

Methow Subbasin

I. Introduction

Various processes are underway within the Columbia Basin that direct hatchery program implementation. The listing of certain populations of fish under the ESA has also dictated hatchery program modifications and reform.

Some of the principal processes are:

Federal:

Hatchery and Genetic Management Plans:

The Hatchery and Genetic Management Plan (HGMP) process was initiated to identify offsite mitigation opportunities associated with operation of the Federal Columbia River Power System. The HGMP process is designed to describe existing propagation programs, identify necessary or recommended modifications of those programs, and help achieve consistency of those programs with the Endangered Species Act. The HGMP process only addresses anadromous salmon and steelhead programs.

Hatchery and Genetic Management Plans are described in the final [salmon and steelhead 4\(d\) rule](#) (July 10, 2000; 65 FR 42422) as a mechanism for addressing the take of certain listed species that may occur as a result of artificial propagation activities. NOAA Fisheries will use the information provided by HGMPs in evaluating impacts on anadromous salmon and steelhead listed under the ESA. In certain situations, the HGMPs will apply to the evaluation and issuance of section 10 take permits. Completed HGMPs may also be used for regional fish production and management planning by federal, state, and tribal resource managers.

The primary goal of the HGMP process is to devise biologically-based artificial propagation management strategies that ensure the conservation and recovery of listed Evolutionarily Significant Units (ESUs). The HGMP process also seeks to document and implement hatchery reform in the Columbia Basin. Much of the initial work on the HGMP process was coordinated and combined with efforts to complete the Artificial Production Review and Evaluation (APRE – see below) analysis, which looked at the same sorts of information.

Artificial Production Review and Evaluation (APRE)

The APRE process seeks to document progress toward hatchery reform in the Columbia Basin. The NPCC used consultants and representatives of the Columbia Basin fishery managers to analyze existing programs and recommend reforms; a draft report that will go to the Council and the region has been prepared. The APRE process includes both anadromous and non-anadromous fish in its analysis.

Pacific Coastal Salmon Recovery Fund

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established in FY2000 to provide grants to the states and tribes to assist state, tribal and local salmon conservation and recovery efforts. The PCSRF was requested by the governors of the states of Washington, Oregon, California and Alaska in response to Endangered Species Act (ESA) listings of West Coast salmon and steelhead populations. The PCSRF supplements existing state, tribal and federal programs to foster development of federal-state-tribal-local partnerships in salmon recovery and conservation; promotes efficiencies and effectiveness in recovery efforts through enhanced sharing and pooling of capabilities, expertise and information. The goal of the Pacific Coastal Salmon Recovery Fund is to make significant contributions to the conservation, restoration, and sustainability of Pacific salmon and their habitat.

The PCSRF's enhancement objective is: *To conduct activities that enhance depressed stocks of wild anadromous salmonids through hatchery supplementation, reduction in fishing effort on depressed wild stocks, or enhancement of Pacific salmon fisheries on healthy stocks in Alaska. This includes supplementation and salmon fishery enhancements.*

US v. OR

United States v Oregon, originally a combination of two cases, Sohappy v. Smith and U.S. v. Oregon, legally upheld the Columbia River treaty tribes reserved fishing rights. Specifically the decision acknowledged the treaty tribes reserved rights to fish at "all usual and accustomed" places whether on or off the reservation, and were furthermore entitled to a "fair and equitable share" of the resource. Although the Sohappy case was closed in 1978, U.S. v. Oregon remains under the federal court's continuing jurisdiction serving to protect the tribes treaty reserved fishing rights. This case is tied closely to U.S. v. Washington, which among other things defined "fair and equitable share" as 50 percent of all the harvestable fish destined for the tribes' traditional fishing places, and established the tribes as co-managers of the resource.

In 1988, under the authority of U.S. v. Oregon, the states of Washington, Oregon and Idaho, federal fishery agencies, and the treaty tribes agreed to the Columbia River Fish Management Plan (CRFMP), which was a detailed harvest and fish production process. There are no financial encumbrances tied to the process. Rather, the fish production section reflects current production levels for harvest management and recovery purposes, since up to 90% of the Columbia River harvest occurs on artificially produced fish. This Plan expired in 1998, and has had subsequent annual rollover of portions in which agreement has been reached. However, a newly negotiated CRFMP is forthcoming.

Hatchery production programs in the upper Columbia sub-basins are included in the management plans created by the fishery co-managers identified in the treaty fishing rights case *United States v Oregon*. The parties to *U.S. v Oregon* include the four

Columbia River Treaty Tribes – Yakama Nation, Warm Springs, Umatilla, and Nez Perce tribes, NOAA-Fisheries, U.S. Fish and Wildlife Service, and the states of Oregon, Washington, and Idaho. The Shoshone-Bannock Tribe is admitted as a party for purposes of production and harvest in the upper Snake River only. These parties jointly develop harvest sharing and hatchery management plans that are entered as orders of the court that are binding on the parties. The “relevant co-managers” described in the *U.S. v Oregon* management plans are, for the mid-Columbia sub-basins, the federal parties, Yakama Nation, and Washington Department of Fish and Wildlife.

Hatchery programs are viewed by the Yakama Nation as partial compensation for voluntary restrictions to treaty fisheries imposed by the tribe to assist in rebuilding upriver populations of naturally-spawning salmonids. Because treaty and non-treaty fisheries are restricted on the basis of natural stock abundance, the tribal priority is to use hatcheries in a manner that supplements natural spawning and increases average population productivity. Perspectives on the appropriate use of hatchery-origin fish for supplementation vary between federal, state, and tribal fish co-managers. Federal and, to a lesser degree, state co-managers place a higher priority on managing the genetic risks of hatchery supplementation of natural populations, while the tribe sees the demographic threats of habitat loss and degradation as the greater risk to natural populations. In general, however, all parties agree that hatcheries can and should be operated as integral components of natural populations where the survival benefits of the hatchery can result in a significant increase in net population productivity.

ESA

Current ESA Section 10 Permits for listed summer steelhead (Permit #1395); listed spring chinook (Permit #1196) and non-listed anadromous fish (Permit # 1347) also direct artificial production activities associated with the habitat conservation plans. Douglas PUD, Chelan PUD and WDFW are co-permittees, therefore provisions within the permits and associated Biological Opinions are incorporated into the hatchery programs undertaken in the HCP's.

State:

The state, along with the federal government have various forums in which they are active. All have some role in determining or balancing artificial production programs, as well as the ones that follow under “other”. Essentially no specific action would occur until the action is determined to be warranted in the already established processes.

Other:

FERC processes:

Under current settlement agreements and stipulations, the three mid-Columbia PUDs pay for the operation of hatchery programs within the Columbia Cascade Province. These

programs determine the levels of hatchery production needed to mitigate for the construction and continued operation of the PUD dams.

Habitat Conservation Plans:

In 2002, habitat conservation plans (HCPs) were signed by Douglas and Chelan PUDs, WDFW, USFWS, NOAA Fisheries, and the Colville Confederated Tribes. The overriding goal of the HCPs are to achieve no-net impact¹ on anadromous salmonids as they pass Wells (Douglas PUD), Rocky Reach, and Rock Island (Chelan PUD) dams. One of the main objectives of the hatchery component of NNI is to provide species specific hatchery programs that may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Biological Assessment and Management Plan:

The biological assessment and management plan (BAMP) was developed by parties negotiating the HCPs in the late 1990s. The BAMP was developed to document guidelines and recommendations on methods to determine hatchery production levels and evaluation programs. It is used within the HCP as a guiding document for the hatchery programs.

All of these processes affect the hatchery programs within the Methow River Basin in one way or another.

Historic and current programs and facilities

Historic programs

The first hatcheries that released salmonids in the mid-Columbia Basin began operation in 1899 near the confluence of the Twisp River on the Methow River (WDFG 1899). This hatchery was built to replenish the salmon (primarily chinook, and coho) runs, which had virtually been eliminated by the 1890s (Gilbert and Evermann 1895; WDFG 1898).

The biggest problems encountered in the early years of the hatcheries were lack of fish for broodstock, and because of irrigation diversions that entrained large numbers of juveniles (both naturally- and artificially produced; WDFG 1904):

Most of the fish planted from the Methow facility in the first few years of production were probably coho (WDFG 1904-1920; Craig and Suomela 1941). For the first few

¹ NNI refers to achieving a virtual 100% survival of anadromous salmonids as they pass the mainstem projects. This is achieved through 91% survival of adults and juveniles (or 93% for juveniles) passing the projects, and 7% compensation through hatchery programs and 2% contribution through a tributary fund, which will fund projects to improve salmonid habitat in the tributaries.

years, species were not differentiated, with up to 3 million eggs per year collected from the Methow.

Very few chinook were released from the first Methow River hatchery (Craig and Suomela 1941). Egg take between the years 1908 - 1912 ranged from 5,000 - 68,000 (average 24,100). In 1915, the hatchery was moved downstream near the mouth of the river at Pateros. The hatchery was moved for two main reasons: it lacked brood stocks other than coho, and the new location lay downstream from the irrigation intakes (WDFG 1917). From WDFG (1917),

Two years of operation of the new hatchery have demonstrated the wisdom of the change. Not only are we now securing more silverside salmon spawn at the new location than we did at the old, but our new location has developed to be the best hatchery in the state for the taking of Steelhead salmon eggs. Also, we have been able here to secure Spring Chinook salmon eggs . . . ,

and from Craig and Suomela,

. . . however, chinooks were never obtained in any quantity. . . some eggs were transferred to Methow from other locations. Even chum salmon eggs were shipped there in 1916 and 1917. . . In many cases there is no indication as to where the transferred chinook eggs were taken, but some were obtained from the U. S. Bureau of Fisheries hatcheries on the lower Columbia and probably some of the Washington hatcheries from that section also contributed late run stock to the Methow River. It is very questionable whether any of these fish were able to return to the Methow River, since the distance they would have to migrate is much greater than that to which the original stock was accustomed. However, these records indicate that the Washington State Fisheries authorities made attempts to introduce strange runs of salmon to the Methow as well as to the Wenatchee.

In 1917, 1.5 million eggs were received at the Methow Hatchery from unknown origin. In the late 1920s, eggs were received from exotic hatcheries, but appear to be mostly late-run chinook (Craig and Suomela 1941).

The release of fry from the early hatcheries on the Wenatchee and Methow rivers probably contributed little to adult returns.

Current program overview:

Current programs

Artificial production of anadromous fish in the Methow Subbasin includes spring Chinook, summer Chinook, summer steelhead and reintroduction of coho salmon (Table 1). Spring Chinook and summer steelhead are currently ESA-listed as endangered through the Endangered Species Act of 1973. Summer Chinook are considered a

depressed population. Once extirpated from the Methow Subbasin, small numbers of coho salmon have been reintroduced, and plans are currently in the feasibility stage for larger scale reintroduction. Hatchery intervention in the Methow Subbasin is guided by a two-pronged approach that encourages local adaptation, preservation and enhancement of specific populations while simultaneously spreading the risk through selection of several artificial production alternatives.

Considerable controversy regarding the effects of the GCFMP, non-indigenous introductions, recent fishery management actions (variable broodstock collection and hatchery mating) on population structure, and regarding interpretation of available genetic data has prompted variable interpretations of spring Chinook population structuring in the Methow Basin. In response to uncertainty about population structure, poor adult returns, and a desire to spread the risk of hatchery intervention strategies, a conceptual approach was developed during the creation of the Biological Assessment and Management Plan (BAMP) for mid-Columbia River Hatchery Programs. The approach consisted of enlarging the effective hatchery supplementation spawning population of Methow River and the Chewuch River populations during periods of low adult returns, by managing them as a single gene pool. During years of sufficient adult returns, tributary trapping locations would be utilized to obtain the broodstock components of each tributary population and within population mating would be a priority in an attempt to preserve and enhance discrete population attributes that exist in the Methow Basin.

Management decisions regarding the Twisp River population varied from those developed for the Methow and Chewuch populations. The Twisp River population was deemed the most divergent of the indigenous populations in the Subbasin and the least tolerant of genetic introgression (Wells Project Coordinating Committee 1995). The Twisp River population is managed more as a distinct population, using adult supplementation and captive broodstock programs. The Joint Fisheries Party (JFP, composed of federal and state agencies and tribes) opted to phase out the Twisp Captive brood program beginning in 2000, leaving 1999 as the last brood year remaining in the program.

Table 1. Artificial anadromous fish production in the Methow Subbasin

Fish Species	Facility	Funding Source	Production level goals
Spring Chinook	Methow Fish Hatchery Acclimation sites at the Methow, Biddle, Twisp and Chewuch Acclimation ponds (Operated by WDFW)	Douglas County PUD	(349,000) ²

² Under the Wells Settlement Agreement, Douglas PUD is required to raise 225,000 spring chinook for Wells mitigation. Once the HCP is approved, Douglas PUD only needs to raise 61,000 fish to meet its NNI obligation for spring chinook. However, under a separate agreement, Douglas will raise an additional

	Winthrop NFH (Operated by USFWS)	Bureau of Reclamation	600,000
Steelhead	Wells Dam Hatchery Complex (Operated by WDFW)	Douglas County PUD	349,000 (post HCP)
	Winthrop NFH (Operated by USFWS)	Bureau of Reclamation	100,000
Summer Chinook	Wells Dam Hatchery Complex (Carlton acclimation pond) (Operated by WDFW)	Chelan County PUD	400,000 ³
Coho	Winthrop NFH (Operated by USFWS)	BPA (Fish & Wildlife Program)	250,000
	Acclimation sites at Eight Mile Creek and Biddle Pond on Wolf Creek (Operated by YN)	BPA (Fish & Wildlife Program)	

Federal programs

Grand Coulee Fish Maintenance Project (GCFMP)

The USFWS operates the Leavenworth NFH Complex in the UCR region constructed by the U.S. Bureau of Reclamation (BOR) to replace fish losses that resulted from construction of Grand Coulee Dam. These programs were authorized as part of the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and re-authorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. The complex consists of three hatchery facilities, Leavenworth, Entiat, and Winthrop NFHs, with the following mission:

“To produce high quality spring Chinook salmon and summer steelhead smolts commensurate with the production goals established by the Columbia River Fisheries Management Plan” (USFWS 2002a)

Historically, these facilities have reared and released spring Chinook salmon eggs transferred from the Carson NFH on the lower Columbia River. Carson-stock spring Chinook salmon are not included in the ESA-listed UCR spring Chinook salmon ESU. The USFWS has discontinued transferring eggs from Carson NFH in favor of utilizing hatchery-origin adult spring Chinook salmon returning to each facility as the primary egg source.

288,000 (which will be reduced to 90,000 after 2013) spring chinook for Chelan PUD for mitigation under the HCP, bringing the total to 349,000 fish

³ Under a “species trade agreement” between Chelan and Douglas PUDs, all 400,000 of these fish are currently for Douglas PUD mitigation. Once the HCP is approved then 200,000 of these fish are raised for Douglas PUD mitigation in exchange for fish at the MFH and the remaining 200,000 fish are for the Chelan PUD mitigation.

The hatcheries built as part of the GCFMP began operation in the early 1940s at Leavenworth (Icicle Creek, a tributary of the Wenatchee River), Entiat, and Winthrop (Methow River). The Leavenworth facility was built as the main hatchery site, and the Entiat and Winthrop hatcheries as substations. These hatcheries were built as part of the program to relocate populations of salmon and steelhead that formerly ascended the Columbia River upstream from the Grand Coulee Dam site.

Winthrop National Fish Hatchery (NFH)

Located on the Methow River, this substation of the Leavenworth NFH complex began operation in 1941. The Winthrop Hatchery released stream-type Chinook every year from 1941 through 1962. Releases of spring Chinook ceased until 1976, when the current program began, and have since been ongoing. Releases of sockeye have taken place at Winthrop from 1943 to 1957. Spring chinook, steelhead and coho are all currently cultured at the facility.

Broodstock origin for fish released from Winthrop NFH has varied over the years. The first four years of releases were from broodstock collected at Rock Island Dam as part of the GCFMP (see above). Eggs from the Cowlitz, Little White, Carson, Klickitat, and Leavenworth (all Carson stock) hatcheries have been raised and released from Winthrop since the current program began in 1976, although since 1992, all brood used for the program has come from adults returning to the Methow River.

Since brood year 1999, which is the same year spring Chinook were listed under the ESA, no releases of the “pure” unlisted Carson stock has occurred. The listed Methow Composite stock has been utilized in an effort to aid in the recovery of that population.

Facility description: Located on the Methow River, at river mile 50.4, this facility has two 40 by 80 ft adult holding ponds (construction was never completed), sixteen 17 x 76 ft. Foster-Lucas ponds, sixteen 12 x 102 ft, and 30 8 x 80 ft raceways. Inside the hatchery building there are 42 (8 tray) incubators, thirty-five 3 x 16 ft fiberglass tanks, and four 16.5 x 16 concrete starting troughs (USFWS 1986c).

The primary water source for the hatchery is the Methow River. The water right allows for withdrawals up to 50 cfs. Spring Branch Springs provides up to 10 cfs, and two groundwater infiltration galleries and wells provide 1,500 gpm each, with a maximum of 2,400 ac. ft. per year each. The springs and infiltration galleries provide warmer water during the winter months. A third infiltration gallery, capable of pumping 4,500 gpm, is currently under construction.

Evaluation: The Mid-Columbia River Fishery Resource Office (MCRFRO) provides monitoring, evaluation, and coordination services concerning Winthrop NFH production. MCRFRO staff monitors hatchery returns, biological characteristics of the hatchery stock, fish marking, tag recovery, and other aspects of the hatchery program, and they maintain the database that stores this information. MCRFRO also cooperates with the hatchery, fish health and technology centers, and co-managers to evaluate fish culture

practices, assess impacts to native species, and coordinate hatchery programs both locally and regionally.

The Leavenworth NFH Complex (which includes Winthrop NFH) has a team comprised of staff from the hatcheries, Fish Health, and the MCRFRO (Hatchery Evaluation Team). Current evaluation practices/studies include: bio-sampling of returning adults, 100% marking of released juveniles, application of PIT tags, assessment of stray rates, travel-time of released juveniles through the Columbia River corridor, assessment of potential of hatchery fish to transfer diseases to wild stocks, success/failure of hatchery produced adults to reproduce naturally, use of NATURE's type rearing⁴, raceway density studies, genetic comparisons of hatchery and wild stocks, and feed (fish food) evaluations, among others.

State programs

Methow Fish Hatchery Complex

The Methow Fish Hatchery Complex (MFHC) was built to compensate for losses of smolts caused by the operation of Wells Dam (Erho and Bugert 1995). The facility was constructed by, and operates, under funding from Douglas PUD. Eggs are collected at weirs on the Methow, Twisp, and Chewuch rivers and incubated discretely at the central facility near the town of Winthrop. Smolts (246,000 for each facility) are released from acclimation ponds on the Twisp, Chewuch, and Methow (central facility) rivers (Peck 1993; Bartlett and Bugert 1994).

One of the guiding principles of the Methow Basin Spring Chinook Salmon Supplementation Plan (MBSCSP) is to increase natural production of the three principal stocks from the main stem Methow, Chewuch, and Twisp rivers. With the supplementation concept in mind, the general supplementation plan has established separate strategies for two of the three streams with the fish managers agreeing to maintain one composite brood stock for the Methow and Chewuch rivers and a separate brood stock for the Twisp River. Each stock will have specific escapement goals, designed to provide a basis for evaluating the progress of achieving the original intent of the program.

Facility description: The MFHC consists of a central facility on the Methow River, near the town of Winthrop, and two satellite facilities on the Chewuch and Twisp rivers. The main facility is located on the Methow River, approximately 45 miles upstream of the confluence with the Columbia River. This facility has three canopy-covered 8 x 78 x 4 ft adult holding ponds, 12 canopy-covered juvenile raceways of the same dimensions as the adult ponds, and 24 indoor 3 x 59 x 4.5 ft start tanks. In addition, there are three separate incubation rooms with 15 single stack (eight trays per stack) vertical incubators and one 107 x 59 x 4.5 ft acclimation pond, which releases into the mainstem Methow River (Bartlett and Bugert 1994).

⁴ NATURE's rearing is a "hands off" approach where artificial substrate and woody debris is added to the raceways. Automatic feeders are also utilized, negating the need to "hand feed".

The main water source for the Methow facility is from four wells that provide almost 10 cfs. An additional water right of 18 cfs of Methow River water is provided, with 11 cfs guaranteed (the additional 7 cfs is shared with Winthrop NFH in the spring; Bartlett and Bugert 1994).

Almost eight miles upstream of the confluence of the Methow River is the Chewuch River acclimation site. The site has one large acclimation pond, which measures 107 x 70 x 4.5 ft. The water source of the acclimation pond is the Chewuch River, which is supplied by gravity feed from the Chewuch Canal Company's irrigation ditch. The maximum flow to the pond is 6 cfs (Bartlett and Bugert 1994). Adult trapping for the Chewuch fish occurs at Fulton Dam, approximately 4.5 miles downstream of the acclimation pond (1.5 miles upstream of the confluence with the Methow River).

The Twisp River acclimation site is approximately 5 miles upstream of the confluence with the Methow River. The facility has one acclimation pond which measures 107 x 59 x 4.5 ft. The water source of the pond is the Twisp River from the Valley Power irrigation canal, with a maximum flow of 6 cfs. The adult collection weir and trap is located adjacent to the acclimation pond (Bartlett and Bugert 1994).

II. Program Goals and Objectives

Federal programs

Grand Coulee Fish Maintenance Project (GCFMP)

The USFWS's mission for the Leavenworth complex is:

“To produce high quality spring Chinook salmon and summer steelhead smolts commensurate with the production goals established by the Columbia River Fisheries Management Plan” (USFWS 2002a)

Winthrop National Fish Hatchery (NFH):

Objectives originally established for the Leavenworth Hatchery Complex, as part of the GCFMP were (from Calkins et al. 1939):

- 1) . . . to bring, by stream rehabilitation and supplemental planting, the fish populations in the 677 miles of tributary streams between Grand Coulee Dam and Rock Island Dam, up to figures commensurate with the earlier undisturbed conditions and with the natural food supply in the streams.
- 2) . . . to produce in addition, by the combination of artificial spawning, feeding, rearing and planting in these streams, a supplemental downstream migration equivalent to that normally produced by the 1,245 miles of streams and tributaries above Grand Coulee Dam.

Current objectives of the USFWS hatcheries are outlined in USFWS (1986a, b). In the USFWS Statement of Roles and Responsibilities, the broad role of the hatcheries are,

. . . to seek and provide for mitigation of fishery resource impairment due to Federal water-related developments . . . the Fishery Resource Program goal, in fulfilling its mitigative responsibilities, is to ensure that established and future fishery resource mitigation requirements are fully and effectively discharged. Implicit in this goal is the replacement of fishery resource losses caused by specific Federal projects . . . and another responsibility of the Leavenworth Hatchery . . . is to restore depleted Pacific salmon and steelhead stocks of national significance in accord with statutory mandates such as the Pacific Northwest Electric Power Planning and Conservation Act, Mitchell Act, Salmon and Steelhead Conservation Act, Pacific Salmon Treaty Act of 1985 and Indian Treaties and related Court decisions.

Shelldrake (1993) updated the objectives of the mid-Columbia NFHs:

- *Hatchery production [specific to each facility].*
- *Minimize interaction with other fish populations through proper rearing and release strategies.*
- *Maintain stock integrity and genetic diversity of each unique stock through proper management of genetic resources.*
- *Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens.*
- *Conduct environmental monitoring to ensure that hatchery operations comply with water quality standards and to assist in managing fish health.*
- *Communicate effectively with other salmon producers and managers in the Columbia River Basin.*

State programs

Methow Fish Hatchery Complex

One of the guiding principles of the Methow Basin Spring Chinook Salmon Supplementation Plan (MBSCSP) is to increase natural production of the three principal stocks from the main stem Methow, Chewuch, and Twisp Rivers. With this in mind, the general supplementation plan has established separate strategies for each of the three streams. Each stock will have specific escapement goals, designed to provide a basis for evaluating the progress of achieving the original intent of the program. From Erho and Bugert (1995),

Methow River: *Collaboration between Winthrop FH and Methow FH is of paramount importance for the MBSCSP. Gene flow between the two hatcheries will inevitably occur. To be consistent with this situation, all spring chinook salmon that spawn in the mainstem Methow River upstream of the Chewuch River confluence will be managed as one genome. To be successful, this management strategy requires three conditions: 1) no spring chinook salmon from outside this*

reach will be imported to either hatchery for propagation and released into the Methow River (exogenous salmon may be reared at the hatcheries if they are acclimated and released into their natal stream), 2) all salmon released from either hatchery into the Methow Basin will be externally marked, and 3) salmon that spawn in the Lost River will be included in this population.

Chewuch River: *The Fishery Parties recognize the opportunity to implement innovative fish cultural practices at Methow FH, yet also are acutely aware of the need to ensure high survival of the supplemented populations. The Chewuch River population will therefore be the designated stock used for innovative hatchery management. In general terms, the Chewuch stock may be considered an experimental “treatment” stream, compared to the Twisp River population, which will serve as the “reference”. Alternative fish culture may include such practices as life skills training (Olla and Davis 1989, Suboski and Templeton 1989), side channel rearing (Budhabhatti and Maughan 1994), and autumn pre-smolt releases (Bjornn 1978, Bilby and Bisson 1987), or other prototypical hatchery strategies.*

Twisp River: *The Twisp River stock will be managed in a manner that ensures the highest survival of both natural and hatchery salmon in that river. Low risk production strategies will be implemented in all stages of the program. The Evaluation Plan will place an emphasis on long-term genetic and demographic monitoring of the Twisp population, to evaluate the stability of a small semelparous population. An estimate of minimum viable population (MVP; Shaffer 1981, 1990, Lacava and Hughes 1984) size will be derived, either through empirical or heuristic analysis (Kapusinski and Lannan 1986). The escapement goal for the Twisp River will then be based upon the estimated MVP.*

The overall goal of the state hatcheries is to use artificial production to replace adult production lost due to smolt mortality at mainstem hydroelectric projects, while not reducing the natural production or long-term fitness of salmonid stocks in the area (WDF 1993). Specific goals of the WDFW hatcheries (WDF 1993) are:

- *Hatchery production [in terms of number of fish released from each site],*
- *Minimize interactions with other fish populations through rearing and release strategies, maintain stock integrity and genetic diversity of each population or unique stock through proper management of genetic resources.*
- *Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens,*
- *conduct environmental monitoring to ensure that the hatchery operations comply with water quality standards and to assist in managing fish health,*
- *communicate effectively with other salmon producers and managers in the Columbia River basin, and with implementers of local and regional flow and spill programs, and*
- *Develop a Conservation Plan and conduct a comprehensive monitoring/evaluation program to determine that the program meets mitigation*

obligations, estimate survival to adult, evaluate effects of the program on local naturally producing populations, and evaluate downstream migration rates in regards to size and timing of fish released.

III. Program Operations

Federal program

Winthrop NFH

USFWS operates the Winthrop National Fish Hatchery (WNFH) located only a few miles downstream from the Methow FH. Broodstock are typically collected from the volunteer trap located in the hatchery outfall. Approximately 600,000 smolts are released annually directly into the Methow River from the WNFH.

Adult spring Chinook salmon return to the hatchery beginning in early to mid-May. The escapement goal for this hatchery is 350 adults for a subsequent release of 600,000 smolts annually. Spawning begins in mid-August and can continue to mid-September. The stock of spring Chinook propagated at WNFH is listed as “endangered” under the Endangered Species Act (ESA). Brood year 1999 was the first year propagating this stock. Prior to the switch in stocks, a Carson NFH (lower Columbia River) stock was utilized (not ESA listed).

In most years, all brood stock used for production are volunteers to the hatchery. Adults swim up the collection ladder and into a holding area. The capacity of this pond can only support about 400 adults. The current program calls for adults in excess of brood needs to spawn naturally. Therefore, hatchery staff must limit the number of adults entering the ladder. A weir is placed in the channel leading to the ladder and is selectively opened and closed.

During years of extremely low adult returns, as in 1996 and 98, all spring Chinook ascending Wells Dam are captured and transferred to WNFH and the Methow Fish Hatchery. Adult brood for the Winthrop program has, in some years, been captured at the MFH and transferred to WNFH.

For years 1984 to 2001, an average of 685 adults of WNFH origin have returned to the Methow River Basin. Although the original objective of this mitigation program was to provide fish for harvest, it is also trying to aid in the recovery of ESA listed populations.

All juveniles released from WNFH have a coded-wire tag (CWT) inserted in their snout. During the spawning of adults, CWT's from all adults are removed and de-coded prior to the mixing of gametes. This way FWS has the ability to manage particular crosses (matings), as some are more desirable than others.

Juveniles are released as yearlings annually, in mid-April. The smolts are forced from the raceways into the ¼ mile long spring fed channel (where the ladder is located), which flows to the Methow River. Currently, all juveniles carry a CWT and a portion may also have an adipose-fin clip (depending on lineage).

Throughout the years, the spring Chinook release goal at WNFH has varied. The current goal is 600,000 smolts at 15 to 18 fish/pound. For years 1980 to 2001, an average of 642,682 have been released annually.

Winthrop NFH also has a small summer steelhead program. This stock is listed as “endangered” under the ESA. The annual release goal is currently 100,000 smolts. Brood for this program is secured at Wells Dam by WDFW; none of the steelhead are collected as volunteers to WNFH. Eyed eggs are transferred to WNFH from Wells Hatchery in January or February each year. Approximately 14 months later, the smolts are volitionally released over a 2 – 4 week period starting in early April. Juveniles are 100% fin-clipped and returning adults may be harvested in the sport fishery above Rocky Reach Dam.

State program

Spring Chinook

The Methow Fish Hatchery operates as an adult-based supplementation program using multiple adult broodstock collection locations including the Chewuch, Twisp, and upper Methow rivers. Additional supplementation includes volunteer returns to Methow Fish Hatchery and Winthrop NFH. The long-term production objective for the Methow Fish Hatchery was set at 738,000 yearling spring Chinook smolts in the Wells Dam Settlement Agreement (1990). However, the maximum capacity of the facility was modified during the development of the Mid-Columbia Habitat Conservation Plan (MCHCP) to 550,000 yearlings at 15 fish/lb. (BAMP 1998).

Poor returns of wild fish and limited broodstock collection capabilities coupled with historically poor spring Chinook replacement rates of 0.7 recruits per spawner (1985-1990; L. LaVoy, WDFW, unpublished data) prompted the development of a 3-tiered broodstock collection protocol for the spring Chinook supplementation program in the Methow Subbasin. Under a revised approach adopted in 1996, the location and extent of broodstock collections is based on projected escapement at Wells Dam (Table 2). Broodstock collection protocols are now developed annually and are determined by adult escapement above Wells Dam, expected escapement to tributary and hatchery locations, estimated wild/hatchery proportion, and production objectives and stock origin (endemic/non-endemic).

Table 2. Broodstock collection guidelines of the Methow Basin spring Chinook supplementation plan (ESA Section 7 Draft Biological Opinion, Section 10 Permit 1196)

Wells Escapement Projection	Broodstock Collection Objective
< 668	100% collection of Wells Dam escapement; place all fish into the adult-based supplementation program.
>668 <964	Pass a minimum of 296 adults upstream of Wells Dam for natural spawning.
> 964	Collection at levels to meet interim production level of 550,000 and 600,000 smolts at Methow Fish Hatchery and Winthrop NFH, respectively.

The hatchery and acclimation ponds are operated in a manner that is consistent with accepted aquaculture standards and those identified in the Wells Dam Settlement Agreement. Broodstock handling, spawning, fertilization, incubation, rearing, fish transport, and release activities are detailed in annual summary reports of specific brood years for the Methow Basin Spring Chinook Salmon Hatchery Program (Bartlett et al. 1994; Bartlett 1996; Bartlett 1997; Bartlett 1998; Bartlett 1999; and Jateff 2001).

Production at the Methow Fish Hatchery has varied considerably since the program began with brood year 1992. The variability in production is entirely a function of poor adult returns and different broodstock collection strategies stemming from adaptive management strategies for this population. Smolt production from the Methow Fish Hatchery has averaged 388,471 smolts over the past five years, representing 71% of the interim production level of 550,000 fish identified in the BAMP (1998).

Since adult returns were so low in the beginning years of the program, WDFW used some Carson stock fish in their program. WDFW is now actively avoiding fish of Carson ancestry in their broodstock, and the WNFH is also moving away from using these fish too.

WDFW spawns both listed hatchery x natural and natural x natural crosses to the extent possible and evaluate the success of the two types of crosses. When possible, naturally produced fish retained for broodstock shall represent the natural-origin population in terms of age composition, sex ratio, and run timing. To the greatest extent possible, WDFW shall maintain known Twisp River spring Chinook salmon as a separate broodstock within the hatchery. The progeny of known Twisp River spring Chinook salmon shall be distinctly marked for identification purposes.

To reduce and control fish disease incidences, WDFW will use the disease control procedures identified in the operations plans and adhere to the Washington Co-Manager, Pacific Northwest Fish Health Protection Committee and IHOT [Integrated Hatcheries Operation Team] fish disease control policies.

Summer Chinook

Artificial production of summer Chinook for the Methow Subbasin is provided through the Rock Island Project Settlement Agreement (and will be superseded by the HCP), via the Eastbank Hatchery. The hatchery was constructed in 1989 and is located adjacent to Rocky Reach Dam on the Columbia River. The program is funded by Chelan County PUD and operated by WDFW. Summer Chinook production at Eastbank Hatchery is intended to mitigate for summer Chinook losses at Rock Island Dam. The production objective for the Methow River is a total of 400,000 yearling summer Chinook at 10 fish/lb (BAMP 1998).

Broodstock (556 adults) are collected at the Wells Dam east ladder trapping facility and transported to the Eastbank Hatchery. These fish originate from Okanogan/Methow (Wells Dam traps) summer Chinook populations of natural or hatchery-origin, and are indigenous to the Methow/Okanogan system. Returning salmon from the Carlton (Methow River) program also volunteer into Wells Fish Hatchery, yet they are identified by Code Wire Tags (CWT) and can be placed into their program of origin if desired (Eltrich et al. 1995; BAMP 1998). Incubation, spawning, and initial rearing of Methow summer Chinook take place at the Eastbank facility. The fish are then transferred to the Carlton Acclimation Pond towards the end of their second winter, where they are volitionally released at smolt size (10fish/lb.) into the Methow River in April-May (these fish are currently raised for Wells mitigation under a “species trade” between Chelan and Douglas PUD. Once the HCPs are finalized, the 400,000 fish will be spilt 50:50 between the two PUDs (until 2013, when Chelan’s obligation may go down)).

Broodstock collection protocols are developed annually and determined by annual escapement at Rocky Reach Dam, subject to in-season adjustments. Specific broodstock collection criteria are listed below (adapted from Petersen et al. 1999b and BAMP 1998). Facility operation description, biological attributes and aquaculture practices and standards are detailed in the HGMP for summer Chinook as developed for the Section 7 Draft Biological Opinion for ESA-section 10 Permit #901/902 (Incidental Take of Listed Salmon and Steelhead from Federal and Non-federal Hatchery Programs that Collect, Rear and Release Unlisted Fish Species; WDFW 2000) and as developed for the Rocky Reach and Rock Island Anadromous Fish Agreement and Habitat Conservation Plan.

- Trap no more than 20% of the adult run, based on counts at Rocky Reach Dam;
- If cumulative adult counts at Rocky Reach Dam are less than 40% of the ten-year average, cease trapping until the 40% escapement level has been reached;
- Begin trapping after June 28 and end trapping on or before August 28;
- Conduct trapping on no more than 3 days per week for a maximum of 16-hours per day;
- Do not use the west ladder on Wells Dam for broodstock collections unless difficulties are encountered with broodstock collections in the east ladder;
- Mark all summer Chinook trapped in the Wells Dam ladders to differentiate them from fish volunteering to the Wells Hatchery trap; and
- Collect the run-at-large including the age-3 component.

Summer Steelhead

Steelhead are collected from the run-at-large at the west ladder trap at Wells Dam. Beginning in 2003, wild origin fish were also collected from the east ladder trap to incorporate a greater number of wild fish into the broodstock (33%). Adult steelhead are spawned and reared at Wells FH.

Approximately 125,000 eyed-eggs are shipped to Winthrop National Fish Hatchery to support a 100,000 smolt program that are released directly from the hatchery into the Methow River. Wells FH annually transports and releases an additional 350,000 smolts into the Twisp, Chewuch, and Methow Rivers and an additional 130,000 steelhead smolts for release into the Okanogan and Similkameen rivers.

Coho

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

Non-anadromous fish releases

Non anadromous fish have been planted within the Methow Basin since the early 1900s. Rainbow trout, cutthroat trout, brook trout, and a few brown trout have all been planted at various times through multiple hatchery programs.

Following micro-habitat work in the 1980s that showed negative effects on pre-smolt steelhead from "catchable" releases of rainbow trout, all releases of rainbow were shifted from streams to various lakes within the basin which did not have connectivity to anadromous areas.

Conservation of the Species: The capture of endangered UCR spring Chinook salmon and summer steelhead by WDFW for artificial propagation efforts are designed to benefit the species. The primary objectives of these efforts are to preserve extant spring Chinook and steelhead populations in the region, and to boost the abundance of remaining stocks. There are risks of ecological and genetic impacts to the ESA-listed juvenile and adult spring Chinook salmon and steelhead resulting from the proposed programs. However,

the risk of extinction to natural populations is high enough that aggressive intervention is required.

Genetic and Ecological Effects on Natural Populations: The genetic risks to naturally produced populations from artificial propagation include reduction in the genetic variability (diversity) among and within populations, genetic drift, selection, and domestication which can contribute to a loss of fitness for the natural populations (Hard *et al.* 1992; Cuenco *et al.* 1993; NRC 1996; and Waples 1996).

Disease interactions between hatchery fish and listed fish in the natural environment may be a source of pathogen transmission. Because the pathogens responsible for diseases are present in both hatchery and natural-origin populations, there is some uncertainty associated with determining the extent of disease transmission from hatchery fish (Williams and Amend 1976; Håstein and Lindstad 1991).

It is acknowledged that among-population diversity for a portion of the ESU (Methow River Basin populations) may be negatively affected by the WDFW and USFWS programs if escapements remain low. Specifically, this effect may result from the consolidation of Methow Basin populations into a single Methow population through collection and mating of upriver-origin spawners arriving at Wells Dam. However, this strategy will provide unique information on how best to increase the abundance of fish, and the populations' recovery.

USFWS and the fisheries co-managers have implemented the phasing out of the non-endemic Carson-stock spring Chinook hatchery program to address the potential for genetic introgression and out-breeding depression. Efforts are being made to minimize the effects of these fish on the natural spawning population. By phasing out the Carson-stock spring Chinook and changing to Methow Composite stock, the potential adverse genetic effects from natural spawning hatchery fish will be greatly reduced.

Direct competition for food and space between hatchery and listed fish may occur in spawning and/or rearing areas, the migration corridor, and ocean habitat. These impacts are assumed to be greatest in the spawning and nursery areas and at points of highest fish density (release areas) and to diminish as hatchery smolts disperse (USFWS 1994).

Competition for space and cover in the Methow River probably occurs between hatchery and natural fish shortly after release and during downstream migration, but based on the smolt travel times the duration of interaction is minimal in the river (WDFW 1998a). Rearing and release strategies at all WDFW salmon and steelhead hatcheries are designed to limit adverse ecological interactions through minimizing the duration of interaction between newly liberated hatchery salmon and steelhead and naturally produced fish.

Hatchery fish may prey upon listed fish. Due to their location, size, and time of emergence, newly emerged Chinook salmon fry are likely to be most vulnerable to predation by hatchery released fish. Their vulnerability is believed to be greatest as they emerge and decreases somewhat as they move into shallow, shoreline areas (USFWS

1994). Emigration out of hatchery release areas and foraging inefficiency of newly released hatchery smolts may minimize the degree of predation on Chinook salmon fry (USFWS 1994).

Hatchery salmonids that do not emigrate after release are said to have residualized. These fish that residualize can adversely affect naturally produced fish through competition and predation. Chinook salmon do not tend to residualize (Groot and Margolis 1991), thus no effects are expected on natural UCR spring Chinook salmon or steelhead in the Wenatchee River.

Harvest Management: Fish harvest in the Columbia River basin affects the listed species by incidentally taking them in fisheries that target non-listed species. The largest potential impacts on UCR spring Chinook and steelhead come from treaty Indian and non-tribal fisheries in the Columbia River mainstem and potentially tributaries (Myers *et al.* 1998).

A sport fishery for steelhead in the UCR has been authorized under Section 10 Permit 1395. In years when the escapement of hatchery origin steelhead is greater than expected (i.e., over-escapement) the fishery was specifically designed to remove excess hatchery fish from the spawning grounds with minimal impacts to the natural origin steelhead.

Domestication of Hatchery Fish: Another concern of the artificial propagation of salmon is domestication, which is the change in quantity, variety, and combination of alleles within a captive population or between a captive population and its source population in the wild that are the result of selection in an artificial environment (Busack and Currens 1995). Domestication occurs because putting fish into an artificial environment for all or part of their lives imposes different selection pressures on them than does the natural environment. The concern is that domestication effects will decrease the performance of hatchery fish and their descendants in the wild. The concern is that hatchery fish selected to perform well in a hatchery environment tend to not perform well when released into the wild due to the difference between the hatchery and the wild environments. Potential impacts to the natural population occur when the hatchery fish spawns in the wild and the resulting performance of the natural population is reduced due to outbreeding depression (Busack and Currens 1995). The selection of broodstock is a common source of biased sampling. In general, broodstock selection should be random but bias occurs when selection is based on particular traits. Genetic changes due to unintentional selection can be caused by the hatchery environment, which allows more fish to survive compared to the natural environment. The elimination of all risks due to genetic diversity loss and domestication is not possible, but NOAA Fisheries believes that these risks can be minimized through the following measures proposed for the adult supplementation program:

- Address genetic concerns regarding selectivity, the collection of adult broodstock at traps for the supplementation program shall be representative of the run-at-large with respect to natural and hatchery parentage, migration timing, age class, morphology, and sex ratio;

- Provide that a proportion of each population that will not be subjected to artificial propagation and the associated potential risk of negative genetic effects, upstream escapement goal of approximately 80 adults per population will be maintained as a minimum level for natural spawning when escapement to Wells Dam is greater than 668 adults;
- An effective population size (N_e) of 500 fish per population per generation should be the *long-term* program production objective to maintain an adequate genetic base, even though an N_e of at least 50 adults per generation is required to reduce the risk of inbreeding depression and genetic drift in the short term (fewer than 5 salmon generations) (BAMP 1998). If fewer adults are available, production can be scaled to ensure that hatchery-origin progeny do not overwhelm the population as a whole;
- Rear fish at minimum pond loading densities to reduce the risk of domestication effects and;
- Eliminate of Carson-stock spring Chinook (a highly domesticated stock) that will further reduce potential genetic effects.

Monitoring and Evaluation: The Wells Settlement Agreement (by which MFHC was authorized, and which will be superseded by the HCP) includes provision for evaluation of the MFHC, both in terms of meeting its production requirements under Phase I of the HCP, and its effects on natural production. This evaluation plan includes genetic monitoring of hatchery and naturally produced fish, migration timing and survival studies of hatchery releases, and studies to evaluate interaction between hatchery- and naturally produced fish. Monitoring and evaluation of the hatchery programs in the Methow River is on-going. The plan for the adult-based supplementation program addresses three critical uncertainties associated with the program:

- whether the hatchery facilities can safely meet their production objectives;
- the effect of the programs on the long-term reproductive success of the population in the natural environment;
- the identification of ways to operate the facilities to reduce the short-term ecological impacts to the naturally produced fish (WDFW 1998a).

Adaptive Management

The monitoring and evaluation program will also provide data that can be used to change the program if the results suggest doing so. The monitoring and evaluation programs will also provide invaluable data on the use of supplementation to conserve and recover ESA-listed salmon species.

Tribal Harvest Allocations

All hatchery programs in the Methow Basin are currently included in the Columbia River Fish Management Plan (i.e., *US v. Oregon*).

IV. Program Success

Federal program

Winthrop NFH was constructed to mitigate for lost habitat due to the construction of Grand Coulee Dam. The original objective of this facility was to provide adults for harvest. This role has changed in recent years. While in some years a sport fishery is open for adult steelhead returning to WNFH, it is desired that adult spring Chinook salmon (in excess of brood needs) are allowed to spawn naturally in the Methow River. This program change was driven by the ESA, and now focuses primarily on recovery.

State program

Viabile Populations:

Spring Chinook

In recent years the number of hatchery fish on the spawning grounds have greatly exceeded the number of wild fish (>90%). The number of spring chinook (hatchery and wild) returning to the Methow Basin has also greatly exceeded escapement levels. While an increase in wild fish abundance has been observed, future adult returns should provide more information to the efficacy of the hatchery program in increasing the abundance of naturally produced populations.

Summer Chinook

Record escapements of summer Chinook in the Methow Basin in recent years have been positively influenced in part by the hatchery program at Carlton Pond. A goal of a supplementation program is to increase the number of spawners by allowing hatchery fish to spawn naturally. Subsequent increases in the number of naturally produced fish on the spawning grounds would support the hypothesis that hatchery fish contributed to future adult returns.

Steelhead

An increase in the number of wild fish incorporated into the broodstock would reduce any potential genetic impacts to the wild fish. In the Methow Basin, a high abundance of hatchery fish due to above average SAR's has lead to escapement levels far above the carrying capacity of the basin. In response, the WDFW developed a methodology using a sport fishery to reduce the number of hatchery fish on the spawning grounds, reducing not only density dependent effects but also genetic impacts.

Hatchery fish have been a dominant part of the spawning population for many years. However, the objective of the hatchery program has only recently changed to a recovery role versus a harvest augmentation role. Wild or naturally produced fish comprise approximately 10% of the run over Wells Dam. If the hatchery program is successful the proportion of wild fish should increase in subsequent years.

Contribution of adults to recovery or harvest:

Returning adults from these programs are intended to increase to naturally spawning populations. The hatchery programs have successfully contributed adults to the naturally spawning populations. However, harvest does occur in years of high abundance on summer chinook. Harvest of steelhead has recently been authorized under Section 10 Permit 1395 as a method to reduce hatchery fish on the spawning grounds.

Summer/fall Chinook smolts released from the Carlton acclimation pond have averaged 0.19 return rate to adults, ranging from 0.02 to 0.81 for brood years 1989 through 1997.

Effects on Wild and Native Populations and Environment: Effects on the wild populations (target and non-target) will be assessed at the juvenile stage using smolt traps and when fish return as adults. The relative productivity of the spawning population will be monitored over time using smolt traps located within the Basin. Relationships between smolt production and spawner abundance (% hatchery fish on the spawning grounds) will provide information related to reproductive potential of the stocks and habitat. Relationships in productivity between stocks would also provide some information regarding competition in the freshwater environment. Smolt traps also provide information regarding trends in other species not directly associated with hatchery programs (i.e., non-target taxa of concern).

Spawning ground surveys will not only be used to develop smolt-to-adult return rates (SARs) for hatchery and wild fish, but provide information on spawn timing and distribution. Biological data collected from carcasses will also provide data concerning age and size at maturity.

Comparisons of any these parameters (juvenile or adult) between hatchery and wild fish would provide insight on the effects hatchery fish may have on wild populations. Any effects that are detected (greater than acceptable levels) would be addressed in subsequent changes in the respective hatchery program.

REFERENCES

- APRE. 2003a. APRE-HGMP Phase II Report, Okanogan Subbasin Summer Steelhead.
- APRE. 2003b. APRE-HGMP Phase II Report, Lower Similkameen (Okanogan) Summer Steelhead.
- NMFS. 2003. Section 10(a)(1)(A) Permit 1412 for Take of Endangered/Threatened Species.
- Fisher, C., Arterburn J. 2003a. Steelhead Surveys in Omak Creek, 2002 Annual Report.
- Fisher, C., Arterburn J. 2003b. Steelhead Surveys in Omak Creek, 2003 Annual Report.
- Fisher, C. 2003c. Snorkel Survey for Salmon Creek – 2003.
- WDFW. 2002. Section 10 direct Take Permit Application to Enhance the Propagation or Survival of Endangered or Threatened Species Under the Endangered Species Act of 1973.
- Wolf, K. and Wagner, P. (Golder Associates. 2002 for the Colville Tribe). Draft Okanogan Basin Summer Steelhead Integrated Recovery Program.
- CCT. 2004a. Okanogan River Summer/Fall Chinook Hatchery and Genetic Management Plan.
- CCT. 2004b. Okanogan River Spring Chinook Hatchery and Genetic Management Plan.
- WDFW. 1999. Hatchery and Genetic Management Plan, Upper Columbia Summer Chinook Salmon Mitigation and Supplementation Program, Eastbank Fish Hatchery and Wells Fish Hatchery Complexes