Boeing Agricultural Industrial Company (BAIC) holds a 40-year agricultural and industrial lease over 40,000 ha of State of Oregon land located adjacent to the Boardman Bombing Range. BAIC subleases a portion of the property for agricultural purposes to Inland Land Company, LLC, and R.D. Offut Company--NW, which irrigate and farm the property. Approximately 10,000 ha on the BAIC leased lands still support high quality shrub-steppe and steppe habitat. Recently, water rights for existing and increased irrigation have been challenged, and settlements requiring mitigation have been negotiated that may provide an opportunity to protect the native-habitats portion of the leased lands (Ward 2001).

Shrub steppe communities support a wide diversity of wildlife. The loss of once extensive shrub steppe communities has reduced substantially the habitat available to a wide range of shrub steppe-associated wildlife, including several birds found only in this community type (Quigley and Arbelbide 1997, Saab and Rich 1997). More than 100 bird species forage and nest in sagebrush communities, and at least one of them (Brewer's sparrow) is an obligate in this subbasin (Braun et al. 1976). In a recent analysis of birds at risk within the interior Columbia Basin, the majority of species identified as of high management concern were shrub steppe species (Vander Haegen et al. 1999). Moreover, over half these species have experienced long-term population declines according to the Breeding Bird Survey (Saab and Rich 1997).

Interior Grasslands

Land use practices in the past 100 years have reduced grassland habitat by 97 %. This habitat type is found primarily in the Columbia Basin Oregon, and Washington, at mid- to low elevations and on plateaus in the Blue Mountains, usually within the ponderosa pine zone in Oregon. Within the subbasin, this habitat type historically occurred at the transition zone between shrub steppe and forest and where fires killed shrubs within the shrub steppe. Despite its importance as a wildlife habitat it was limited in distribution within the subbasin historically. Modern altered fire intervals and conversion into agriculture have converted large portions of remaining shrub steppe into grassland habitat.

Description of Habitat

Historic

Historic vegetation patterns can only be inferred from sites thought to resemble historic conditions. Several shrub and grass associations were commonly interspersed with one another forming a diverse floral mosaic. The combination of elevation, aspect, soil type, and proximity to surface and/or ground water contributed to the vegetation potential of a site. Fire was likely the primary disturbance factor with intervals ranging between 50 and 100 years (Stinson et al. 2004); large mammals such as Rocky Mountain elk (*Cervus elaphus nelsoni*), small mammals such as ground squirrels (*Spermophilus* sp.), mass wasting, and flooding in perennial and ephemeral streams probably contributed secondary localized disturbance roles. Shrubs and perennial bunchgrasses co-dominated with a micro-biotic crust of lichens, mosses, green algae, and micro-fungi on the surface of the soil (Belnap et al. 2001). Biotic crusts are critical for binding soil particles together protecting the soil from wind and water erosion, fixing nitrogen, accumulating nutrients used by vascular plants, and out competing invasive species (Stinson et al. 2004).

Estimates for historic shrub cover at undisturbed sites vary between 5 and 30% (Daubenmire 1970, Dobler et al. 1996, Crawford and Kagan 2001). Perennial bunchgrass cover was estimated to vary between 69-100% (Daubenmire 1970).

The dominant shrub-grass association was Antelope bitterbrush (*Purshia tridentata*) and bluebunch wheatgrass (*Agropyron spicata*) (Daubenmire 1970). Scattered throughout this dominant cover type were many other bunchgrasses including Sandberg's bluegrass (*Poa secunda*), needle and thread (*Stipa comata*), Thurber's needle grass (*Stipa thurberina*), Idaho fescue (*Festuca idahoensis*), Indian rice grass (*Achnatherum hymenoides*), squirreltail (*Elymus elymoides*) and Cusick's bluegrass (*Poa cusickii*). Scattered shrubs also included two rabbitbrush species (*Chrysothamnus viscidiflorus* and *Chrysothamnus nauseosa*), short-spine horsebrush (Tetradymia spinosa), spiny hopsage (*Grayia spinosa*), rigid sagebrush (*Artemesia rigida*), basin sagebrush (*A. tridentata tridentata*) and three-tip sagebrush (*A. tripartita*) (Crawford and Kagan 2001).

Most of these shrub species had their own unique association with one or more bunchgrasses and dominated a portion of the landscape. For example, at higher elevations and north facing slopes three-tip sagebrush and Idaho fescue was the dominant association. On ridge tops where shallow soils (i.e., basaltic lithosols) were common, rigid sagebrush and Sandberg's bluegrass and/or bluebunch wheatgrass dominated. Rabbitbrush was common in areas where fires had recently burned. Within the shrub steppe landscape there also were alkaline adapted community types, usually associated with drainage bottoms, perennial and ephemeral streams, or seeps and springs.

A diversity of flowering herbaceous plants, known as forbs, were present with these shrub-bunch grass associations. Perennial forb species included several balsamroots (e.g., *Balsamorrhiza careyana, B. hookeri, B. sagitata*), milkvetches (e.g., *Astragalus columbianus, A. spaldingii*), desert parsleys (e.g., *Lomatium triternatum, L. gormanii, L. canbyi*) and burrow weed (*Hyplopopus bloomer*)(Daubenmire 1970).

Sagebrush/bunchgrass obligates within the subbasin included Brewer's sparrow (*Spizella breweri*) and the sagebrush vole (*Lemmiscus curtatus*). Other shrub steppe species include Rocky Mountain mule deer (*Odocoileus hemionus hemionus*)/Columbian black-tailed deer (*Odocoileus hemionus columbianus*), short-eared owl (*Asio flammeus*), loggerhead shrike (*Lanius ludovicianus*), lark sparrow (*Chondetes grammacus*), grasshopper sparrow (*Ammodramus leconteii*), western rattlesnake (*Crotalus viridis*), short-horned lizard (*Phrynosoma douglasii*), and the great basin spadefoot (Scaphiopus intermontanus).

A decade or more is required for big sagebrush to recolonize depending on fire severity and season, seed, rain, postfire moisture, and plant competition (Crawford and Kagan 2001); whereas three-tip sagebrush is a late seral species that reestablishes (from seeds or commonly from sprouts) within 5-10 years following a disturbance (Crawford and Kagan 2001).

Ephemeral wetlands have historically been an important feature of shrub steppe. There is very little literature on this landscape feature, but many bird species have been observed using these wetlands (D. Lichtenwald, pers. comm.) and arid species such as the great basin spadefoot are known to breed in these temporary pools (Leonard et al. 1993). Further study of these wetlands is needed to determine their importance to this subbasin.

Current

Shrub Steppe

Shrub-steppe habitat still dominates most of southeastern Oregon although half of its original distribution in the Columbia Basin has been converted to agriculture (Crawford and Kagan 1998-2003). The pattern of agricultural conversion has resulted in a disproportionate loss of deep soil communities not reflected in typical measures given for habitat loss (Vander Haegen et al. 2000). Alteration of fire regimes, fragmentation, livestock grazing, and the addition of >800 exotic plant species have changed the character of shrub-steppe habitat. Quigley and Arbelbide [181] concluded that Big Sagebrush and Mountain Sagebrush cover types are significantly smaller in area than before 1900, and that Bitterbrush/Bluebunch Wheatgrass cover type is similar to the pre-1900 extent. They concluded that Basin Big Sagebrush and Big sagebrush-Warm potential vegetation type's successional pathways are altered, that some pathways of Antelope Bitterbrush are altered and that most pathways for Big Sagebrush-Cool are unaltered. Overall this habitat has seen an increase in exotic plant importance and a decrease in native bunchgrasses. More than half of the Pacific Northwest shrub-steppe habitat community types listed in the National Vegetation Classification are considered imperiled or critically imperiled (Crawford and Kagan 1998-2003).

The Biological Resources Division of the U.S. Geological Service has identified native shrub and grassland steppe in Oregon and Washington as an endangered ecosystem, with an 85-90% decline in habitat acreage (Noss et al. 1995). An estimated 10.4 million acres of shrub-steppe existed in Washington prior to the 1800s of which approximately 40% remains (Dobler et al. 1996). Ask Jimmy Kagan. In Klickitat County, WA., 60,168 acres are enrolled in the U.S. Department of Agriculture's Conservation Reserve Program (CRP) and in Oregon, 67,255 and 81,72 acres are enrolled in Gilliam and Sherman counties, respectively (as of: 9/30/04) (USDA-FSA 2004).

Most of the shrub steppe in Klickitat County is owned by agricultural producers and livestock ranchers. The State of Washington owns and manages several smaller but key parcels as well. Shrub steppe included in cropped private land tends to be fragmented into relatively small patches (Dobler et al. 1996). There are a few exceptions where relatively large (<12,000 acres) shrub steppe parcels exist in close proximity to public land. They are usually associated with steep topography such as on ridges that were historically not productive for cultivation. A redeeming quality is they remain mostly intact and, at a minimum, act, as wildlife (e.g., elk, mule deer) corridors for dispersal between public lands with a mixed quality of management. For example, wildife originating on the Klickitat Wildife Area, owned by WDFW, must cross private land to access the Simcoe Mountains and Grayback wildlife area to the North.

Stresses

Altered fire regimes

Fire alone is capable of setting back to a seral stage many sagebrush-steppe dependent species from the subbasin. Not only does wildfire kill sagebrush it may open the community to expansion of invasive alien species such as cheatgrass (*Bromus tectorum*), and knapweeds, especially on south facing slopes. North facing slopes of ridges appear to be more resilient to invasion following fire probably because of cooler microclimates. Cheatgrass can germinate when some native bunchgrasses are dormant during the cold season. Native bunchgrasses, including Sandberg and Big Bluegrass compete effectively with Mediterranean annuals. South facing slopes tend to be warmer with less snow accumulation. Warmer soil temperatures permit cheatgrass to germinate. As a result, many remaining shrub steppe areas in the Subbasin have significant cheatgrass problems on south facing slopes. Techniques for restoring shrub steppe into healthy bunchgrass stands need further development. However, conservation agencies have observed significant voluntary efforts at restoring shrub steppe habitat communities.

In the Rock Creek watershed, fire intervals are similar to other historical fire intervals in eastern Washington, except in the upper reaches of Rock Creek, where fire intervals are longer, possibly up to 50 years, compared to 10-20 year fire intervals in the lower reaches of Rock Creek (Beeks pers. comm.).

Inappropriate Grazing

Of the 894,000 acres of privately owned land used for grazing in Klickitat County, 47% is rangeland. Open native grassland used for grazing by livestock and wildlife is mainly on river breaks and in mountainous areas, including east of the Klickitat River, from south of the Simcoe Mountains to the Columbia River, and east of Bingen, Washington along the Columbia River.

Rangeland in the best ecological condition usually is interspersed with areas of small grain cropland. Because a cropping system of winter wheat-summer fallow is used in the area, these areas of rangeland are rested from grazing during alternate growing seasons.

Generally, the range of plants in the survey area is suited to grazing in fall and winter or early spring. Grazing should be deferred from year to year. The plants are not suited to continuous grazing early in the growing season. Use of practical grazing methods, a high level of management, and range improvements to speed up ecological processes are beneficial to the areas of rangeland.

Very shallow areas of rangeland generally are in good or excellent condition because the short period of plant growth generally does not correspond with the periods of livestock grazing. Areas that are over used and in poor condition generally are those where the periods of livestock grazing overlap with the critical periods of use by wildlife in the spring.

To maintain the condition of the rangeland, livestock should be moved to irrigated pastures or to areas of grazeable woodland in summer. Range plants can be grazed intensively for a brief period, and then they should be allowed to recover for the remainder of the growing season (Guenther 1997).

Development and Land Conversion

Many sources contribute to increased fragmentation. Collectively, these comprise a significant threat to the ecological integrity of shrub steppe biota. Agriculture and residential development are the two most significant sources of fragmentation across the subbasin. The construction of roads and other infrastructure completely change the nature of the landscape. Many of these lands were formerly under cultivation and have potential for restoration under farm conservation programs (such as Conservation Resource Program). Restoring native vegetation to agricultural land in key areas may offer valuable opportunities for reducing fragmentation in important habitats.

Invasive Non-Native Plant Species

While linked in many areas to inappropriate grazing practices, other sources also exacerbate this stress, including recreational use, residential development, and frequent fire. As with habitat fragmentation, we cannot point to a single highly ranked source for this limiting factor across the site. However, in selected locales throughout the subbasin, invasive non-native species pose a serious threat to biotic integrity of the shrub steppe. The abundance of such locations, the diversity of sources, and the continued or increasing nature of this threat, combines to yield a medium-high rank for this limiting factor.

Off Road Vehicles

Off Road Vehicle (ORV) use can cause damage to shrub steppe and grassland vegetation, especially the fragile microbiotic crust layers. This type of activity is often unregulated and unmanaged in this subbasin (J. Hill, pers. comm.). Limiting ORV traffic to specific marked areas, or eliminating it completely, will protect shrub steppe/grassland habitat, reduce stream sedimentation from snowmelt, rain fall runoff from tire tracks, dirt roads. By not degrading shrub steppe and grassland habitat with vehicles off of designated roads, better quality feed will result for wildlife and livestock. Overall quality of wildlife habitat will be improved.

4.4.1 Rocky Mountain Mule Deer (*Odocoileus hemionus hemionus*)/Columbian black-tailed deer (*Odocoileus hemionus columbianus*)

The Washington Department of Fish and Wildlife (WDFW) identifies deer east of US-97 as Rocky Mountain mule deer and deer west of US-97 as Columbian black-tailed deer. In Oregon, black-tailed deer are found primarily west of the Cascade Mountain Range and mule deer are native to eastern Oregon (ODFW 2004d). In reality, throughout the east slopes of the Cascades, there is a hybrid zone, where the deer are a mix of both subspecies' genotypes. Phenotypically, these deer look like black-tails, albeit large black-tails until you get out of the coniferous forest associated with the Cascade foothills. Once you get into the open country, the deer quickly become Rocky Mountain deer phenotypes (S. McCorquodale, pers. comm.) For simplicity, in this writing both subspecies will be referred to as deer, unless information is specific to only one subspecies. This writing will cover general information on both subspecies as well as regional information on both subspecies and their hybrids.

Rationale for Selection

Historically, deer have been important to the people and ecology of Oregon and Washington, and remain so today. Deer serve as a food and clothing source for Native Americans. Additionally, they provide recreational opportunities for hunters and wildlife watchers, and contribute tremendous economic benefits to local communities. Deer also occupy an important ecological niche. They convert tremendous volumes of plant matter into animal protein, provide prey for a wide variety of predators and scavengers, and contribute to the cycling of nutrients (E. Holman, pers. comm.). Furthermore, deer are the most widely distributed and numerous native species of ungulate in Washington and Oregon. As such, mule/black-tailed deer have been chosen as a focal species to represent Shrub Steppe/Interior Grasslands wildlife focal habitat, which provides important deer habitat, especilly during winter months.

Key Life History Strategies: Relationship to Habitat

Summary

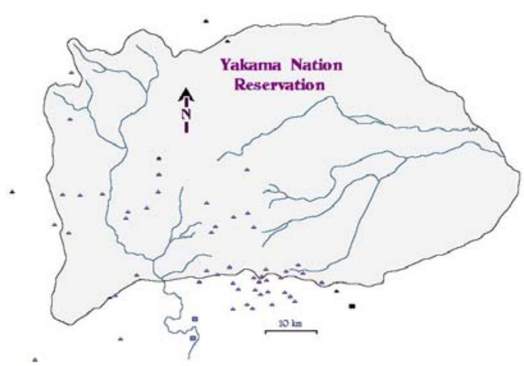
The most important habitat factors affecting deer in this subbasin are:

- Winter range: Deer need suitable cover and forage to survive harsh winter conditions. Large sagebrush is important for both of these.
- Forage (year round): Deer need available forage year round. Fire can destroy sagebrush, an important food in winter.

General

Habitat requirements vary with vegetative and landscape components contained within each herd range. Deer tend to frequent steep, brushy slopes of canyon walls and adjacent ridges (Ward 2001). Deer occupying mountain-foothill habitats live within a broad range of elevations, climates, and topography, which includes a wide range of vegetation; many of the deer using these habitats are migratory. Deer occupy a wide variety of habitats in Washington and Oregon; some live in desert shrubs, some in woodlands, and some in conifer forests. These areas include, but are not limited to: canyon complexes along the major rivers, the conifer-dominated forests of western Washington and Oregon, the shrub-steppe habitats of eastern Washington and Oregon, various mountainous habitats in the Cascade, Blue and Selkirk ranges, etc. Some of these areas are dominated by native bunch grasses or shrub steppe vegetation. Deer also occupy agricultural areas, which were once shrub steppe or native grassland.

The terrestrial habitats of the Lower Mid-Columbia Mainstem subbasin provide important winter and breeding habitat for a variety of species. Shrub steppe habitat provides important wintering areas for mule/black-tailed deer (*Odocoileus hemionus hemionus/Odocoileus hemionus columbianus)*. These deer migrate annually from their summer range on the Yakama Reservation, in the Klickitat and Yakima subbasin, and from their winter ranges in both the Klickitat and Rock Creek subbasins (figure x). In the Rock Creek watershed, the oak/shrub steppe fringe provides important food and cover for deer. Here, sagebrush, bitterbrush and acorns make up part of their winter diet. These migrating deer were part of a Klickitat basin deer study conducted by the Yakama Nation (McCorquodale 1999).



Note: Black square represents trapping area in the Rock Creek subbasin, and blue squares are trapping areas in the Klickitat subbasin

Figure 10 Map showing winter trapping areas (squares) and summer-fall activity centers of radio-collared deer (triangles) (McCorquodale 1999).

During summer, deer are scattered over much of eastern Washington and Oregon. Preferred summer habitat provides adequate forage to replace body reserves lost during winter and to maintain normal body functions. Summer habitat also includes areas specifically used for reproductive purposes. These areas must have an adequate amount of succulent vegetation, offering highly nutritional forage. In addition, areas used for reproduction should provide isolation from other deer, security from predators and minimal competition from other ungulates. Summer habitat can be found in areas varying from lowland agricultural lands to high elevation mountain areas (ODFW 2003a).

Diet and Foraging

Although mule deer commonly are considered to be “browsers”, they consume a wide variety of plant materials and in some seasons graze extensively (ODFW 2004e). During the fall season, high quality forage should be available to allow does to recover from the rigors of nursing fawns and prepare for the leaner winter months. In the subbasin late summer/fall rains may create a green-up that is very important for deer. The fall green-up provides the nutrition necessary to maintain body condition for the coming winter, and maintain the fertility of does that breed in late fall. Good spring range conditions are important because they provide the first opportunity for deer to reverse the energy deficits created by low quality forage and winter weather.

Winter can be a difficult time for deer. Winter weather forces deer to migrate to lower elevations and forage quality and availability may be limited. Energy demands elevate at the end of gestation and jump dramatically when does start supporting their young after parturition (S. McCorquodale, pers. comm.). Ideally, deer winter range should be free of disturbance and contain abundant, high quality forage. Poor winter range conditions and severe winter weather can result in high mortality, especially among the old and young. Severe winters, particularly winters with cold temperatures and deep and/or hardpacked snow, would likely be the major weather-related cause of death among adults (S. McCorquodale, pers. comm.).

In winter, new growth of twigs of shrubs and trees is browsed, especially that of species high in fat content (ODFW 2004e). Deer generally do not do well on strict grass diets, as these tend to have low digestibility when mature. Deer do not need as much food as elk, but they need higher quality forage. (S. McCorquodale pers. comm.). Woody browse that is known to be highly palatable and nutritious, such as antelope bitterbrush, is an important component of quality deer winter range. Sagebrush, rabbit-brush, juniper, and mountain-mahogany, are also among those typically browsed. In the most productive winter ranges of central Oregon, favorite shrubs such as bitterbrush and mountain- mahogany stand above the snow, in typical years, providing food and shelter (ODFW 2004-Mule deer Intro.).

In the Klickitat subbasin, McCorquodale (1999) found that deer ate grasses and shrubs such as antelope bitterbrush, snowberry, and ceanothus (*Ceanothus* spp.) in winter and a lot of forbs, some grasses, and quite a few shrub leaves (e.g. currant) during the growing season. The absence or presence of highly digestible shrubs, such as bitterbrush, is essential to survival (Hobbs 1989).

Weather, especially severe winters, often leads to public requests or demands to initiate supplemental feeding. However, artificial feeding programs can easily divert the public’s attention away from the real problem: maintenance and enhancement of habitat needed for year-round support of mule deer. Although natural strategies developed by deer for winter survival (e.g. migration, animal distribution, dispersal, and foraging behaviors) are preferred to artificial feeding, game managers recognize that human intervention to control damage or increase survival may, at times, be necessary (ODFW 2003a).

Forage preferences of deer in grassland-dominated habitats also are dependent upon time of year. In a report published on the ecology of mule deer on the Yakima Training Center, Yakima County (1995), deer were found to avoid a bunchgrass cover type in spring and summer but favored that habitat during winter months (Raedeke et al 1995). A diet analysis from this study showed that 47%of the deer diets were forbs, 39%were shrubs, and only 13%were grasses. Preferred forbs were balsamroot (*Balsamorhiza* spp.), buckwheat (*Eriogonum* spp.), and lupine (*Lupinus* spp.). Shrubs included antelope bitterbrush and willow, while cheatgrass and steppe bluegrass (*Poa secunda*) were important grasses. Deer were more dependant on browse during the summer months when energetic needs are at their highest (Raedeke et al. 1995).

Establishing Dens

Mule deer in the subbasin often use islands as a location to give birth. Does likely select islands because of the security from land predators, primarily coyotes. The small number of islands in the subbasin, the apparent loss of size (possibly existence) of some islands to erosion, the formation of land bridges to some islands during low water levels, and the inundation of some islands during periods of high water levels limits this use of islands in the subbasin by mule deer (Ward 2001).

Wintering

In the Klickitat subbasin, deer winter range is associated with south facing breaks and uplands of the lower Klickitat River Canyon, which is south of the Yakama Nation Reservation (McCorquodale 1999). In the Klickitat subbasin, the WDFW owns and manages the Klickitat Wildlife Area. For wintering deer, habitat with an oak component is very important in this region.

For deer in the Rock Creek watershed, corporate timberlands provide some winter range in the upper reach. In the lower reaches of Rock Creek, winter range consists of shrub steppe and is supplemented with agriculture.

Winter habitat is found predominately in lower elevation areas of Eastern Oregon. These areas usually have minimal amounts of snow cover and provide a combination of geographic location, topography, and vegetation that provides structural protection and forage. Due to the low nutritive values of available forage during the winter, deer are forced to rely on their body reserves acquired during the summer for winter survival. Big-game winter ranges have been delineated during implementation of county planning and federal land-management planning efforts. Identified big-game winter ranges typically are used by both deer and elk. Due to the combined use by these species, the winter range designations can have limitations if used to determine specific deer winter range areas (ODFW 2003a).

Population Status and Trend

Status

Historically, deer where thought to have occupied much of what is now as eastern Washington and Oregon. Today, deer can be found in every county within eastern Washington (**Figure 11**) and Oregon (McCorquodale 1999, ODFW 2003a), from higher elevations (6,000 ft.) in the mountains, to the lowland farming areas (Ashley and Stovall 2004). Mule deer are widespread in the Columbia Plateau Province in Oregon (ODFW 1993) and deer winter range extends along south-facing slopes and associated uplands in the Klickitat subbasin of Washington (McCorquodale 1999).

As is commonly the case in many western big game populations, the Klickitat deer herd has an abundance of summer range but winter range is limited. The last three decades have marked considerable conversion of deer winter habitat to land uses that are less favorable to deer. Current habitat conditions likely are not able to support high wintering deer populations. Further development or habitat loss will continue to reduce the capacity of the landscape to support deer. Managers should continue to make winter habitat maintenance, enhancement and acquisition a priority (McCorquodale 1999).

Additionally, the importance of habitat conditions on summer range has recently been shown to be of significance to ungulate populations such as deer. Specifically, adequate quantities of high-quality forage must be available during spring and summer months to allow for recovery from winter food shortages, successfully recruit young, assure pregnancy in females, secure nutritional reserves prior to the coming winter, etc. (Holman, pers. comm.). In addition to the aforementioned management priority of winter range, habitat maintenance and enhancements on summer range should be conducted as well.

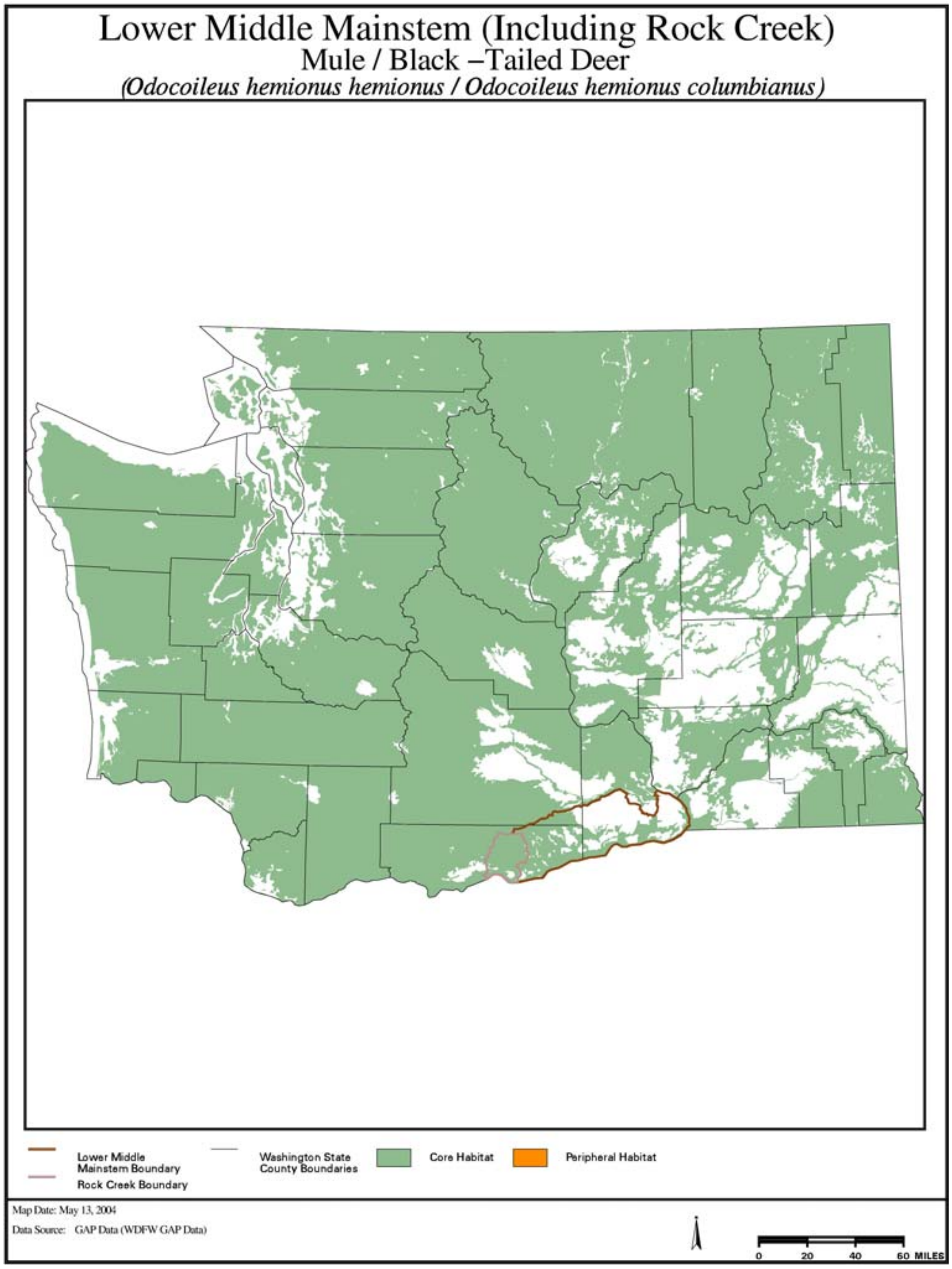


Figure 11 Potential habitat for mule/black-tailed deer in the lower mid-Columbia mainstem (including Rock Creek) subbasin and Washington (Johnson and Cassidy 1997)

Trends

Washington

Historic population levels in Klickitat County are unknown but are generally thought to be higher than current deer numbers (McCorquodale 1999). In a comparative deer harvest report from 1948 to 1986, harvest numbers rose from 814 in 1948 to a peak of 6,300 in 1964, and dropped to 1,391 animals by 1986 (Oliver 1986). In its best year, Klickitat County contributed only 9.9%of the total statewide harvest.

In 1959, a retired Wildlife Agent, Dick Thompson, claimed that "deer were as thick as rabbits" (Oliver 1986) but landowners soon took to large kills of deer to control damage to crops. Record harvests in the mid 1960s coupled with severe winter conditions drastically reduced deer populations. Deer have never fully recovered in Klickitat County (Oliver 1986). Deer population numbers continue to fluctuate drastically due to weather, hunting of "problem deer," and other factors.

Harvest data may not always be a reliable source for population trends. In the Rock Creek watershed, number of deer harvested has likely dropped due to the decrease in hunters over the past 50 years. This decrease is, in part, the result of an increase in private hunting clubs formed by local landowners.

There are various hypotheses as to why historical deer populations were maintained. One theory is that periods of high population levels were also associated with infrequent severe winters; perhaps the large-scale conversion of historical winter range to agricultural and residential development reduced deer numbers. An additional possibility is that in lieu of the increased agricultural production, deer use of crop forage led to higher population levels. The Rock Creek drainage east of the Klickitat is approximately 95,000 ha and has habitats similar to the Klickitat (McCorquodale 1999). Historically, it was thought that deer summering in the Klickitat possibly winter in the Rock Creek subbasin.

According to McCorquodale (1999), deer populations largely reflect the recent history of winter severity. Populations increase during mild winters while severe winters can cause a crash in the population. Most deer herds are currently thought to be stable or declining across much of eastern Washington. There are exceptions to the current, widespread decline, most notably, herds in southeastern Washington and portions of Grant, Douglas, Spokane, and Whitman Counties.

Oregon

Oregon's mule deer population was estimated at 39,000 to 75,000 animals from 1926 to 1933 (Bailey 1936). Mule deer populations increased and peaked from the mid-1950s through the mid-1970s. The estimated spring population in 1990 was 256,000 animals and the estimated 2001 population was 283,000 (ODFW 2003a).

ODFW normally conducts mule deer surveys twice annually. Trend counts are conducted during March and April and are used to measure overwinter survival of populations. They are made along the same routes or areas each year and are traveled by vehicle, horseback, aircraft, or on foot. All observed deer are counted, and the number is compared to the previous year's information to determine if populations have increased or decreased. Population trends for the Biggs and Columbia Basin GMU's between 1998 and 2001 are detailed in **Table 14** (ODFW 2000-2001).

Table 14 Mule deer population trends for the Biggs and Columbia Basin GMU's (1998-2001), OR.

	Miles Traveled	Deer Observed			
		2001	2000	1999	1998
Biggs #43	270		1,519	567	108
Columbia Basin #44	67	86	255	248	87

Herd composition counts are conducted during November and December and again along with spring trend counts during March and April. Deer are classified as bucks, does, and fawns to calculate ratios of bucks, fawns, and does in each management unit. All of the information collected is used to simulate yearly gains and losses through computer modeling and are compared with management objectives for each unit to determine if objectives are being met (ODFW 2000-2001).

Table 15 Mule deer herd composition counts for Biggs and Columbia Basin GMUs (2000-2001), OR.

	Bucks		Does		Fawns		Total	
	2001	2000	2001	2000	2001	2000	2001	2000
Biggs #43		122		652		279		1,053
Columbia Basin #44	64	38	709	275	367	144	1,140	457

Management Issues

Washington

The management of deer in the eastern Klickitat County is the responsibility of the WDFW, Yakama Nation, two large forest landowners (Boise Cascades and Campbell Group), and many smaller-scale forest, agricultural, and residential landowners. WDFW’s Game Management Plan, 2003-2009 (2003), will guide their management of hunted wildlife through 2009.

The focus of the plan is on the scientific management of game populations, harvest management, and other significant factors affecting game populations. Many factors that determine deer population levels are beyond the control of state wildlife managers-such as weather, wild fires, disease, and timber harvest. As such, preferred strategies emphasize improvements in population monitoring, mule deer research, and refinement of population model inputs such as mortality and recruitment rates. Hunting season changes will maintain current, general season strategies while ensuring that a variety of hunting opportunities are available and balanced within each of WDFW’s seventeen districts.

Rocky Mountain elk were historically uncommon in the Klickitat County but during the last 10 years, the number of wintering elk has increased (McCorquodale 1999). Deer have been shown to be sensitive to elk and it is thought that deer will avoid areas where there are elk. In Oregon at the Starkey project, radio collared deer actually moved into areas where roads were recently built to avoid the elk that had moved out of that area (Stephenson, pers. comm.). Additionally, ongoing research efforts at the Starkey Experimental Forest suggest that the presence of cattle leads to an increase of interspecific competition among elk and deer (Holman, pers. comm.). Specifically, in the absence of cattle, deer and elk tend to select different foods, with elk making much more extensive use of grass than deer. With the introduction of cattle, the supply of grass available to elk is reduced causing them to browse more extensively on shrubs and forbs preferred by deer. Elk are generally more adaptable, capable of utilizing a wider variety of foods, require more food and are better able to cope with severe winter conditions than are deer (Holman, pers. comm.).

Deer populations in Game Management Unit’s (GMU’s) 588 and 382 in Klickitat County persist at a level where landowners sometimes complain about too many deer on their winter wheat, and in their gardens or landscaping. Partially in response to these concerns, the WDFW establishes hunting seasons designed to result in limited antlerless deer harvest and a relatively stable overall deer population. In some limited cases, WDFW has authorized "hotspot" hunts to reduce damage and complaints from landowners (McCorquodale 1999).

Oregon

The management of mule Deer in the Oregon portion of the subbasin is the responsibility of ODFW. In response to declining deer populations and increasing hunting pressure, the first Mule Deer Plan was written and adopted in 1990. ODFW's Oregon Mule Deer Management Plan was updated in 2003 and provides guidance for managing this species in the subbasin. The goal of the plan is to manage mule deer populations to attain the optimum balance among recreational uses, habitat availability, primary land uses, and other wildlife species. The focus of the plan is three-fold: to maintain, enhance, and restore mule deer habitat; optimize recruitment of mule deer populations and maintain buck ratios at approved levels; and enhance all recreational uses of the resource (ODFW 2003a).

Approximately 60,167 acres of CRP have been created in the farmlands of Klickitat County, WA. and a total of 149,038 acres in Gilliam and Sherman counties, OR. by converting cropland to grassland. This has resulted in an improvement in habitat conditions for deer. The CRP lands provide both food and cover in agricultural areas where little existed after post settlement and development and before CRP was created.

Relationship with Riparian/Fisheries Issues

The presence of streams is an important water supply in the arid environments of the Lower Mid-Columbia River Subbasin. Healthy and abundant riparian areas can serve as buffers against extreme weather/environmental conditions such as drought or severe winters. Healthy and abundant riparian areas may also serve to provide habitat for deer that is more attractive than agricultural or residential habitats, thereby partially reducing the undesirable effects of a robust deer population, i.e. damage claims (Holman, pers. comm.).

Out-of-Subbasin Effects and Assumptions

Mule deer populations are either non-migratory or migrate to avoid deep snows (Severson and carter 1978, Eberhardt et al. 1984), or to find more nutritious forage (Garrott et al. 1987) and drinking water (Rautenstrauch and Krausman 1989). McCorquodale (1999) noted that although deer wintering in the lower Klickitat were both migratory and resident, most individuals were migratory and exhibited strong fidelity to their seasonal home ranges. He found that wintering radio collared deer from the Klickitat Wildlife Area and Rock Creek dispersed widely during the spring through fall period. Rock Creek migrants summered northwest through west of their home range while Klickitat deer migrated north or east of their winter home ranges (figure 13). Spring migrations started around the end of March and concluded during the second week of May. Peak activity for deer movement was recorded in April. Summer ranges, for the most part, were snowfree by mid-April. Summer to winter home range migrations were found to generally occur between late September and early December.

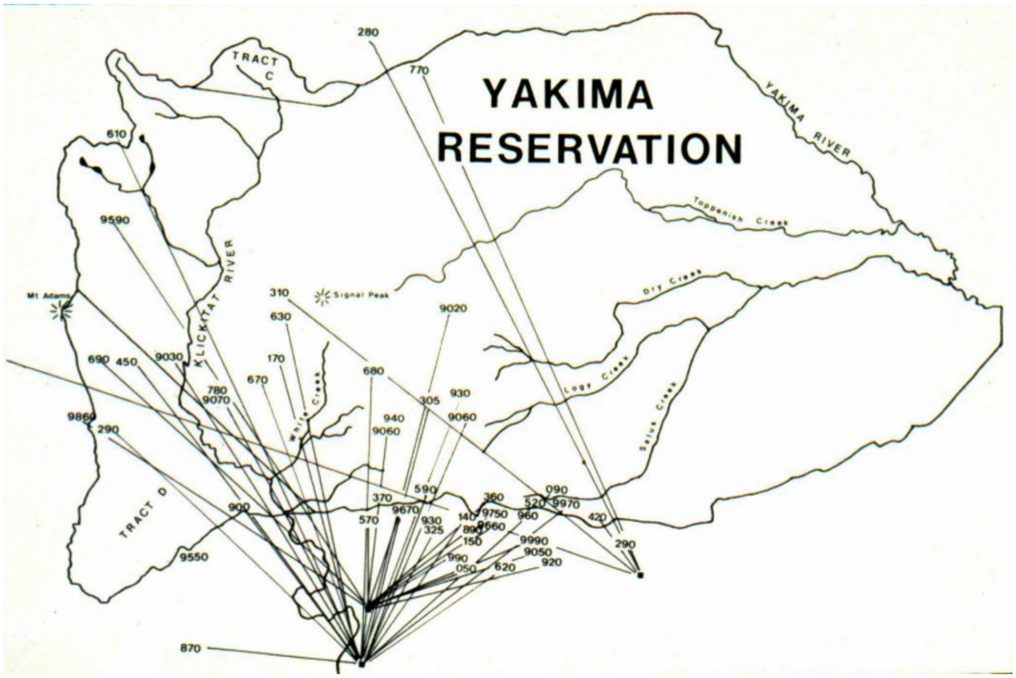


Figure 12 Movements of radio-collared deer from the Rock Creek and Klickitat subbasin (McCorquodale 1999)

Factors Affecting Population

A multitude of factors limit the ability of landscapes to support populations of deer. These factors are both human-caused and climactic in nature and include nutrition, weather, habitat quality, predation, and accidents, among others. These factors may work independently or in concert to suppress deer populations. Loss of suitable forage to weeds may cause deer to concentrate on habitats near highways where accidental deaths and disturbance may be higher than desirable. Deer populations are primarily a function of the availability of high-quality habitat. Logically, when habitat conditions are compromised, deer populations are suppressed. In contrast, deer are very reproductively fit and when conditions are favorable, they readily increase in number and occupy available habitats. Populations existing under high-quality habitat conditions generally increase to the point of carrying capacity at which point, some limiting factor suppresses the population. WDFW and ODFW attempt to manage deer populations at a level where large-scale winter mortality does not become the primary source of this population suppression (Holman, pers. comm.).

Some of the factors that collectively limit deer populations are listed below.

Land Conversion

The conversion of shrub steppe and grassland habitat to agricultural croplands has resulted in the alteration of hundreds of thousands of acres of deer habitat in eastern Washington and Oregon. This has been mitigated to some degree by the implementation of the Conservation Reserve Program (CRP). Approximately 1,386,359 acres in southcentral and southeast Washington and 494,865 acres in eastern Oregon have been converted to CRP (USDA-FSA 2004). (This includes counties which historically had large concentrations of shrub steppe and grassland habitat). Furthermore, agricultural areas may provide an extensive supply of food for deer such as winter green-up in harvested wheat fields or standing alfalfa. However, large numbers of deer may not be tolerated by landowners in agricultural areas and WDFW is legally mandated to address damage caused by wildlife (Holman, pers. comm.).

Land conversion to residential, commercial, and industrial uses also results in the direct loss or severe degradation of habitat for deer. Specifically, establishment of impervious surfaces, fencing, removal of vegetation, etc. all reduce the ability of a given landscape to support populations of deer. Although many mule deer ranges in Oregon will no longer support historic deer population levels, moderate population increases may be attained in some units with careful management (ODFW 2003a).

Fire Management

Fire suppression has resulted in a decline of habitat conditions in the mountain and foothills of the Blue Mountains, as well as other portions of Washington and Oregon. Increased fire suppression has contributed to the encroachment of woody vegetation, the loss of desirable shrub and forage species, and lowered the nutritional value of shrub plants for deer (ODFW 2003a). 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 deer (Young and Robinette 1939, Leege 1968; 1969).

Wildfires in sagebrush habitats often burn vast acres, burn extremely hot and can result in the loss of critical winter range habitat. In many areas, it may take 30 to 50 years before the areas have recovered to a level to support significant numbers of deer (ODFW 2003a).

Hunting

Technological advancement in outdoor equipment (e.g. weapons, ammunition, transportation, GPS, radios, cellular phones, and waterproof and insulated clothing) has increased hunter efficiency and is changing the way many people hunt. Technological improvements in hunting equipment will continue and game managers will be constantly challenged to determine how new technologies may impact future hunting opportunities and may be required to develop rules that limit the effectiveness of the hunter or equipment (ODFW 2003a).

Mortality in one study (McCorquodale 1999) was mainly associated with hunting except for the period of 1992-1993. Most hunting mortalities occurred in off-reservation areas, although deer made considerable use of reservation lands (McCorquodale 1999). Illegal take of female deer was quite common during the study period of 1988-1995. The majority of the does were killed during the branch-antlered male deer season. WDFW uses recreational hunting to manage deer within the biological capacity of the species to support an annual harvest and provide recreation. WDFW's deer population objectives and therefore seasons are partially established in response to the impact of deer on private landowners, primarily agricultural (Holman, pers. comm.).

Deer often cause problems for landowners. In the past landowners often took matters into their own hands. In the early 1960's, the Klickitat County Farmers Wildlife Control Association was formed among landowners in Goldendale, White Salmon, Glenwood and elsewhere (Oliver 1986). Hundreds of deer were killed in the Goldendale and White Salmon River Valley. Today deer populations are considerably smaller, problems with deer are smaller and more sporadic, and the killing of "problem" deer is much more closely managed. Landowners still influence the

In Washington, the Lower-Mid-Columbia Mainstem subbasin is comprised of the East Klickitat (# 372) and Kiona (#382) GMUs. The total mule deer harvested in these two GMUs for 2001, 2002, and 2003 totaled 586, 761, and 519, respectively (WDFW 2001-2003). Black-tailed deer are not found in the East Klicktat and Kiona GMUs and none were harvested during this time period.

Only mule deer occupy the Oregon side of this subbasin. Columbian black-tailed deer primarily inhabit that portion of the state west of the Cascade summit. The mule deer harvest in Oregon State was generally low during the 1930s, with a reported harvest of 6,506 deer in 1934. The end of World War II brought a substantial increase in hunting pressure with 53,030 and 90,126 deer harvested in 1952 and 1955, respectively. Harvest peaked during the 1960s with an average of 82,540 mule deer taken, and a peak of 97,951 deer harvested in 1961. In 1991, controlled buck hunting was initiated in response to low post-season, buck-to-doe ratios in many WMUs and hunter numbers were substantially reduced. Twelve units already had limited-entry hunting due to deer recruitment problems that started during the winter of 1983-84. Total hunter numbers were reduced from 104,745 in 1990 to an average of 85,991 from 1991-1999, a decrease of approximately 18%. During this same time period, mule deer harvest decreased from 36,668 in 1990 to an average of 31,952 (1991-1999), a reduction of 13% (ODFW 2003a, 1999).

Within Oregon, the LMM subbasin is comprised of the Biggs (#43) and Columbia Basin (#44) GMUs. In 2000, the 2,777 hunters harvested (archery and rifle) a total of 1,813 mule deer in the Biggs unit and 3,285 hunters harvested 1,897 mule deer in the Columbia Basin unit. Black-tailed deer are not found in the Biggs and Columbia Basin GMUs.

Weather

Weather conditions can play a major role in the productivity and abundance of deer. Drought conditions can have a severe impact on 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. Winter weather can result in high mortality of all age classes, but the young, old, and mature bucks usually sustain the highest mortality depending on the severity. In McCorquodale’s 1999 study, the dominant form of non-hunting mortality resulted from winterkill. If 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. The 1992-1993 period marked the greatest loss of deer of all ages from winterkill because that was also a period of high snow depths. Deer populations in central and eastern Washington are reported to be growing in some locations in response to recent mild winters (WDFW 2003).

Invasive non-native plants

Establishment of invasive plants such as yellow star thistle and cheat grass have reduced the capacity of the landscape to support deer.

Roads

The construction of roads and railways are detrimental to deer. These activities result in the direct loss of habitat due to the establishment of hardened surfaces, vegetation removal, etc. Additionally, roads and railways fragment habitats, facilitate human access to remote areas (as in forest roads), interrupt migration corridors, increase disturbance and may cause direct mortality due to deer-vehicle collisions.

Disturbance

Deer are sensitive to a variety of primarily human-caused sources of disturbance. Such activities as ATV use, snowmobile use, the driving of forest roads, hiking, mountain-biking, uncontrolled pets, etc., all disturb deer. Deer are especially sensitive to such disturbance during winter when energy reserves are low. During such times, deer conserve energy by reducing their metabolic rate and attempting to move as little as needed. Disturbances during this time can cause the loss of important energy reserves and therefore reduce the ability of given habitats to support deer (Holman, pers. comm.).

Energy Development

The impacts of energy development are varied. In the Klickitat subbasin these impacts currently consist primarily of the inundation of reservoirs in former deer habitat, the establishment of transmission lines with the associated roads, weed dispersal, disturbance, etc. (Holman, pers. comm.). The potential for future energy related limiting factors exists as well. Such future developments likely include oil and gas exploration and wind power.

Certain species in the Columbia River basin were selected during the USFWS Habitat Evaluation Procedure (HEP) loss assessment process, and used to model impacts from adjacent hydro-development. The mule deer was one of those selected.

Klickitat County is in the process of developing a county-wide Environmental Impact Statement (EIS) that considers the cumulative environmental and fish and wildlife impacts of potential emergy development in the county. The EIS will guide the development of an "energy overlay" in County zoning ordinances that will direct future energy development away from environmentally/fish and wildlife sensitive areas.

Interspecific competition

As previously mentioned, deer compete with many other species for available forage and other habitat components. The most significant of these competitive relationships occur among deer, elk, and livestock.

Predation

Mule deer are preyed upon by cougars, bobcats, coyotes, and black bears (Ashley and Stovall 2004). The most significant predators of mule deer in Oregon are coyotes and cougars. Cougars rely on deer and elk as their primary prey, feeding on both adults and young throughout the year. In Oregon, cougars have increased from an estimated population of 200 in 1961 to more than 4,000 in 2001 (ODFW 2003a). Coyote predation on fawns can have a significant impact on the deer population when coyote populations are high, and fawn productivity is low (Ashley and Stovall 2004). Coyote populations in Oregon increased significantly after use of the poison compound 1080 was banned on federal lands in 1972. In general, population numbers of both predators have increased during the past few decades. Large numbers of predators may function to negatively affect population increases in deer herds and the effects are most noticeable after those winters when deer populations experience high mortality rates (ODFW 2003a).

The effect of predation on mule deer is often difficult to determine due to numerous factors that can affect mule deer herds. Differences in deer and predator densities, species of predators, weather, disease, human harvest, and whether the prey population is at habitat carrying capacity influence study results (ODFW 2003a).

Herbicide

The use of herbicide to treat forest plantations following timber harvest is commonplace. The use of these chemical treatments greatly reduces the available forage that would be expected to occur following forest cover removal. Chemical treatments tremendously shorten and reduce the vigor of the period of early succession following timber harvest. These activities reduce the ability of the landscape to support populations of deer.

Disease

Several parasites are known to occur in mule deer and are common throughout the west. Ticks and deer keds are the most common external parasites found on deer. Both parasites feed by sucking blood from their hosts and can become a problem if an individual deer is in a weakened condition (ODFW 2003a).

Diseases are of greater concern because they are difficult to diagnose and have potential for a greater negative impact to deer populations. Mule deer populations that are relatively stable and that are found in good habitat rarely are in danger of disease epizootics. However, the danger of disease transmittal is more serious when deer herds are concentrated or suffer from nutritional deficiencies (in winter). Because mule deer share rangeland with other wild and domestic animals and often occur adjacent to big game farm facilities, the potential exists for transmission of certain diseases and parasites. Diseases in deer are best managed by maintaining healthy habitats, managing appropriate animal densities, and recognizing diagnostic symptoms of various diseases (ODFW 2003a).

4.4.2 Grasshopper Sparrow (*Ammodramus savannarum*)

Rationale for Selection

Throughout the United States, this sparrow has experienced population declines throughout most of its breeding range (Brauning 1992, Brewer et al. 1991, Garrett and Dunn 1981). BBS data (Robbins et al. 1986) have shown a decreasing long-term trend for the grasshopper sparrow (1966-1998) (Sauer et al. 1999). In 1996, Vickery (1996) reported that grasshopper sparrow populations have declined by 69% across the U.S. since the late 1960s. Grasshopper sparrows rely on healthy grasslands and prefer undisturbed, native bunchgrasses communities, a habitat that is being replaced by non-native grassland communities such as cheatgrass. Grasshopper sparrows are listed as a state candidate species in Washington, a sensitive species in Oregon (vulnerable/peripheral or naturally rare), and are on the Oregon PIF list. Due to their association with healthy grassland habitats, they have been chosen as a focal species for the Interior Grassland wildlife focal habitat.

Key Life History Strategies: Relationship to Habitat

Summary

Recommended habitat objectives include the following:

- Vegetative composition dominated by native bunchgrasses (Altman and Holmes 2000);
- Vegetation complexity (Altman and Holmes 2000) with bunchgrass cover >15% and >60% total grass cover;
- Bunchgrass >25 cm (10 in) tall;
- Shrub cover <10%, and
- Large unbroken patches >40 ha (100 ac) (Altman and Holmes 2000).
- Patches should be undisturbed (exotic grass detrimental; vulnerable in agricultural habitats from mowing, spraying, etc.).
- Moderately deep litter and sparse coverage of woody vegetation (Smith 1963, Bent 1968, Wiens 1969, 1970, Kahl et al. 1985, Arnold and Higgins 1986).

General

Grasshopper sparrows use most types of grassland, especially tallgrass and midgrass, but also shortgrass where shrubs or tall forbs are present. In addition to native grasslands, they will nest in Conservation Reserve Program (CRP) lands planted to taller grasses and may be heavily reliant on these in the shortgrass region.

Abundance of grasshopper sparrows seems to be 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).

They are highly territorial, and require the presence of tall forbs, scattered trees, or shrubs for singing perches. 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).

Vander Haegen et al. (2000) found no significant relationship with vegetation type (i.e., shrubs, perennial grasses, or annual grasses), but did find one with the percent cover perennial grass. Grasshopper sparrows require some areas of bare ground since they forage on the ground. Some studies (Bock and Webb 1984, Whitmore 1981) show a preference for high-quality rangeland with only 20-25% bare soil.

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).

Nesting

Although little is known of breeding in the state of Oregon, males have been observed singing as early as April 23 in eastern Oregon. A pair was observed carrying food in Morrow County on May 31st and the bird has been observed using stalks of the large velvet lupine that grows in this county (Janes 1983). Two nests were found in the Willamette Valley in early July and fledglings were observed in mid-July (Altman 1997 and OBBA). Males are rarely observed beyond July (Marshall et al. 2003).

Diet and Foraging

Grasshopper sparrows eat a wide wariety of insects, including grasshoppers. They also eat weed and grass seeds picked from the ground (Marshall et al. 2003).

Population Status and Trend

Status

Grasshopper sparrows have a spotty distribution at best across eastern Washington and Oregon (Figure 14). In Washington, they they have been found in various locales including Conservation Reserve Program (CRP) areas and appear to utilize CRP property in southeast Washington on a consistent basis (Denny, pers. comm.). East of the Cascades Mountains they occur in scattered, native bunchgrass remnants between cultivated fields on north-facing slopes or on marginal soils, including the Columbia Plateau (e.g. Sherman, Gilliam, Morrow, and Umatilla counties). Densitites in Morrow Co. varied from 1.1 individuals/100 ac (20.3 individuals/km^2) in the Boardman area to 8.2 individuals/100 ac. in the Heppner area (Janes 1983).

Conversion of bunchgrass prairies to dryland wheat and other crops presents a threat to this species in northcentral and northeast Oregon (Marshall et al. 2003). Interior grasslands in the Umatilla/Willow subbasin are estimated to have declined by 74% since historic times (c. 1850). Inaddition, subbasin planners believe that the quality of remaining grassland habitat has also decreased, although no quantitative data on habitat quality of historic or current interior grasslands of the subbasin are available through assessment databases, such as IBIS. Most grassland habitat is under no or low protected status and most is privately-owned, suggesting that strategies should emphasize increased protection and enhancement by working with private landowners.

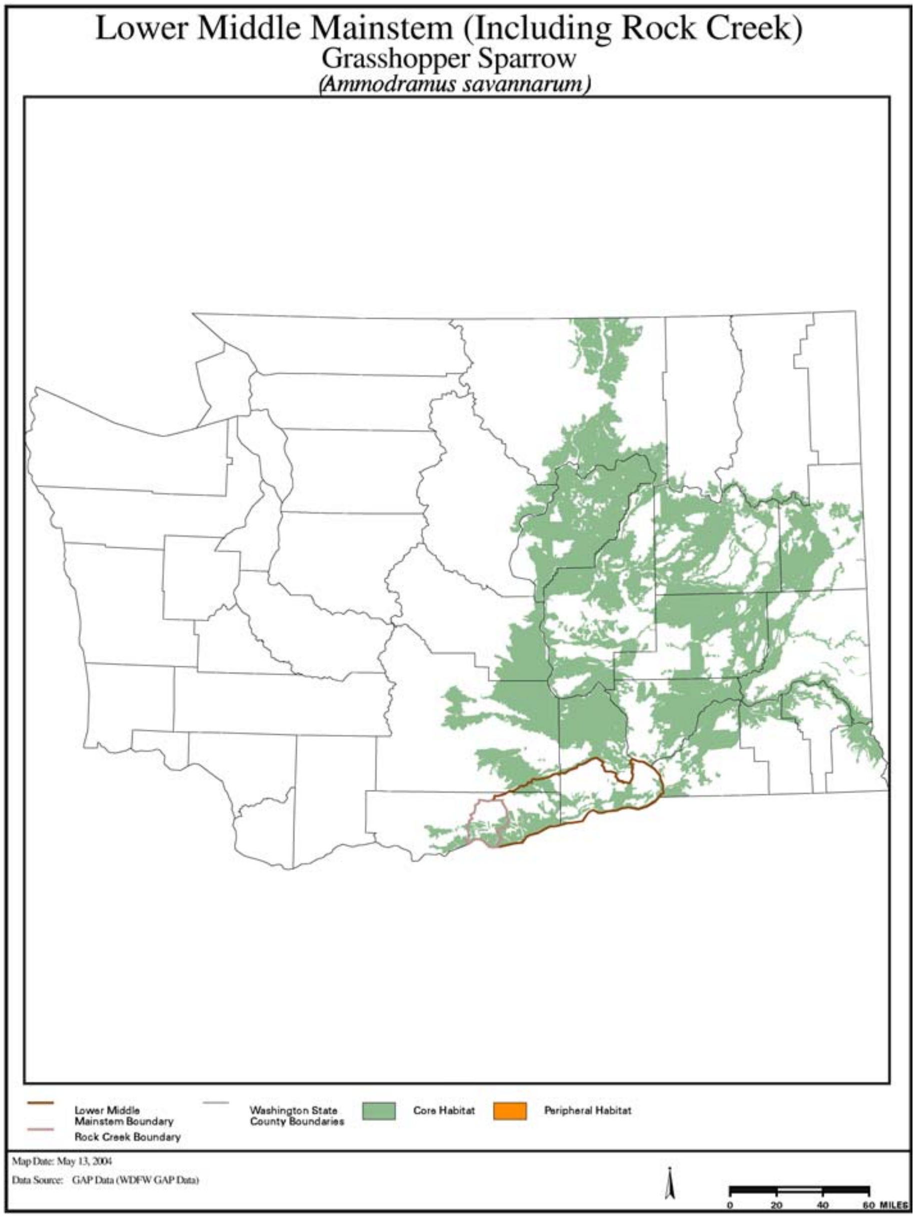


Figure 13 Potential habitat for grasshopper sparrow in the Lower Mid-Columbia Mainstem (including Rock Creek) and Washington (Smith et al. 1997)

Trend

Throughout the United States this sparrow has experienced population declines throughout most of its breeding range (Brauning 1992, Brewer et al. 1991, Garrett and Dunn 1981). In 1996, Vickery (1996) reported that grasshopper sparrow populations have declined by 69% across the U.S. since the late 1960s.

Accordingly, Breeding Bird Survey data show long term declines from 1980 through 2002 of –3.0, -1.6 and –10.7 for Washington, Oregon, and Idaho, respectively. The entire Intermountain Grassland area shows large decrease of –12.4 over this same time period.

Washington, Oregon and the entire intermountain grassland area show an increasing negative trend when looking at the more recent time period (1996-2002) indicating that recently, populations have decreased even more (Sauer et al. 2003).

Management Issues

Grasshopper sparrow populations can vary widely in a particular location from year to year, as the birds move around in response to changes in their habitat. This tendency is reinforced by its semi-colonial nesting habits. Incentives to public land managers and private landowners are needed to create a landscape mosaic of grassland parcels of different structural stages to provide grasshopper sparrow populations with options for establishing breeding grounds in any given year.

Grasshopper sparrows are considered a grassland-interior species. In several studies, including some in Colorado, breeding populations were more abundant in areas distanced from other land-use types, such as suburban developments, recreational trails, and cropland (Vickery 1996). Provide suitable habitat in patches large enough--at least 12 ha (30 ac)--to accommodate breeding birds.

Grasshopper sparrow populations usually respond negatively to grazing or burning in areas where grasses are already comparatively short and sparse (Saab et al. 1995), due to loss of needed nest cover and song perches. In some areas, vegetation requires several growing seasons to recover to conditions suitable to this species. Graze lightly or not at all in areas of short, sparse grasses. Burn grassland parcels in rotation, such that some unburned habitat is always available.

Mowing operations in hayfields often destroy nests or expose them to predators. Landowners should delay mowing until after the completion of nesting, i.e., late July (Shugaart and James 1973, Warner 1992).

Relationship with Riparian/Fisheries Issues

Healthy grasslands and shrub steppe is very important in maintaining healthy riparian systems. Upland and floodplain grassland/shrub steppe is important in capturing and holding onto water during snowpack and flooding. During snowpacks, shrubs and bunchgrasses hold onto snow and shade it, reducing the melt rate. When snow melts, the vegetation keeps the moisture from flowing along the surface, but instead infiltrating into the ground. The water than percolates through the soil, where it can be used by vegetation, eventually entering streams. By moving through soil, the water is cleaned, carrying less sediment into the stream then if it entered as runoff. The soil also acts to dissipate the kinetic energy of water as it moves down the elevational gradient. This is also very important during heavy rain and flooding. Grassland/shrub steppe also holds onto water longer, releasing it slowly into the drier seasons, keeping streams running longer, important to fish and other riparian dependent wildlife. Unhealthy grassland/shrub steppe can lead to eroded stream banks, high sediments loads, and more extreme flooding.

Out-of-Subbasin Effects and Assumptions

In spring, the grasshopper sparrow is a notably late migrant, arriving in southern British Columbia in early to late May (Vickery 1996). Grasshopper sparrows arrive in Colorado in mid May and remain through September. They winter across the southern tier of states and south into South America (Marshall et al. 2003).

Data regarding the movements of grasshopper sparrows outside of the breeding season is scarce due to their normally secretive nature (Zeiner et al.1990). Although diurnally active, grasshopper sparrows are easily overlooked as “they seldom fly, preferring to run along the ground between and beneath tufts of grass” (Pemberton 1917). Because of their secretive nature, the northern limit of their winter range is poorly known. Migratory individuals have been recorded casually south to western Panama (Ridgely and Gwynne 1989) and (in winter) north to Maine (PDV), New Brunswick, Minnesota (Eckert 1990), and western Oregon (Vickery 1996).

Factors Limiting Population

Fragmentation

Fragmentation is often a result of agricultural development and can have several negative effects on landbirds: insufficient patch size for area-dependent species; increases in edges and adjacent hostile landscapes; reduced productivity through increased nest predation, nest parasitism, and reduced pairing success of males. Making this loss of habitat even more severe is that the grasshopper sparrow, like other grassland species, shows sensitivity to the grassland patch size (Herkert 1994a and b, Samson 1980, Vickery 1994, Bock et al. 1999). Herkert (1991) in Illinois found that grasshopper sparrows 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.

Inappropriate Grazing

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

Parasitism

Grasshopper sparrows are vulnerable to parasitism by brown-headed cowbirds (Elliott 1976, 1978; Davis and Sealy 2000). In Kansas, cowbird parasitism cost grasshopper sparrows about two young/parasitized nest, but there was a low likelihood of nest abandonment due to cowbird parasitism (Elliott 1976, 1978). An increase in livestock grazing intensity within shrubsteppe or grassland habitat could increase populations of cowbirds, making grassland species more susceptible to nest parasitism.

Altered Fire Regimes

The impact of fire on grassland birds in North America has shown similar results as grazing studies: namely, bird response is highly variable. 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 from fire. 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. The invasion of non-native grass species, such as cheatgrass, has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires.

Mowing and haying

This 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 on grasshopper sparrows 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).

4.4.3 Brewer's Sparrow (*Spizella breweri*)

Rationale for Selection

Although not currently listed, Brewer's sparrows have significantly declined across their breeding range in the last 25 years, a cause for concern because this species is one of the most widespread and ubiquitous birds in shrub steppe ecosystems (Saab et al. 1995). Oregon-Washington Partners in Flight consider the Brewer's sparrow a focal species for conservation strategies for the Columbia Plateau (Altman and Holmes 2000). Brewer's sparrow is an indicator of healthy shrub steppe habitat and for that reason, they were chosen as a focal species for the Shrub Steppe/Interior Grassland wildlife focal habitat.

Key Life History Strategies: Relationship to Habitat

Summary

Recommended habitat objectives include the following (Altman and Holmes 2000):

- Patches of sagebrush cover 10-30%;
- Mean sagebrush height > 64cm (24 in);
- High foliage density of sagebrush,
- Average cover of native herbaceous plants > 10%, and
- Bare ground >20%.

General

Vander Haegen et al. (2000) determined that Brewer's sparrows were more abundant in areas of loamy soil than 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 sparrows prefer areas dominated by shrubs rather than grass (Knick and Rotenberry 1995). Brewer's sparrow abundance in eastern 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 <20%(Dobler 1994). Removal of sagebrush cover to <10%has a negative impact on populations (Altman and Holmes 2000).

Nesting

Brewer's Sparrows are strongly associated with big sagbrush and tend to breed in shrublands with an average canopy height of less than 5 ft. (1.5 m) (Marshall et al. 2003). In the Great Basin, they also use greasewood, rabbitbrush, and shadscale.

Diet and Foraging

During summer, the Brewer's sparrow feeds on weed seeds and insects taken from foliage, the ground, and the bark of sagebrush (Stokes 1996, Wiens et al. 1987). Their winter diet consists primarily of seeds (Rosenberg et al. 1991) .

Population Status and Trend

Status

Brewer's sparrow is often the most abundant bird species in appropriate sagebrush habitats, comprising an aveage of 55% of all birds in shrub-steppe bird communities (Rotenberry and Wiens 1980) The bird is abundant east of the Cascades summit during the summer and is a probable and possible breeder in some portions of Sherman and Gilliam counties, Oregon (Marshall et al. 2003). However, widespread long-term declines and threats to shrub steppe 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. See **Figure 14** for map of potential habitat.

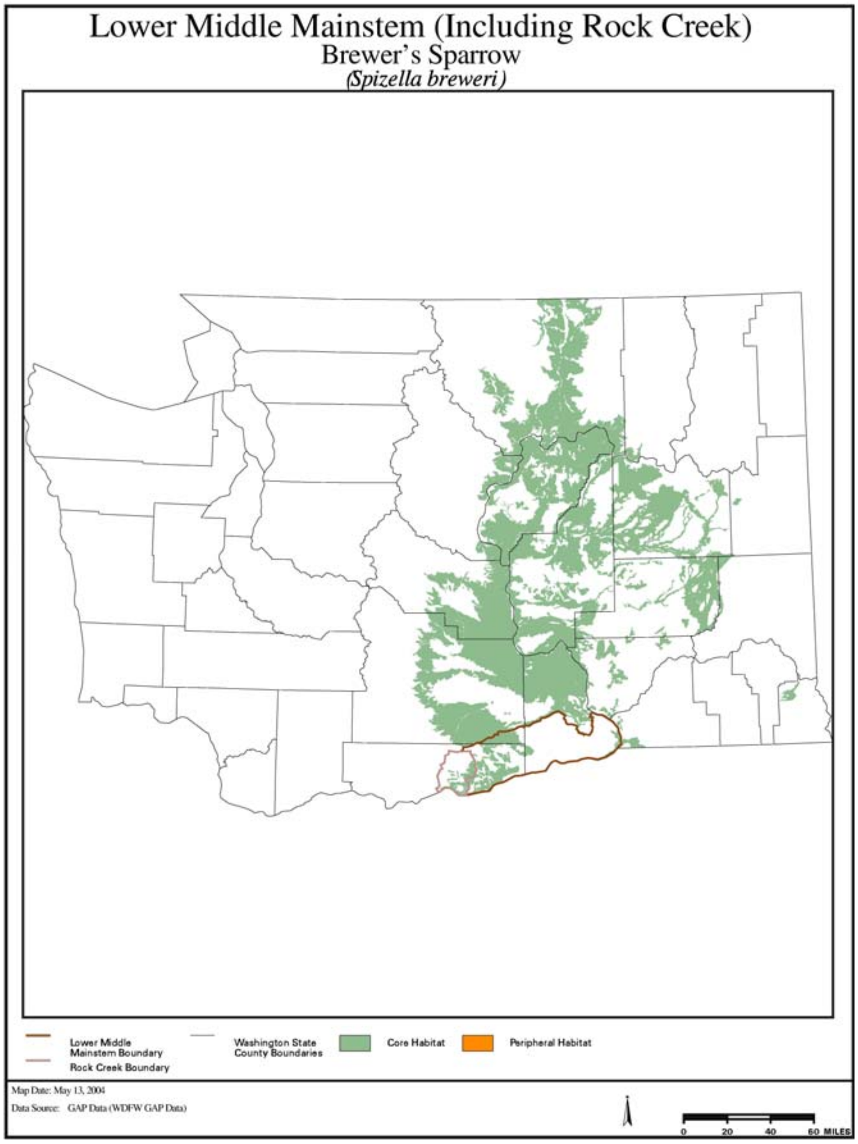


Figure 14 Potential Brewer's sparrow habitat in the Lower Mid-Columbia Mainstem (including Rock Creek) and Washington (Smith et al. 1997)

Trends

BBS data for Washington state indicate a significant population decline of about 3.1% per year fom 1996-1998. Oregon has experienced a decline of 2.6% per year for the same time period (Sauer et al. 1999). Within the entire Interior Columbia Basin, over 48% of watersheds show moderate or strong declining trends in source habitats for this species (Wisdom et al. in press) (from Altman and Holmes 2000). Surveys have shown significant declines in Brewer's sparrow in many other states, but sample sizes for Washington are too small for accurate estimates of trends.

Relationship with Riparian/Fisheries Issues

Healthy grasslands and shrub steppe is very important in maintaining healthy riparian systems. Upland and floodplain grassland/shrub steppe is important in capturing and holding onto water during snowpack and flooding. During snowpacks, shrubs and bunchgrasses hold onto snow and shade it, reducing the melt rate. When snow melts, the vegetation keeps the moisture from flowing along the surface, but instead infiltrating into the ground. The water then percolates through the soil, where it can be used by vegetation, eventually entering streams. By moving through soil, the water is cleaned, carrying less sediment into the stream then if it entered as runoff. The soil also acts to dissipate the kinetic energy of water as it moves down the elevational gradient. This is also very important during heavy rain and flooding. Grassland/shrub steppe also absorbs water and releases it slowly during the drier seasons to keep streams running and to enhance riparian habitat for fish and wildlife. Unhealthy grassland/shrub steppe can lead to eroded stream banks, high sediments loads, and more extreme flooding.

Out-of-Subbasin Effects and Assumptions

A few Brewer's sparrows arrive at their spring breeding grounds in Oregon in early April, but most arrive between late April and early July. Southward migration begins in mid-July and peaks during late August. Most have dispersed by mid-September (Marsall et al. 2003).

No data could be found on the migration and wintering grounds of the Brewer's sparrow. It winters from the southwest edge of the U.S. to the southern tip of Baja California and central Mexico (Rotenberry et al. 1999, Sauer et al. 1999, AOU 1998) and, as a result, faces a complex set of potential effects during its annual cycle. Habitat loss or conversion is likely happening along its entire migration route (Ferguson, pers. comm.). Management requires the protection or enhancement of shrub, shrub steppe, desert scrub and grassland habitats, and the elimination or control of noxious weeds. Migration routes and wintering grounds need to be identified and protected.

Factors Affecting Population

Habitat Loss and Fragmentation

Direct habitat loss due to conversion of shrublands to agriculture coupled with sagebrush removal/reduction programs and development have significantly reduced available habitat and contributed towards habitat fragmentation of remaining shrublands. Within the entire Interior Columbia River Basin, nearly 60% of native shubsteppe has been lost to agriculture (Dobler et al. 1996) and 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).

Inappropriate Grazing

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.

Invasive Non-Native Weeds

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.

Altered Fire Regimes

Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to grasslands dominated by introduced vegetation as the fire cycle escalates, 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 shrub steppe, altering shrubland habitats.

4.4.4 Shrub Steppe/Interior Grasslands and Focal Species Key Findings, Limiting Factors and Working Hypotheses

Table 16 Key findings, limiting factors and working hypotheses for the Shrub Steppe/Interior Grasslands focal habitat and its representative focal species

SHRUB STEPPE/INTERIOR GRASSLANDS HABITAT		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Habitat has undergone structural and compositional changes. This includes lost species diversity, reduced microbiotic crust, changes in shrub cover and invasion by noxious weeds	Loss of Habitat Quality	Encouraging proper grazing will improve range conditions by reducing future spread of invasive exotic plant species and helping to reestablish a native plant community. Proper livestock management can also reduce soil disturbance in sensitive areas and benefit microbiotic crusts. Properly managed grazing in critical areas will help reduce the damage to native grasses and shrubs will improve Brewer's sparrow habitat and increase population size and presence.
	Vegetation and Soil Damage	Limiting ORV traffic to specific marked areas, or eliminating it completely, will protect shrub steppe/grassland habitat, reduce stream sedimentation from snowmelt, rain fall runoff from tire tracks, dirt roads.
	Displacement of Native Vegetation with Non-Native Vegetation	Reduction of invasive non-native plant species will increase water availability to native shrubs, forbs and grasses and decrease danger of large wildfires.
	Reduction in Age Class, or Complete Loss, of Shrub Steppe Vegetation	Increasing fire frequency intervals and thereby reducing fire intensity will allow native shrub species to reach late seral conditions and reestablish areas they were once historically found. Microbiotic crusts will increase in quantity and quality as well.
	Loss of Ephemeral Wetlands	Ephemeral wetlands are a uniquely important part of the shrub steppe and grasslands adding diversity and stability to the plant community.
Habitat has historically undergone and continues to undergo loss of large contiguous patches resulting in fragmentation of both habitat and wildlife populations.	Loss of Shrub Steppe/Grassland Habitat	Halting new development on shrub steppe/grassland habitat and implementing current shrub steppe and grassland conservation will reverse the fragmentation of this habitat and maintain existing patches.

SHRUB STEPPE/INTERIOR GRASSLANDS HABITAT		
Key Findings	**Limiting Factors**	**Working Hypotheses**
SHRUB STEPPE/INTERIOR GRASSLANDS - FOCAL SPECIES		
Mule/Black-Tailed Deer		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Deer are an important species economically, culturally and ecologically.	Loss of Shrub Steppe Habitat Within Winter Range	Protecting important wintering areas from land conversion and development will increase winter survival.
	Reduction in Age Class, or Complete Loss, of Shrub Steppe Vegetation	Decrease fire in shrub steppe will protect sagebrush, important in winter for cover and forage.
	Hunting Mortality	Responsible management of deer for hunting in the subbasin will benefit both people and deer.
Grasshopper Sparrow		
Key Findings	**Limiting Factors**	**Working Hypotheses**
The principal factors reducing grasshopper habitat is: habitat loss and fragmentation and habitat degradation and alteration.	Loss of Grassland Habitat within Breeding Range	Restoring converted, abandoned habitat back into native bunchgrass habitat will increase available habitat and reverse population declines.
	Loss of Grassland Habitat Quality	Properly managed grazing will decrease spread of non-native understory plant species and help reestablish a native plant community.
	Displacement of Native Vegetation with Non-Native Vegetation	Control of non-native weeds will maintain and increase habitat available to grasshopper sparrow.
Brewer's Sparrow		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Brewer's sparrows have suffered loss of habitat from land conversion and degradation reducing their population size and distribution.	Loss of Shrub Steppe Habitat within Breeding Range	Restoring converted, abandoned habitat back into shrub steppe will increase available habitat and reverse population declines.
	Loss of Shrub Steppe Habitat Quality	Properly managed grazing in critical areas will help reduce the damage to native grasses and shrubs will improve Brewer's sparrow habitat and increase population size and presence.

SHRUB STEPPE/INTERIOR GRASSLANDS HABITAT		
Key Findings	**Limiting Factors**	**Working Hypotheses**
	Displacement of Native Vegetation with Non-Native Vegetation	Controlling the spread of non-native weeds, and removing weeds from historical shrub steppe/grassland habitat will improve habitat for Brewer's sparrow and increase population size and presence.

4.5 Ponderosa Pine (*Pinus ponderosa*)/Oregon White Oak (*Quercus garryanna*)

Rationale For Selection

Due to the alteration of ponderosa pine/Oregon White Oak habitat and loss of late seral pines, and due to the importance of large pines to wildlife, the Ponderosa Pine/Oregon White Oak wildlife habitat type was chosen as a focal wildlife habitat. This habitat type occurs primarily on the Washington side of the subbasin. In the Oregon portion of the subbasin, this habitat is restricted to a narrow strip of ponderosa pine dominant forest within the northern edge of the Umatilla National Forest (See IBIS map,). This area was not covered in this subbasin plan (See **Figure 1**); it was included in the Umatilla Subbasin Plan along with other information on Willow Creek and its tributaries.

Ponderosa Pine

This habitat occurs in much of eastern Washington and eastern Oregon, including the eastern slopes of the Cascades (Crawford and Kagan, 1998-2003). Much of the ponderosa pine forest in Washington State lies at lower elevations under state and private ownership. Ponderosa Pine habitat generally occurs on the driest sites supporting conifers in the Pacific Northwest. It is widespread and variable, appearing on moderate to steep slopes in canyons, foothills, and on plateaus or plains near mountains. In Oregon, this habitat can be maintained by the dry pumice soils, and in Washington it can be associated with serpentine soils. Average annual precipitation ranges from about 14 to 30 inches (36 to 76 cm) on ponderosa pine sites in Oregon and Washington and often as snow. This habitat can be found at elevations of 100 ft (30m) in the Columbia River Gorge to dry, warm areas over 6,000 ft (1,829 m). Timber harvest, livestock grazing, and pockets of urban development are major land uses (Crawford and Kagan, 1998-2003).

Much of the ponderosa pine land base in this subbasin was heavily harvested in the first part of the last century, leaving very little late seral or old growth habitat today. Fire suppression and grazing had additional impacts. Noss, et al. (2001) considers ponderosa pine ecosystems to be one of the most imperiled ecosystems of the West and the USGS Biological Resources Division classifies old-growth ponderosa pine (Pinus ponderosa) forests in the northern Rocky Mountains, Intermountain West, and eastside Cascades Mountains as endangered (85-98% decline) (Noss et al. 1995). Much of this land is now over stocked with an understory of Douglas-fir and grand fir (*Abies grandis*) or smaller diameter pine. The loss and alteration of historic vegetation communities has impacted landbird habitats and resulted in species range reductions, population declines and some local and regional extirpations (Altman 2000). Interior Columbia Basin studies (Wisdom, et al. 2999) found that wildlife species declines were greatest in low-elevation, old-forest habitats. A more detailed discussion of habitat dynamics for this forest type can be found in Johnson and O'Neil (2001).

There is major dependency on ponderosa pine habitats by white-headed woodpecker (*Picoides albolarvatus*), western gray squirrel (*Sciurus griseus*), Lewis' woodpecker (*Melanerpes lewis*) and flammulated owl (*Otus flammeolus*). Other species that are dependent upon or benefit substantially from this habitat include the pygmy nuthatch (*Sitta pygmaea*) and Williamson's sapsucker (*Sphyrapicus thyroideus*). Other birds that seem to prefer mature ponderosa pine stands are western wood-peewee (*Contopus sordidulus*), mountain chickadee (*Poecile gambeli*), red-breasted nuthatch (*Sitta canadensis*), hermit thrush (*Catherus guttatus*), western tanager (Piranga ludoviciana), chipping sparrow (*Spizella passerine*), Cassin's finch (Cardopacus cassinii), red crossbill (*Loxia curvirostra*) and evening grosbeak (*Coccothraustes vespertinus*) (Hutto and Young 1999). Clark's nutcracker (*Nucifraga columbiana*) and brown creepers (*Certia americana*) also use ponderosa pine as a food source (Dixon, pers. comm.).

Oregon White Oak

Oregon white oak woodlands consist of stands of pure oak or oak/conifer associations. In oak/conifer associations, ponderosa pine and Douglas-fir are important conifer components of these habitats. East of the Cascades, important oak habitat stands should generally be ≥ 5 acres in size to be functional habitat for wildlife. In more developed areas, though, single oaks or small stands of oaks that are < 1 acre in size, can also be valuable to wildlife when the oaks are late seral. These oaks are larger in diameter, contain more cavities for nesting, produce more acorns, and have a large canopy. Late seral oaks are an important component of all oak forests.

Oregon white oak, known by many as Garry oak, is Washington's only native oak species (Miller 1985). It provides a unique plant community that provides forage, nesting and cover habitat to oak obligate species as well as many other more generalist species. There is a diversity of wildlife species found in all of Washington's oak forests, but in the oak forests found along Klickitat River, there are several bird species present not otherwise found in Washington State (Manuwal 1989). These include acorn woodpecker (*Melanerpes formicivorus*), scrub jays (*Aphelocoma coerulescens*), and dusky flycatchers (*Empidonax oberholseri*).

Over the last two centuries, oak habitats have changed due to land conversion, timber practices and fire suppression. Today's oak stands are denser with smaller trees. Younger, denser stands do not provide as good wildlife habitat as the older, more open stands. Late seral oak stands are important to western gray squirrels, white-headed woodpeckers and Lewis' woodpecker. In upland oak-pine stands, some of the more common birds include the chipping sparrow, Nashville warbler (*Vermivora ruficapilla*), lazuli bunting (*Passerina anoena*), red-breasted nuthatch, western tanager, and ash-throated flycatcher (*Myiarchus cinerascens*). In the oak-pine riparian areas, some of the most common birds are the spotted towhee (*Pipilo erythrophthalmus*), black-headed grosbeak (*Pheucticus melanocephalus*), American robin (*Turdus migratorius*), black-throated gray warbler (*Dendroica nigrescens*), MacGillivray's warbler (*Oporornis tolmiei*), lazuli bunting and red-breasted nuthatch. Reptiles found in oak habitats include the California Mountain king snake (*Lampropeltis zonata*), sharptail snake (*Contia tenuis*), western rattlesnake (*Crotalus viridis*), southern alligator lizard (*Elgaria multicarinata*), and the western skink (*Eumeces skiltonianus*) (St. John 2002). There are also many invertebrates species that use oak forests.

Description of Habitat

Ponderosa Pine

Historic

Prior to 1850, much of the ponderosa pine habitat in this subbasin, and other parts of the inland northwest, was mostly open and park like with relatively few undergrowth trees. Ponderosa pine forests historically burned approximately every 5-30 years prior to fire suppression, preventing contiguous understory development and, thus, maintaining relatively open ponderosa pine stands. Similar fire cycles are likely in this subbasin as well.

The 1930s-era timber inventory data (Losensky 1993) suggests large diameter ponderosa pine-dominated stands occurred in very large stands, encompassing large landscapes. Such large stands were fairly homogeneous at the landscape scale (i.e. large trees, open stands), but were relatively heterogeneous at the acre scale, with "patchy" tree spacing, and multi-age trees (Hillis et al. 2001).

Ponderosa pine forms climax stands that border grasslands and is a common member in many other forested communities (Steele et al. 1981). Ponderosa pine is a drought tolerant tree that usually occupies the transition zone between grassland and forest. Climax stands are characteristically warm and dry, and occupy lower elevations throughout their range. Key understory associates in climax stands typically include grasslike species such as bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*), elk sedge (*Corex geyeri*), pine grass and shrubs such as bitterbrush (*Purshia tridentata*), various ceanothus pecies (redstem (*Ceanothus sanguineus*), deer brush (*C. integerrimus*), snowbrush (*C. velutinus*), squaw carpet (*C. prostrates*)) and common snowberry (*Symphoricarpus albus*). Ponderosa pine associations can be separated into three shrub-dominated and three grass-dominated habitat types.

Four community types are associated with ponderosa pine (Cooper et al. 1991):

- Ninebark (Physocarpus malvaceus);
- Common snowberry;
- Idaho fescue, and
- Bluebunch wheatgrass

Daubenmire and Daubenmire (1984) recognize two more habitat types within the ponderosa pine series:

- Needlegrass (*Stipa comata*)
- Bitterbrush

In some places, the change from steppe to closed forest occurs without the transitional ponderosa pine zone, for example, at locations along the east slopes of the north and central Cascades. More commonly, the aspect dependence of this zone creates a complex inter-digitization between the steppe and ponderosa pine stands, so that disjunct steep zone fragments occur on south-facing slopes deep within forest while ponderosa pine woodlands reach well into the steppe along drainages and north slopes.

The successional status of ponderosa pine can be best expressed by its successional role, which ranges from seral to climax depending on specific site conditions. It plays a climax role on sites toward the extreme limits of its environmental range and becomes increasingly seral with conditions that are more favorable. On more mesic sites, ponderosa pine encounters greater competition and must establish itself opportunistically, and is usually seral to Douglas-fir and true firs (mainly grand fir and white fir). On severe sites, it is climax by default because other species cannot establish. On such sites, establishment is likely to be highly dependent upon the cyclical nature of large seed crops and favorable weather conditions (Steele 1988).

Current

Quigley and Arbelbide (1997) concluded that the interior ponderosa pine habitat type is significantly less in extent than pre-1900 and that the Oregon white oak habitat type is greater in extent than pre-1900. They included much of this habitat in their dry forest potential vegetation group, which they concluded has departed from natural succession and disturbance conditions. The greatest structural change in this habitat is the reduced extent of the late-seral, single-layer condition. This habitat is generally degraded because of increased exotic plants, decreased overstory canopy, and decreased native bunchgrasses. One third of Pacific Northwest Oregon white oak, ponderosa pine, and dry Douglas-fir or grand fir community types listed in the National Vegetation Classification are considered imperiled or critically imperiled.

Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives 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 for timber in much of this habitat. Under most management regimes, typical tree size decreases and tree density increases in this habitat. Ponderosa pine/Oregon white oak habitats are now denser than in the past and may contain more shrubs than in pre-settlement habitats. In some areas, new woodlands have even been created with tree establishment at the forest-steppe boundary.

Throughout most of the zone, ponderosa pine is the sole dominant in all successional stages. At the upper elevation limits of the zone, on north-facing slopes in locally mesic sites, or after long-term fire suppression, other tree species Douglas fir, grand fir, western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta latifolia*), western juniper (*Juniperus occidentalis*), or Oregon white oak may occur. At the upper-elevation limits of the zone, in areas where the ponderosa pine belt is highly discontinuous, and in cooler parts of the zone, Douglas-fir, and occasionally western larch, lodgepole pine, and grand fir become increasingly significant. In Yakima and Klickitat Counties, Oregon white oak may be present, especially in drainages (extensive Oregon white oak stands are assigned to the Oak zone). In the BIue Mountains, small amounts of western juniper commonly occur. Lodgepole pine is common in the northeast Cascades and northeastern Washington (Daubenmire and Daubenmire 1968).

Stresses

Timber Activities

The ponderosa pine ecosystem has been heavily altered by past forest management. Specifically, the removal of overstory ponderosa pine since the early 1900s and nearly a century of fire suppression have led to the replacement of most old-growth ponderosa pine forests by younger forests with a greater proportion of Douglas-fir than ponderosa pine (Habeck 1990). Clear-cut logging and subsequent reforestation have converted many older stands of ponderosa pine/Douglas-fir forest to young structurally simple ponderosa pine stands (Wright and Bailey 1982).

Ponderosa pine is shade intolerant and grows most rapidly in near full sunlight (Franklin and Dyrness 1973, Atzet and Wheeler 1984). Logging is usually done by a selection-cut method.

Older trees are taken first, leaving younger, more vigorous trees as growing stock. This effectively returns succession to earlier seral stages and eliminates climax, or old growth, conditions. Logging also impacts understory species by machine trampling or burial under slash. Clearcutting generally results in dominance by understory species present before logging, with invading species playing only a minor role in post logging succession (Atzet and Wheeler 1984).

Fire Suppression

Ponderosa pine has many fire resistant characteristics. Seedlings and saplings are often able to withstand fire. Pole-sized and larger trees are protected from the high temperatures of fire by thick, insulative bark, and meristems are protected by the surrounding needles and bud scales. Other aspects of the pine's growth patterns help in temperature resistance. Lower branches fall off the trunk of the tree, and fire caused by the fuels in the understory will usually not reach the upper branches. Ponderosa pine is more vulnerable to fire at more mesic sites where other conifers as Douglas-fir, and grand fir form dense understories that can carry fire upward to the overstory. Ponderosa pine seedlings germinate more rapidly when a fire has cleared the grass and the forest floor of litter, leaving only mineral rich soil (Fischer and Bradley 1987).

Fire suppression has lead to a buildup of fuels that, in turn, increase the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover, reduce fine fuels that carry low intensity fires, and tends to favor shrub and conifer species. Fire suppression combined with grazing creates conditions that support cloning of oak and invasion by young conifers, including shade tolerant species such as grand fir.

Successional and climax tree communities are inseparable in this zone because frequent disturbance by fire is necessary for the maintenance of open woodlands and savanna. Natural fire frequency is very high, with cool ground fires believed to normally occur at 8 to 20 year intervals by one estimate and 5 to 30 year intervals by another. Ponderosa pine trees are killed by fire when young, but older trees survive cool ground fires. Fire suppression favors the replacement of the fire-resistant ponderosa pine by the less tolerant Douglas-fir and grand fir.

The high fire frequency maintains an arrested seral stage in which the major seral tree, ponderosa pine, is the "climax" dominant because other trees are unable to reach maturity. The ponderosa pine zone is most narrowly defined as the zone in which ponderosa pine is virtually the only tree. As defined in this document, the ponderosa pine zone encompasses most warm, open-canopy forests between steppe and closed forest, thus it includes stands where other trees, particularly Douglas-fir, may be co-dominant with ponderosa pine (Daubenmire and Daubenmire 1968).

The major defining structural feature of this zone is open-canopy forest or a patchy mix of open forest, closed forest, and meadows. On flat terrain, trees may be evenly spaced. On hilly terrain, the more common pattern is a mix of dry meadows and hillsides, tree clumps, closed forest in sheltered canyons and north-facing slopes, shrub patches, open forest with an understory of grass and open forest with an understory of shrubs. Without fire suppression, the common belief is that the forest would be less heterogeneous and more savanna-like with larger, more widely spaced trees and fewer shrubs (see Daubenmire and Daubenmire 1968 for a dissenting opinion).

Inappropriate Grazing

Excessive grazing of ponderosa pine stands in the mesic shrub habitat type tends to lead to swards of Kentucky bluegrass and Canada bluegrass (*Poa compressa*). Native herbaceous understory species are replaced by introduced annuals, especially cheatgrass and invading shrubs under heavy grazing pressure (Agee 1993). In addition, 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.

Oregon White Oak

Historic

Oak and oak/conifer habitats are usually confined to drier microsites between conifer and grassland or shrubsteppe habitats (Stein 1980, Crawford and Kagan 1998-2003). Ponderosa pine and Douglas-fir are often important tree species components of oak habitats and can increase their value to wildlife. In our area, understory shrubs are often dominated by bitterbrush and big sagebrush (*Artemesia tridentata*) (Taylor and Boss 1975). Understory forbs are often dominated by the same species common to adjacent shrub steppe and grassland habitats, such as lupine, balsamroot, Idaho fescue, bluebunch wheatgrass, elk sedge, and other common grass-like species.

Nest cavities are an important component of oak forests. Many of the cavities found in oak trees are created by woodpeckers. Woodpeckers, which are primary excavators, cannot create cavities in all trees and snags (Jackman 1975). It is important to have trees of varying ages and diameters to increase the number of woodpecker-created cavities in an oak forest (Conner et al. 1975). In turn, the higher number of cavities present is directly related to the density of cavity-nesting species (Jackman 1975), such as the flammulated owl, a secondary cavity user. Cavities can also be created when decay-causing organisms infect a wound, such as a broken bole or branch, and the tree grows around the wound to contain the decay (Gumtow-Farrior and Gumtow-Farrior 1994). This can create large, deep cavities inside the tree that are used by species such as the western gray squirrel for nesting and rearing young.

Oak has always been an important food source for wildlife. Oaks support insects within its bark that are eaten by woodpeckers (Jackman 1975). The most important food source from oaks is acorns. Oak masts (acorns) make up the significant portion of the diet of many species of birds and mammals (Voeks 1981, Miller 1985, Larsen and Morgan 1998). Consumers of acorns include western gray squirrel, Douglas' squirrel (*Tamiasciurus douglasii*), Lewis' woodpecker, deer, acorn woodpeckers, scrub jays and black bear (*Ursus americanus*). Acorn production fluctuates yearly for unknown reasons (Larsen and Morgan 1998).

Leaves are an important food source for deer and elk, and contain significant amounts of protein (Miller 1985). Deer and elk, in turn, are an important prey item for several carnivores such as cougars (*Puma concolor*), whose population depends on the healthy deer population (Barrett 1980). Some invertebrates also rely on oak leaves during larval stages (Pyle 1989, Larsen and Morgan 1998). Leaf litter also may help retain soil moisture that aids in oak seedling survival.

Current

In Washington and Oregon, ponderosa pine-Douglas-fir woodland habitats occur along the eastern slope of the Cascades, the Okanogan Highlands, and in the Blue Mountains. Ponderosa pine woodland and savanna habitats occur in the foothills of the Blue Mountains, along the eastern base of the Cascade Range, the Okanogan Highlands, and in the Columbia Basin in northeastern Washington. Ponderosa pine is widespread in the pumice zone of south-central Oregon between Bend and Crater Lake east of the Cascade Crest. Ponderosa pine-Oregon white oak habitat appears east of the Cascades in the vicinity of Mt. Hood near the Columbia River Gorge north to the Yakama Nation and south to the Warm Springs Nation. Oak dominated woodlands follow a similar distribution as Ponderosa Pine-White Oak habitat but are more restricted and less common (Crawford and Kagan 1998-2003) (Figure 15).

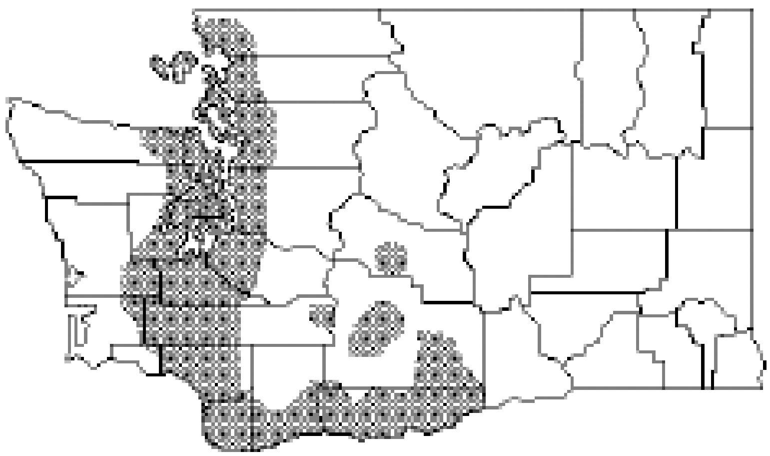


Figure 15 Range of Oregon white oak woodlands in Washington. Map derived from WDFW data files and the literature (Larsen and Morgan 1998)

Stresses

Fire Suppression

Fire suppression has created denser forests with smaller trees. In oak forests, it has led to denser understories, smaller trees and higher fuel loads. Historically, oak forests, like ponderosa pine, were more open and park-like. Open-canopy stands of oak generally have more complex plant understories than closed-canopy stands and can, therefore, support more wildlife species. Canopy cover of 25-50%provides ideal habitat for a variety of species as well as needed gaps for sunlight (Barrett 1980).

Although conifer encroachment is an issue in oak forests in many parts of Washington State, it may not be in eastern Washington. Conifer encroachment, predominately by Douglas-fir, occurs primarily west of the Cascade crest and in wetter areas on the east side, such as the White Salmon River drainage of the Columbia Gorge. In drier areas east of the Cascades, conifer competition with oaks is generally negligible. Oregon white oak is usually sub-climax and becomes climax only on dry, rocky, southerly exposures (UFS 1965).

Land Conversion

Most oak woodlands in Washington state are privately owned, and private parcels collectively comprise the largest contiguous tracts (WDW 1993, Larsen and Morgan 1998). Statewide mapping is underway by WDFW to quantify the extent of Washington State’s oak habitat. Klickitat County and adjoining lands harbor the largest stands of Oregon white oak in

Washington State. Klickitat County alone, contains approximately 195,000 acres of oak and oak/pine woodlands with >25% canopy coverage. Within this area, there has been conversion of oak stands to agricultural lands, urban development, and losses from fuelwood cutting. These are believed to be the most significant contributors to oak woodland decline (Larsen and Morgan 1998). These land conversions are still taking place. Oregon white oak responds to fire by reestablishment through sprouting. Subsequent to settlement, fire control has resulted in less fire tolerant species competing for habitat with oak, thus replacing it in the community. This is arguably the significant impact to oak on private lands.

Woodcutting

Woodcutting may remove the largest trees from oak forests. Snags and snag recruitment trees may also be removed. Oak snags and dead portions of live trees harbor insect populations and provide nesting cavities and perches for birds and mammals.

Insects and Disease

Some trees succumb to defoliating insects or insects that attack by creating galls between the tree's bark and wood (UFS 1965). Recent insect blights have occurred in Klickitat County where already drought stressed trees have succumbed (Weiler, pers. comm.).

Thirty-one species of fungi also affect Oregon white oak. Some inhibit growth, and others kill trees. The major decay fungi are shoestring root rot (*Amillaria mellea*) and trunk rot (*Polyporus dryophilus*) (UFS 1965). Decomposing fungi, coupled with the rotting characteristics of this oak species, simplify the excavation of cavities for woodpeckers by softening wood (Jackman 1975). The process is often facilitated by the loss of limbs that expose heartwood (Gumtow-Farrior 1991).

A recent introduction of Sudden Oak Death syndrome, caused by the fungus Phytophthora ramorum, infects and kills other species of oak in California State. Oregon white oak is currently known to be a host to this fungus, but is not killed by it. Managers must stay aware of this fungus in case it mutates into a form deadly to our oaks.

Timber Activities

Clearcutting reduces oak habitat and the numbers of animals within, encourages conifer encroachment, and creates edges. The extent of this activity in this subbasin is currently low or is not occuring. Edges increase the frequency of predation on interior nesting species (Connel et al. 1973, Conner et al. 1979, Chasko and Gates 1982, Reed and Sugihara 1987).

Appropriate timber practices within oak stands vary according to location and tree species composition. When stands are thinned, Douglas-fir and ponderosa pine are harvested, temporarily leaving pure stands of oak. Selective cutting practices can allow for the retention of different age-class and species composition within stands (Conner et al. 1979), and age diversity within stands contributes to species richness and breeding bird diversity (Connel et al. 1973).

Failure to thin even-aged oak stands and failure to open canopy above overshaded oak sprouts and saplings may result in dense, even-aged oak stands of little diversity. Dense, even-aged oak stands support fewer kinds of wildlife.

Oak/Pine Mixed Zones

The difference between conifer encroachment and those oak/conifer associations valuable to wildlife is often unclear. Consultation with biologists from the WDFW and other oak specialists is strongly recommended whenever uncertainty prevails. Almost without exception, conifers associated with oaks in eastern Washington and along drier sites in the Columbia Gorge do not encroach negatively on oaks. Conifer/oak associations in these areas are limited and very valuable as actual or potential habitat, particularly for western gray squirrels and wild turkeys. Conversely, conifer encroachment on oaks in western Washington and along wetter sites in the Columbia Gorge, such as the White Salmon drainage, is prevalent and undesirable.

Oak/conifer associations provide contiguous aerial pathways for squirrels and other animals. Mixed oak/conifer associations are particularly important in potential western gray squirrel habitat and for increasing stand diversity for breeding birds (Rodrick and Milner 1991, WDW 1993).

Failure to provide conifer associations in oak woodlands may limit the number of species of breeding birds present. In addition, roost sites for wild turkeys and other birds, as well as feeding sites for squirrels, will be absent.

4.5.1 Western Gray Squirrel (*Sciurus griseus*)

Rationale for Selection

Although the western gray squirrel was once abundant and widespread throughout oak-conifer forests, its range in Washington State has contracted to three disjunct populations, one of which includes portions of Klickitat County and the Lower Mid-Columbia Mainstem Subbasin. The Oregon side of the subbasin lacks the western gray squirrel’s preferred ponderosa pine/Oregon white oak habitat and the squirrel is not found in this area. Population loss and fragmentation is largely due to disease (i.e., mange) associated with invasion of California ground squirrels and seasonal weather differences, which effect acorn production. Habitat loss and degradation is also a likely long-term factor. In the future, competition from the introduced eastern grey squirrel may also be an issue. The western gray squirrel is heavily associated with both ponderosa pine and Oregon white oak forests. In the Columbia River Gorge, Oregon white oak-ponderosa pine forests prevail. These forests follow stream drainages northward toward Goldendale and into Yakima County (Franklin and Dyrness 1973).

A 1993 unpublished status review by the Washington Department of Wildlife found that the species was “in danger of extirpation from most of its range in Washington” (WDW 1993), although in Klickitat County the population appears to be stable. The western gray squirrel is now a state threatened species in Washington State and a federal species of concern. Due to their strong association with late seral oak and pine forests, the western gray squirrel was chosen as a focal species for the Ponderosa Pine/Oregon White Oak wildlife focal habitat.

Key Life History Strategies: Relationship to Habitat

Summary

Recommended habitat objectives include the following (Foster 1992):

- Contiguous canopy cover (mean = 60%);

- Nest tree age (69-275 yr, mean = 108 yr);
- Diameter at breast height (21-58 cm, mean = 40 cm; 8.2-22.6 in, mean = 15.7 in);
- Within 180 m (600 ft) of water;
- Adequate food sources with acorns important in winter and early spring and pine cones and seeds in late summer and fall, and
- Adequate habitat within home range -- In Klickitat County 95% home ranges from 10-187 ha (mean 73 ha) for males and 3-44 ha (mean 21 ha) for females (Linders 2000).

General

Western gray squirrels need a variety of mast-producing trees for food, cover and nesting sites (WDW 1993). The quality of the habitat is influenced by the number of mast-bearing tree species in and near the nest tree sites, the age and size of the trees, and proximity to permanent water (Cross 1969, Gilman 1986, Foster 1992). The western gray squirrel is usually associated with mature forests, which provide the above-mentioned characteristics (WDW 1993).

Generally, the squirrels require trees of sufficient size to produce an interconnected canopy for arboreal travel (Foster 1992). Barnum (1975) observed no use of a lone pine tree that was full of green cones, conceivably because there was no travel cover available.

Since extinction or extirpation rates are partly area-dependent, the size of reserves, spacing of reserves, and location of dispersal corridors are important. Individual reserves must be large enough to ensure stability of the ecosystem and to provide a buffer from disturbance (Frankel and Soulé 1981).

Oak was more common in Washington 10,000 years ago, before a long-term climatic change (Kertis 1986). The western gray squirrel was probably more widely distributed in prehistoric times and has diminished recently along with the oak woodlands (Rodrick 1987). Presently, both the oak and the squirrel are at the northern extent of their ranges and are subject to increased pressure from a variety of environmental factors.

Nesting

Most squirrels build round stick nests, approximately 60 cm (2 ft) in diameter, in pole to sawtimber-sized conifers, about one third of distance from the top of the tree and next to the trunk. The nests are lined with lichen, moss, and bark shavings (WDW 1993).

Population Status and Trend

Status

The Western Gray Squirrel is listed as a threatened species in Washington, while its status in Oregon is yet to be determined (ODFW 2004b). In a 2003 Status Review and 12-month finding for a petition to list the Washington population of the western gray squirrel (68 FR 34682), the USFWS concluded that listing was not warranted because the Washington population of western gray squirrels is not a Distinct Population Segment and, therefore, not a listable entity. The Washington populations are discrete from the Oregon and California populations and are declining; they are not “significant to the remainder of the taxon”. The U.S. Forest Service considers the squirrel to be a sensitive species, and uses it as an oak-pine community management indicator species in the Columbia River Gorge National Scenic Area.

Lewis and Clark (Thwaites 1904) described western gray squirrels as locally abundant in the Columbia River Gorge (see **Figure 16** for map of historic distribution). In a book written on the Klickitat area (Neils 1967), Norris Young, an early settler of the town of Klickitat, wrote in 1890 "About this time our grub was getting low. We had killed almost enough gray squirrels to cover our roof and fringe the eaves with squirrel tails. However, we stayed until our food was all gone and we started to live on meat alone."

Residents have noticed a decline of western grays in Klickitat County (Rodrick 196). Prior to the invasion of the California ground squirrel (*Spermophilus beecheyi*), local residents reported more western gray squirrels in the gorge in the 1920s (WDW 1993). Ground squirrel both competed for food and introduced mange to this population, likely contributing to the decline in western gray squirrels (WDW 1993). For example, during a study of western gray squirrels in Klickitat County conducted in 1998 and 1999, an outbreak of mange killed all but 4 of 22 squirrels being monitored by radiotelemetry (Cornish et al. 2001). Although exact reasons for their decline are unknown, changes in the landscape may have played a role.

Isolated populations remain in the southeast slope Cascade region, and the Columbia River Gorge, the latter being the largest in the state (figure 18). Recent records indicate that western gray squirrels are present in five major tributaries of the Columbia Gorge: the Klickitat River, Catherine, Majors, and Rock Creeks, and the White Salmon drainage. In Klickitat County, the population seems to have been stable during the past 20 years. Since 1973, D. Morrison (from WDW 1993, pers. comm.) has observed several western grays each year on the Klickitat Wildlife Area. The western gray squirrel appears to be widely distributed across forested habitats of Klickitat County, but populations are localized. The core population of the western gray squirrel is currently found in the lower Klickitat drainage from the southern Yakama Nation boundary to the mouth of the Klickitat River.

Figure 16 Historic distribution of western gray squirrels in Washington (Source: WDFW, unpub. data)

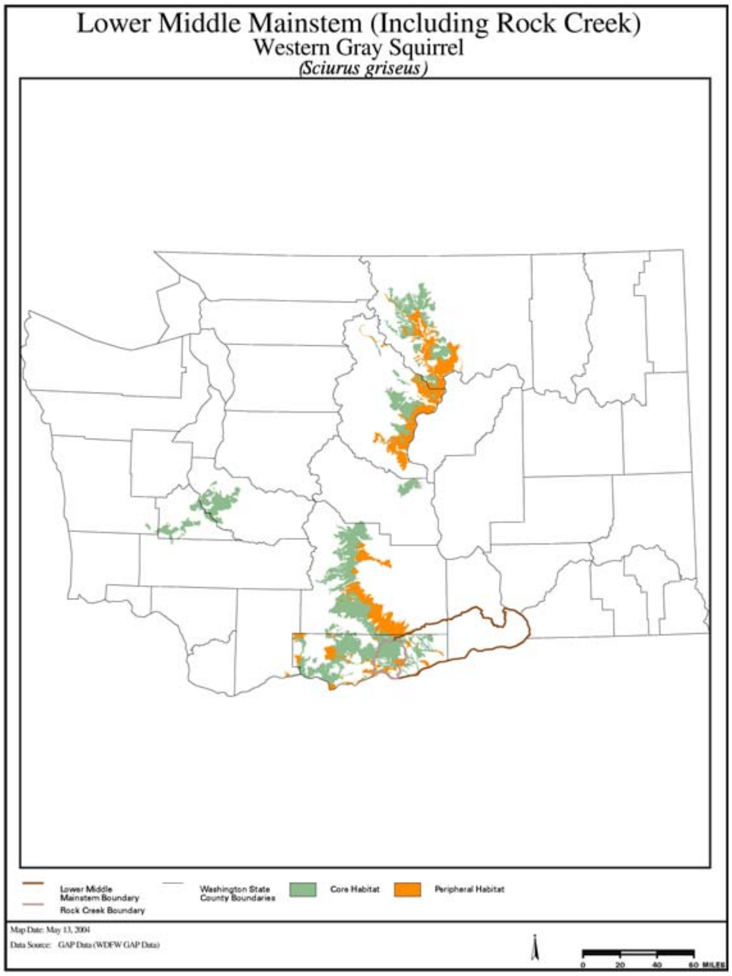


Figure 17 Potential habitat for western gray squirrel in the Lower Mid-Columbia Mainstem (including Rock Creek) subbasin and Washington State (Johnson and Cassidy 1997)

Trend

Long-term trends in the South Cascades population are unclear, although researchers did observe a decline in response to a widespread mange outbreak in 1998-9 and a subsequent rebound in the years following (M. Linders unpubl. data). In Klickitat County, the population seems to have been stable during the past 20 years.

Management Issues

Persistence of this species in the state of Washington will likely depend on state-level protections of oak-conifer habitats and voluntary efforts by landowners and federal entities.

The Washington Department of Fish and Wildlife is in the process of writing a draft recovery plan, which is expected to be due out for public review in the summer of 2004.

Anecdotal evidence suggests there was essentially no acorn crop in the Columbia Gorge in 1991, and an insignificant crop in 1992 (from WDW 1993), indicating that weather cycles associated with mast failures also may cause cyclical declines in squirrel populations.

Out-of-Subbasin Effects and Assumptions

A radio telemetry study of 25 western gray squirrels in Klickitat County, Washington, found 95% MCP year-round home ranges from 10-187 ha (mean 73 ha) for males and 3-44 ha (mean 21 ha) for females (Linders 2000). Home ranges of males were largest, then breeding females, with nonbreeding females having the smallest ranges (Linders 2000).

Relationship with Riparian/Fisheries Issues

In lower Columbia subbasins, oak habitat is commonly found along the main rivers and their tributaries. Large oak trees can provide shade for streams edges, while roots can provide bank stabilization. Healthy riparian terrestrial habitat provides habitat for wildlife as well as nutrients and woody debris, an important stream component for fish.

Factors Affecting Population

Weather

Annual fluctuations in rain and temperature can effect acorn production, which will result in annual fluctuation in western gray squirrel mortality.

Absence of late seral oak and pine

Older trees produce more acorns and pine seeds, vital food sources, and produce better nesting sites (cavities in oak, platforms in pine). There is also an increase in crown connectivity, which is important for arboreal travel.

Presence of non-historical squirrel species:

There has been an increase in California ground squirrels in this subbasin, but the affect on the western gray squirrel population is largely anecdotal. They moved up through Oregon naturally, but there was a rapid increase in their numbers here following the construction of dams and bridges across the Columbia River (WDW 1993). They likely compete for food and nesting, and it has been suspected that California ground squirrels transferred manage to the western gray squirrel population causing a population crash (Brady, pers. comm., 1993).

Eastern gray squirrels (*Sciurus carolinensis*) were introduced into western Washington. Although it is not clear whether eastern gray squirrels displace western gray squirrels, they do areas where westerns were found historically, but are no longer present. This may be due to easterns tolerance of developed areas that westerns do not have. This may have caused easterns to replace rather than displace westerns (WDW 1993). Eastern gray squirrels have been observed in the Big White Salmon subbasin (Anderson and Backus, pers. comm.). There presence in the Rock Creek watershed has not yet been determined.

4.5.2 White-Headed Woodpecker (*Picoides albolarvatus*)

Rationale for Selection

White-headed woodpeckers are a native species that is associated with healthy ponderosa pine forests. They are usually found in montane coniferous forest at 4,000-9,000 ft. elevation and depend on large, old growth (or late seral) ponderosa pines or mixed conifer forest dominated by ponderosa pine for nesting and food (Bull et al. 1986, Dixon 1995a,b, Frenzel 2000). They are also a Washington state candidate species, an Oregon State sensitive species (critical), and a partners in flight (PIF) species and are on the Priority Habitats and Species (PHS) list. Due to their strong association with ponderosa pine forests, they were chosen as a focal species for the Ponderosa Pine/Oregon White Oak focal wildlife habitat.

Key Life History Strategies: Relationship to Habitat

Summary

- Mature and old-growth ponderosa pine and mixed conifer forests (Lewis et al. 2002);
- Varying recommendations on average dbh (diameter at breast height): 10 trees per acre over 20 in. dbh and two trees per acre over 28 in. (Blair and Servheen 1993); mean of 10 trees per acre >21 in. dbh, at least 2 trees per acre > 31 in. dbh (Altman 2000); nine trees over 27 in. dbh per acre (Dixon 1995b); mean 28 in. (Frederick and Moore 1991), and mean of 1.1 trees per acre of 31 in. dbh, for nesting (Frenzel 1998);
- Recommendations also vary regarding large, decayed snags for nesting and roosting: mean average = 51.5 cm dbh (Buchanan et al. 2003), 39.6 cm dbh (J. Kozma, unpub. data); mean of 5 snags per acre over 21 in. dbh, for nesting (Frenzel 1998), and mean of 1.4 per acre > 8 in. dbh with > 50% > 25 in. dbh in a moderate to advanced state of decay (Altman 2000);
- Home Range: 333 acres – predominantly old growth habitat (Dixon 1995b), and 720 acres – fragmented habitat.
- Varying mean canopy closure recommendations include: 56% (Dixon 1995b, Frederick and Moore 1991), 10-40% (Altman 2000)and nesting may not occur in stands with > 26% canopy cover (Frederick and Moore 1991);
- Low tree density, mean 116 trees per acre (Frederick and Moore 1991), and
- Sparse understory vegetation, increased height of first canopy layer (Bate 1995).

Nesting

White-headed woodpeckers need old growth ponderosa pine forest habitats for healthy populations. Large pines eventually turn into large dead trees, or snags, which are ideal for nesting. White-headed woodpeckers favor selection of completely dead and moderately to well-decayed snags for nesting, but studies conducted in Oregon, Idaho, and California revealed the birds also use stumps, leaning logs, and the dead tops of live trees (Dixon 1995a, 1995b, Frederick and Moore 1991, Milne and Hejl 1989).

This species is a weak primary excavator and unable to excavate into hard wood (Raphael and White 1984, Milne and Hejl 1989, Dixon 1995). Therefore, snag decay is often a better predictor of nest site selection in white-headed woodpeckers than diameter of the snag (Frederick and Moore 1991). These birds prefer to build nests in trees with large diameters with preference increasing with diameter. This species typically roosts in both live and dead ponderosa pine trees averaging 60 cm dbh and 7 m tall (Lewis et al. 2002). Oregon studies conducted in the Deschutes and Winema national forests (Dixon 1995 a,b) revealed a 25.6 in. (65 cm; for 43 nests) and 31.5 in. (80 cm; for 16 nests) mean dbh, respectively.

Diet and Foraging

The white-headed woodpecker forages primarily on ponderosa pine seeds. It also feeds on invertebrates (e.g. spruce budworm, larvae, ants, and cicadas) (Dixon 1995b) and insects (e.g. ants, beetles, and scale insects) (Garrett et al. 1996)

Large diameter trees reduce energy expenditure and decrease vulnerability to predation since more time is spent foraging on one tree rather than flying to many trees to find the same quantity of food. In addition, large diameter pine trees often have large cone crops providing a more abundant winter food source. Large conifers selected for foraging also have furrowed bark with numerous fissures; important for species like white-headed woodpeckers that forage predominately by peering and probing bark crevices for insects (Garret et al. 1996). During cold spring weather, birds foraged primarily on ponderosa pine cones, with stomach contents of two males and two females yielding 70-90%pine seeds (Ligon 1973). In early summer, males foraged primarily on the thick cluster of growing needles on branches, presumably taking mostly arthropods (Ligon 1973). In late summer, both males and females foraged on the main trunk of trees and unripened (green) pinecones.

Open stands are important, however, not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989). Old growth ponderosa pine trees produce higher numbers of cones, an important source of food for white-headed woodpeckers. 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. Milne and Hejl (1989) found 68%of nest trees to be on southern aspects.

Population Status and Trend

Historically, white-headed woodpeckers were likely widespread and patchy across the lower elevation forests dominated by large ponderosa pine in the Klickitat subbasin, Washington. North of the subbasin, in the Wenas Valley, bird watcher's records at the site of an annual Audubon Society campout since the 1950s, indicate substantially reduced observations of this species over the years. The area has been logged for large diameter overstory trees several times during this period.

Although its overall range in Oregon appears to be similar to historic patterns (Gabrielson and Jewett 1940), the woodpecker's distribution is believed to have become more patchy because of habitat deterioration associated with timber harvest and fire suppression. There is no ponderosa pine habitat in the areas of Oregon convered by this subbasin plan and the white-headed woodpecker is not known to inhabit the Columbia Plateau Province in Oregon (ODFW 1993).

Although populations appear to be stable at present, this species is of moderate conservation importance because of its relatively small and patchy year-round range and its dependence on mature, montane coniferous forests (figure 19). Knowledge of this woodpecker's tolerance of forest fragmentation and silvicultural practices will be important in conserving future populations.

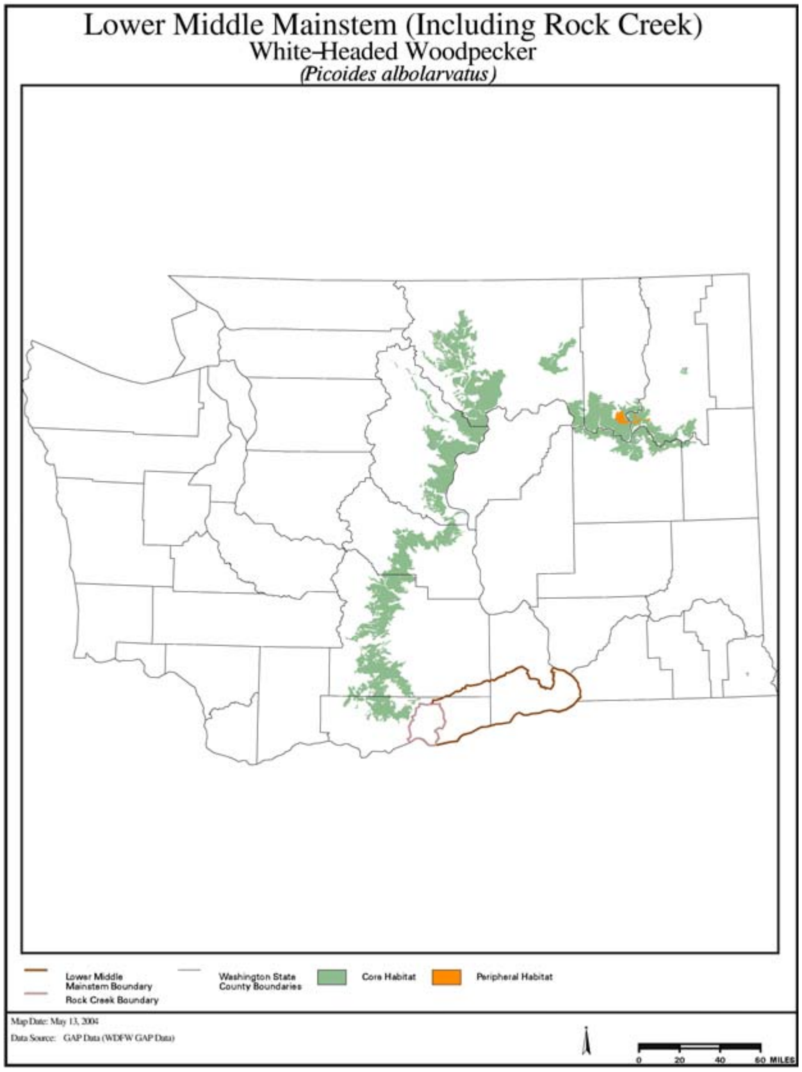


Figure 18 Potential habitat for white-headed woodpeckers in the Lower Mid-Columbia Mainstem (including Rock Creek) subbasin and Washington State (Smith et al. 1997)

Management Issues

Connor (1979) states that managing for the minimum habitat requirements may cause gradual population declines. Therefore, it is recommended that forests be managed using average rather than minimum suggested values.

Relationship with Riparian/Fisheries Issues

The historic heavy harvests of ponderosa pine forests resulted in increased runoff into adjacent streams, increasing sediment and raising temperatures for those streams. Maintaining appropriate buffers adjacent to streams capable of supporting white-headed woodpeckers will increase the health of the streams and reduce sedimentation. This will in turn provide better habitat for fish and other stream dependent species.

Out-of-Subbasin Effects and Assumptions

The white-headed woodpecker is a non-migratory bird and occupies the same home range year round. However, some birds have been recorded wandering to atypical habitats (lower elevation, suburban areas, etc.) during the winter. Local movement of birds may be in response to locally abundant food sources such as spruce budworms (*Choristoneura occidentalis*) and pine seeds (Garret et al. 1996). Most records of movement outside of normal breeding areas occur from August to April.

Factors Affecting Population

Timber Activities

Logging has removed much of the old growth cone producing pines throughout this species' range, 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

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 resulting 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.

4.5.3 Ponderosa Pine/Oregon White Oak Habitat and Focal Species Key Findings, Limiting Factors and Working Hypotheses

Table 17 Key findings, limiting factors and working hypotheses for the Ponderosa Pine/Oregon White Oak focal habitat and its representative focal species

PONDEROSA PINE/OREGON WHITE OAK		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Habitat communities have changed considerably in stand structure and composition compared to historical conditions.	Reduction of Large Diameter Trees and Snags	Appropriate silvicultural practices that retain old overstory trees, increase average diameter of dominant trees, increase snag density and size will recover ponderosa pine late seral composition and structure. These conditions increase habitat and forage available to wildlife.
	Increased Stand Density and Decreased Average Tree Diameter	Reintroduction of an ecologically-based fire regime will recover late seral ponderosa pine and Oregon white oak stand dynamics, ecological function by decreasing stand and stem density, improving wildlife habitat quality and decreasing susceptibility to disease and stand replacement fire.
	Loss of Native Understory Vegetation and Composition	Properly managed grazing will decrease spread of non-native understory plant species and help reestablish a native plant community. Presence of native grasses and forbs will provide good conditions for both wildlife and livestock.
Habitat communities have suffered habitat loss and fragmentation.	Loss of Large Tracts of Old Growth, or Late Seral Forests	Silvicultural practices and land use that retain large tracts of intact late seral forests will decrease temporary fragmentation of focal species habitat.
PONDEROSA PINE/OREGON WHITE OAK - FOCAL SPECIES		
Western Gray Squirrel		
Key Findings	**Limiting Factors**	**Working Hypotheses**
Focal Species have suffered fragmentation between populations due in large part to fragmentation and degradation of late seral oak, pine and riparian conditions on which they depend.	Loss of Large Tracts of Old Growth, or Late Seral Forests	Silvicultural practices that retain large tracts of intact late seral forests will decrease temporary fragmentation of western gray squirrel habitat.
	Increased Stand Density and Decreased Average Tree Diameter	Utilizing fire as a tool to improve used and potentially used wildlife habitat will increase the quality of degraded habitat and result in greater numbers of western gray squirrels.

PONDEROSA PINE/OREGON WHITE OAK		
Key Findings	**Limiting Factors**	**Working Hypotheses**
	Loss of Native Understory Vegetation and Composition	Properly managed grazing will decrease spread of non-native understory plant species and help reestablish a native plant community. Presence of native grasses and forbs will provide good conditions for both western gray squirrels and livestock.
	Loss of Individual, Late Seral Trees (From Woodcutting)	Discouraging woodcutting in old growth stands will help retain late seral trees in landscape.
Focal species have suffered declines from competition due to presence of squirrel species historically not present.	Increased Competition with Western Gray Squirrels	Reduction of California ground squirrels will increase survival of western gray squirrels locally, increasing numbers present in the subbasin.
White-Headed Woodpecker		
Loss of late seral pine trees has decreased nesting and foraging habitat for white-headed woodpeckers and fragmented potential habitat.	Loss of Large Tracts of Old Growth, or Late Seral Forests	Silvicultural practices that retain large tracts of intact late seral forests will decrease temporary fragmentation of white-headed woodpecker habitat.
	Increased Stand Density and Decreased Average Snag Diameter	Utilizing fire as a tool to improve used and potentially used wildlife habitat will increase the quality of degraded habitat and result in greater numbers of white-headed woodpeckers.
	Reduction of Large Diameter Trees and Snags	Appropriate silvicultural practices that retain old overstory trees, increase average diameter of dominant trees, increase snag density and size will recover ponderosa pine late seral composition and structure. These conditions increase habitat and forage available to wildlife.
	Loss of Individual, Late Seral Trees (From Woodcutting)	Discouraging woodcutting in old growth stands will help retain late seral trees in landscape.

4.6 Habitat of Concern: Lower Mid-Columbia Mainstem

Mainstem/Riverine Habitat Conditions

Physical/Habitat Structure and Composition

Islands in the Columbia River and other parts of the subbasin are of extreme importance to several species of wildlife. Islands provide nesting habitat free of terrestrial predators for ground nesting birds such as Canada geese, ducks, pelicans, and other colonial nesting species. In addition, this subbasin supports one of the largest Northwest concentrations of wintering waterfowl, (Canada geese *Branta canadensis* and mallards *Anas platyrhynch* (ODFW 1993). Development of the hydropower system (increased open water habitat) and agricultural grain production have contributed to the increase in breeding and migrant/wintering waterfowl numbers. In John Day Reservoir, islands occupy approximately 700 ha (USACE 2000).

Embayments, which are shallow water habitats typically connected to the mainstem Columbia River via culverts or small channels, provide special wildlife values. In most embayments, water fluctuates less than in the river because of the elevation of the culvert or inlet channel. The magnitude of waves is also relatively low in embayments. The reduced water fluctuation and protection from wave action is beneficial to wildlife directly, and indirectly, as a result of conditions that promote diverse riparian and wetland vegetative communities. Embayments are of special importance to beaver and muskrats because of the reduced water fluctuations and also provide food resources and protected loafing and roosting areas for waterfowl and other water birds.

Abundance of embayments differs among reaches of the Columbia River. McNary Reservoir appeared to have 21 embayments in the mid-1970s (Asherin and Claar 1976). Approximately 17 embayments are connected to John Day Reservoir, with the largest being Paterson Slough in the Umatilla National Wildlife Refuge (approximately 420 ha). The Dalles Pool had 19 embayments in the mid-1970s (Tabor 1976).

River deltas and mudflats occur along McNary reservoir, particularly at the mouth of the Walla Walla River. These areas provide critical migration stop-over habitat for shorebirds, and are frequently used by waterfowl and wading birds. These extensive shallow-water areas and mudflats are critical for shorebird foraging. Because these areas attract shorebirds and waterfowl, they are often used by predators as well, including peregrine falcon, bald eagle, and others (Ward 2000).

The quantity of riparian and wetland habitat identified in mid-1970s inventories was small (Tabor 1976). An example is John Day Reservoir, where only 230 ha of riparian habitat and 925 ha of wetland habitat remain (USACE 2000). The implications of riparian area degradation and alteration are significant for fish populations that utilize these habitats for rearing and resting (Lautz 2000).

Vegetative Habitat Structure and Composition

Riparian areas within the Lower Mid-Columbia Mainstem subbasin have been degraded in part by the invasion of exotic plant species. One such species is False Indigo. Just 10 years ago, the shoreline and islands of the lower mid-Columbia River were comprised of shrub-steppe and grassland cover. Now, false indigo has displaced much of the native vegetation along the

Washington and Oregon shorelines, as well as the perimeter of many of the islands. One small island, Straight Six, is completely covered with this invasive weed (Morgan, ODFW, and Browers, USFWS, Pers. Comms. 2004).

Mainstem Wildlife Resources

The Northwest Area Committee, a multi-agency spill response planning group, identified a number of areas in Columbia River mainstem, including the Dalles, John Day, and McNary pools, where habitat resources and concentrations of waterfowl and shorebirds nest, breed, and winter. Within the Dalles Pool these areas include: 1) mouth of Deschutes River; 2) between Maryhill, WA and Rufus, OR; 3) mouth of Spanish Hollow Creek at Biggs Junction OR; 4) NE of Miller Island in the Columbia River Mainstem - sensitive nesting species, gull and tern nesting area; and 5) islands south and southeast of Brown’s Island (includes concentration of diving ducks) (Northwest Area Committee 2004a).

The John Day pool includes the following waterfowl and shorebird habitats: 1) NE of I-82 bridge, near Plymouth WA; 2) second inlet west of Plymouth; 3) island between Irrigon and Umatilla, east and north entrances; 4) shallow water area, WA side, north of Irrigon, OR; 5) Paterson Slough; 6) WA side, east end of abandoned railroad tracks; 7) Big Blalock Island and two islands sw of Big Blalock; 8) Glade, Willow, and Alder creeks; 9) first set of small islands east of Long Walk Island, south end and se point of island, and area between Sand Island and island to the west; inlet east of Messner; 10) northeast corner and west end of Whitcomb Island; 11) Crow Butte Island; 12) inlet entrances to Threemile Canyon; 13) shallow water habitat, RM 255.8; 14) Jones Canyon and Sundale; 15) John Day River mouth and inlet just northwest of John Day Dam (Northwest Area Committee 2004b).

McNary Pool also has many habitat areas that attract large numbers of waterfowl and shorebirds: 1) Strawberry Island - Canada goose nesting habitat and wildlife refuge; 2) Sacajawea State Park shores; 3) inlet west of Highway 410 and inlet just east of Snake River railroad trestle (south end) - sensitive marsh habitat, Hood and Sacajawea Park; 4) inlet just west of Snake River railroad trestle, and inlet mouths south of Snake River railroad trestle (south end); 5) entrance to Villard Pond; 6) point south of and east end of Columbia River railroad trestle; 7) Foundation Island – geese, cormorants, shorebirds, herons; 8) entrance to Casey Pond; 9) south tip of Corps of Engineers habitat management area; 10) Badger Island; 11) mouth of Walla Walla River (various wildlife resources); 12) Juniper Canyon – marsh, Corps of Engineers habitat management area, shallow water habitat; 13) point on south shore opposite Spukshowski Canyon; 14) point northeast of Cold Spring Junction; 15) first island north of Cold Springs Junction; 16) northeast point of peninsula jutting out, north of Cold Springs Junction; 17) two largest islands east of Hat Rock State Park and passageways between the two islands (Northwest Area Committee 2004c).

Environmental/Population Relationships/Limiting Factors

The productivity of shallow water habitats is limited in the Columbia River portion of the subbasin because of fluctuating water levels that are caused by power production at the dams. Shallow water habitats can be very productive for submergent, emergent, and aquatic vegetation, in addition to benthic invertebrate populations. Aquatic plants and invertebrates are important forage resources for many wildlife species. Shallow water habitats comprise approximately 3,600 ha in John Day Reservoir (USACE 2000).

Deltas and mudflats along McNary reservoir and the mouth of the Walla Walla River are affected by fluctuating water levels. Mudflats may not be exposed during critical times, eliminating important food sources for this assemblage of birds.

Hydropower development and fluctuating water levels have also decreased beaver production by destroying their habitat, altering ecosystem and riparian function, and by alternately flooding and exposing their dens. In addition, beavers have been negatively impacted by changes in stream channel morphology, and direct mortality caused by road and railroad construction and maintenance in close proximity to the shoreline of the Columbia River. Degradation of streams through human development has contributed to a decline in the recruitment of aspen and cottonwood, important habitat and food sources for beaver.

Functional Relationship of Assessment Unit with Subbasin

Fluctuating water levels that result from power generation at the dams on the Columbia River have reduced the value of shoreline areas for wildlife (Tabor et al. 1981). Although impoundments have degraded fish and wildlife habitat, they have increased the amount of open water available for some species of wildlife including migrant/wintering waterfowl.

Riparian/Floodplain Condition and Function

The dominant shoreline type within the impoundments is usually rip-rap, followed by smaller rock or sand (Hjort et al. 1981). Shoreline gradient in rip-rapped areas is often very steep (>45^{o}). In the relatively common backwaters, banks are often eroded, and substrate is often smaller than in main reservoirs.

Stream Channel Conditions and Function

Mainstem reservoirs in the Columbia Plateau Province have little storage capacity, and discharges through dams are run-of-the-river; therefore, water velocity is generally fast enough to prevent occurrence of a thermocline and oxygen depletion in deep water.

4.7 Habitat of Concern: Agriculture

Agriculture has replaced much of the native habitats historically existing in the subbasin, especially interior grasslands and shrub steppe. Due to the extensive presence of agriculture, it is considered a habitat type today. Some native species still exist in this habitat type, but the diversity of wildlife and plant species is decreased compared to historical habitat that have been replaced by agriculture. Also, agriculture has resulted in introduced plants and animals in the subbasin, many spreading beyond the borders of the agricultural habitat, reducing the quality of native habitats still existing today. Due to the quantity, and likely permanence, of this habitat it must be considered in management of wildlife in the subbasin. It is not considered a focal habitat, but is a habitat of concern that must be addressed in this subbasin plan. Although there are no focal species chosen for this habitat type, some of the wildlife species that are found in these habitats are deer, great blue herons (*Ardea herodias*), Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), gopher snakes (*Pituophis catenifer*), as well as many other species.

Key Finding

This subbasin depends on agriculture as its leading economic base. Agricultural lands are also an important habitat component in the subbasin and are found in areas that were historically shrub steppe or interior grasslands. Athough not a historic land use, agriculture does provide many benefits to wildlife. A significant portion of what has been traditionally cropped is now in CRP (Conservation Reserve Program). This program provides permanent native grass with scattered native shrubs that create excellent habitat for wildlife. The remaining agricultural land is predominantly alfalfa, wheat, or pasture. Agriculture like most other industries is becoming more environmentally friendly. No till or direct seeding is now being used wherever it is feasible, reducing emissions, erosion, and conserving natural resources.

In Oregon's Sherman, Gilliam, and Wasco counties, ESA consultation with NOAA/Fisheries has resulted in plans for conservation-oriented Resource Management Systems for dry cropland and range and pastureland. See 6. Inventory/Federal Plans.