U.S. Fish and Wildlife Service

# U.S. Fish and Wildlife Service
# Columbia River Basin Hatchery Review Team
# Assessments and Recommendations

## Columbia Plateau Province, Deschutes River Watershed

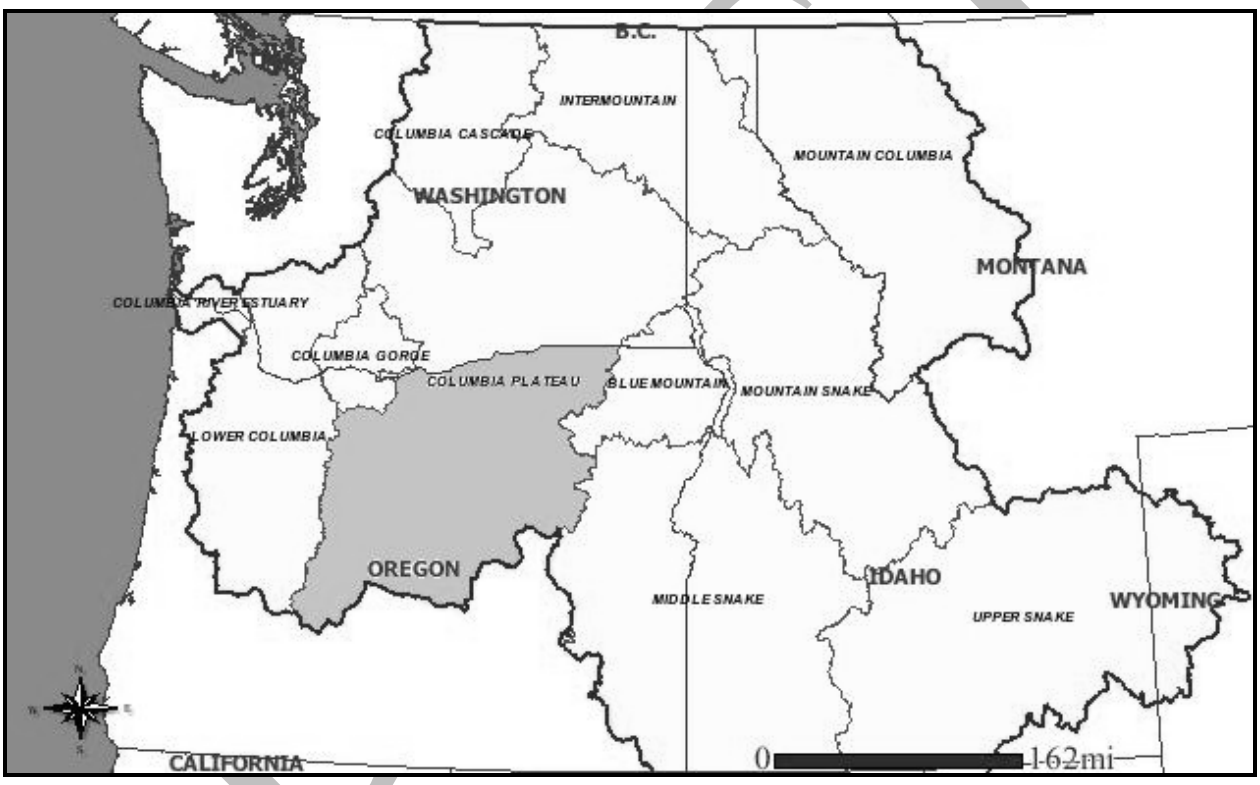


**FIGURE 1. -- Columbia Plateau Province**

## 1. Warm Springs National Fish Hatchery

**January 2006**

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# I. Introduction

In the past 150 years, habitat alterations, hydroelectric development and consumptive fisheries have affected most of the salmon and steelhead trout (*Oncorhynchus mykiss*) populations in the Pacific Northwest. To mitigate for those impacts, hatcheries have been used to increase the number of fish available for harvest. However, long-term conservation needs of natural salmonid populations and their inherent genetic resources require a reexamination of the role of hatcheries in basin-wide management and conservation strategies.

Hatcheries need to be part of a holistic and integrated strategy that combines habitat, hydropower and harvest needs for conserving and managing fishery resources. These strategies must establish short- and long-term goals for both hatchery-propagated and naturally-spawning populations. However, modifying hatchery programs and operations to achieve both conservation and harvest goals in a coordinated manner is difficult and complex. Scientific uncertainties exist regarding the ability of hatcheries and hatchery-origin fish to directly assist with recovery of naturally-spawning populations, while sustaining major fisheries. Uncertainties also exist regarding genetic and ecological interactions between natural- and hatchery-origin fish. Only an objective, collaborative, science-based approach can address these problems in a manner that is both scientifically defensible and accepted by the public.

In an effort to improve its hatchery programs, the US Fish and Wildlife Service (Service) is beginning a three-year review of the 21 Columbia River Basin salmon and steelhead hatcheries that the Service owns or operates. The goal is to ensure that Service hatcheries are operated on the best scientific principles, and contribute to sustainable fisheries and the recovery of naturally-spawning populations of salmon, steelhead and other aquatic species of concern.

This internal review will, in many ways, resemble the recent and successful Puget Sound and Coastal Washington Hatchery Reform Project,[1] which the Service believes provides both a solid template and operational tools (e.g. software spreadsheets, population dynamic models) for reviewing Service hatcheries in the Columbia River Basin. The Service also believes that much of the background information necessary for reviewing hatcheries in the Columbia Basin has already been compiled in Hatchery and Genetic Management Plans (HGMPs),[2] Comprehensive Hatchery Management Plans (CHMPs),[3] and the Artificial Propagation Review and Evaluation (APRE)[4] database developed by the Northwest Power and Conservation Council (NWPCC).

Based on the recommendations of the Service's Pacific Regional Office Hatchery Review Working Group (Working Group),[5] the Assistant Regional Director for Fisheries (ARD) has assembled a Columbia Basin Hatchery Review Team (Review Team). This Review Team, comprised of Service and other federal agency scientists, has adapted the Puget Sound/Coastal Washington Hatchery Scientific Review Group's (HSRG) scientific framework, principles and hatchery review tools and is applying them to create reform recommendations for each hatchery program. The team provides excellent continuity with the HSRG because two members



[1] *For more information on this project, and for all project publications, see www.hatcheryreform.org.*
[2] *For more information on HGMPs, visit www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Hatcheries/Hatchery-and-Genetic-Management-Plans.cfm.*
[3] *For more information on CHMPs, visit www.fws.gov/pacific/Fisheries/CHMP.htm.*
[4] *For more information on APRE, visit www.nwcouncil.org/fw/apre/.*
[5] *The Working Group's report and all other Columbia Basin Hatchery Review documents are available from the project's website, www.fws.gov/pacific/fisheries/hatcheryreview/.*

(including the chair) have served on the HSRG, the vice chair served on the policy-makers' Hatchery Reform Coordinating Committee, and three other members represented the Service at HSRG regional review meetings. The Service has contracted for project facilitation with Long Live the Kings (LLTK), a non-profit organization devoted to restoring wild salmon to the waters of the Pacific Northwest. LLTK has provided facilitation, communications and coordination for the Puget Sound/Coastal Washington process.

Review Team members include:

- **Don Campton** (Chair), Senior Scientist, USFWS Abernathy Fish Technology Center
- **Douglas DeHart** (Vice Chair), Senior Fishery Biologist, USFWS Pacific Regional Office
- **Ray Brunson**, Fish Health Biologist, USFWS Olympia Fish Health Center
- **Tom Flagg**, Supervisory Fish Biologist, NOAA Fisheries Manchester Research Station
- **Joe Krakker**, Fishery Biologist, USFWS Lower Snake River Compensation Plan Office
- **Larry Marchant**, Project Leader, USFWS Spring Creek NFH
- **Doug Olson**, Hatchery Assessment Team Leader, USFWS Columbia River Fisheries Program Office
- **Carl Schreck**, Senior Scientist/Professor, US Geological Survey/Oregon State University
- **Larry Telles**, Fish Biologist, USFWS Quilcene NFH
- **Dave Zajac**, Fish and Wildlife Biologist, USFWS Western Washington Fish and Wildlife Office
- **David Carie** (alternate), Fisheries Management Biologist, USFWS Mid-Columbia Fishery Resource Office
- **Susan Gutenberger** (alternate), Supervisory Microbiologist, USFWS Lower Columbia River Fish Health Center

Team support members include:

- **Michael Kern** (Facilitator), Project Director, Long Live the Kings
- **Amy Gaskill** (Outreach), External Affairs Specialist, USFWS Pacific Region Fisheries Program

The Fisheries ARD has appointed a Hatchery Oversight Team (Oversight Team) to succeed the Working Group as the Service's primary internal mechanism to oversee the review process, monitor its progress, and transmit communications and reports from the Review Team to the ARD and project leaders within the Service's Pacific Region Fisheries Program. The Oversight Team is coordinated by the Pacific Region Hatchery/Science Team Leader and includes participation by line supervisors within the Fisheries Program. The Oversight Team, along with the ARD, will be the primary contact group between the Service and its partners, to develop policies for implementing or modifying the Review Team's recommendations.

The process began in October 2005 with a review of the Warm Springs National Fish Hatchery (NFH) on the Warm Springs River in the Deschutes River watershed/Columbia Plateau province in Oregon. This review is being conducted as a pilot to help the Service test and refine the review process. Fishery co-managers and stakeholders are involved in the review process and have been asked to comment on draft reports and recommendations.

The Review Team reviewed a large number of background documents, received a tour of the hatchery, and observed a presentation on habitat in the Deschutes watershed. The Team then

met with the Service's tribal cooperators, the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO), the Oregon Department of Fish and Wildlife (ODFW), and the National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NOAA Fisheries) to discuss the purpose of the review, hatchery operations, Deschutes watershed stock goals and interactions, and specific issues the co-managers wanted the Review Team to consider. The Review Team then assessed benefits and risks from the current hatchery program to the stock propagated in the hatchery and other salmonid stocks in the basin, and drafted a set of preliminary recommendations for improving the program. The review concluded with an oral presentation of these findings to the CTWSRO, ODFW and NOAA Fisheries. The Review Team then drafted this report. The finalized version of this report will be published in early 2006 following co-manager and stakeholder/public review and comment periods.

Following this pilot review, the Service will adjust the process as necessary and then review three more regions—Mid-Columbia, Lower Columbia, and Lower Snake River Compensation Plan facilities. These facilities include five NFHs in the Lower Columbia region (Eagle Creek, Carson, Little White Salmon, Willard and Spring Creek); three NFHs in the Mid-Columbia region (Leavenworth, Entiat and Winthrop); three NFHs in the Snake River region: (Dworshak, Kooskia and Hagerman); and nine federally-owned hatcheries that are operated by the states of Washington, Oregon and Idaho as part of the Lower Snake River Compensation Plan (Lyons Ferry, Tucannon, Irrigon, Lookingglass, Wallowa, Clearwater, McCall, Sawtooth and Magic Valley). The Service plans to complete reviews of all these facilities by 2008.

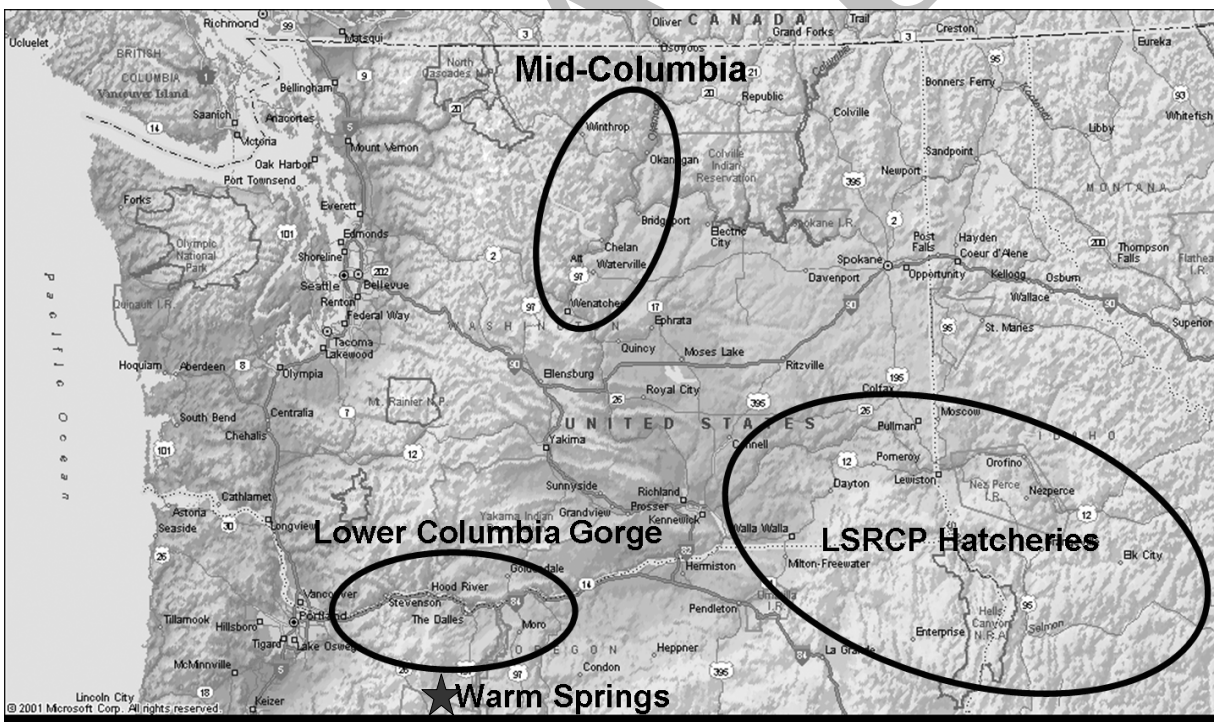



**FIGURE 2. -- Regions of the US Fish and Wildlife Service Columbia River Basin Hatchery Review Project**.

# II. Components of This Report

This report provides the assessments and recommendations developed by the Review Team upon reviewing the propagation programs conducted currently at the Warm Springs NFH. This hatchery is operated by the Service and co-operated by the CTWSRO. The recommendations contained in this report are based upon the best scientific information available at the time of the review. In keeping with the tenets of adaptive management, it will be necessary to review and adapt these recommendations as new scientific information becomes available and/or goals change.

## Description of Watershed, Goals, Stock Status, Hatchery Program

The following report contains a general overview of the Deschutes River watershed, tables containing ratings for all salmonid stocks in the watershed (as provided by the co-managers), and then an assessment of and recommendations for the Warm Springs spring Chinook salmon (*Oncorhynchus tshawytscha)* hatchery program. This includes the program's effects on other stocks, and consistency with management priorities, in the watershed. The stock tables provide stock goals/management premises for the recent past (approximately five years ago), current condition, and short-term (10–15 year) and long-term (50–75 year) future goals or expectations. If a hatchery program is associated with a stock, the stock tables also document program type, federal authorization and purpose(s), as expressed to the Review Team by the co-managers at workshops before and during the review process. These workshops used the recently-developed All-H Hatchery Analyzer (AHA) decision support tool[6] to document goals/premises and strategies. The tables in this report include the AHA output graphs for the stocks, or—where AHA analysis has not been conducted—qualitative ratings from the Artificial Production Review and Evaluation (APRE) database.[7] Full AHA analyses are included in the appendices. Below are definitions of the ratings included in the tables.[8]

**Biological significance** is a measure of the biological uniqueness of a particular stock relative to other stocks of the same species. This measure considers a number of specific factors such as stock origin (e.g. native or non-native), biological attributes (e.g. life history), and population subdivisions. A stock is defined as having either *low*, *medium* or *high* biological significance. The ratings for each stock described in this report are based on the criteria described by Mobrand et al. (2005) and reflect the consensus assessments of the comanagers.

**Population viability** considers a number of specific factors such as mean recruits per spawner or adult-to-adult replacement rates, age class structure, spawner escapement, and proportion of hatchery-origin fish in natural spawning. This rating refers to the ability of a stock to sustain itself in the natural environment (except in the case of a segregated harvest program, in which case the ratings refer to the stock's ability to sustain itself in the culture environment). In AHA, the estimated mean number of adult fish returning annually to the habitat and/or hatchery provides information about viability. Qualitative assessments of stock viability in this report are based on the criteria described by Mobrand et al. (2005).

[6] *For more information on AHA, see* AHA Technical Discussion Paper *on the Publications page of www.hatcheryreform.org.*
[7] *For more information on APRE, visit http://www.nwcouncil.org/fw/apre/.*
[8] *A more detailed discussion of these definitions is available in the HSRG's 2004* Principles and Recommendations *report and* Hatchery Reform in Washington State: Principles and Emerging Issues *essay for Fisheries Magazine, both of which are available on the Publications page of www.hatcheryreform.org.*

In AHA, the quantity and quality of **habitats** available for spawning, fresh water rearing, migration and estuarine residence to a particular stock can be assessed through estimates of the *capacity* and *productivity* of the habitat to support adult spawners and produce smolts.

**Harvest** can be assessed in AHA by the mean number of adult fish harvested annually in mixed stock and/or terminal fisheries.

The **type** of hatchery program with respect to broodstock management is also recorded. Hatchery programs are classified as *integrated* if the intent of the program is for the natural environment to drive the genetic constitution and adaptation of hatchery-origin fish via systematic inclusion of natural-origin fish into the broodstock. *Segregated* programs are those in which the intent is to maintain the hatchery population as a distinct, genetically segregated population via the use of hatchery-origin adults only for broodstock.

The **federal authorization** describes the legal authority/context under which the hatchery program operates.

The **primary and secondary purpose(s)** of the hatchery program are defined as either conservation, harvest, both and/or another purpose (such as education, research, socioeconomic or cultural/ceremonial).

Following this table, the Assessments and Recommendations sections include: 1) a *Description of the Current Hatchery Program*; 2) *Operational Considerations of the Current Program* (unique or important attributes recognized by the Review Team in considering the way the program is currently being operated); 3) the *Benefits and Risks* conferred by the program on the target stock and other anadromous stocks in the watershed; 4) the Review Team's *Recommendations* from considering benefits and risks; 5) a section for *Comments and Responses* to the review and recommendations from co-managers and stakeholders.

## Benefit and Risk Assessments

In conducting this review, the Review Team considered all possible benefits and risks potentially conferred and imposed, respectively, by the hatchery program.

**Benefits** considered include, but were not necessarily restricted to:

- Contributions to tribal and non-tribal harvests (commercial and recreational).
- Short- and long-term conservation benefits (both demographic and genetic).
- Research opportunities afforded by the program.
- Educational, cultural/ceremonial and socioeconomic benefits conferred by the program and the hatchery facility itself.

**Risks** considered include, but were not necessarily restricted to:

*Genetic Risks*

- Risks from artificial propagation on the genetic constitution and fitness of hatchery-origin fish of the cultured stock.

- Risks from natural spawning by hatchery-origin adults on the mean fitness of natural-origin fish of the same species in target and non-target watersheds.

*Demographic Risks*

- Risks from the hatchery facility and operations on the abundance of the propagated stock in the target watershed including the following: pre-spawning mortality associated with trapping, holding and/or bypassing adults; inadequate fish health protocols and water flow alarms to prevent catastrophic fish losses in the hatchery; poaching by humans; and predation by birds, mammals and other fish species at the point of release or on the hatchery grounds (e.g. by otters and birds).
- Risks associated with surface feeding under normal hatchery conditions that may increase vulnerability of released juveniles to predators, which may decrease smolt-to-adult survival.

*Ecological Risks*

- Competition, predation, and disease transfer from hatchery-origin adults and juveniles of the propagated stock to naturally spawning populations of the same species or stock in target and non-target watersheds.
- Competition, predation, and disease transfer from hatchery-origin adults and juveniles of the propagated stock to naturally spawning populations of different species in target and non-target watersheds, including non-salmonid fish species of particular concern (e.g. lamprey).
- Risks from the hatchery facility and operations on the aquatic biota and ecosystem within the target watershed, including the effects of hatchery effluent, water intake, use of chemicals, and upstream/downstream passage of fish and other aquatic species in the watershed.
- Risk of antibiotic use resulting in developing resistant strains of pathogenic organisms that infect salmonid fishes, other aquatic species, and humans.
- Producing fish that are not qualitatively similar to natural fish in size, growth rate, morphology, behavior, physiological status or health, which may adversely affect performance and increase adverse ecological interactions.

*Physical Risks*

- Risks from the hatchery facility and operations to human health and safety, including potential contaminants.

In the context of the benefits and risks outlined above, all operational and physical components of the hatchery program were reviewed. These components included trapping and holding of adult fish for broodstock, spawning and fertilization protocols, incubation of eggs, early rearing and ponding, feeding protocols (including the use of therapeutics and other measures to control disease), release protocols, and any other information available regarding the benefits and risks of the hatchery program between the time of release of juveniles to the return, capture and/or natural spawning of adults for broodstock.

The Review Team has also assembled a *Warm Springs NFH Briefing Document* (excerpted from various background documents reviewed by the Team) containing detailed information about the facility and its program, goals and operations. This briefing document, which includes citations

to the source documents, will be available from the web site during the public review period for this report (see Appendix B).

## Recommendations, Co-Manager and Stakeholder Comments

After careful assessment of the benefits and risks conferred by the hatchery program, the Review Team developed a series of recommendations to increase the likelihood of achieving the desired goals of the program and/or reducing biological and other risks. Recommendations for the current hatchery program are grouped into the following categories: broodstock choice/collection and natural/hatchery spawning; incubation/rearing; release/outmigration; facilities/operations; monitoring/accountability; and education/research. The review team then considered potential alternatives to the existing hatchery program at the Warm Springs NFH with an overall assessment of the value and merits of the current program relative to those potential alternatives.

The co-managers (represented by the CTWSRO, ODFW and NOAA Fisheries) were given the opportunity to review an earlier draft of this report, in order to provide corrections and comments prior to public distribution. Those corrections and comments were included in this revised report.

Finally, stakeholders in the Columbia River Basin (representing non-government organizations and users of fishery resources) are being given the opportunity to provide direct comments on this report as part of a general public review process. Those stakeholder comments will be included in the final version of this report.

# III. Deschutes River Watershed Overview[9]

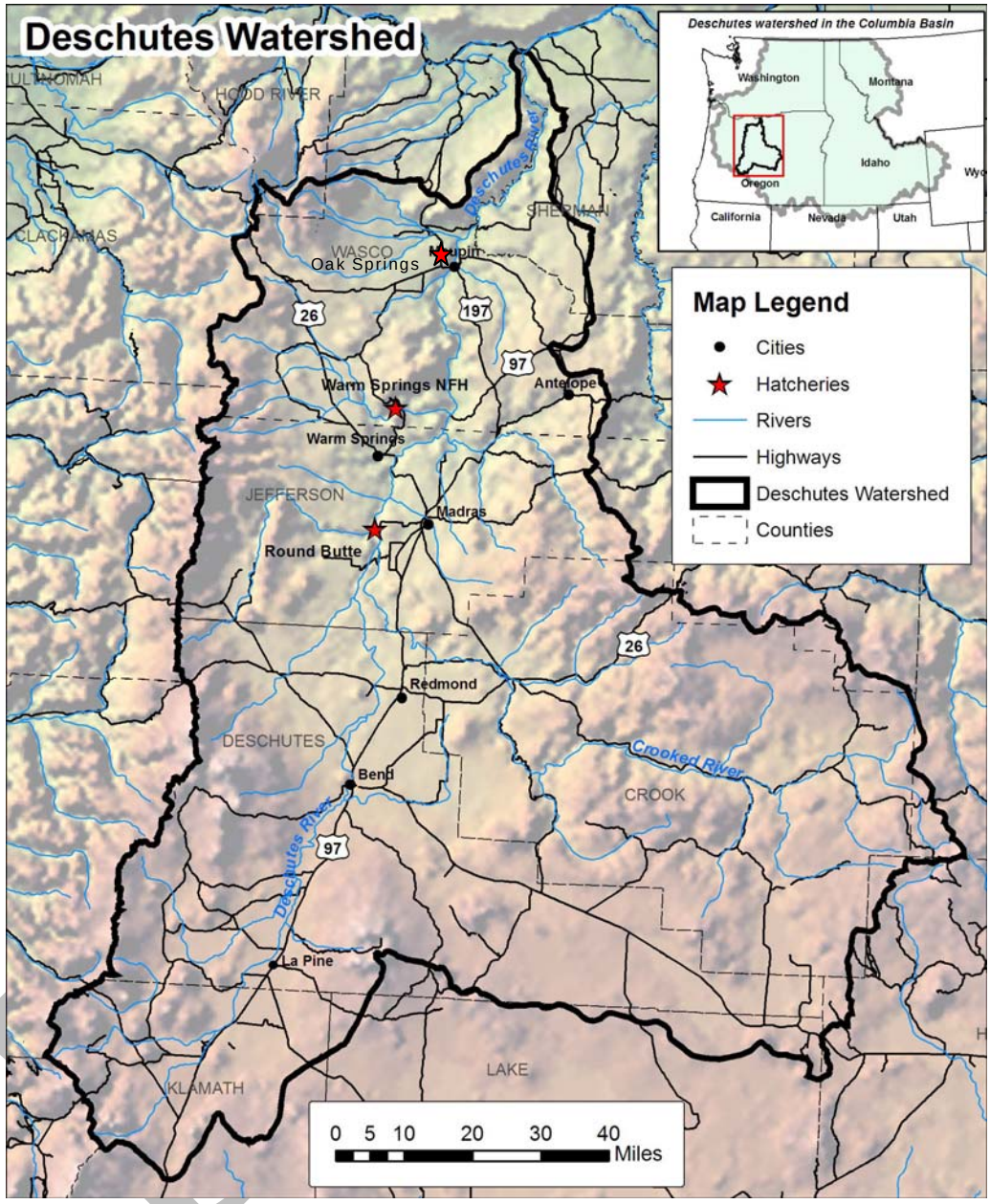



**FIGURE 3. -- Deschutes River Watershed Overview Map**

[9] *Primary source documents for information in this section include:*
*Lower Deschutes River Subbasin Management Plan, Oregon Department of Fish and Wildlife, July 1997.*
*Deschutes Subbasin Plan, NW Power and Conservation Council, December 2004.*
*Integrated Hatchery Operations Team-Operation Plans for Anadromous Fish Production Facilities in the Columbia River Basin, Volume II-Oregon, Prepared by ODFW and USFWS for the BPA, June 1996.*
*Warm Springs Hatchery and Genetic Management Plan, draft prepared by USFWS for NOAA Fisheries and USFWS, August 2004.*
*Salmon Hatcheries for the 21st Century: A Model at Warm Springs National Fish Hatchery, prepared by D.E. Olson, B. Spateholts, M. Paiya, and D.E. Campton, American Fisheries Society Symposium 44:585-602, 2004.*

The Deschutes River flows north into the Columbia River, and its watershed encompasses over 10,700 square miles (17,120 km) in central Oregon. The watershed extends west to the crest of the Cascade Mountains, south to lava plateaus, east into the Ochoco Mountains and the plateau between the Deschutes and John Day rivers, and north to the Columbia River at river mile 206 (rkm 330). The headwaters of the Deschutes River, and most major tributaries, receive large amounts of precipitation, but much of the watershed lies in the rain shadow of the Cascades Mountains and is sheltered from western Oregon's heavy rainfall. Average annual precipitation ranges from as high as 100 inches (254 cm) in the Cascade Mountains, mostly as snow, but drops to only 20 inches (51 cm) in the Ochoco Mountains and between nine (23 cm) and 14 inches (35 cm) in the Deschutes Valley and eastern plateaus.

## Fisheries

The lower Deschutes River is known nationally and internationally for its sport fishing. Resident rainbow trout (*Oncorhynchus mykiss)*, summer steelhead, spring and fall Chinook are the most popular species. The lower Deschutes River also supports an important tribal fishery for the Confederated Tribes of the Warm Springs Reservation of Oregon. Both summer steelhead and spring Chinook are supplemented with hatchery produced fish. Rainbow trout and fall Chinook are not stocked but reproduce naturally in the mainstem Deschutes River (downstream of Round Butte dam). Bull trout (*Salvelinus confluentus)*, kokanee (*Oncorhynchus nerka*) and introduced brown trout (*Salmo trutta*) are also significant in the area above Round Butte Dam.

## Conservation

Sustainable natural production of trout, salmon and steelhead is an important fisheries management goal in this watershed. Rainbow trout and fall Chinook salmon populations are considered healthy and robust, with no direct hatchery supplementation (some out-of-basin straying of hatchery fall Chinook may occur). The summer steelhead population in the Deschutes River is part of the mid-Columbia Evolutionarily Significant Unit (ESU), which is listed as threatened under the U.S. Endangered Species Act (ESA). The listing determination was made, in part, because of the influence of out-of-basin hatchery strays constituting over one-half of the steelhead adults in the Deschutes Basin in many years. Bull trout (char) are listed as threatened under ESA; however, the population is relatively abundant in the upper Deschutes River (Lake Billy Chinook and Metolius River) and in Shitike Creek. In Lake Billy Chinook, the bull trout populations are strong enough to support a harvest. The Warm Springs River has limited, but low, production of bull trout, as compared to the Metolius River and Shitike Creek. Spring Chinook salmon have a limited distribution in the Deschutes River, and are naturally produced in the Warm Springs River and Shitike Creek. Plans are underway to reintroduce spring Chinook and steelhead into historic habitat upstream of Round Butte Dam, as part of the dam's relicensing agreement.

## Habitat

Native American tribes lived in the region and harvested fish and wildlife for thousands of years. More intensive land development occurred with the first influx of settlers more than 100 years ago. Since that time, grazing by cattle, sheep and horses, farming practices, timber harvest, road construction/maintenance, railroad construction/maintenance, and the constructions of dams have all had an impact on the river, its tributaries and streamside vegetation. The result has been a

reduction in aquatic habitat quality, riparian vegetation, soil compaction and a decrease in stream bank stability.

The mouth of the Deschutes River is upstream of two mainstem dams on the Columbia River—Bonneville and The Dalles. In the Deschutes River, construction of the Pelton Round Butte Hydroelectric Complex in the late 1950s blocked anadromous fish from part of their historic spawning and rearing habitat above river mile 102 (rkm 164). Major spawning and rearing areas that were blocked include Squaw Creek, the Metolius River, and Crooked River. Major tributaries accessible to anadromous fish downstream from the hydroelectric complex can be divided into two groupings—east and west side tributaries—based on topography, habitat and flow regimes.

East side tributaries drain the eastern portion of the Deschutes River watershed and include Buck Hollow, Bakeoven and Trout creeks. All three streams provide spawning habitat for summer steelhead populations. West side tributaries originate along the east slope of the Cascade Mountains and include the Warm Springs River and Shitike Creek. These latter two streams support populations of spring Chinook and summer steelhead. Another west side tributary, the White River, has an impassable falls two miles upstream from its confluence with the Deschutes River and is a major, glacier fed tributary draining from Mt. Hood. The White River supports natural populations of rainbow trout and other native resident fish.

The White River enters the Deschutes just downstream of Sherars Falls, a major geologic feature at river mile 44.4 (rkm 71). The falls are classified as *Class Five* rapids, impassable by boats and historically limiting the distribution of fall Chinook to primarily downstream of the falls before construction of a fish ladder. However, spring Chinook and steelhead were able to negotiate the falls before the ladder. The falls were first laddered in the 1920s, with a trap added in the late 1970s. ODFW operates the trap to sample salmon and steelhead during their upstream migration.

## Current Status of Salmonid Stocks

The co-managers have identified seven principal salmonid stocks in the Deschutes River watershed:

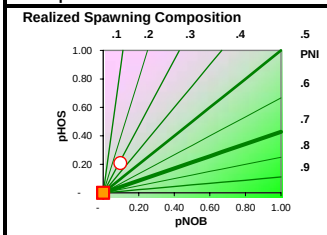
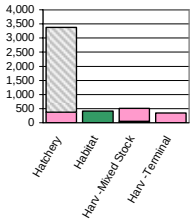
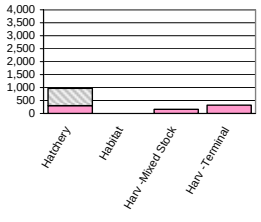
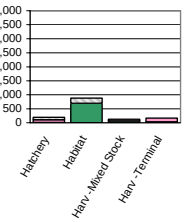
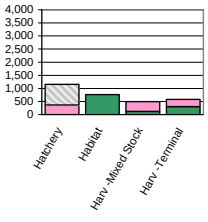
- Warm Springs River spring Chinook salmon (*naturally-spawning plus integrated hatchery-spawning*)
- Deschutes River, Round Butte Hatchery spring Chinook (*segregated hatchery-spawning*)
- Deschutes River fall Chinook (*naturally-spawning*)
- Deschutes River summer steelhead trout (*naturally-spawning)*[10]
- Deschutes River, Round Butte Hatchery summer steelhead trout (*segregated hatchery-spawning*)
- Deschutes River rainbow/redband trout (*naturally-spawning*)
- Deschutes River bull trout (*naturally-spawning*)

Future co-manager plans and cooperative agreements include reintroduction of anadromous salmonid fishes upstream of Pelton and Round Butte Dams on the mainstem Deschutes River. These reintroductions were taken into account in the AHA analyses (Appendix B). Tables 1-6 below include output graphs from AHA and the co-managers' ratings for the Deschutes River

[10] *NOAA Fisheries' Technical Recovery Team (TRT) has subdivided this stock into two demographically-independent populations coinciding with west side and east side tributaries; see www.nwfsc.noaa.gov/trt.*

stocks. Evaluations for the Warm Springs River spring Chinook stock are presented in Table 7 as part of the review of the hatchery program for that stock. Qualitative ratings of *biological significance* and *population viability* in Tables 1-7 are based on the criteria described by Mobrand et al. (2005). More detailed analyses of population viability for ESA listed stocks are currently under development by NOAA Fisheries (www.nwfsc.noaa.gov/trt/trt_Columbia.htm).

## TABLE 1. -- Deschutes River Round Butte Hatchery spring Chinook

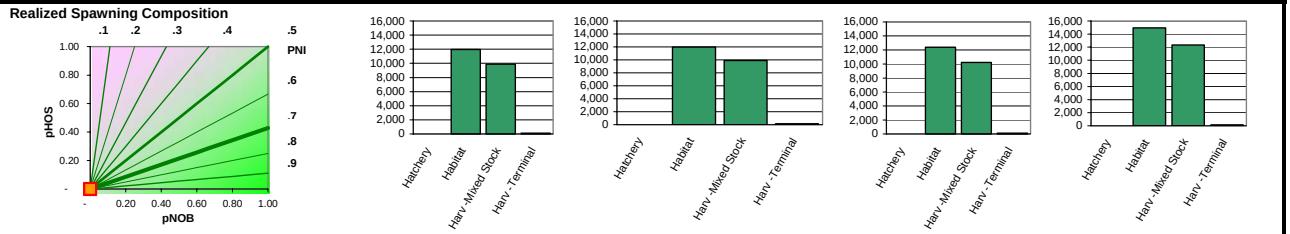
| **Stock Goals/Management Premises**[11] | | | | |
|---|---|---|---|---|
| Proportion of Natural Influence | Recent Past | Current | Short-Term | Long-Term |
|  |  |  |  |  |
| *Biological Significance* | Co-managers rate this stock as being of medium significance, now and into the future. | | | |
| *Population Viability* | Co-managers believe this segregated hatchery stock is viable, in that an annual average of ~1,000 fish currently return to the hatchery. Co-managers intend to convert this to an integrated program in the short-term (via reintroducing spawning above Round Butte/Pelton dams), expecting this to increase the stock's adaptation to the natural environment and, therefore, its fitness and viability (with an annual average of ~750 fish returning to the habitat). | | | |
| *Habitat* | Co-managers estimate that spring Chinook habitat currently has the capacity to support 1,500 adult spawners and that this will remain the same in the short- and long-terms. | | | |
| *Harvest* | Co-managers estimate that current conditions provide an annual average of ~500 fish for harvest, the majority in terminal fisheries and almost all of hatchery origin. Co-managers intend changes in hatchery, habitat and harvest management to increase harvest to ~1,000 fish, divided evenly between the mixed stock and terminal fisheries. | | | |
| **Hatchery Program**[12] | | | | |
| *Type* | Segregated | | | |
| *Federal Authorization* | Round Butte/Pelton Dam FERC licenses | | | |
| *Primary Purpose* | Harvest: *Supply fish for harvest as* mitigation for loss of natural production due to habitat losses upstream of Pelton Dam | | | |
| *Secondary Purposes* | Conservation*: Gene bank, broodstock source for reintroduction.* | | | |



[11] *Information in these tables is adapted from—and intended to provide a "snapshot" of the results from—the co-managers' All-H Hatchery Analyzer (AHA) workshops on these stocks in September 2005. For more detail on AHA, see AHA Technical Discussion Paper on the Publications page of www.hatcheryreform.org. An AHA user's guide and all AHA analyses are available from the AHA section of the prototype Managing for Success web site at www.mobrand.com/mfs. Chart at left shows proportion of natural influence (PNI), the degree to which the natural environment is/will drive the adaptation of the population over time, due to proportion of hatchery-origin fish spawning in natural environment (pHOS) and proportion of natural-origin fish in hatchery broodstock (pNOB). Shapes on graph plot the stock's estimated recent past (dark square), current (diamond) and short-term future (10–15 years, circle) and long-term future (50–75 years, light square) PNI. Stacked bar charts at right show number of adult fish estimated to return to the hatchery, habitat, mixed stock harvest or terminal harvest in the recent past, currently, and in the short-and long-term futures. Pink (light grey) bars represent hatchery-origin fish; green bars (dark grey) represent natural-origin fish; cross-hatched gray bars represent hatchery-origin fish surplus to broodstock needs at hatchery or excess of pHOS goal in habitat and natural spawning grounds. See Components of This Report section for definitions of biological significance, population viability, habitat and harvest ratings.*

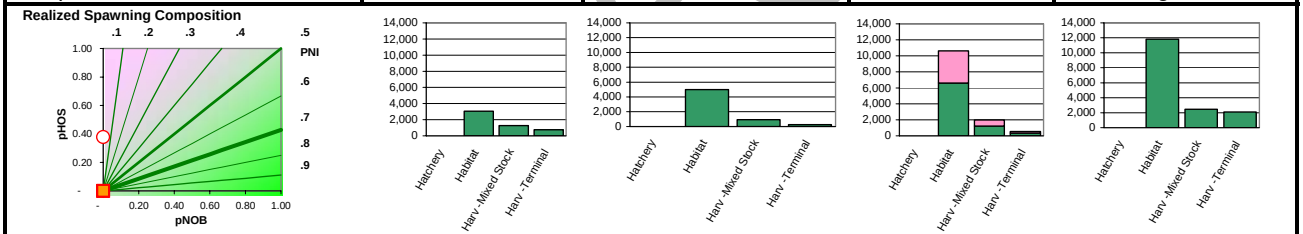
[12] *See Components of This Report section for definitions of hatchery program type, authorization, purposes.*

## TABLE 2. -- Deschutes River fall Chinook

| Stock Goals/Management Premises | | | | |
|---|---|---|---|---|
| Proportion of Natural Influence | Recent Past | Current | Short-Term | Long-Term |
|  | | | | |

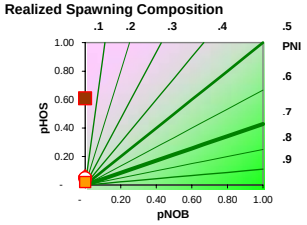
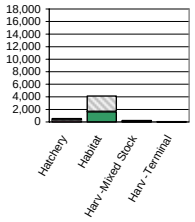
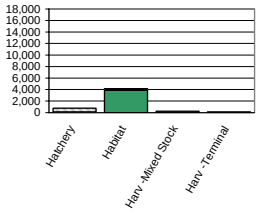
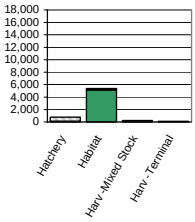
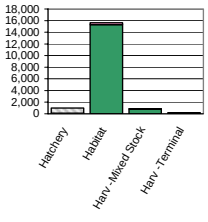
| | |
|---|---|
| *Biological Significance* | Co-managers rate this stock as being of medium to high biological significance, now and into the future. |
| *Population Viability* | Co-managers believe this stock is of high viability, with annual averages of ~12,000 fish currently return to the habitat. Co-managers intend this to increase to an annual average of over 14,000 fish returning to the habitat in the long-term. |
| *Habitat* | Co-managers estimate that fall Chinook habitat currently has the capacity to support just under 30,000 adult spawners, and that this will increase to over 32,000 in the long-term. |
| *Harvest* | Co-managers estimate that current conditions provide an annual average of ~10,000 fish for harvest, almost all in mixed stock fisheries. Co-managers intend this to increase to ~12,000 fish in the long-term. |

## TABLE 3. -- Deschutes River summer steelhead

| Stock Goals/Management Premises | | | | |
|---|---|---|---|---|
| Proportion of Natural Influence | Recent Past | Current | Short-Term | Long-Term |
|  | | | | |

| | |
|---|---|
| *Biological Significance* | Co-managers rate this stock as being of medium biological significance, now and into the future |
| *Population Viability* | Co-managers believe this stock is viable, although it is listed as threatened under ESA, and recent viability analysis for recovery planning suggest that some populations may not be viable. Co-managers estimate an annual average of ~4,000 natural-origin adults currently return to the habitat. Co-managers expect this latter number to increase to almost 12,000 fish in the long-term, as a result of habitat improvement and reintroduction above Round Butte Dam using hatchery fish. |
| *Habitat* | Co-managers estimate that summer steelhead habitat can currently support over 8,000 adult spawners, and that this will increase to over 16,500 in the long-term. |
| *Harvest* | Co-managers estimate that very few of these fish are currently harvested in mixed stock or terminal fisheries, although a significant harvest may occur in the Zone 6 fisheries. Co-managers expect changes in habitat to increase harvest in the long-term to almost 4,000 fish, divided almost evenly between the mixed stock and terminal fisheries. |

## TABLE 4. -- Deschutes River Round Butte Hatchery summer steelhead

| Stock Goals/Management Premises | | | | |
|---|---|---|---|---|
| Proportion of Natural Influence | Recent Past | Current | Short-Term | Long-Term |
|  |  |  |  |  |
| *Biological Significance* | Co-managers rate this stock as being of medium biological significance, moving to low in the future if steelhead stocks recover across the Basin. | | | |
| *Population Viability* | Co-managers estimate that an annual average of over 750 fish currently return to the hatchery, which is well above the broodstock collection goal of 125 adults. | | | |
| *Habitat* | Co-managers estimate that summer steelhead habitat currently has the capacity to support over 8,000 adult spawners and that this will increase to over 16,500 in the long-term. | | | |
| *Harvest* | *Harvest numbers in AHA need to be confirmed by ODFW* | | | |
| **Hatchery Program** | | | | |
| *Type* | Segregated | | | |
| *Federal Authorization* | Round Butte/Pelton Dam FERC licenses | | | |
| *Primary Purpose* | Harvest: Provide harvest, mitigate for impacts of hydro facility, provide minor gene bank component. | | | |
| *Secondary Purposes* | Conservation: Provide a gene bank for this stock. | | | |

## TABLE 5. -- Deschutes River rainbow/redband trout

| Stock Goals/Management Premises | | | |
|---|---|---|---|
| ***No AHA analysis is available on this stock; ratings below are modified from the APRE database[13]*** | | | |
| ○ = Low ◒ = Medium ● = High | | | |
| | **Now** | **10-15 years** | **30-50 years** |
| **Biological Significance** | ● | ● | ● |
| **Viability** | ◒ | ● | ● |
| **Habitat** | ◒ | ◒ | ● |
| **Harvest** | ○ | ○ | ○ |

[13] *Artificial Production Review and Evaluation (APRE), available at http://www.nwcouncil.org/fw/apre/*

## TABLE 6. -- Deschutes River bull trout

| Stock Goals/Management Premises | | | |
|---|---|---|---|
| *No AHA analysis is available on this stock; ratings below are modified from the APRE database* | | | |
| **Deschutes River bull trout: *Natural*** | | | |
| ○ = Low ◒ = Medium ● = High | | | |
| | **Now** | **10-15 years** | **30-50 years** |
| **Biological Significance** | ◒ | ◒ | ◒ |
| **Viability** | ◒ | ◒ | ● |
| **Habitat** | ◒ | ◒ | ● |
| **Harvest** | ○ | ○ | ◒ |

### Other Species of Concern

Other species of concern that are observed passing the Warm Springs NFH site include Pacific lamprey (*Lampetra tridentate)*, various sucker species (*Catostomus)*, and mountain whitefish (*Prosopium williamsoni)*. In 2004, the following adult fish were recorded at the Warm Springs NFH during upstream passage in the Warm Springs River: three Pacific lamprey, 394 sucker sp. and 493 whitefish. The CTWSRO have expressed concern that the barrier weir at the hatchery may inhibit upstream passage of lamprey.

### Salmon and Steelhead Hatcheries in the Deschutes Watershed[14]

***Warm Springs National Fish Hatchery* (US Fish and Wildlife Service)**

Warm Springs NFH is located at river mile 10 (rkm 16) of the Warm Springs River, within the Warm Springs Indian Reservation. The Warm Springs River enters the Deschutes River at river mile 84.4 (rkm 135), which in turn enters the Columbia River at river mile 205.6 (rkm 329). The hatchery site lies in Section 24, Township 8 South, Range 12 East, Willamette Meridian, Oregon. Shitike Creek, the site of a spring Chinook restoration program associated with the hatchery, enters the Deschutes River at river mile 97 (rkm 155) after flowing approximately 31 miles (61 km) from its headwaters near Mount Jefferson. The hatchery currently maintains one program: Warm Springs River spring Chinook. Warm Springs NFH is fully funded by the Service. The hatchery has a staff of six full-time employees and has an annual operating budget of approximately $550,000. The Service also provides a substantial amount of monitoring and evaluation support for this program. For example, approximately $400,000 (separate from the operating budget) was allotted for monitoring and evaluation projects in fiscal year 2005.

***Round Butte State Hatchery* (Oregon Department of Fish and Wildlife)**

Round Butte Hatchery is located on the Deschutes River at the base of Round Butte Dam, 10 miles (16 km) west of Madras, Oregon. The hatchery was constructed by Portland General Electric to mitigate for losses of wild spring Chinook and summer steelhead in the Deschutes

[14] *See Figure 3.*

River upstream of Pelton and Round Butte Dams. Hatchery propagation started in 1972. Pelton Ladder (a former fish passage ladder that now has some sections converted for hatchery rearing) is operated as a satellite rearing facility. The Bonneville Power Administration pays for the part of Pelton Ladder operation specific to production for the Hood River. The federal license for operating the dams for hydroelectricity is now co-owned by Portland General Electric and CTWSRO, who are also responsible for funding fisheries mitigation projects, including hatchery operations. Part of the new relicensing agreement is to use hatchery-origin fish to reintroduce salmon and steelhead upstream of the dams for initiating natural reproduction. The mitigation agreement also calls for a return of 1,800 summer steelhead adults and 1,200 spring Chinook adults to the project area. The hatchery has a staff of five full-time employees.

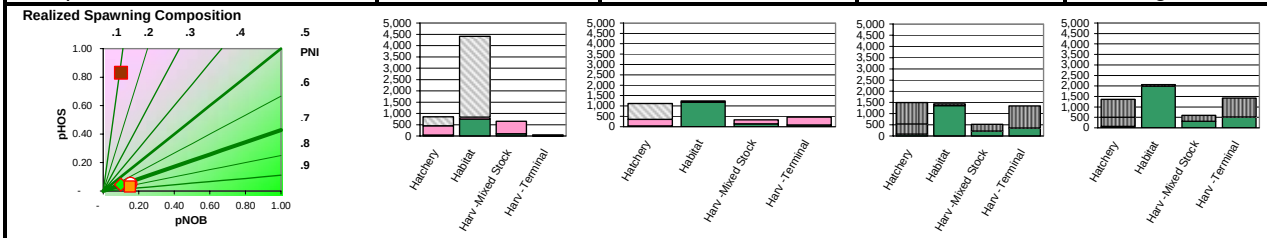
***Oak Springs State Hatchery* (Oregon Department of Fish and Wildlife)**

Oak Springs Hatchery is located on the Deschutes River, about nine miles (14 km) from Maupin, Oregon. The hatchery was constructed in several phases, beginning in 1922. It is operated with State of Oregon funds and raises steelhead and rainbow trout. The steelhead are transferred to basins outside the Deschutes River. The rainbow trout are only stocked into standing waters. There are no fish ladders at this facility and no anadromous fish are collected for broodstock. Over six full-time employees operate the hatchery.

# IV. Warm Springs River Spring Chinook, Warm Springs NFH

**US Fish and Wildlife Service, Operator**
**Confederated Tribes of the Warm Springs Reservation of Oregon, Cooperator**

## TABLE 7. – Warm Springs River Spring Chinook

| **Stock Goals/Management Premises**[15] | | | | |
|---|---|---|---|---|
| Proportion of Natural Influence | Recent Past | Current | Short-Term | Long-Term |
|  | | | | |
| *Biological Significance* | Co-managers rate this spring Chinook stock as being of high biological significance, now and into the future. | | | |
| *Population Viability* | Co-managers expect this stock to remain viable over time, with an annual average of over 1,000 fish returning to the habitat currently and over 2,000 expected in the long-term. Co-managers intend changes in hatchery, habitat and harvest management to increase the stock's adaptation to the natural environment and, therefore, its fitness and viability. | | | |
| *Habitat* | Co-managers estimate that spring Chinook habitat currently has the capacity to support less than 2,000 adult spawners. Co-managers intend short- and long-term habitat improvements to increase capacity to ~ 2,500 and ~3,000 adult spawners, respectively. | | | |
| *Harvest* | Co-managers estimate that current conditions provide an annual average of just under 1,000 fish for harvest, divided almost evenly between mixed stock and terminal fisheries. The majority of these fish are of hatchery origin. Co-managers intend changes in hatchery, habitat and harvest management to increase harvest to almost 2,000 fish, ~1,500 in the terminal fishery. | | | |
| **Hatchery Program**[16] | | | | |
| *Type* | Integrated | | | |
| *Federal Authorization* | Warm Springs Hatchery Authorization Act, 1966 | | | |
| *Primary Purpose* | Harvest: Support tribal and non-tribal fisheries in the Warm Springs and Deschutes rivers; return as many harvestable adults as possible, consistent with production objectives and escapement goals for natural-origin adults, once wild escapement is achieved. | | | |
| *Secondary Purposes* | Conservation: Assist with conservation/ sustainability of naturally spawning spring Chinook in the Warm Springs River<br>Cultural/Educational: Provide cultural and educational opportunities to tribal members<br>Research: Provide research opportunities associated with artificial propagation of native salmonid resources | | | |

[15] *Information in this table is adapted from—and intended to provide a "snapshot" of the results from—the co-managers' All-H Hatchery Analyzer (AHA) workshops on these stocks in September 2005. For more detail on AHA, see AHA Technical Discussion Paper on the Publications page of www.hatcheryreform.org. An AHA user's guide and all AHA analyses are available from the AHA section of the prototype Managing for Success web site at www.mobrand.com/mfs. Chart at left shows proportion of natural influence (PNI), the degree to which the natural environment is/will drive the adaptation of the population over time, due to proportion of hatchery-origin fish spawning in natural environment (pHOS) and proportion of natural-origin fish in hatchery broodstock (pNOB). Shapes on graph plot the stock's estimated recent past (dark square), current (diamond) and short-term future (10–15 years, circle) and long-term future (50–75 years, light square) PNI. Stacked bar charts at right show number of adult fish estimated to return to the hatchery, habitat, mixed stock harvest or terminal harvest in the recent past, currently, and in the short-and long-term futures. Pink (light grey) bars represent hatchery-origin fish; green bars (dark grey) represent natural-origin fish; cross-hatched gray bars represent hatchery-origin fish surplus to broodstock needs at hatchery or excess of pHOS goal in habitat and natural spawning grounds. See Components of This Report section for definitions of biological significance, population viability, habitat and harvest ratings.*

[16] *See Components of This Report section for definitions of hatchery program type, authorization, purposes.*

## Assessments

### *Description of Current Hatchery Program*

The Warm Springs National Fish Hatchery (NFH) spring Chinook broodstock has been derived from adults returning to the Warm Springs River since the beginning of the program in 1978. During the first four years of broodstock collection (1978–81), 100% of the broodstock was collected from natural-origin, spring Chinook trapped in the Warm Springs River. Since 1981, the majority of broodstock has been of Warm Springs NFH origin, with no wild fish included in the broodstock in several low return years. The *Warm Springs NFH Operation and Implementation Plan 2002–06* prescribes that an average of 10% of the hatchery broodstock be derived from natural-origin adults, based on a sliding scale that varies from 0–20%, depending on the estimated number of natural-origin adults returning to the Warm Springs River. Surplus hatchery-origin adults returning to the hatchery help support the Shitike Creek Restoration Program.[17]

The current broodstock objective is to collect 630 adults and release 750,000 juvenile fish—10% as fall sub-yearlings (75,000) and 90% as spring yearlings (675,000)—into the Warm Springs River at the hatchery site. 100% of all released fish have a clipped adipose fin and a coded wire tag. Broodstock and juvenile production goals are set to provide an adult return of 2,250 or more hatchery-origin spring Chinook to the mouth of the Deschutes River for harvest and upriver escapement. The hatchery goal is to achieve a minimum 0.3% juvenile-to-adult survival rate to the mouth of the Deschutes River. The escapement goal for natural-origin spring Chinook to the Warm Springs River is a minimum of 1,300 adults upstream of the Warm Springs NFH.

Broodstock for the program are collected via a fish ladder and trap located at the barrier weir on the Warm Springs River, adjacent to the hatchery. Spawners are randomly collected over the entire run and randomly spawned from ripe fish over a three to four week period between late August and early September. Fertilized eggs from each adult pair are incubated in separate colanders until eyed to enable segregation or culling of eggs from females at high risk for bacterial kidney disease (BKD) to reduce vertical transfer of pathogens, particularly *Renibacterium salmoninarum*, the causative agent of BKD. Eyed eggs are sorted by BKD-antigen level via an enzyme-linked immunosorbent assay (ELISA) of the female parents, and counted into Heath incubator trays for incubation through yolk-sac absorption. At ponding, fry are started in 13’ x 3’ x 2’ indoor starter tanks. Juveniles are subsequently moved outdoors to 75’ (23 m) modified rectangular Burrows ponds for rearing to release. The Warm Springs River is the water source for all components of the hatchery program. Temperatures during the rearing cycle range between 32° F (0° C) in winter and 72° F (22° C) in summer. All juveniles are released on station. The hatchery stock averages 4.3 adult recruits per spawner.

### *Operational Considerations of Hatchery Program*

The Service recognizes that the CTWSRO have the principal management responsibility for fishery resources on the Warm Springs Indian Reservation. The Service and the Tribe have a memorandum of understanding and an agreement that the operation of the hatchery is to be

[17] *In 2000, the Service and CTWSRO initiated a program to boost the spawning population of spring Chinook in Shitike Creek by releasing into the Creek adult hatchery fish from Warm Springs NFH. Between 83 and 265 live adults have been outplanted each year.*

compatible with, and complement, the Tribe's fishery management goals. Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

**Broodstock Choice/Collection, Hatchery and Natural Spawning**

- Because this hatchery program uses the integrated genetic broodstock management strategy, the size of the program is constrained by the size of the naturally-spawning population from which broodstock must be taken. Consequently, the carrying capacity of the habitat upstream of the hatchery in the Warm Springs River is also considered in determining the appropriate size of the hatchery program.
- The conservation component of the program relies on maintaining a properly integrated broodstock, maintaining a viable natural population in the watershed, and taking an adaptive management approach for the hatchery component, to prevent genetic divergence of hatchery-origin fish from the natural component, so that hatchery-origin fish can potentially be used as a genetic repository or gene bank if needed or desired (e.g. in the event of a catastrophic environmental event).
- The hatchery employs a volitional adult-bypass system, where adults without coded-wire tags can be diverted upstream without human intervention, and hatchery-origin fish with coded wire tags are diverted into a hatchery holding pond, thus precluding hatchery-origin adults with coded-wire tags from passing upstream and potentially interbreeding with natural-origin fish. However, this system does have a 5–10% error rate due to tag loss and mechanical aspects of the bypass system.
- Marking (clipping) 100% of hatchery-origin fish allows them to be distinguished from natural-origin fish, thus preventing masking of the true status and viability of the natural-origin component of the population, and allowing differential harvest of hatchery- and natural-origin fish.
- Returns of hatchery-origin adults to the Warm Springs River have ranged from a low of 52 fish in 1994 to a high of 6,891 in 2002. Returns have increased in recent years, with an annual average of 3,317 fish for the period 1995–2004. During this same time period, wild fish returns to the Warm Springs River have ranged from 237–2,705, averaging 1,338 fish. From brood years 1985–96, juvenile to adult survival has averaged 0.29% for the hatchery stock (low 0.005%, high 1.27%). During this same period, juvenile to adult survival for the wild stock has averaged 1.72% (low 0.37%, high 3.19%). With egg to juvenile survival being much higher in the hatchery environment as compared to wild fish (84% vs. 10%) and juvenile to adult survival being higher in wild fish, the adult recruit per spawner ratio is similar between the two groups (three adult recruits to the Deschutes River per spawner in the Warm Springs River). In this context, the hatchery adds considerable capacity to the natural habitat, but not necessarily increased productivity (see Appendix B).
- Spawning protocols involve stripping eggs and milt from each parent individually into separate containers, followed by the random pairwise "mating" of those gametes by a third person who has not directly seen the fish. This approach maximizes the likelihood that both selection and mating of adults is truly random, thus maximizing the likelihood that the genetic broodstock goals will be achieved.
- Based on previous research, males less than 60 cm in fork length are assumed to be three year-old fish (age 3) and are selected for spawning in proportion to their presence among all

adults, to an upper limit representing the maximum observed proportion among natural-origin adults (two to five percent).

**Incubation/Rearing**

- High summer water temperature constrains the number of juveniles that can be reared.
- The program has a narrow temperature/date window for marking juvenile fish.
- Round Butte hatchery spring Chinook have been reared and released at Warm Springs NFH on four occasions when adult returns of Warm Spring hatchery fish have been insufficient to meet broodstock goals and predicted future harvest goals. However, those fish were given differential marks (ventral fin clips) prior to release, and were only used for broodstock at Warm Springs NFH during the first two occasions.

**Release/Outmigration**

- Smolts are released semi-volitionally over a four to six week window in the fall (10%–30% of total production), and a three to four week period in the spring (70%–90% of total production). For brood years 1994–2003, a range of 420,866–827,665 fish were released from the hatchery into the Warm Springs River. The ten year average was 662,799 fish.

**Facilities/Operations**

- The current program size is at its upper limit, based on the existing number of raceways and rearing containers, and the need to meet optimum density objectives consistent with fish health concerns. Rearing density evaluations are ongoing.
- The physical location of the hatchery is several kilometers downstream from the principal natural spawning and rearing areas of spring Chinook in the Warm Springs River. This physical segregation of the hatchery and natural components of the population's habitat minimizes the likelihood of adverse ecological interactions between hatchery- and natural-origin spring Chinook.
- Cross-training of hatchery personnel is sufficient to cover essential hatchery functions.
- There are some problems with security and poaching at this facility because of insufficient fencing. Also, video monitoring, alarm systems, and USFWS staff that live on site are considered minimal.
- Many fish holding vessels (ponds, raceways) do not have separate water alarms to indicate water flow or water level failures.

**Education/Research**

- The hatchery facility and operations are open to the public. A visitor's center describes the facility, fish production goals, management goals and ecosystem function. The hatchery schedules tours for visiting groups and provides opportunities for student interns. The hatchery staff is involved in community/volunteer meetings and outreach programs.
- There is a well-developed monitoring and evaluation program in this watershed, on- and off-station. In fiscal year 2005, approximately $400,000 was allotted by the Service for evaluation projects.

- The hatchery is also providing facilities to accommodate a steelhead kelt reconditioning project being investigated by CTWSRO. One objective of the project is for CTWSRO to collect up to 100 wild steelhead kelts in Shitike Creek and bring them to a new egg and rearing isolation facility at the hatchery for a nine month reconditioning period. Reconditioned steelhead will then be transported by CTWSRO back to Shitike Creek for natural spawning. This Bonneville Power Administration research project, in cooperation with the Columbia River Inter-Tribal Fish Commission, was initiated in 2005.

## *Benefit and Risk Analysis*

### Harvest, Conservation and Other Benefits Conferred by Hatchery Program to the Target Stock

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagation of the target stock,[18] the Review Team identified the following benefits of the spring Chinook program at the Warm Springs NFH:

***Harvest***

- Harvest benefit to the Tribes and non-Tribal sport fishers. Co-managers estimate that current conditions provide an annual average of just under 1,000 fish for harvest, divided almost evenly between mixed stock and terminal fisheries. The majority of these fish are of hatchery origin.

***Conservation***

- Conservation benefit from use of native broodstock, by providing a genetic repository and demographic buffer against catastrophic loss.
- Conservation benefit by diverting harvest from wild fish, although CTWSRO do have limited wild harvest opportunities when run-size estimates are sufficient to allow a fishery on natural-origin adults.
- Conservation benefit by providing opportunity to screen and treat adults and carcasses to reduce pathogen transmission and remove strays.
- Potential conservation benefit (increased spawning distribution) from outplanting of live adults to Shitike Creek.

***Research/Education/Cultural/Socioeconomic***

- Cultural benefit to the Tribes by making surplus hatchery fish available to Tribal members.
- Cultural, educational and employment benefits to both Tribal and non-Tribal (including new visitor center).
- Research/monitoring/evaluation/fisheries management benefit to target stock.

### Harvest, Conservation and Other Benefits Conferred by the Hatchery Program to Other Stocks and Species in the Watershed

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to non-target species and stocks,[19] the Review Team identified the following

[18] *See Components of This Report for a description of these potential benefits and risks.*
[19] *Ibid.*

benefits of the spring Chinook program at the Warm Springs NFH to other species and stocks:

***Conservation***

- Conservation benefit from removing non-native marked steelhead and coho salmon (*Oncorhynchus kisutch),* which keeps them from spawning with wild fish and reduces disease concerns.
- Conservation benefit from outplanting live adults into Shitike Creek, which expands natural spawner distributions, and outplanting carcasses into Shitike Creek and the Warm Springs River which provides nutrient enhancement.

***Research/Education/Cultural/Socioeconomic***

- Research/monitoring/evaluation/fisheries management benefits to other stocks (e.g., bull trout, mountain whitefish).

**Risks Posed by the Hatchery Program to the Target Stock**

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the target stock,[20] the Review Team identified the following risks of the hatchery program to spring Chinook salmon in the Warm Springs River:

***Genetic***

- Potential small, genetic domestication selection risk to the target stock if not enough wild fish are included with the hatchery broodstock.
- Potential genetic (phenotypic) risk to the target stock from response to hatchery environment.
- Potential genetic fitness risk of rearing and releasing Round Butte spring Chinook at Warm Springs NFH, if returnees pass upstream to spawn.
- Potential genetic fitness risk from including early-returning fall Chinook in broodstock (however, spawn timing is believed to not overlap).

***Demographic***

- Potential demographic risk because bypass methodology and holding pond may increase pre-spawning mortality of wild fish.
- Potential demographic risk from pathogen amplification.
- Small demographic risk to wild fish from removing up to five percent of wild population for hatchery broodstock.
- Demographic risk of catastrophic brood year loss, due to lack of low water alarms.
- Potential demographic risk to wild spawners from concentrating predators at release location and adults entering and exiting facility.

***Ecological***

- Potential ecological risk of disease transfer and amplification from carcass outplants; this is minimized by processing and screening each carcass for pathogens in this program.

[20] *Ibid.*

- Potential ecological risk from antibiotic resistance in bacterial flora within wild stock from erythromycin injections and prophylactic use of medicated feeds for hatchery-reared fish, and antibiotics in effluent.
- Potential ecological (predation) risk to wild spawners from concentrating predators at release location and adults entering and exiting facility.
- Otters entering holding pond pose additional ecological (predation) risk to target stock.
- Potential ecological risk if permanent and/or temporary barrier weirs alter spawning distribution in the Warm Springs River or Shitike Creek.
- Potential ecological risk if water quality standards are not met and/or not stringent enough.
- Potential ecological risk from non-treatment of waste water, although cleaning effluent water is discharged into a settling pond, and tested water meets NPDES standards.
- Potential ecological (competition) risk from sub-yearling fall releases of spring Chinook in the Deschutes.
- Potential ecological (redd superimposition/competition) risk if coho passed upstream at weir are not native to the watershed.

***Physical***

- Physical risk to hatchery and wild fish from touching, handling, etc. for research/ monitoring/disease prevention/broodstock.
- Potential physical risk from mechanical requirements to manipulate water temperatures and flow.

**Risks Posed by the Hatchery Program to Other Non-Target Stocks and Species**

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to non-target stocks and species,[21] the Review Team identified the following risks of the hatchery program to non-target stocks and species:

***Demographic***

- Potential demographic risk because bypass methodology and barrier weir may increase pre-spawning mortality of wild fish (e.g., lamprey).

***Ecological***

- Potential ecological risk if permanent and/or temporary barrier weirs alter spawning distribution and/or non-salmonid passage in the Warm Springs River or Shitike Creek.
- Potential ecological risk from non-treatment of waste water, although cleaning effluent water is discharged into a settling pond. Tested water meets NPDES standards.
- Potential ecological (competition) risk to fall chinook from sub-yearling fall releases of spring Chinook in the Deschutes.
- Potential ecological risk from hatchery-origin “mini-jacks” and other residualized fish that fail to outmigrate from the Deschutes River basin.

***Physical***

- Potential physical (contamination) risk (PCBs, etc.) from carcass outplants.

[21] *Ibid.*

## Recommendations[22]

### *Recommendations for the Current Program*

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that many of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below address those risks or potential problems considered by the Review Team to warrant a potential modification or adjustment to the current program, as well as to maximize benefits.

***Broodstock Choice and Collection/Hatchery and Natural Spawning***

**WS1** – Form a task team to revisit this program's "sliding scale" NOB (natural-origin fish in hatchery broodstock):HOS (hatchery-origin fish spawning naturally) management guidelines, in order to ensure hatchery component of the Warm Springs spring Chinook population remains properly integrated with natural component, and is able to meet conservation and harvest goals over the long-term. Elements to consider in these revised guidelines include:

- **WS1a** – Ensure natural-origin fish represent, on average, a minimum of 10% of the hatchery broodstock and continue to assess this number.
- **WS1b** – Take no more than five percent of natural-origin adults for broodstock.
- **WS1c** – Review existing NOB population size "floor" and "ceiling" in sliding scale to ensure that NOB exceeds HOS.
- **WS1d** – Ensure size of the hatchery program is consistent with these parameters.
- **WS1e** – Minimize HOS proportion down from a fixed proportion (up to 10%) to ensure that NOB exceeds HOS in a sliding scale, based on the predicted or estimated total number of natural-origin adult returns.

**WS2** – Continue intercepting and removing marked steelhead (representing out-of-basin hatchery-origin strays) that arrive at weir.

**WS3** – Develop and implement a specific management strategy and protocol regarding upstream passage of coho salmon and non-native species. As part of this strategy, determine origin of returning coho (hatchery versus wild) through scale sampling, extraction and reading of coded wire tags, and other potential methods.

**WS4** – Investigate the causes of wild fish pre-spawning mortality and take steps to reduce it. This may involve modifying fish health and handling procedures (specifically examine passage system operational protocols and erythromycin injections).

**WS5** – Continue investigating the causes of hatchery fish pre-spawning mortality and take steps to reduce mortality that are ecologically sound. These actions may involve adult holding pond modifications (such as installing covers/netting, darkening the bottoms, etc.) and/or modifying fish handling procedures (such as more frequently checking condition of fish in ponds).

[22] *The Review Team believes that the Warm Springs Hatchery Evaluation Team—as a whole, in task teams and/or with outside assistance and expertise—will be the logical body to implement most of the following recommendations.*

***Incubation/Rearing***

**WS6** – Phase out the regularly-scheduled, prophylactic use of erythromycin-medicated feed and develop program-specific criteria for therapeutic treatment of bacterial kidney disease (BKD) in juvenile fish.

**WS6a** – Identify, evaluate and propose alternative culture or treatment strategies to control BKD that reduce biological, human health and environmental risks, while maintaining program benefits.

**WS6b** – Develop a three-year implementation and phase-out plan for prophylactic use of erythromycin-medicated feed and develop new standard operating procedures that preclude the regularly-scheduled use of medicated feeds as part of the next five-year (2007–11) operational plan for the hatchery. The implementation and phase-out plan should describe and assess the specific benefits and risks of the current, regularly-scheduled use of erythromycin feed at Warm Springs NFH.

**WS6c** – For additional guidance, the Review Team is drafting a scientific white paper on the known benefits and risks of antibiotics in fish culture as a foundation for basin-wide recommendations governing their use in federal hatcheries, consistent with existing federal regulations and guidelines (in preparation).

**WS7** – Improve hatchery rearing environment so chemical and antibiotic use can be reduced, or are no longer needed. This should include reducing densities, increasing flows and/or modulating water temperatures. In particular, the number of nursery starter tanks should be increased to maintain density indices at appropriate levels.

**WS8** – Explore opportunities and potential value of more closely mimicking rearing conditions experienced by the wild portion of the population. This could include adding structure to raceways, painting raceways, use of underwater feeders, etc.

**WS9** – Continue feeding and growth strategy studies.

***Release/Outmigration***

**WS10** – Continue to explore whether volitional releases improve survival. If so, pursue program and/or facility modifications (e.g., pond modifications, acclimation sites, staging sites), to improve volitional release methods.

**WS10a** – Explore the need to provide protection of smolts at the hatchery release outlet, to reduce the impacts of predators and or staging of predators at the outlet.

***Facilities/Operations***

**WS11** – Purchase and install adequate water and security alarm systems at hatchery facility. Alarms should be designed to signal both low and high water levels so steps can be made to adjust facility or water flows appropriately.

**WS12** – Study the effects of weir and ladder operations on resident fish and lamprey. If negative effects are observed, take steps to improve these operations to address the effects.

***Monitoring/Accountability***

**WS13** – Ensure conservation objectives are consistent across planning and operational documents.

**WS14** – Collect genetic monitoring baseline information for both hatchery (Warm Springs and Round Butte spring Chinook) and wild fish to confirm genetic continuity between these two components of the population.

**WS15** – Form a task team to investigate the harvest benefits and risks (e.g. natural spawning by hatchery-origin fish from a segregated hatchery program) from rearing and releasing Round Butte hatchery spring Chinook at Warm Springs NFH. Consider discontinuing this element of the program if the risks outweigh the benefits and those risks cannot be reduced and/or eliminated.

**WS16** – Evaluate kelt reconditioning program to determine if it should be a continuing activity at the hatchery.

**WS17** – Assess potential contaminants in hatchery and wild juveniles and returning adults that could affect human and ecological health, especially considering the higher salmon consumption levels among tribal members (Review Team notes that this has been proposed through the Service's *Fisheries Operational Needs* system).

**WS18** – Maintain monitoring program for wild fish and size/time/density studies for hatchery fish. Monitor these characteristics in wild fish, to establish a baseline for hatchery fish.

**WS19** – Investigate hooking mortality on wild fish to evaluate selective fishery downstream.

**WS20** – Continue to evaluate ecological interactions between hatchery and wild fish, including aquatic and terrestrial predators. Consider using existing models, such as PCD Risk.[23]

***Education/Research***

**WS21** – Continue efforts to enhance the visitor center, and other outreach activities, in order to provide additional educational benefits. Seek ways to document and quantify educational benefits. Explore opportunities for Warm Springs NFH to be included in Lower Columbia Gorge outreach programs.

[23] *See Busack et al.*, Tools for Evaluating Ecological and Genetic Risks in Hatchery Programs (Final Report), *BPA Project No. 2003-058-00, Contract No. BPA00016399, April 7, 2005. PCD Risk available electronically at ftp://ftp.bpa.gov/pub/efw-RAMP/.*

**WS22** – Seek additional opportunities to coordinate with tribal youth training programs (for example student interns, youth career training, working with Mount Hood Community College).

*Potential Alternatives to Existing Program*

***Adjustments of Production of Spring Chinook at Warm Springs NFH***. The current production level at Warm Springs NFH is meeting management goals for this stock. Increases in the size of the present hatchery program would pose risks to the current integrated broodstock strategy and are not recommended. Experiments with reduced rearing densities are continuing at Warm Springs NFH. If further reductions in rearing density can be accomplished without reducing the ability of the program to meet management goals, such adjustments should be implemented.

***Outplanting of Spring Chinook from Warm Springs NFH***. The current program of outplanting adult spring Chinook into Shitike Creek is under evaluation. The results of those investigations, in consultation with the CTWSRO, should dictate whether that program continues and should consider the effects of outplanting on other species. The CTWSRO have considered outplanting spring Chinook into the lower White River near Sherars Falls. However, that alternative is not under active consideration at this time. The state of Oregon has also raised the possibility of using spring Chinook from Warm Springs NFH for reintroduction experiments above Pelton and Round Butte dams. This option is opposed by the CTWSRO, due to the uncertainty of success of those experiments and the likely reduction in return of fish outplanted in this manner. The priority for Warm Springs NFH should remain maintenance of production and viability of Warm Springs spring Chinook.

***Rearing of Other Stocks at Warm Springs NFH***. Rearing of summer steelhead at Warm Springs NFH was attempted previously and discontinued due to unsuitability of the hatchery water supply for this purpose. The current strategy for the Warm Springs NFH is closely linked to maintaining the genetic integrity of spring Chinook salmon native to the Warm Springs River. Consideration of rearing other stocks of spring Chinook at Warm Springs NFH should be strongly discouraged. Small numbers of coho of unknown origin also enter the Warm Springs River at this time. Historic use of the Warm Springs watershed by coho is uncertain. A dedicated program to rear coho at Warm Springs NFH for local introduction appears undesirable at this time, and would likely conflict with the spring Chinook program.

***Discontinuation of Current Hatchery Program***. The management objectives of the current hatchery program are linked to tribal- and non-tribal harvest benefits, and those benefits could not be met without the current program, other than by substantial changes in current habitat conditions in the watershed. Those changes would necessarily include substantial improvements to habitat in the Deschutes River watershed, which would increase the productivity and stability of naturally-spawning spring Chinook. Reestablishment of naturally-spawning spring Chinook in the area of the Deschutes River watershed above Pelton Dam would be the second factor in meeting watershed management goals without hatchery production. A proposal to attempt reintroduction of spring Chinook in Deschutes tributaries above Pelton Dam is under discussion, but its potential success and the resulting gain in productivity remain uncertain. Depending on the success of various measures to restore natural production in tributaries of the Deschutes watershed, this alternative could be revisited at some time in the future.

*Recommended Alternative*

After consideration of the above-described alternatives, the Review Team recommends continuation of the current program and recommends against the alternatives. For nearly 30 years, the spring Chinook program at Warm Springs NFH has provided substantial harvest benefits to tribal fishers in the Warm Springs and Deschutes rivers, and to non-tribal recreational fishers in the lower Deschutes River. The program is one of the first hatchery programs for Pacific salmon to have systematically implemented an integrated genetic broodstock management strategy, to maximize the potential viability and fitness of hatchery-origin fish while, at the same time, minimizing genetic and ecological risks to natural-origin spring Chinook salmon in the Warm Springs River. The naturally-spawning population in the Warm Springs River is viable and self-sustaining. The Review Team expects this viability to potentially increase as the CTWSRO continue to make habitat improvements in the upper Warm Springs River and improve the genetic integration of the hatchery broodstock via implementation of the recommendations described above.

The spring Chinook program at Warm Springs NFH serves as a prototype case study in hatchery management and strategies to reduce risks to a natural population, while implementing a hatchery program intended to provide harvest opportunities and achieve conservation goals. The program also demonstrates the successful implementation of the integrated hatchery broodstock concept. As noted in the recommendations above, though, additional fine-scale adjustment of the sliding scale for including additional natural-origin adults in the broodstock may be desired. The value of this program as an integrated fishery, hatchery, and natural population management model, supported by careful evaluation and long-term data, is a significant project benefit.

# V. Comments and Response

*Co-Manager Comments and Response*

**Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO)[24]**

- In short, the CTWSRO feel that the Review Team did a comprehensive and thorough evaluation of the Warm Springs NFH. However, we do have one major concern.

- At this time, the CTWSRO Branch of Natural Resources does not concur with recommendation WS6. We have serious concerns about phasing out the prophylactic use of erythromycin-medicated feed. Data indicate that we would see a significant decline in smolt-to-adult survival (SAR) if medicated feed was not administered in the method currently used by hatchery staff. A reduction in SAR would lead to reduced harvest opportunities for tribal fishers, reduced donation fish used by the tribal public, and in some cases, the hatchery would not be able to meet its broodstock requirements to maintain current production levels. We feel that the current feeding protocol is a very effective tool in reducing the effects of Bacterial Kidney Disease (BKD). It is premature to phase out the current program until an appropriate alternative has been identified, tested and approved. We would welcome additional information regarding other methods of reducing BKD at the hatchery, as long as these methods would maintain and or exceed the current SAR.

***Review Team Response:*** *The relative benefits and risks of using erythromycin-medicated feed in a regularly-scheduled, prophylactic manner generated much discussion among Review Team members. We all agreed that the use of antibiotics needs to be minimized. We also agreed that the available data indicate that regularly-scheduled use of medicated feeds was providing smolt-to-adult return (SAR) survival benefits, as outlined in the comment above from the CTWSRO. We concluded that uncertainties regarding the known and unknown biological risks of antibiotics warranted some action at this time. The Review Team will continue to discuss options with CTWSRO as we attempt to achieve the most scientifically-defensible solution that maximizes fishery and biological benefits, while minimizing risks to the ecosystem and Warm Springs River stock of spring Chinook salmon.*

***Review Team Note:*** *In addition to the comments above, suggested edits from the CTWSRO have been included in the present version of this report.*

**Oregon Department of Fish and Wildlife (ODFW)[25]**

- ODFW commends both the work of the Review Team and the Service's efforts to review and improve hatchery operations under their jurisdiction.

- ODFW feels strongly that results of this review can be used to support the Service's goal of ensuring hatcheries are operated on the best scientific principles and contribute to

[24] *Provided by Mike Gauvin, CTWSRO Fisheries Management Supervisor.*
[25] *Provided by Rod French, ODFW District 7 Biologist.*

sustainable fisheries and the recovery of naturally-spawning populations and other aquatic species of concern.

- ODFW appreciates the opportunity to participate in the review process and provide comment on the draft manuscript resulting from the review.

***Review Team Note:*** *Suggested edits from ODFW have been included in the present version of this report. The Review Team has no additional response.*

**National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NOAA Fisheries)[26]**

- This is a good assessment of the Spring Chinook salmon program at the Warm Springs NFH.

- In the descriptions of summer steelhead in the Deschutes River Basin, the report should refer to the Interior Columbia Technical Recovery Team's (ICTRT) viability and population identification reports.[27] These documents identify the summer steelhead populations in the Deschutes River Basin (Population Identification Report), the type of population (major spawning group, minor spawning aggregate), and what the minimum viable population size would be for those populations. This information should be applied to the assessment, especially the analysis represented in Table 3.

***Review Team Response:*** *NOAA Fisheries' ICTRT has identified two demographically independent population groups for summer-run steelhead in the Deschutes River Basin: those associated with "west-side" tributaries (and adjacent mainstem regions) and those associated with "east-side" tributaries (and adjacent mainstem regions). These distinctions are based primarily on "dramatic habitat and life history differences, although the boundary is uncertain due to continuous spawning via the mainstem."[28] In our report, we have acknowledged this potential subdivision on page 10 (footnote 10).*

- In addition to the updated population identification, the report should base its viability assessment using the VSP criteria that have been developed for the region (see McElhany et. al. 2000). The viability assessment drafted by the ICTRT (see above) applies these criteria in their analysis. I would recommend that future hatchery assessments refer to these VSP criteria, and the population reviews that are being developed as part of the recovery planning process.

***Review Team Response:*** *We used the population viability criteria described by Mobrand et al. (2005) to arrive at qualitative measures of population viability in Tables 1-7. These criteria are identical to those used by the Hatchery Scientific Review Group (HSRG). We are currently discussing alternative measures of population viability with NOAA Fisheries.*

- In the Deschutes River summer steelhead AHA model output (Table 3), how was the summer steelhead population determined to be of medium significance? ODFW (in

[26] *Provided by Richard Turner, NOAA Fisheries Hatchery and Inland Fisheries Branch.*
[27] *Available at www.nwfsc.noaa.gov/trt/trt_Columbia.htm.*
[28] *See www.nwfsc.noaa.gov/trt/col_docs/steelheadpopulations.xls.*

developing a recovery scenario for the MCR steelhead Cascade Eastern Slope Tributaries major population grouping or MPG), identified the Deschutes River Westside population as being one of the four of seven populations in the MPG that is needed for recovery (Carmichael 2005). Because of this, the medium significance should to be changed.

***Review Team Response:*** *We used the criteria of Mobrand et al. (2005) to derive measures of biological significance for each stock in Tables 1-7. This measure of biological significance reflects the biological uniqueness of a stock relative to other stocks of the same species within and outside the ESU. Biological significance, as described here, is a measure of the innate biological attributes of a stock independent of population viability or potential role in ESA recovery. Our "medium" rating for biological significance of Deschutes River steelhead is based on the assessment that major life history adaptations and other biological attributes of those fish are shared with other stocks of summer-run steelhead in the mid-Columbia region.*

- In the population viability discussion (Table 3), the population is considered to be viable, while also stating that half of the escapement is composed of hatchery steelhead, and the PNI (proportion of natural influence) shows that hatchery fish will drive population adaptation. These factors, especially the proportion of hatchery fish on the spawning grounds, and the origin of those hatchery steelhead, are the reasons that the populations in the Deschutes River Basin are listed as threatened. The TRT, in their analysis, determined that the population was at moderate risk (6–25% in 100 years) of extinction (Carmichael 2005). This conclusion does not support a determination that the population is viable.

***Review Team Response:*** *We understand that there are several reasons why the mid-Columbia ESU is currently listed as threatened under the ESA. Although large numbers of out-of-basin steelhead of hatchery-origin (primarily from the Snake River) have been straying into the Deschutes River, the actual threat those fish pose to the natural sustainability of steelhead in the Deschutes River is largely unknown. Our general conclusions regarding the viability of steelhead in the Deschutes River basin, as assessed by ODFW and the other co-managers, are that steelhead in the Deschutes River are currently maintaining themselves via natural reproduction (albeit at relatively static levels). As noted previously, we are currently discussing alternative measures of population viability with NOAA Fisheries.*

- In Table 7, the Warm Springs spring Chinook salmon program is described as being an integrated program. This may need some clarification since the definition of an integrated program differs from group to group. Under the definition of an integrated program on page 7, this program may not qualify as integrated because the hatchery uses such a low percentage of naturally produced spring Chinook in the broodstock. This low proportion of naturally produced fish would be expected to limit the ability of the natural population to drive adaptation of the hatchery origin spring Chinook. This program, under definitions that NOAA Fisheries is developing, would be considered an integrated harvest program, with the goal of providing fisheries benefits while minimizing impacts on naturally spawning spring Chinook. There are some conservation benefits from this program, in that it can act as a gene bank for the Warm Springs Chinook population, if escapement becomes severely depressed, and also as a source of adults for reintroduction efforts, as is being done in Shitike Creek.

***Review Team Response:*** *We follow the definition of the HSRG, where an "integrated" hatchery broodstock is one in which wild fish are incorporated into the hatchery broodstock at a rate sufficient to maintain the genetic characteristics of wild fish among hatchery-produced fish. The goal of genetic integration, as noted in the comment above, is for the natural environment to be the principal determinant of the genetic make-up of hatchery-produced fish. To achieve this goal, two parameters must be controlled: (1) the proportion of natural spawners composed of hatchery origin fish (pHOS) must be minimized; and (2) the proportion of the hatchery broodstock composed of natural origin fish (pNOB) must substantially exceed pHOS. If pHOS equals zero, then one can show mathematically that the goal of genetic integration will be achieved if at least 10% of the hatchery broodstock is derived each year from natural-origin adults. However, if pHOS is greater than zero, then pNOB must be increased proportionately to achieve the goals of genetic integration. As suggested by our recommendation WS1, we believe the goals of genetic integration may currently only be marginally achieved in the Warm Springs NFH stock of spring Chinook salmon because pHOS can approach 10%, and pNOB for the broodstock has been averaging about 10% since 2000. Hence, we recommended a reevaluation of the current sliding scale such that pHOS can be reduced and pNOB adjusted upwards.*

References:

Carmichael, R. 2005. Letter to Paula Burgess (via e-mail) regarding recovery scenarios for Cascades Eastern Slope Tributaries. November 14, 2005.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. NOAA Tech Memo NMFS-NWFSC-42.

Mobrand, L, J. Barr, L. Blankenship, D.E. Campton, T.T.P. Evelyn, T.A. Flagg, C.V.W. Mahnken, L.W. Seeb, P. Seidel, and W.W. Smoker. 2005. Hatchery reform in Washington state: principles and emerging issues. Fisheries 30(6): 11-23.

*Stakeholder Comments and Response*

*(To be added after stakeholder review)*

# Appendices

## Appendix A

*Warm Springs NFH Briefing Document*, available from the Columbia Basin Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/

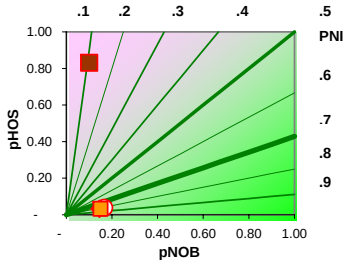
## Appendix B: AHA Analysis for Salmonids Stocks in the Watershed

### Warm Springs River Spring Chinook

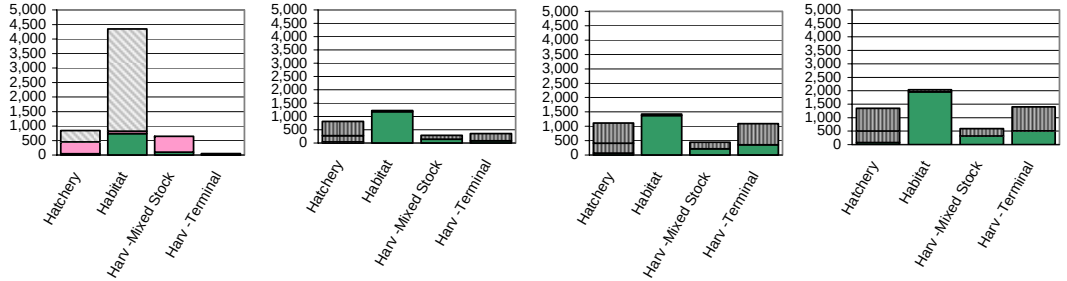
| | | | | Biological Significance: | | LOW | | LOW | | LOW | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Subbasin: Deschutes | Species: Spring Chinook | Administrator: Jim Newton | | Management Intent: | | Sustainable natural stock that | | Sustainable natural stock that | | | |
| | | | | Management Strategy: | | Protect habitat, integrated | | Improve habitat, integrated | | | |
| Deschutes Spring Chinook (Warm Spring | | Historic | | Before Listing | | Current | | Plan | | Long-term (PFC) | |
| Hab | [EDT] Prod. \| Capacity | 11.58 | 3,534 | 4.47 | 1,830 | 4.47 | 1,830 | 5.50 | 2,500 | 7.75 | 3,037 |
| | Min NOR Escape \| %Kelt | 1 | | 1 | | 800 | | 800 | | 800 | |
| | Smolt Prod. \| Capacity | 206 | 62,820 | 79 | 32,535 | 79 | 32,535 | 98 | 44,444 | 138 | 53,998 |
| Hydro | SAR [Mar.\|Total] Vary? (Y/N) | 0.072 0.072 | y | 0.072 0.056 | y | 0.072 0.056 | y | 0.072 0.056 | y | 0.072 0.059 | y |
| | Passage Surv [Juv. \| Adult ] | 1.00 | 1 | 0.82 | 0.96 | 0.82 | 0.96 | 0.82 | 0.96 | 0.86 | 0.96 |
| | Adj. Prod. \| Adj. Capacity | 14.74 | 4,498 | 4.47 | 1,830 | 4.47 | 1,830 | 5.50 | 2,500 | 8.10 | 3,174 |
| Harv | Harv -Mixed Stock | NORs | HORs | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 |
| | Harv -Terminal | NORs | HORs | 0.010 | 0.010 | 0.070 | 0.250 | 0.200 | 0.400 | 0.200 | 0.400 |
| | Total Exploitation Rate | NORs | HORs | 0.119 | 0.12 | 0.17 | 0.33 | 0.29 | 0.47 | 0.29 | 0.47 |
| Hatch | | | | pNOB pHOS | | pNOB pHOS | | pNOB pHOS | | pNOB pHOS | |
| | Broodstock Composition | pNOB-Goal | pHOS-Goal | 10% | 10% | 10% | 10% | 15% | 10% | 15% | 10% |
| | | pNOB-Realized | pHOS-Realized | 10% | 83% | 15% | 3% | 17% | 4% | 15% | 3% |
| | Hatchery Type -> | | [Int /Seg /None] | Local Import | Int | Local Import | Int | Local Import | Int | Local Import | Int |
| | Broodstock Numbers by Source | Local | Imported / Smolt Release | 451 | 538,233 | 630 | 752,522 | 500 | 597,240 | 500 | 597,240 |
| | Brood Exported (from HOR Surplus) | Exported Brood | % Marked | | | | | | | | |
| | Destination for HOR Returns | % to Hatchery | % to Nat. Spawn. | 18% | 82% | 95% | 5% | 95% | 5% | 95% | 5% |
| | Productivity of Hatchery Fish | Recruits/Spwnr | Fitness? [Y / N] | 10.0 | y | 4.0 | y | 4.5 | y | 4.5 | y |

SAVE

Realized Spawning Composition




Expl Rate ⇨ Harv. Rate



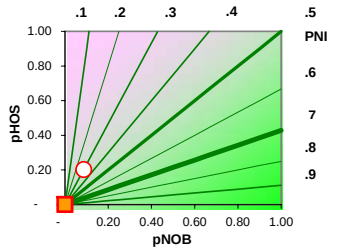
## Deschutes River Round Butte Hatchery spring Chinook

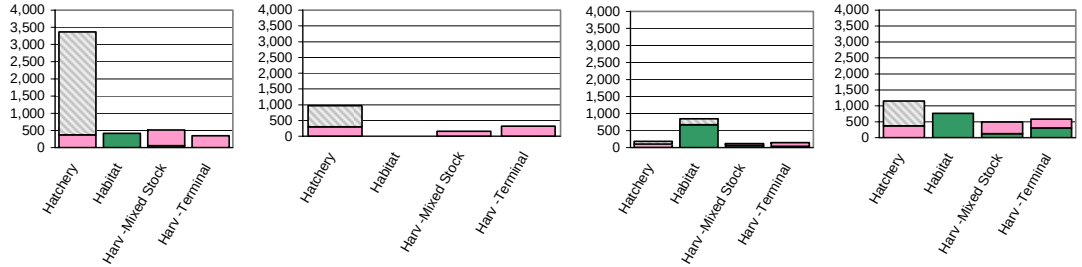
| Subbasin | Species | Administrator | | | Biological Significance: | LOW | LOW | LOW |
|---|---|---|---|---|---|---|---|---|
| Deschutes | Spring Chinook | Jim Newton | | | Management Intent: | Mitigate for lost habitat | Transition to natural production | Sustained natural production |
| | | | | | Management Strategy: | No acces to habitat above dam | Use hatchery to seed habitat | Abandon hatchery |
| Deschutes Spring Chinook (Round Butte)- | | Historic | | Before Listing | | Current | Plan | Long-term (PFC) |
| Hab | [EDT] Prod. \| Capacity | 11.58 | 3,534 | 4.47 | 558 | 0.01 | 0 | 4.60 | 1,500 | 4.60 | 1,500 |
| | Min NOR Escape \| %Kelt | 1 | | 1 | | 1 | | 500 | | 500 | |
| | Smolt Prod. \| Capacity | 206 | 62,827 | 79 | 9,920 | 0 | 0 | 82 | 26,667 | 82 | 26,667 |
| Hydro | SAR [Mar.\|Total] Vary? (Y/N) | 0.072 | 0.072 | y | 0.072 | 0.056 | y | 0.072 | 0.056 | y | 0.072 | 0.056 | y | 0.072 | 0.059 | y |
| | Passage Surv [Juv. \| Adult ] | 1.00 | 1 | | 0.82 | 0.96 | | 0.82 | 0.96 | | 0.82 | 0.96 | | 0.86 | 0.96 | |
| | Adj. Prod. \| Adj. Capacity | 14.74 | 4,499 | 4.47 | 558 | 0.01 | 0 | 4.60 | 1,500 | 4.81 | 1,568 |
| Harv | Harv -Mixed Stock | NORs | HORs | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 |
| | Harv -Terminal | NORs | HORs | | 0.093 | | 0.250 | 0.070 | 0.250 | 0.300 | 0.093 |
| | Total Exploitation Rate | NORs | HORs | 0.110 | 0.19 | 0.11 | 0.33 | 0.17 | 0.33 | 0.38 | 0.19 |
| Hatch | | | | pNOB | pHOS | pNOB | pHOS | pNOB | pHOS | pNOB | pHOS |
| | Broodstock Composition | pNOB-Goal | pHOS-Goal | | | | | 10% | | | |
| | | pNOB-Realized | pHOS-Realized | | | | | 9% | 20% | | |
| | Hatchery Type -> | | [Int /Seg /None] | Local | Import | Seg | Local | Import | Seg | Local | Import | Int | Local | Import | None |
| | Broodstock Numbers by Source | Local | Imported / Smolt Release | 371 | | 667,800 | 300 | | 317,520 | 225 | | 238,140 | 371 | | 667,800 |
| | Brood Exported (from HOR Surplus) | Exported Brood | % Marked | | | | | | | | | | | | |
| | Destination for HOR Returns | % to Hatchery | % to Nat. Spawn. | 100% | | | 100% | | | 50% | 50% | | 100% | | |
| | Productivity of Hatchery Fish | Recruits/Spwnr | Fitness? [Y / N] | 10.0 | y | | 4.3 | y | | 4.3 | y | | 4.3 | y | |

OPEN SAVE

| Expl Rate | Harv. Rate |
|---|---|
| 0.10 | 0.10 |
| 0.10 | 0.11 |
| 0.10 | 0.13 |
| 0.30 | 0.30 |

Realized Spawning Composition



## Deschutes River fall Chinook

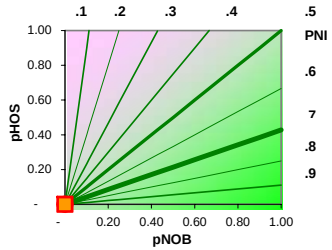
| Subbasin | Species | Administrator | Biological Significance: | LOW | LOW | LOW |
|---|---|---|---|---|---|---|
| Deschutes | Fall Chinook | Jim Newton | Management Intent: | | | |
| | | | Management Strategy: | | | |

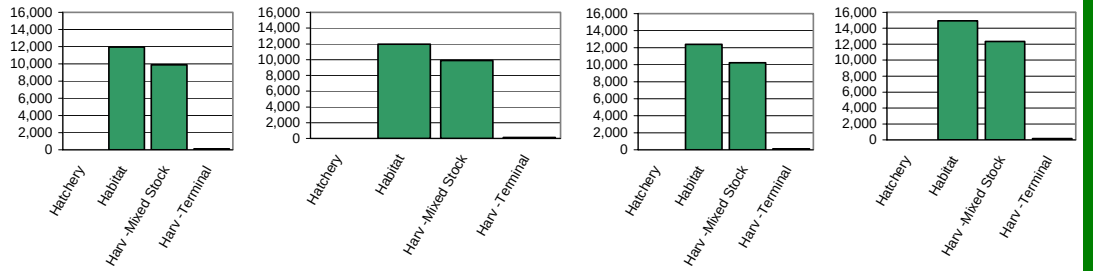
| Deschutes Fall Chinook | | Historic | | Before Listing | | Current | | Plan | | Long-term (PFC) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hab | [EDT] Prod. \| Capacity | 7.50 | 34,633 | 5.75 | 29,411 | 5.75 | 29,411 | 5.75 | 29,411 | 6.60 | 32,442 |
| | Min NOR Escape \| %Kelt | 1 | | 1 | | 1 | | 1 | | 1 | |
| | Smolt Prod. \| Capacity | 380 | 1,753,550 | 291 | 1,489,167 | 291 | 1,489,167 | 291 | 1,489,167 | 334 | 1,642,648 |
| Hydro | SAR [Mar.\|Total] Vary? (Y/N) | 0.029 0.029 | y | 0.029 0.020 | y | 0.029 0.020 | y | 0.029 0.020 | y | 0.029 0.021 | y |
| | Passage Surv [Juv. \| Adult ] | 1.00 | 1 | 0.72 | 0.94 | 0.72 | 0.94 | 0.74 | 0.94 | 0.76 | 0.94 |
| | Adj. Prod. \| Adj. Capacity | 11.02 | 50,905 | 5.75 | 29,411 | 5.75 | 29,411 | 5.89 | 30,103 | 6.91 | 33,968 |
| Harv | Harv -Mixed Stock | NORs | HORs | 0.450 | | 0.450 | | 0.450 | | 0.450 | |
| | Harv -Terminal | NORs | HORs | 0.010 | | 0.010 | | 0.010 | | 0.010 | |
| | Total Exploitation Rate | NORs | HORs | 0.456 | | 0.46 | | 0.46 | | 0.46 | |
| Hatch | | | | pNOB pHOS | | pNOB pHOS | | pNOB pHOS | | pNOB pHOS | |
| | Broodstock Composition | pNOB-Goal | pHOS-Goal | | | | | | | | |
| | | pNOB-Realized | pHOS-Realized | | | | | | | | |
| | Hatchery Type -> | | [Int /Seg /None] | Local Import | None | Local Import | None | Local Import | None | Local Import | None |
| | Broodstock Numbers by Source | Local Imported | Smolt Release | | - | | - | | - | | - |
| | Brood Exported (from HOR Surplus) | Exported Brood | % Marked | | | | | | | | |
| | Destination for HOR Returns | % to Hatchery | % to Nat. Spawn. | | 100% | | 100% | | 100% | | 100% |
| | Productivity of Hatchery Fish | Recruits/Spwnr | Fitness? [Y / N] | | y | | y | | y | | y |

OPEN SAVE

| Expl Rate | Harv. Rate |
|---|---|
| 0.10 | 0.10 |
| 0.10 | 0.11 |
| 0.10 | 0.13 |
| 0.30 | 0.30 |

Realized Spawning Composition



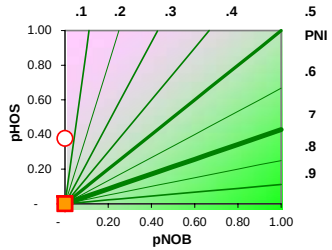
## Deschutes River summer steelhead

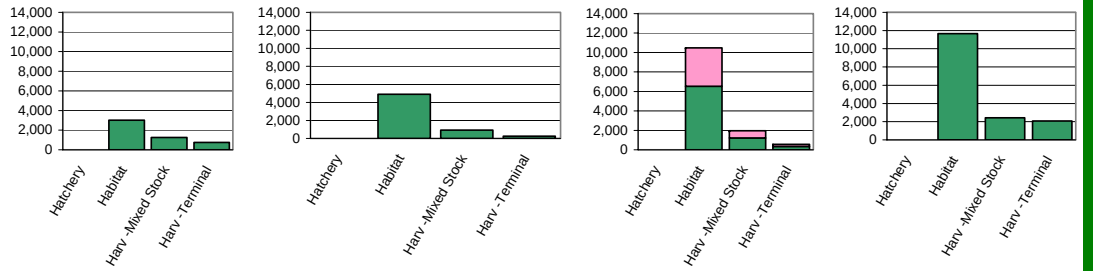
| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Biological Significance: | | LOW | | LOW | | LOW | |
| Subbasin | | Species | | Administrator | | | | Management Intent: | | Conservation and maintain viability into | | Conservation and maintain | | Conservation and maintain | |
| Deschutes | | Summer Steelhead | | Jim Newton | | | | Management Strategy: | | Habitat restoration and protection | | Habitat restoration and | | Habitat protection (and | |
| Deschutes Summer Steelhead | | | | Historic | | | | Before Listing | | Current | | Plan | | Long-term (PFC) | |
| Hab | [EDT] Prod. \| Capacity | | | 11.60 | 17,000 | | | 3.77 | 8,276 | 3.77 | 8,276 | 4.00 | 9,000 | 9.07 | 16,630 |
| | Min NOR Escape \| %Kelt | | | 1 | | | | 1 | | 1 | | 1 | | 1 | |
| | Smolt Prod. \| Capacity | | | 313 | 458,098 | | | 102 | 223,003 | 102 | 223,003 | 108 | 242,522 | 245 | 448,117 |
| Hydro | SAR [Mar.\|Total] | Vary? (Y/N) | | 0.053 | 0.053 | y | | 0.053 | 0.037 | y | 0.053 | 0.037 | y | 0.053 | 0.038 | y | 0.053 | 0.038 | y |
| | Passage Surv | [Juv. \| Adult ] | | 1.00 | 1 | | | 0.72 | 0.97 | 0.72 | 0.97 | 0.74 | 0.97 | 0.75 | 0.97 |
| | Adj. Prod. \| Adj. Capacity | | | 16.52 | 24,207 | | | 3.77 | 8,276 | 3.77 | 8,276 | 4.08 | 9,174 | 9.36 | 17,158 |
| Harv | Harv -Mixed Stock | | | NORs | HORs | | | 0.250 | | 0.150 | | 0.150 | 0.150 | 0.150 | |
| | Harv -Terminal | | | NORs | HORs | | | 0.200 | | 0.050 | | 0.050 | 0.050 | 0.150 | |
| | Total Exploitation Rate | | | NORs | HORs | | | 0.400 | | 0.19 | | 0.19 | 0.19 | 0.28 | |
| Hatch | | | | | | | | pNOB | pHOS | pNOB | pHOS | pNOB | pHOS | pNOB | pHOS |
| | Broodstock Composition | | | pNOB-Goal | pHOS-Goal | | | | | | | 0% | 43% | | |
| | | | | pNOB-Realized | pHOS-Realized | | | | | | | | 38% | | |
| | Hatchery Type -> | | | | [Int /Seg /None] | | | Local | Import | Int | Local | Import | Int | Local | Import | Int | Local | Import | Int |
| | Broodstock Numbers by Source | | | Local | Imported | Smolt Release | | | | - | | | - | | 350 | 441,000 | | | - |
| | Brood Exported (from HOR Surplus) | | | Exported Brood | % Marked | | | | | | | | | | | | | | |
| | Destination for HOR Returns | | | % to Hatchery | % to Nat. Spawn. | | | | | 100% | | | 100% | | | 100% | | | 100% |
| | Productivity of Hatchery Fish | | | Recruits/Spwnr | Fitness? [Y / N] | | | | | y | | | y | | | 12.6 | | | n |

OPEN SAVE

| Expl Rate | Harv. Rate |
|---|---|
| 0.10 | 0.10 |
| 0.10 | 0.11 |
| 0.10 | 0.13 |
| 0.30 | 0.30 |

Realized Spawning Composition



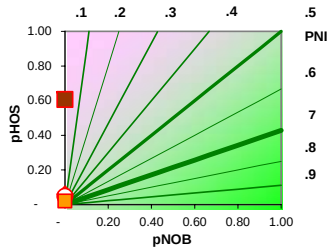
## Deschutes River Round Butte Hatchery summer steelhead

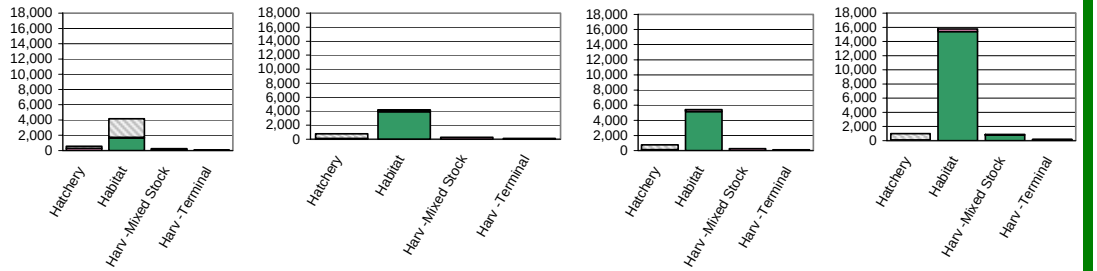
| Subbasin | Species | Administrator | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Deschutes | Summer Steelhead | Jim Newton | | Management Intent: | | Provide harvest, mitigate for impacts of | | Provide harvest, mitigate for | | Provide harvest, mitigate for | | | |
| | | | | Management Strategy: | | Segregated hatchery program | | Segregated hatchery program | | Segregated hatchery program | | | |
| Deschutes Summer Steelhead | | Historic | | Before Listing | | Current | | Plan | | Long-term (PFC) | | | |
| Biological Significance: | | | | LOW | | LOW | | LOW | | | | | |
| Hab | [EDT] Prod. \| Capacity | 11.60 | 11,593 | 3.77 | 8,276 | 3.77 | 8,276 | 4.00 | 9,000 | 9.07 | 16,630 | | |
| | Min NOR Escape \| %Kelt | 1 | | 1 | | 1 | | 1 | | 1 | | | |
| | Smolt Prod. \| Capacity | 313 | 312,383 | 102 | 223,003 | 102 | 223,003 | 108 | 242,522 | 245 | 448,117 | | |
| Hydro | SAR [Mar.\|Total] Vary? (Y/N) | 0.053 | 0.053 y | 0.053 | 0.037 y | 0.053 | 0.037 y | 0.053 | 0.038 y | 0.053 | 0.038 y | | |
| | Passage Surv [Juv. \| Adult ] | 1.00 | 1 | 0.72 | 0.97 | 0.72 | 0.97 | 0.74 | 0.97 | 0.75 | 0.97 | | |
| | Adj. Prod. \| Adj. Capacity | 16.52 | 16,507 | 3.77 | 8,276 | 3.77 | 8,276 | 4.08 | 9,174 | 9.36 | 17,158 | | |
| Harv | Harv -Mixed Stock | NORs | HORs | 0.050 | 0.050 | | 0.180 | | 0.180 | 0.050 | 0.050 | | |
| | Harv -Terminal | NORs | HORs | 0.010 | 0.010 | | 0.100 | | 0.100 | 0.010 | 0.010 | | |
| | Total Exploitation Rate | NORs | HORs | 0.060 | 0.06 | | 0.26 | | 0.26 | 0.06 | 0.06 | | |
| Hatch | | | | pNOB | pHOS | pNOB | pHOS | pNOB | pHOS | pNOB | pHOS | | |
| | Broodstock Composition | pNOB-Goal | pHOS-Goal | | | | 5% | | 5% | | 5% | | |
| | | pNOB-Realized | pHOS-Realized | | 61% | | 6% | | 5% | | 2% | | |
| | Hatchery Type -> | | [Int /Seg /None] | Local Import | Int | Local Import | Int | Local Import | Int | Local Import | Int | | |
| | Broodstock Numbers by Source | Local Imported | Smolt Release | 293 | 369,558 | 125 | 189,000 | 125 | 189,000 | 125 | 189,000 | | |
| | Brood Exported (from HOR Surplus) | Exported Brood | % Marked | | | | 100% | | 100% | | 100% | | |
| | Destination for HOR Returns | % to Hatchery | % to Nat. Spawn. | 18% | 82% | 75% | 25% | 75% | 25% | 75% | 25% | | |
| | Productivity of Hatchery Fish | Recruits/Spwnr | Fitness? [Y / N] | 10.0 | y | 10.0 | y | 10.0 | y | 10.0 | y | | |

OPEN SAVE

| Expl Rate | Harv. Rate |
|---|---|
| 0.10 | 0.10 |
| 0.10 | 0.11 |
| 0.10 | 0.13 |
| 0.30 | 0.30 |

Realized Spawning Composition




## Deschutes River rainbow/redband trout
## Deschutes River bull trout

No AHA analysis has been conducted for these stocks. APRE summary information is provided in the Deschutes Watershed Overview section of this report.

# List of Tables and Figures

## FIGURES



## TABLES

**Pacific Region Fishery Resources**
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**Portland, OR 97232**
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**U.S. Fish and Wildlife Service**
**www.fws.gov**

**For Columbia River Basin Hatchery Review Information**
**www.fws.gov/pacific/Fisheries/Hatcheryreview/**

**The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.**

**January 2006**