Proceedings and Findings of the Summer/Fall Chinook Salmon Summits

2009 Status Report

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Qualifier

> ***<u>It is not the intent of this paper to expand or contract any parties current rights, management authorities, or obligations, nor alter or supersede any current legal processes or agreements (e.g., US v OR)</u>. Rather, it is the intention of this paper to coordinate with the various processes and managers to update the current knowledge of the Upper Columbia River summer/fall Chinook salmon ESU and develop and analyze management options for this ESU.***

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AABM	aggregate abundance-based management regimes
CCPUD	Chelan County Public Utility District
CCT	Confederated Tribes of the Colville Reservation
CTC	Chinook Technical Committee
DCPUD	Douglas County Public Utility District
ER	exploitation rates (ER)
ESU	Evolutionary significant unit
HCP	Habitat Conservation Plan
HR	harvest rates
HOR	hatchery origin returns (or recruits)
HSRG	hatchery scientific review group
ICTRT	Interior Columbia Technical Recovery Team
ISBM	individual stock-based management regimes
MPG	major population group
MSF	mark-selective fisheries
NMFS	National Marine Fisheries Service (or NOAA Fisheries)
NBC	Northern British Columbia
NOR	natural origin returns (or recruits)
NRR	natural replacement rate (productivity)
pHOS	proportion of hatchery origin spawners
PNI	proportionate of natural influence
pNOB	proportion of natural origin broodstock
pNOS	proportion of natural origin spawners
PFMA	Pacific Fishery Management Areas
PSF	Pacific Salmon Commission
PST	Pacific Salmon Treaty
SEAK	southeast Alaska
SaSI	
SUS	Summer Chinook salmon
QCI	Queen Charlotte Islands
UCR	Upper Columbia River
WCVI	west coast of Vancouver Island
WDFW	Washington Department of Fish and Wildlife
YN	Yakama Nation
URB	Up-river brights
USFWS	US Fish and Wildlife Service

1.0 Introduction

1.1 Genesis of the summit

Following completion of the Hatchery Scientific Review Groups (HSRG) recommendations, staff from the Washington parties to *U.S. v. Oregon* (WDFW, Yakama Nation, USFWS, NMFS) have met four times with staff from the Colville Confederated Tribes (at their request) to review and discuss recent monitoring and evaluation information, contemporary harvest information, identify gaps in information, consider the recommendations from the HSRG review, and concerns expressed by the Colville Tribes concerning Upper Columbia River Summer/Fall Chinook. The goal of the meetings was to develop and refine options for management actions as appropriate to ensure conservation objectives, artificial production objectives and harvest management objectives are well linked to protect and perpetuate this valuable natural resource. The joint meetings, referred to as 'Summer Chinook Summits' have covered a broad range of information, including the recent assessments by the HSRG, observations of adult returns, spawning levels and productivity estimates, harvest and exploitation rates, modeling of population response to increased hatchery production from the upcoming Chief Joseph Hatchery and other mitigation programs, population structure, and conservation objectives.

The Upper Columbia River summer/fall-run Chinook ESU includes all late-run (summer and fall), ocean-type Chinook salmon in the mainstem Columbia River and its tributaries between Chief Joseph and McNary dams (excluding Marion Drain fall Chinook).

1.2 Purpose of report

The purpose of this report is to capture the proceedings, analyses, findings and recommendations of the managers that participated in the summer/fall (late run) Chinook salmon summit that met four times in 2009.

It is widely acknowledged that summer- and fall-run Chinook that migrate to the UCR have similar life history and overlap in spawn timing and space; however, for management purposes, the analyses and discussion in this report focuses on the summer-run portion of the late-run Chinook salmon populations in the UCR.

2.0 Development of goals and objectives for the ESU

Prior to developing potential management scenarios affecting UCR summer/fall Chinook, it is important to develop goals and objectives for their conservation and harvest. Without clear goals and objectives, it will be difficult to define and measure success of any scenario. This report examines possible future management objectives.

2.1 Overarching goal

The goal of this fishery resource manager group is to provide a framework within which the participants may exercise their sovereign powers in a coordinated and systematic manner in order to protect (conserve), rebuild, and enhance upper Columbia River summer/fall Chinook while providing harvest opportunities for both treaty Indian and non-treaty fisheries.

> ***Whatever recommendations are developed within this framework will need to be fully vetted and in most cases implemented under other management authorities, such as US v OR, PST, or state, tribal, and federal programs.***

2.2 Objectives

Objective 1:	Define and implement management options that maintain healthy and viable UCR summer-run Chinook populations in the Wenatchee, Methow and Okanogan river basins.
Objective 2:	Within the context of maintaining a healthy and viable ESU; select an ESU population management option that promotes sustainable summer Chinook salmon harvest objectives of relevant sovereign managers.
Objective 3:	Select an ESU population management option that meets both conservation and harvest objectives and is relatively cost-effective in implementation (relates to only UCR summer Chinook salmon).
Objective 4:	Develop a management framework that achieves conservation and harvest objectives, and promotes co-manager coordination and consistent management.

3.0 Current legal processes

Understanding the multiple legal frameworks of current management processes is important so a full understanding of 1) how current management of late-run Chinook was developed, and 2) how potential changes in run sizes could be managed in the future.

3.1 2008-2017 *U.S. v Oregon* Management Agreement (May 2008, page 40):

> *The parties agree to manage upper Columbia River summer Chinook based on an interim management goal of 29,000 hatchery and natural origin adults as measured at the Columbia River mouth. The management goal is based on an interim combined spawning escapement goal of 20,000 hatchery and natural adults. ...Mainstem fisheries will not be managed for these individual components. The parties agree to consider new information related to the escapement goals as it becomes available.*
>
> From page 41: *The Parties recognize that, should Chief Joseph Hatchery be constructed, the Chief Joseph Hatchery Program may be approved and implemented during the term of this Agreement. Following any such Program approval, the Parties will instruct TAC to calculate appropriate adjustments to the upper Columbia River summer Chinook interim escapement goals to address the aggregate broodstock and escapement needs of*

> *the upper Columbia summer Chinook programs. …TAC will present its recommended adjustments to the Policy Committee.*

Table 3.1. Upper Columbia Summer Chinook Interim Goals from 2008-2017 Management Agreement.

Stock Group	Spawning Objective Components
Wenatchee/Entiat/Chelan Natural spawners	13,500
Methow/Okanogan Natural spawners	3,500
Hatchery	3,000

3.2 Agreement between CCT and WDFW on Jointly Managed Salmon and Steelhead Populations (June 2007, page 8-9).

> *The parties will cooperate to ensure sufficient numbers of Okanogan summer/fall Chinook escape ocean and freshwater fisheries to meet agreed upon escapement objectives. This cooperation is critical, as exploitation of UCR summer/fall Chinook has been allowed to increase substantially in recent years, in both marine and freshwater fisheries. The Chinook of the Okanogan, Methow and Columbia rivers above Wells Dam are currently managed as a single stock by WDFW, although WDFW's Salmonid Stock Inventory (SaSI) (2002) identifies two populations, the Methow and Okanogan summer Chinook. The Okanogan population represents a broad range of run timing, including both early and late components. At this time, the Parties agree to manage the Okanogan population as a single unit with regard to timing, maintaining all components. The cumulative natural escapement objective for the aggregated stock [Methow and Okanogan] is currently 3,500 summer Chinook above Wells Dam. This value represents an estimate of… MSY for the two large tributary streams and portion of the mainstem Columbia River. Hatchery programs associated with the Methow and Okanogan rivers require an additional 560 adults for broodstock, which brings the total escapement objective to 4,100 summer/fall Chinook. … Should the [Chief Joseph Hatchery] program be implemented, the natural escapement target for waters above Wells Dam would be initially set at 4,700 adult Chinook. The hatchery broodstock needs would increase from 560 to 2,250, so that the current escapement objective would increase to 6,950 summer/fall Chinook. … When that occurs, the Parties agree to seek an initial increased escapement objective to Priest Rapids Dam, anticipated to be approximately 24,000 upper Columbia River summer Chinook.*
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> *WDFW will base its decisions on whether to promulgate mark selective fisheries on several factors including mark rates in each fishery, availability and feasibility of appropriate selective gear, Proportion of Natural Influence (PNI) objectives, and broodstock management needs.*

Table 3.2. Upper Columbia River Escapement Objectives for Summer Chinook.

Stock Component	**Current spawning escapement objective**[1]	**Potential spawning escapement objective**[2]
Wenatchee/Entiat/Chelan natural spawners	13,500	13,500
Methow/Okanogan natural spawners	3,500	4,700
Hatchery broodstock	3,000	5,830

[1] Based upon current production programs.
[2] Based upon future production programs."

3.3 WDFW Harvest Framework for Non-Treaty Fisheries directed at Salmonids originating above Priest Rapids Dam (Draft, April 2006, page 5).

> *The Draft "Harvest Framework for Non-Treaty Fisheries directed at Salmonids originating above Priest Rapids Dam" was not formally adopted by the Washington Fish and Wildlife Commission because it represents only a part of a more comprehensive recreational fishery plan. However, the underlying conservation and harvest sharing principles were formally adopted in November 2006, which helped lay the foundation for the CCT/WDFW Agreement which was formally adopted in June 2007 with the specific measurable objectives presented in II., above. To date, there is no completed, broadly developed recreational fishing plan.*

Table 3.3. Upper Columbia River Escapement Objectives for Summer Chinook.

Stock Component	**Current spawning escapement objective**[1]	**Potential spawning escapement objective**[2]
Wenatchee/Entiat/Chelan natural spawners	13,500	13,500
Methow/Okanogan natural spawners	3,500	4,700
Hatchery broodstock	3,000	4,140

[1] Based upon current production programs.
[2] Based upon future production programs.

3.4 Pacific Salmon Treaty (Chapter 3, 8c, page 55):

> *. . . for the purposes of this Chapter, and based on stock-specific information exchanged preseason, Canada and the United States shall limit the total adult equivalent mortality rate in the aggregate of their respective ISBM fisheries to no greater than 63.5 percent and 60 percent, respectively, of that which occurred during the 1979 to 1982 base period*

> *on the indicator stocks identified in Attachments IV and V*[1] *for stocks not achieving their management objectives. This limit shall be referred to as the general obligation. For those stocks for which the general obligation is insufficient to meet the agreed MSY or other biologically-based escapement objectives, the Party in whose waters the stock originates shall further constrain its fisheries to the extent necessary to achieve the agreed MSY or other biologically-based escapement objectives, provided that a Party is not required to constrain its fisheries to an extent greater than the average of that which occurred in the years 1991to 1996. Notwithstanding the foregoing, a Party need not constrain its ISBM impacts on a stock originating in its waters to an extent greater than necessary to achieve the agreed MSY or other biologically-based escapement objectives;*

Table 3.4. Stock Groups, Indicator Stocks and Management Objectives Applicable to Obligations Defined in Paragraph 13 for S.E. Alaska Troll, Net, Sport AABM Fisheries (from Attachment I, page 70), Northern B.C. (Areas 1-5) Troll and Queen Charlotte Island Sport (Areas 1-2) AABM fisheries (from Attachment II, page 71), West Coast Vancouver Island Troll and Outside Sport AABM Fisheries (from Attachment III, page 72), and Obligations Defined in Paragraphs 8 and 13 for All Southern U.S. Fisheries (from Attachment V, page 74).

Stock Group[a]	**Stocks in Group (Indicator Stocks)**	**Management Objective**
Columbia River Falls	Upriver Brights Deschutes Lewis	Escapement
Columbia River Summers	Mid-Columbia Summers	Escapement

[a] SEAK fisheries will be managed to achieve escapement objectives for Southeast Alaska and Transboundary River Chinook stocks.

3.5 HSRG recommendations for UCR summer/fall Chinook

In 2009, the Hatchery Science Review Group (HSRG) published their findings after reviewing all Columbia River Basin fish hatcheries. The information included in this section is primarily copied from the 2009 report (HSRG 2009), including the background information that follows.

The objective of the HSRG's Columbia River Basin review was to change the focus of the Columbia River hatchery system. In the past, these hatchery programs have been aimed at supplying adequate numbers of fish for harvest as mitigation primarily for hydropower development in the Basin. A new, ecosystem-based approach is founded on the idea that harvest goals are sustainable only if they are compatible with conservation goals.

The "HSRG solution" also highlights the biological principles that the HSRG believes must form the foundation for successful use of hatcheries and fisheries as management tools. Those principles are intended to provide a framework for making decisions and prioritizing investments based on clear and explicit goals, defensible science and informed and adaptive management. The HSRG review focused on hatchery programs, but took into account natural populations, survival conditions in the mainstems of the Columbia and Snake rivers and the Columbia River estuary, and harvest regimes. No review of habitat or hydroelectric measures was conducted. Nonetheless, the HSRG concluded that the value of habitat improvements (in terms of the

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[1] Assuming size limits in effect during 1991-1996.

abundance and productivity of natural populations) would increase if those improvements were preceded by hatchery reforms. Similarly, hatchery and habitat improvements would be enhanced with harvest reforms. The review did not include analysis of existing laws, policies, and agreements pertaining to either harvest or hatchery management. The flexibility contained in the adaptive management clauses of many of the agreements can accommodate reforms similar to those proposed by the HSRG.

The solutions proposed by the HSRG for Columbia Basin hatchery programs demonstrate that these programs can be redesigned to better meet conservation and harvest goals. However, the HSRG is not suggesting that these are the only solutions available to meet those goals.

3.5.1 Upper Columbia summer/fall Chinook ESU

The summer Chinook component of the UCR ESU includes the Wenatchee summer Chinook, Entiat summer Chinook, Methow summer Chinook, Okanogan/Similkameen summer Chinook, Upper Middle Columbia Mainstem summer Chinook (Turtle Rock Hatchery), and Upper Middle Columbia Summer Chinook (Wells Hatchery). NMFS concluded that at the time of their review, this ESU did not merit protection under ESA (NMFS 1995 and 50 CFR Parts 222, 226, and 227). The following is a summary of the HSRG's findings and recommendations for this ESU.

3.5.1.1 Wenatchee River summer Chinook

Historical Chinook runs to the Wenatchee River were about 41,000 fish; however, the proportion that were summer/fall-run Chinook (late-run) is not known (UCSRB 2007). Late-run Chinook historically used the mainstem of the Wenatchee River, from its mouth to Lake Wenatchee. Tumwater Dam (RM 32.7) and Dryden Dam (RM 17.6) on the Wenatchee River are thought to have been partial obstacles to upstream passage of adults before 1957 (NPPC 2004).

Current Conditions

- Wenatchee summer Chinook are thought to be mixture of native summer Chinook and Chinook from the Grand Coulee Fish Maintenance Project (1939 to 1943), which dispersed offspring of fish attempting to return to spawning grounds above Grand Coulee Dam into Upper Columbia tributaries below the dam. A Wenatchee summer Chinook stock has been maintained at the WDFW Eastbank Hatchery since 1989. Yearling smolts are acclimated in the Dryden Acclimation Pond and released into the Wenatchee River.
- Late-run Chinook can be found spawning in the Wenatchee River from RM 1.0 to Lake Wenatchee RM 54. It has been reported that the since the early 1960s, the number of redds have decreased downstream of Dryden Dam (RM 17.5) and increased upstream of Tumwater Dam (RM 32.7) (NPPC 2004). The highest densities of redds are found near the City of Leavenworth (RM 23.9 to 26.4) and in the Tumwater Canyon (RM 26.4 to 35.6). Summer Chinook spawn in September and October.
- The 10-year average summer-run Chinook adult counts at Rock Island Dam are approximately 46,000 fish, which include both hatchery-origin and natural-origin adults and fish returning to multiple rivers. Based on redd counts, Wenatchee summer Chinook abundance ranged from about 4,000 to 9,100 from 1996 to 2001. According to the results

of carcass surveys, adult escapement to the Wenatchee River consists primarily of naturally-produced fish.

Current Population Status and Goals

- ESA Status: Not Listed
- Population Description: Wenatchee summer Chinook are thought to be mixture of native summer Chinook and Chinook from the Grand Coulee Fish Maintenance Project (1939 to 1943), which dispersed adult fish trapped at Rock Island Dam and offspring of fish attempting to return to spawning grounds above Grand Coulee Dam into Upper Columbia tributaries.
- Recovery Goal for Abundance: Not Applicable
- Productivity Improvement Expectation: Increase over time as habitat actions designed to improve the abundance and productivity of ESA listed spring Chinook are implemented.
- Habitat Productivity and Capacity: Productivity: 4.25; Capacity: 13,360

Current Hatchery Programs Affecting this Population

Wenatchee summer Chinook (Dryden Pond): This integrated conservation program releases a maximum of 864,000 smolts (720,000 recent average) (10 fpp-yearlings) starting in mid-April. Fish are reared at the Eastbank Fish Hatchery on well-water and then transferred in the spring to Dryden Pond for acclimation and release to the Wenatchee River (Rkm 26.0). Both NOR and HOR adults are collected at the left and right bank Dryden traps and Tumwater Dam trapping facility and transported to the Eastbank Hatchery. The program has a recruit per spawner value of 9.8.

The number of hatchery adult strays (referred to as internal or in-basin) from the Dryden Pond program spawning with natural-origin Wenatchee summer_-run Chinook is estimated at 2,193 fish. Hatchery adults from the following programs are assumed to stray to the Wenatchee River system and possibly spawn with native late-run Chinook: Methow summer_Chinook, Okanogan-Similkameen summer_Chinook, Upper Middle Columbia-Mainstem summer_Chinook (Turtle Rock), Upper Middle Columbia-Mainstem Columbia summer_Chinook (Wells)

Adult strays from these programs are defined as external strays (out-of-subbasin). It is estimated that 233 hatchery fish from these programs affect Wenatchee summer Chinook.

Effect on Population of Removing Hatchery

HSRG analysis estimated that Adjusted Productivity (with harvest and fitness factor effects from AHA) would increase from 2.3 to 2.8. Average abundance of natural-origin spawners (NOS) would increase from approximately 5,321 fish to approximately 6,338 fish. Harvest contribution of the natural and hatchery populations would decrease from approximately 9,794 fish to approximately 7,805 fish.

Observations

Managers have not assigned a population designation for the Wenatchee summer Chinook. The current program is consistent with the standards for a Primary population. This integrated conservation program releases a maximum of 864,000 smolts (10 fpp-yearlings) starting in mid-April. The Managers have stated their goal for this program as; “Increase the abundance of the natural adult population of unlisted species, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity. In addition, provide harvest opportunities in years when spawning escapement is sufficient to support harvest." (Goal statement adopted by Habitat Conservation Plan Committee, Hatchery Sub-Committee). Broodstock is collected at Dryden and Tumwater dams and is nearly 100% natural-origin. The natural population seems to be robust and healthy and provides substantial harvest benefits. The lower river spawning (near Dryden) is comprised of greater than 50% hatchery-origin spawners; however, the highest density of redds is found higher in the basin near Leavenworth and above Tumwater Canyon.

Overall, the percent of hatchery-origin spawners is approximately 20%. Approximately 15% of the returns from this program are reported to spawn outside the subbasin. Numerous fish infected with *Saprolegnia* sp. (fungus) were observed in Dryden Pond. Managers indicated that this has been observed frequently and occurs shortly before release.

All fish are adipose fin-clipped and coded wire-tagged. No fisheries are currently selective on summer Chinook.

There appears to be an opportunity to use this method to remove hatchery fish, provide additional harvest opportunities, and improve productivity of the population.

Recommendations

The HSRG recommends that managers prioritize analysis of genetic data collected to determine the population structure of summer Chinook in the upper Columbia River Basin.

The HSRG has no specific recommendations to improve upon the broodstock management protocols for this program. To address the fungus problem, managers should accelerate release dates, allow volitional release of early migrating smolts and/or implement other protocols to ensure production of healthy fish.

No fisheries are currently mark-selective on summer Chinook, and there appears to be an opportunity to use this method to remove hatchery fish, improve productivity of the population and provide additional harvest opportunities in the Wenatchee River.

In order to improve the viability and productivity of natural upper Columbia River summer Chinook populations, the HSRG recommends immediate management of all freshwater sport fisheries as mark-selective fisheries. The Colville Tribes' growing cultural and subsistence fishery should continue to develop its selective capacity. Research on selective gear for the commercial fishery should commence immediately.

The HSRG also recommends that fishery managers immediately review the capacity of upper Columbia River summer Chinook populations to tolerate current and future high exploitation rates and adopt fisheries management and hatchery production strategies that are compatible with species conservation and survival.

3.5.1.2 Entiat River summer_Chinook

The Entiat summer/fall-run Chinook population is likely composed of the descendents of hatchery fish released by the Entiat National Fish Hatchery from 1941 to 1976. According to the Entiat Subbasin Plan, summer/fall-run Chinook were not native to the Entiat River (NPPC 2004).

Current Conditions

Entiat River summer/fall Chinook begin entering the subbasin in June. These fish spawn in late September to early November in the lower 23 miles of the mainstem Entiat River downstream of Preston Creek. Summer/fall-run redd counts made since 1957 show that adult abundance is less than 250 fish.

Current Population Status and Goals

- ESA Status: Not Listed
- Population Description: Entiat Summer Chinook are thought to have originated from hatchery operations associated with the Grand Coulee Fish Maintenance Project (1939 to 1943), and Entiat National Fish Hatchery releases to the subbasin. The HSRG classifies this population as Stabilizing.
- Recovery Goal for Abundance: Not Applicable
- Productivity Improvement Expectation: Productivity is expected to increase over time as habitat actions designed to improve the abundance and productivity of ESA listed spring Chinook are implemented in the subbasin.
- Habitat Productivity and Capacity: Productivity: 1.69; Capacity: 300

Current Hatchery Programs Affecting this Population

No hatchery programs currently release summer/fall-run Chinook to the Entiat River. Relatively large numbers of out-of-basin strays from the following hatchery programs may spawn in the subbasin: Methow Summer Chinook, Okanogan Similkameen Summer Chinook, Upper Middle Columbia Mainstem Summer Chinook (Turtle Rock Hatchery), Wenatchee Summer Chinook, Upper Middle Columbia Summer Chinook (Wells Hatchery),

Estimated number of hatchery strays affecting this population:

- Hatchery strays from integrated in-basin programs: 0
- Hatchery strays from in-basin segregated and out-of-basin hatchery programs: 220 fish

Observations Managers have not assigned a population designation for the Entiat summer Chinook. No hatchery programs for summer Chinook operate in the subbasin. The Entiat River population appears to be composed of stray hatchery fish. Under current habitat and harvest conditions, no population would exist in the absence of these hatchery fish.

Recommendations Due to the low productivity and capacity, the HSRG recommends that this population be managed as a Stabilizing population.

3.5.1.3 Methow River Summer Chinook

The Methow summer Chinook population is likely composed of the descendents of hatchery fish released through the Grand Coulee Fish Maintenance Project, which began introducing juvenile Chinook salmon of mixed stock origin into the Methow in 1940 (Fish and Hanavan 1948;

summarized in Chapman et al. 1994). It is not clear whether summer/fall Chinook historically used the Methow basin (Mullan 1987; Chapman et al. 1994). Natural spawning populations have been observed since the late 1950s (Chapman et al. 1994).

Current Conditions

Methow summer Chinook spawn in late September to early November in the mainstem Methow River from the confluence of the Chewuch River to the mouth of the Methow. From 1986 to 2003, adult run size to the Methow River has ranged from 332 to 4,630 fish. Average adult return for this period has been ~1,300 fish. In 2002, the WDFW rated this stock as Healthy.
The stock is considered a mixed stock with composite (hatchery and natural) production. Winthrop and Leavenworth National Fish hatcheries have in the past released Chinook salmon captured at Wells Dam to the Methow River. The Eastbank Hatchery still produces and releases juvenile summer Chinook to the Methow River each year.

Current Population Status and Goals

- ESA Status: Not Listed
- Population Description: Methow summer Chinook are thought to be mixture of native summer Chinook and Chinook from the Grand Coulee Fish Maintenance Project (1939 to 1943), which dispersed offspring of fish attempting to return to spawning grounds above Grand Coulee Dam into Upper Columbia tributaries below the dam.
- Recovery Goal for Abundance: Not Applicable
- Productivity Improvement Expectation: Productivity is expected to increase over time as habitat actions designed to improve the abundance and productivity of ESA listed spring Chinook are implemented in the subbasin.
- Habitat Productivity and Capacity: Productivity: 1.76 ; Capacity: 1,531

Current Hatchery Programs Affecting this Population

The primary hatchery program that is most likely to affect Methow summer-run Chinook is the Methow/Okanogan Summer Chinook (Me-Ok) (Carlton Pond). This integrated harvest program releases up to 400,000 (10-15 fpp) fish each year to the Methow River. Fish are acclimated prior to their release at Carlton Pond (Rkm 90.2). Fish are force-released at ~10 fpp from mid-April to mid-May from the Carlton Ponds. All fish released are mass-marked with an adipose fin-clip and coded-wire tag. An additional 576,000 fish of similar size are released outside of the subbasin in the Okanogan River subbasin (from Similkameen Pond). Adults for broodstock are collected at Wells Dam from the run at large and held/spawned at the Eastbank Hatchery. All incubation and juvenile rearing activities occur at this facility or at the two acclimation ponds (Carlton and Similkameen). Broodstock protocols for the Methow and Okanogan programs call for a goal of 100% of the hatchery broodstock to be collected from the natural run-at-large crossing Wells Dam; however, this has not been achieved. The average pNOB for brood years 1993 through 2005 (run-at-large) has been 0.56. The average PNI for this program is 0.45 (pHOS = 66%). The program has a recruit per spawner value of 4.0.

Effect on Population of Removing Hatchery

HSRG analysis estimated that Adjusted Productivity (with harvest and fitness factor effects from AHA) would increase from 0.5 to 1.1. Average abundance of natural-origin spawners (NOS) would decrease from approximately 271 fish to approximately 108 fish. Harvest contribution of the natural and hatchery populations would go from approximately 938 fish to approximately 149 fish.

Observations

The Managers have stated their goal for this program as; “Increase the abundance of the natural adult population of unlisted species, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity. In addition, provide harvest opportunities in years when spawning escapement is sufficient to support harvest” (goal statement adopted by Habitat Conservation Committee, Hatchery Sub-Committee). To achieve this goal, managers have established a mitigation goal of 400,000 smolts for this program. The average release since 1989 has been 368,590 smolts. Managers have not assigned a population designation for the Methow summer Chinook. Managers are uncertain whether or not the Methow historically supported an independent population of summer Chinook. It is being managed as an integrated population based on an aggregate of fish returning above Wells Dam. Under current conditions, this population does not meet the standards for a Primary or Contributing population.

Current management does not allow any population structure above Wells Dam. Current management is to collect broodstock at Wells Dam comprised of an unknown mixture of natural-origin adults from the Methow, Okanogan and mainstem Columbia rivers. A proportion of this aggregate broodstock is released into the Methow River. Fish released into all tributaries are the progeny of 100% natural-origin adults comprising this aggregate broodstock. Smolt-to-adult returns in the Methow River average approximately one-third of the return rates of progeny from the same broodstock source released in the Okanogan River. The cause of this major difference is unknown. We note that a disproportional number of high BKD titer juveniles are used in the Methow program. There are no means to manage the composition of hatchery and natural-origin adult summer Chinook on the spawning grounds. Currently, hatchery-origin adults comprise approximately 66% of the naturally-spawning population in the Methow River.

At current harvest rates and existing productivity and capacity levels, it does not appear that Methow summer Chinook can be a self-sustaining population. In fact, there would be no natural spawning component present without the support of the hatchery program. An effective integrated program cannot be operated here under current conditions.

No fisheries are currently selective on summer Chinook. There appears to be an opportunity to use this method to remove hatchery fish, provide additional harvest opportunities, and improve productivity of the population.

Recommendations

The HSRG recommends that managers prioritize analysis of genetic data collected to help determine the population structure of summer Chinook in the upper Columbia River Basin. Managers need to clearly define the overall summer/fall Chinook population structure above Rocky Reach Dam to maintain or increase abundance, productivity and diversity of these populations.

If it is determined that summer Chinook returning to the Methow River is a distinct population, the HSRG recommends that broodstock management strategies be implemented to meet the standards of a Contributing or Primary population. This would require an ability to collect fish returning to the Methow River, control hatchery fish on the spawning grounds, and reduce harvest rates on natural-origin fish to allow a self sustaining population to exist. However, under the current habitat conditions, accomplishing this will require significant reductions in harvest rates and removal of hatchery strays. This would still result in a relatively small population (less than 200 natural-origin fish).

If it is determined that fish returning to the Methow River are not a distinct population but rather a component of the mainstem spawning aggregate, the HSRG recommends that the Methow could be considered a Stabilizing population and managed as a component of the Wells Hatchery program.

We encourage managers to investigate the reasons for poor survival of the Carlton Pond releases. We also encourage managers to consider collecting broodstock from throughout the full run, at least into mid-October.

3.5.1.4 Okanogan River Summer Chinook

Okanogan summer Chinook were identified as a stock based on their distinct spawning distribution, later river entry timing, spawn timing and genetic composition. Historically, adult spawning likely occurred throughout the mainstem Okanogan and major tributaries. Summer Chinook from the Similkameen River, a major Okanogan River tributary, sampled from 1991 to 1993, were significantly different from other upper Columbia summer Chinook stocks. Summer Chinook spawn from early October to mid-November in the mainstem Okanogan River from RM 40.3 (Riverside) to Zosel Dam (Colville Tribe 2004), in the Similkameen River and in Canada above Lake Osoyoos. From 1992 to 2003, adult runs have ranged from 341 to 13,857 fish. WDFW rated this stock as Healthy (http://wdfw.wa.gov/webmaps/salmonscape/sasi).

The stock is considered to be mixed with composite (hatchery and natural) production. Fish are reared at the Eastbank Hatchery and then transferred to the Similkameen Acclimation Pond for release each year. Broodstock consists primarily of Methow River and Okanogan River adults.

Current Population Status and Goals

- ESA Status: Not Listed
- Population Description: Okanogan summer Chinook consist of a composite population of hatchery and natural-origin adults from the Methow and Okanogan Rivers.
- Recovery Goal for Abundance: Not Applicable
- Productivity Improvement Expectation: Productivity is expected to increase over time as habitat and hatchery actions designed to improve the abundance and productivity of ESA listed steelhead are implemented in the subbasin.
- Habitat Productivity and Capacity: Productivity: 6.0 ; Capacity: 10,000

Observations

The Managers have stated their goal for this program as; “Increase the abundance of the natural adult population of unlisted species, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity. In addition, provide harvest opportunities in years when spawning escapement is sufficient to support harvest.” (Goal statement adopted by Habitat

Conservation Committee, Hatchery Sub-Committee) To achieve this goal, managers have established a mitigation goal of 576,000 smolts for this program. The average release since 1989 has been 491,336 smolts. Managers have not assigned a population designation for the Okanogan summer Chinook. It is being managed as an integrated population based on an aggregate of fish returning above Wells Dam. This population could meet the standards for a Primary population; however, current practices do not allow for the management of specific populations of summer Chinook upstream of Wells Dam. Currently, the program collects broodstock from the east ladder at Wells Dam (predominantly natural-origin adults of Methow, Okanogan and mainstem Columbia River origin). Adults are transferred to the Eastbank Hatchery, where spawning, incubation, and early rearing occur. The release objective for the program is 576,000 smolts. Presmolts are transferred from the Eastbank Hatchery to an acclimation facility on the Similkameen River (in the Okanogan system). Smolts are released in the spring following an over-winter acclimation period. Between 1992 and 2003, the average spawning escapement for the Okanogan and Similkameen rivers averaged 4,288 adults (with a range between 473 and 13,857 fish). The estimated smolt-to-adult return rate for this program is 0.9%, approximately three times higher than that observed for the Methow River summer Chinook program.

Recommendations

A program of the current size (576,000 smolts) could be operated as an integrated program consistent with the standards of a Primary population (PNI greater than 0.67). This would require collecting broodstock throughout the full run timing from fish returning to the Okanogan system instead of at Wells Dam. There are multiple options to accomplish this. For example, one option is managing pNOB at 50%, a pHOS target of approximately 25%, which would require removing at least 50% of returning hatchery fish.

A larger integrated program, also consistent with the standards of a Primary population, is possible if pNOB could be increased or pHOS could be further reduced.
In order to improve the viability and productivity of natural upper Columbia River summer Chinook populations, the HSRG recommends immediate management of all freshwater sport fisheries as selective fisheries. The Colville Tribes' growing cultural and subsistence fishery should continue to develop its selective capacity. Research on selective gear for the commercial fishery should commence immediately.

The HSRG also recommends that fishery managers immediately review the capacity of upper Columbia River summer Chinook populations to tolerate current and future high exploitation rates and adopt fisheries management and hatchery production strategies that are compatible with species conservation and survival.

The HSRG recommends that managers implement a BKD control strategy for their spring and summer/fall Chinook hatchery programs where BKD has proved a recurring problem.

3.5.1.5 Upper Middle Columbia Mainstem hatchery summer Chinook

The Upper Middle Columbia Mainstem hatchery summer Chinook population is a hatchery population that is not included as part of the Upper Columbia summer /fall-run Chinook ESU. This population has no viability or recovery goals. The population includes hatchery-origin fish from the Wells and Turtle Rock hatchery programs.

Current Conditions

- The program collects hatchery-origin adult summer Chinook at Wells Hatchery (near Wells Dam). Broodstock consists primarily of hatchery-origin adults, but some natural-origin fish have been collected. The primary consideration in broodstock collection is to achieve a minimum escapement of 2,000 adults and jacks past Wells Dam each year. The program has a release goal of 840,000 juvenile summer Chinook from Wells Hatchery and 1.278 million juveniles from Turtle Rock Hatchery

Current Population Status and Goals

- ESA Status: Not Listed
- Population Description: These are segregated harvest programs that are maintained through the collection of hatchery-origin adults at Wells Dam.
  Recovery Goal for Abundance: Not Applicable
- Productivity Improvement Expectation: Not Applicable
- Habitat Productivity and Capacity:
  - Mainstem population: Productivity: 5.0; Capacity: 6,000
  - Wells Hatchery population: Productivity: 0; Capacity: 0

Current Hatchery Programs Affecting this Population

Two primary hatchery programs make up this population.

Wells Hatchery summer Chinook: The program is described as an integrated harvest type designed to mitigate for the effects of Wells Dam operations on fisheries. The program releases 840,000 juvenile summer Chinook. The release includes 320,000 yearling at 10 fpp (R/S of 16.5) and 484,000 sub-yearlings (242,000 at 50 fpp, R/S of 1.2 and 242,000 at 25 fpp, R/S unknown to date). All released fish are mass-marked. Incubation and rearing activities are performed on-station. Broodstock are collected from fish entering the facility ladder (77% of total) and at Wells Dam (east ladder).

Turtle Rock via Wells Hatchery: This program is defined as a segregated harvest program, with a production goal of 1.078 million sub-yearlings and 200,000 yearlings (8 fpp). Included in the sub-yearling release is a group of 450,000 accelerated sub-yearlings that are reared at the Eastbank Hatchery and force-released from the Turtle Rock Hatchery when they reach 25 fpp. Non-accelerated sub-yearlings (628,000 fish release) are transferred as emergent fry to Eastbank Hatchery rearing units. They are then transferred as unfed fry to the Turtle Rock annex facility where they are reared to 80 fpp. In early May, they are transferred to the Turtle Rock Island facility for final rearing and are force-released in early July at approximately 55 fpp. For the yearling production, emergent fry are transferred and reared at the Rocky Reach Annex rearing units to ~ 40-50 fpp, transferred in late October to the Turtle Rock Island facility where they are reared from late October to April, and then force- released in mid-April at ~8 fpp. All yearling fish are mass-marked (coded wire-tagged and adipose fin-clipped); 200,000 from each of the sub-yearling groups are marked (coded wire-tagged and adipose fin-clipped); the remainder are given only an adipose clip. Broodstock for the program are collected at Wells Hatchery.

Observations

Managers have not assigned a population designation for the mainstem Columbia summer Chinook. The Managers stated goal for this program as: “Increase the abundance of the natural adult population of unlisted species, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity. In addition, provide harvest opportunities in years when spawning escapement is sufficient to support harvest” (goal statement adopted by Habitat Conservation Committee, Hatchery Sub-Committee). To achieve this goal, managers have established a mitigation goal of approximately 2 million smolts (combined programs described below). Chinook have been observed spawning in the mainstem upstream of Rocky Reach Dam although little is known about the abundance, productivity or composition of this population. Under current conditions, we cannot assess whether this population meets the standards for a Primary or Contributing population.

This population is being managed as an integrated population (10% pNOB) based on an aggregate of fish returning above Wells Dam. Currently, adult composition on the spawning grounds is not being managed. Broodstock for the Wells and Turtle Rock programs is collected at Wells Hatchery from mid-July through early September. There are no adult collection facilities at the Turtle Rock release site. All Turtle Rock yearlings are marked and coded wire-tagged, but only a portion of the sub-yearlings (200,000) are marked and tagged. Future plans for Turtle Rock production are to transition from subyearlings to 600,000 yearlings, to be acclimated and released at the confluence of the Chelan and Columbia rivers.
No fisheries are currently selective on summer Chinook. There appears to be an opportunity to use this method to remove hatchery fish, provide additional harvest opportunities, and improve productivity of the population.

Recommendations

The HSRG recommends that managers prioritize analysis of previously collected genetic data to help determine if the mainstem spawning aggregate is a distinct population of summer/fall Chinook in the upper Columbia River Basin. Managers need to clearly define the overall summer/fall Chinook population structure above Rocky Reach Dam to maintain or increase abundance, productivity and diversity of these populations. The HSRG identified two potential options for managing the Wells on-station and Turtle Rock/Chelan programs depending upon the designation of the mainstem spawning component:

If the mainstem spawning aggregate is not considered a distinct population, the Wells on-station program could be managed as a segregated population and provide broodstock for the Turtle Rock/Chelan releases. The Wells and Turtle Rock/Chelan programs would be based on hatchery-origin fish returning to Wells and would need to be segregated from the distinct population(s) above Wells Dam.

If the mainstem spawning aggregate is a distinct population, then the Wells on-station program should be managed as an integrated program. This requires an assessment of potential productivity and capacity of natural-origin mainstem spawners. This information should be used to develop appropriate PNI values consistent with the standards for a Contributing or Primary population. Broodstock for the Wells on-station release should be collected throughout the run and should be managed consistent with the population designation. Broodstock for the Turtle

Rock/Chelan could be derived from excess hatchery fish returning on-station to Wells. This would be possible only after the proposed conversion from sub-yearlings to yearlings and the resulting reduction in broodstock needs at the Turtle Rock/Chelan release site.

In order to reduce the potential for straying, adult collection capabilities should be included in the proposed program at Chelan River. In addition, managers should monitor straying from the proposed Chelan program.

Managers should consider collecting broodstock from throughout the fall run, at least into mid-October. Prior to the transition from Turtle Rock releases to Chelan, the entire release at Turtle Rock should be adipose fin-clipped.

In order to improve the viability and productivity of natural upper Columbia River summer Chinook populations, the HSRG recommends immediate management of all freshwater sport fisheries as selective fisheries. The Colville Tribes' growing cultural and subsistence fishery should continue to develop its selective capacity. Research on selective gear for the commercial fishery should commence immediately.

The HSRG also recommends that fishery managers immediately review the capacity of upper Columbia River summer Chinook populations to tolerate current and future high exploitation rates and adopt fisheries management and hatchery production strategies that are compatible with species conservation and survival.

3.5.1.6 Downstream of Rock Island Dam

We also include the HSRG recommendations for the Priest Rapids, Ringold, and Yakima fall Chinook programs since these fish most likely spawn in the UCR.

The HSRG recommends that the Priest Rapids and Ringold programs use only local broodstock and adipose fin-clip all hatchery releases to facilitate broodstock management, monitoring of pHOS, and to allow selective removal of hatchery fish. These hatchery changes would allow management consistent with a Primary population designation. Given the limitations of the Ringold facility to collect hatchery returns, investments in expansion are encouraged at the Priest Rapids facility.

For the Yakima River program, the HSRG recommends that managers prioritize developing an approach to collect local broodstock. All juveniles should be marked for broodstock and harvest management, and pHOS should be consistent with whatever population designation the managers decide for Yakima River fall Chinook.

4.0 Current Conditions

To better understand the effects of management on the populations, it is essential to know what the current conditions are. The following captures the various factors that are currently affecting these populations.

4.1 Stock Structure

The Upper Columbia River summer/fall Chinook ESU is one of the most robust and diverse groups of Chinook in the Columbia River. This ESU consists of populations or major spawning groups from the Hanford Reach area of the mainstem Columbia River upstream to Chief Joseph Dam and inclusive of tributaries from the Yakima River to the Okanogan River (NMFS 1998). This ESU represents one of the largest and most productive races of Chinook in the state of Washington, and provides for fisheries from Alaska to the mainstem Columbia River to tributaries such as the Okanogan and into Canada. NMFS conducted a biological assessment and determined the ESU was not warranted for listing under the Endangered Species Act and the Washington Department of Fish and Wildlife has classified most of the stocks within the ESU as healthy (Myers et al. 1998; NMFS 1998; SaSI 2002).

NMFS did not formally define populations or major population groups (MPG) within the ESU. Likewise, the Interior Columbia Technical Recovery Team (ICTRT) did not define the population structure or establish viability criteria for summer/fall Chinook because they were not listed under the ESA. Therefore, the relevant Co-managers have voluntarily and cooperatively developed and proposed Upper Columbia summer/fall Chinook ESU substructure and conservation objectives as part of the Summer Chinook Summit. We have applied the principles of ESU, MPG, and population viability established by the ICTRT for other Chinook ESUs in the interior Columbia Basin. We recognize that there are scientific uncertainties and further analysis that could change the outcome of the conservation objectives outlined in this document. Upon review by a broader group, completion of further analysis, or in light of new and better information we intend to update this assessment of ESU substructure and conservation objectives for Upper Columbia summer/fall Chinook.

4.1.1 ESU substructure and population designations

Upper Columbia summer/fall Chinook represents a single ESU because of genetic, life history and spatial distribution similarities (Myers et al. 1998). The ESU includes adult Chinook that migrate into the Columbia River from early summer through late fall. For fisheries management purposes, the ESU is split into two runs, summer Chinook and fall Chinook. In general, the summer Chinook component arrives earlier, and tends to spawn earlier, but with considerable overlap with the later-arriving fall component. Juvenile life history pathways for natural ESU fish are predominately “ocean-type” with a variable proportion of “reservoir rearing type” that enters the ocean later as yearling smolts. Hatchery production of the summer Chinook component mostly produces a yearling or “stream type” smolt to enhance survival through the hydroelectric system. Hatchery production of the later arriving fall component releases sub-yearling or ocean type smolts. There is uncertainty regarding the historical composition of the run timing life histories for the extant populations. Currently, the Yakama River and Hanford Reach populations have a fall run-timing whereas the populations in the upper tributaries are dominated by summer run timing (DART 2009; Appendix A).

4.2 Current status of populations

Since the early 1970s, the number of summer/fall Chinook ascending Rock Island Dam have fluctuated until the 2000s, when dramatic increases occurred (Figure 4.1). Current abundance over Rock Island Dam remains relatively high compared to the previous decades.

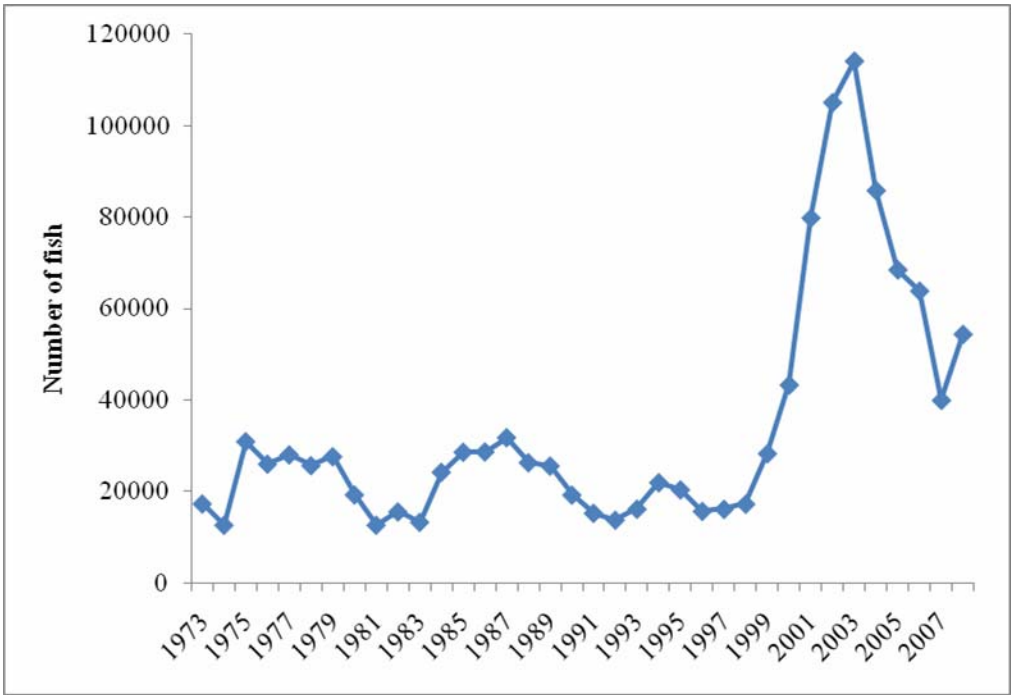

Figure 4.1. Rock Island counts of summer/fall Chinook (including jacks; source: Chelan PUD and DART).

4.2.1 Wenatchee

Abundance

Between the mid-1980s and through the 1990s, summer/fall Chinook total numbers declined at Rock Island, Rocky Reach, and Wells dams. The magnitude of the decline increased the further upstream the counts were. This suggests that the run into the Wenatchee River remained high or increased, while runs ascending upstream of Rocky Reach, and Wells did not. The run of summer/fall Chinook into the Wenatchee River has continued to increase since redd counts began in 1960 (Chapman et al. 1994), and especially between 2001 and 2006, when a modern record abundance was estimated. The 12-year geomean of estimated escapement has ranged from approximately 6,300 to over 7,000 fish (Figure 4.2).

The escapement into the Wenatchee River appears to be still primarily composed of naturally produced fish based on carcass sampling (pHOS = 0.12; Hillman et al. 2009). The Eastbank Hatchery program releases fish in the lower Wenatchee River (near Dryden), primarily for the purpose of reseeding the lower river habitat.

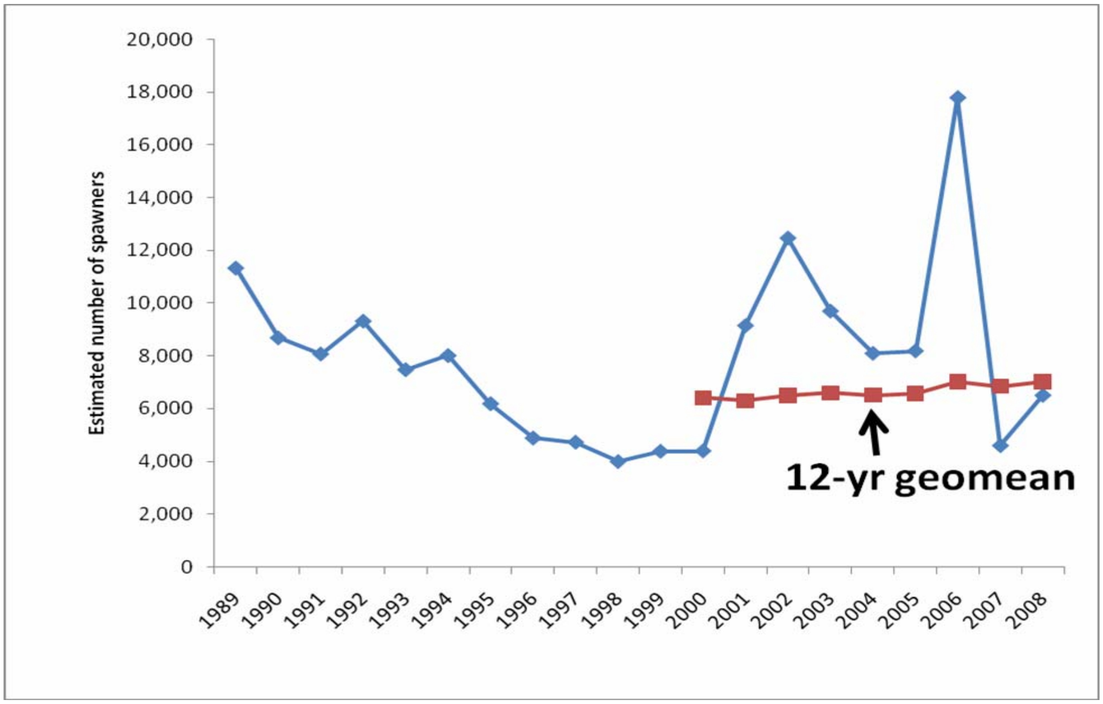

Figure 4.2. Estimated Wenatchee River escapement between 1989 and 2008 (Hillman et al. 2009).

Productivity

Current productivity of naturally produced fish has been estimated as part of the CCPUD's hatchery evaluation. Replacement (spawner:spawner) has ranged from 0.63 to over 10, with a 12-yr (1989-2000) geomean of 1.79 (Hillman et al. 2009).

Spatial Structure

Summer/fall Chinook salmon currently spawn in the Wenatchee River between RM 1.0 and Lake Wenatchee (RM 54; Figure 4.3). Within that area the distribution of redds of summer/fall Chinook has changed. Peven (1992) notes that, since the early 1960s, numbers of redds have decreased downstream from Dryden Dam (RM 17.5), while they have increased upstream from Tumwater Dam (RM 32.7). On a smaller scale, Peven (1992) reports that, since at least 1975, densities of redds (i.e., redds/mile) were highest near Leavenworth (RM 23.9-26.4) and in Tumwater Canyon (RM 26.4-35.6

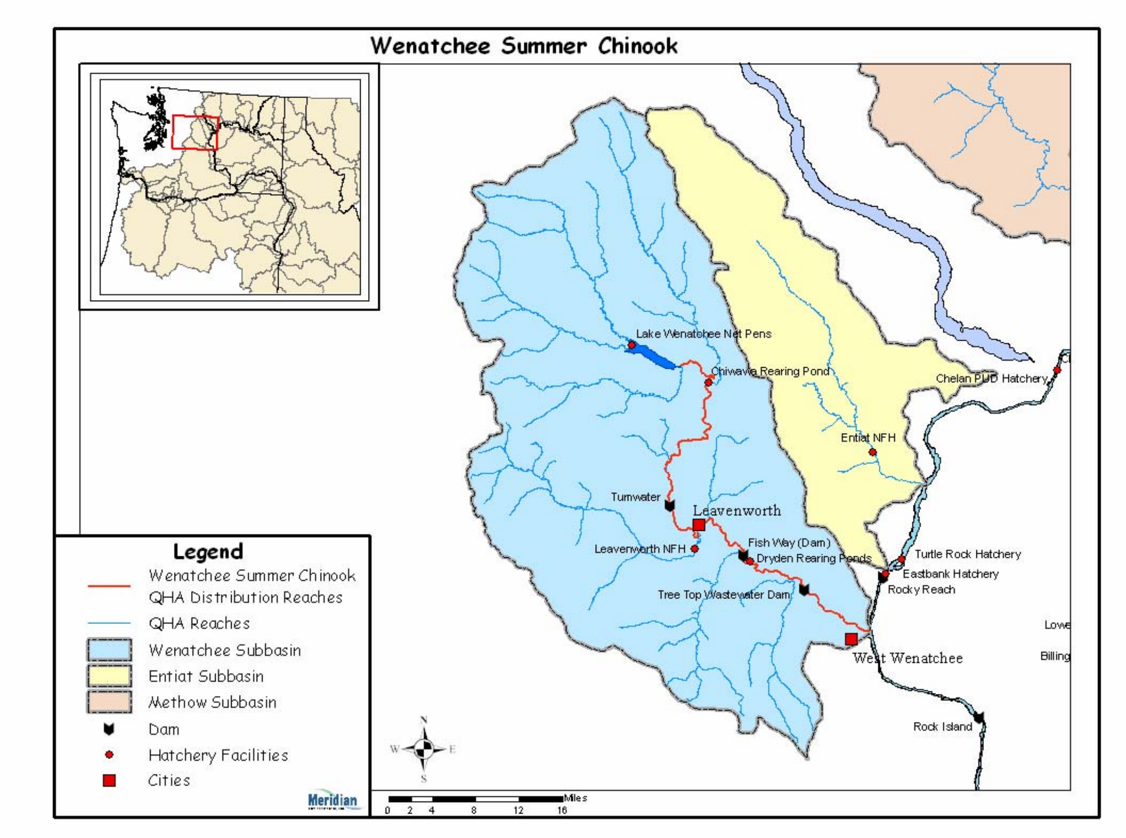

Figure 4.3. Wenatchee River basin summer Chinook distribution (from HSRG 2008).

Diversity

Currently, genetic sampling has not found any differences among late-run Chinook within or among basins within the UCR, but additional analysis is on-going.

4.2.2 Entiat

Abundance

Redd counts in the Entiat River basin are currently the only abundance indicator available. The lack of an existing hatchery program and inconsistencies between the difference in counts at Rocky Reach and Wells Dams (i.e., in some years, it appears more fish pass Wells Dam than Rocky Reach; see section 7.1.3) have precluded our ability to determine total basin escapement levels. The USFWS has conducted spawning ground surveys for both spring and summer Chinook salmon since 1994. Prior to that (1957-1991) CCPUD monitored summer Chinook salmon spawning in the lower Entiat River. In general, the Entiat redd counts show a similar pattern as the other summer Chinook populations, low in the early 1990s, and climbing steadily through the decade and dramatically after 2000 (Figure 4.4). The 12-year geomean of estimated escapement has ranged from approximately 42 to over 110 fish (Figure 4.4). Coded wire tag recoveries and scale analysis of recovered carcasses indicate that a large portion of the spawning population is made up of hatchery strays from outside the Entiat River Basin.

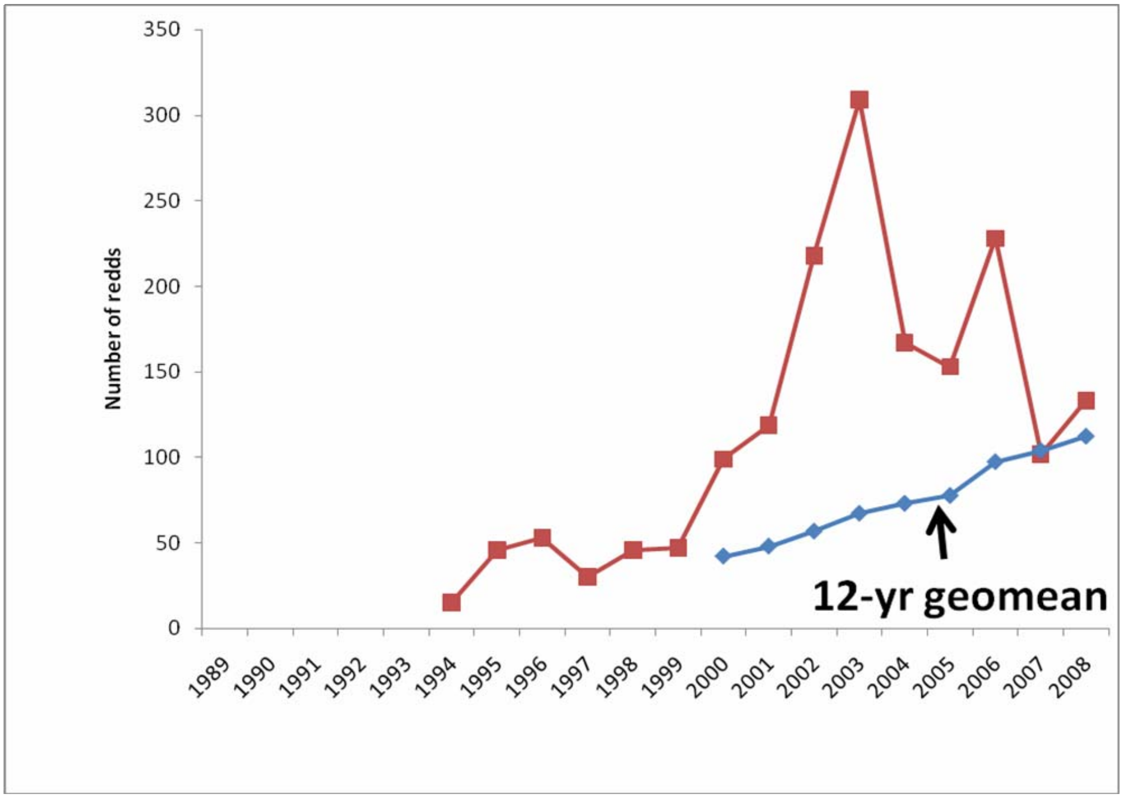

Figure 4.4 Entiat River redd counts between 1994 and 2008 (Hamstreet 2009).

Productivity

Current productivity is not known at this time.

Spatial Structure

Summer Chinook that spawn in the Entiat utilize the lower 23 miles of the river (Figure 4.5). Stray hatchery origin spawners tend to utilize spawning areas in the lower Entiat River (below RM 6.8) whereas natural origin spawners are predominately found in spawning areas above RM 16.2. For the period between 2001 and 2009 stray hatchery adult escapement into the upper spawning areas averaged 9% (10 year average; range was 6-15 %) of the carcasses recovered, whereas in the same period stray hatchery escapement made up 56 % (10 year average; range was 40-73 %) of the carcasses recovered in the lower spawning areas (C. Hamstreet, USFWS, personal communication). Whether this partial separation has prevented genetic introgression between stray hatchery SUS and natural origin spawners is unknown but is currently being investigated by USFWS.

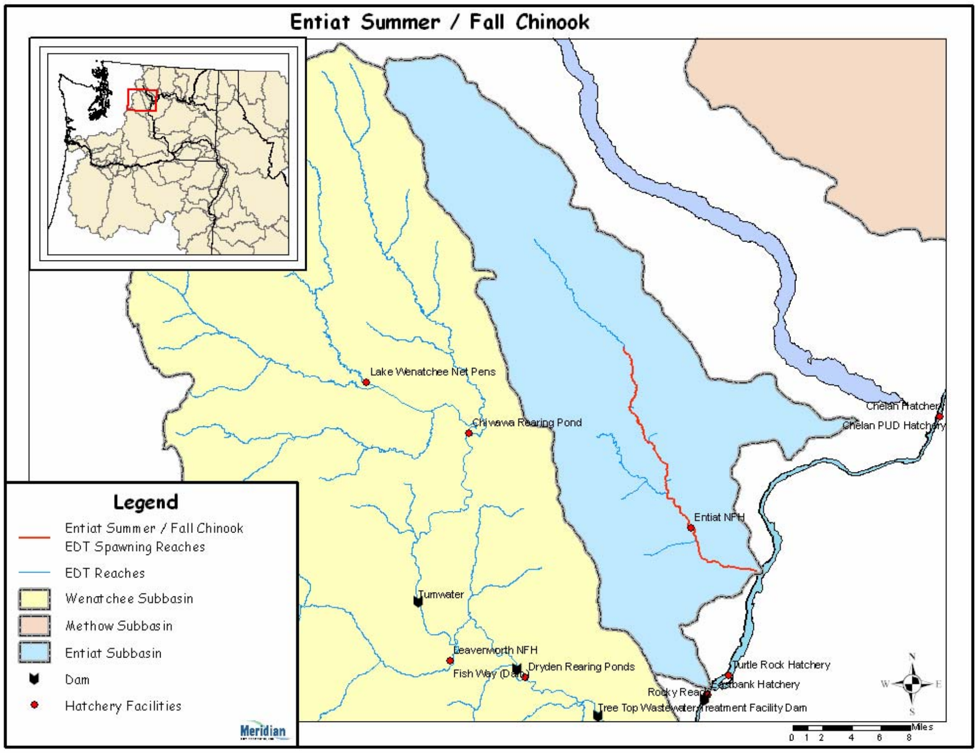

Figure 4.5. Entiat River basin summer Chinook distribution (from HSRG 2008).

Diversity

Currently, genetic sampling has not found any differences among late-run Chinook within or among basins within the UCR, but additional analysis is on-going.

4.2.3 Methow

Abundance

Redd counts in the Methow River show a precipitous decline from the mid-1960s through the early 1990s (Chapman et al. 1994). Since the early 1990s, runs have increased, and sharply since 2000 (Figure 4.6), partially due to the hatchery releases from the Eastbank Hatchery program (based on carcass sampling, e.g., Miller 2003), and in more recent years, high smolt-to-adult returns of hatchery and naturally produced fish. The 12-year geomean of estimated escapement has ranged from approximately 775 to 1,800 fish (Figure 4.6).

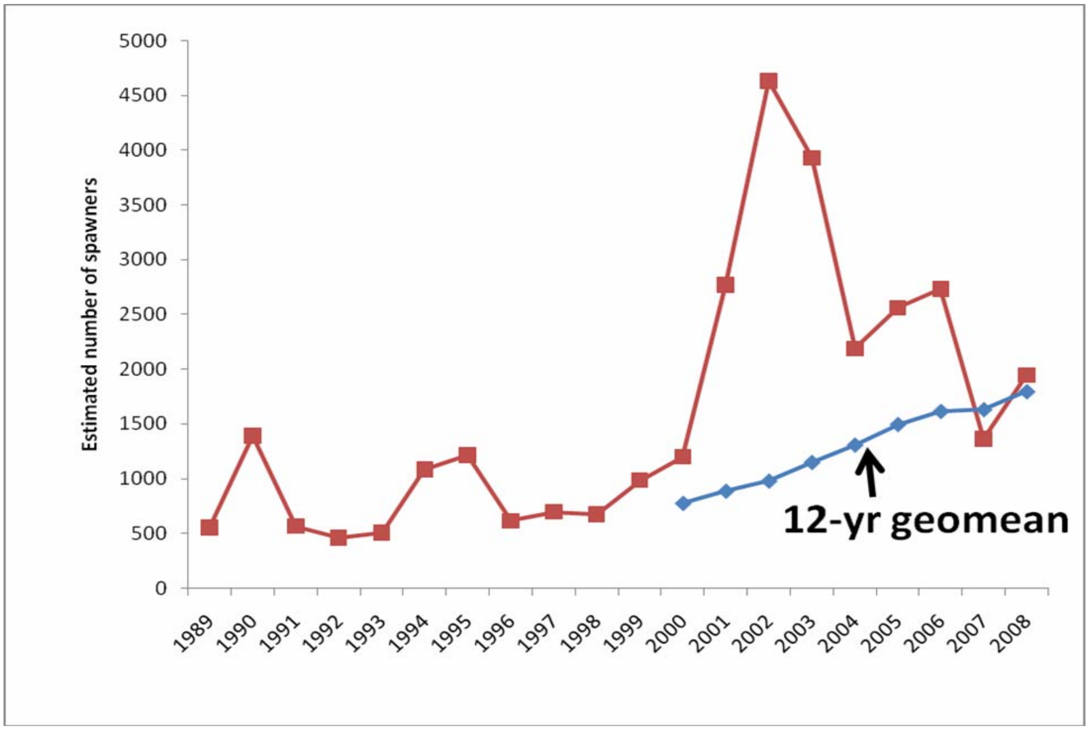

Figure 4.6 Methow River escapement between 1989 and 2008 (Hillman et al. 2009).

Productivity

Current productivity of naturally produced fish has been estimated as part of the CCPUD's hatchery evaluation. Replacement (spawner:spawner) has ranged from 0.96 to over 21, with a 12-yr (1989-2000) geomean of 2.68 (Hillman et al. 2009).

Spatial Structure

In the Methow River, summer/fall Chinook salmon spawn between RM 2.0 and the Winthrop hatchery diversion dam (RM 51.6; Figure 4.7). Chinook redds are scattered throughout that area, with redds found within almost every river mile (Hillman and Miller 1993). The overall distribution of redds of summer/fall Chinook in the Methow River has changed little since 1987, when ground surveys began (Miller 2003). During that period, redds were most abundant between Carlton and Twisp (RM 27.2-39.6), and least abundant between Winthrop and the hatchery diversion dam (RM 49.8-51.6) (Hillman and Miller 1993).

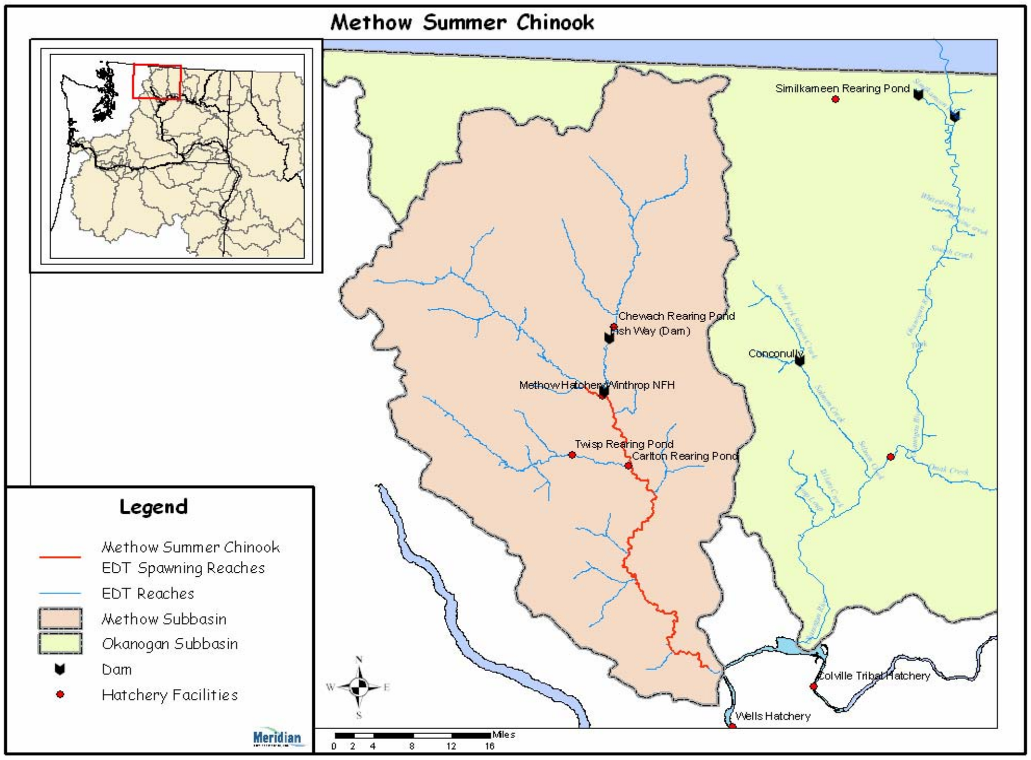

Figure 4.7. Methow River basin summer Chinook distribution (from HSRG 2008).

Diversity

Currently, genetic sampling has not found any differences among late-run Chinook within or among basins within the UCR, but additional analysis is on-going.

4.2.4 Okanogan/Similkameen

Abundance

Redd counts in the Okanogan and Similkameen began in 1956, and similarly to the Methow, showed increasing escapement until the late 1960s, and then declined (Chapman et al. 1994). However, dissimilar to the Methow, the number of fish spawning in the Okanogan and Similkameen remained at very low numbers until the rise in the 1990s, which is believed to be due to the hatchery releases from Eastbank Hatchery primarily. The Eastbank satellite pond is located on the Similkameen River, and most of the spawning fish return to the short section of the Similkameen that is open to anadromous fish. As with other populations, redd counts increased dramatically in the 2000’s (Figure 4.8). The 12-year geomean of estimated escapement has ranged from approximately 1,700 to over 5,000 fish (Figure 4.8).

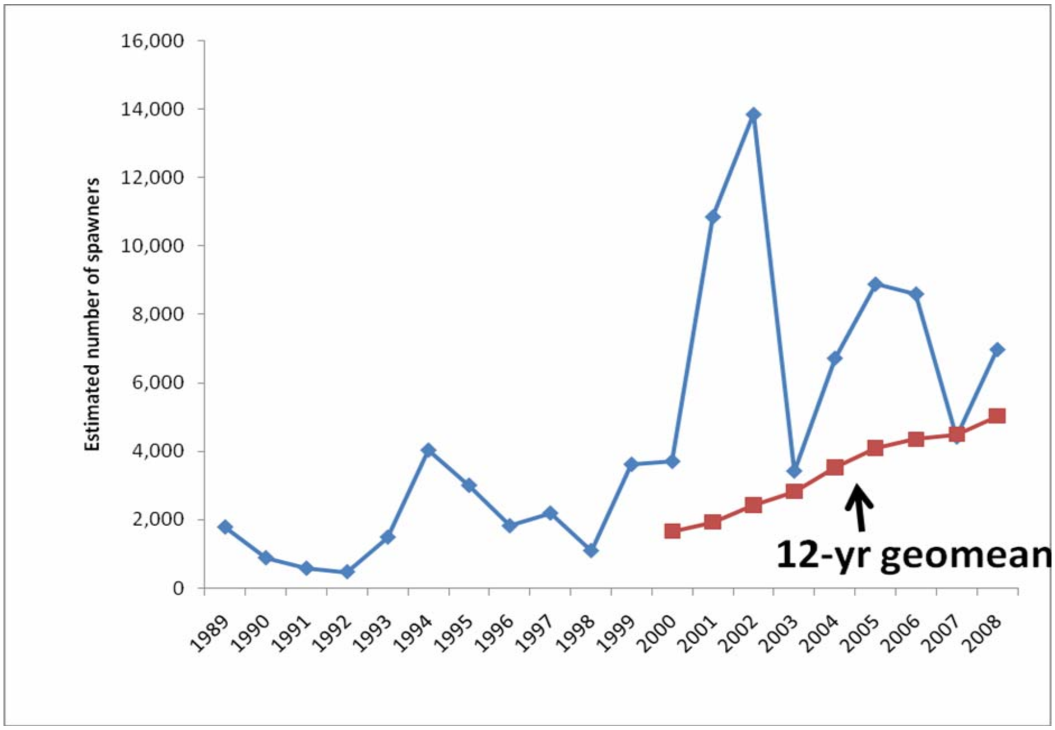

Figure 4.8 Okanogan/Similkameen River escapement between 1989 and 2008 (Hillman et al. 2009).

Productivity

Current productivity of naturally produced fish has been estimated as part of the CCPUD's hatchery evaluation. Replacement (spawner:spawner) has ranged from 0.51 to over 13, with a 12-yr (1989-2000) geomean of 2.10 (Hillman et al. 2009).

Spatial Structure

In the Okanogan Basin, summer/fall Chinook salmon spawn in both the Okanogan and Similkameen rivers (Figure 4.9). In the Okanogan River, Chinook usually spawn between RM 14.5 (just downstream of Malott) and Zosel Dam (RM 77.4). In the Similkameen River, Chinook spawn between its mouth and Enloe Dam (RM 8.9). In both rivers, redds are highly clumped, and those distributions have not changed since 1987 when ground surveys were first conducted (Hillman and Miller 1993; Miller 2003). During that period, densities of redds in the Okanogan River were highest between Okanogan and Omak (RM 26.1-30.8), McLoughlin Falls and Tonasket (RM 48.9-56.8), and the Similkameen River confluence and Zosel Dam (RM 74.1-77.4); they were lowest between Tonasket and the Similkameen River confluence (RM 56.8-74.1) (Hillman and Miller 1993). In the Similkameen River during the same period, densities of redds were highest between the mouth and the county road bridge (RM 0-5). Unlike in other mid-Columbia streams, Hillman and Miller (1993) found that summer/fall Chinook in the Okanogan Basin constructed most of their redds near islands, i.e., in braided segments.

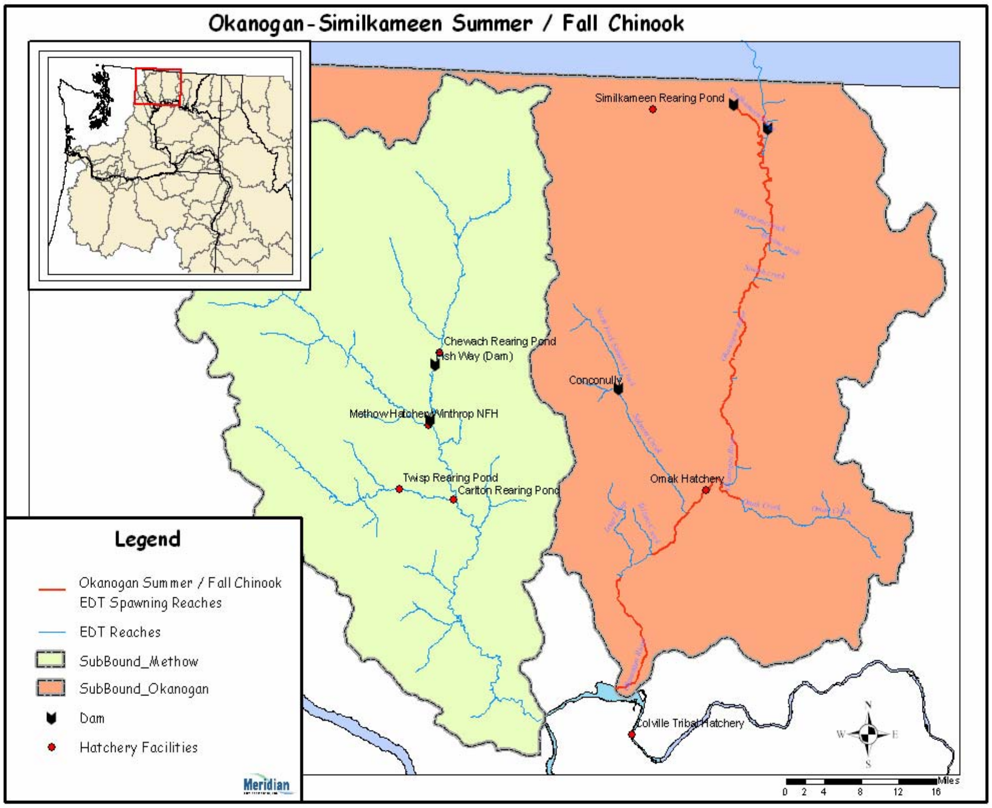

Figure 4.9. Okanogan Basin summer Chinook distribution (from HSRG 2008).

Diversity

Currently, genetic sampling has not found any differences among late-run Chinook within or among basins within the UCR, but additional analysis is on-going.

4.3 Hatchery programs

The current summer Chinook salmon hatchery production in the UCR basin is conducted as part of anadromous fish agreement and Habitat Conservation Plans (HCP) for the operation of Wells, Rock Island, and Rocky Reach dams. The parties to these agreements include the applicable dam operators, CCPUD for Rock Island and Rocky Reach HCPs and DCPUD for the Wells HCP, as well as relevant State (WDFW), Tribal (YN and the CCT), and Federal (USFWS and NMFS) fishery managers. These agreements commit CCPUD and DCPUD to a 50 year program intended to ensure no net impact of their hydro projects on salmon and steelhead runs in the UCR Basin. This will be achieved by a combination of mitigation efforts including hatchery production, habitat restoration, and on-site fish passage measures. A single new federally funded hatchery program has been initiated by the USFWS in the Entiat River Basin and is in partial fulfillment of US Bureau of Reclamation mitigation goals for the construction of Grand Coulee Dam.

Chelan County Public Utility District #1 funds the operation of summer Chinook programs releasing juvenile fish into the mainstem Columbia River (Turtle Rock), as well as the

Wenatchee, Methow, and Okanogan basins (Table 4.1). These programs are conducted in conjunction with the WDFW which operates the hatcheries and assists with monitoring and evaluation efforts. The specific goals, performance, and evaluation of CCPUD hatchery mitigation programs as outlined in the Rock Island and Rocky Reach HCPs are overseen by a committee consisting of members from each of the HCP signatory entities. Specific information for each of these programs is provided in brief below.

Douglas County Public Utility District funds a single summer Chinook hatchery program releasing juvenile fish into the mainstem Columbia River at Wells Dam. This program is conducted at Wells Hatchery located at the base of Wells Dam. This hatchery is operated by WDFW and was built for mitigation for the construction and operation of Wells Dam.

Table 4.1. Current release goals, average release size (BY2000 - 2007 (in thousands) and smolt to adult return rates (by life stage at release) for summer Chinook salmon hatchery programs in the Upper Columbia River basin.

Release Site	Agency	Yearling			Sub-Yearling			Accelerated Sub-Yearling		
		Target Release	Average Release	SAR	Target Release	Average Release	SAR	Target Release	Average Release	SAR
Mainstem (Turtle Rock)[1]	CCPUD/ WDFW	200	198.6	0.013	810	478.1	0.0005	810	401.0	0.0002
Wenatchee	CCPUD/ WDFW	864	760.1	0.0056						
Entiat[2]	USFWS/ BOR	200	NA	NA						
Mainstem (Wells)	DCPUD/ WDFW	320	334.0	0.009	484	419.0	0.007			
Methow	CCPUD/ WDFW	400	334.1	0.0024						
Okanogan	CCPUD/ WDFW	576	417.1	0.0093						
Total		2,560	2,043.9		1,294	897.1		810	401	

[1] Sub yearling releases from Turtle Rock will likely be discontinued and converted to yearling releases from Chelan Falls FH. The future release target for mainstem yearling releases under this program is anticipated to increase to 600,000.

[2] Summer Chinook Salmon production at Entiat NFH is a new program initiated in 2009. The first release is slated for spring of 2011.

4.3.1 Wenatchee River programs

CCPUD funds and WDFW operates the Dryden fish acclimation pond. This acclimation pond was built as mitigation for the operation of Rock Island Dam under the 1989 Rock Island Settlement Agreement. Broodstock is captured primarily at Dryden Dam, and if needed at Tumwater Dam. Fish are initially reared at the Eastbank Hatchery and final rearing and release takes place from February through April. The target release goal for this program is 864,000 yearling smolts.

4.3.2 Hatchery programs upstream of Wells Dam

CCPUD funds and WDFW operates the Similkameen (Okanogan Basin) and Carlton (Methow Basin) fish acclimation ponds. These acclimation ponds were built as mitigation for the operation of Rock Island Dam under the 1989 Rock Island Settlement Agreement. The release of summer Chinook from the Carlton acclimation pond is in part a trade with DCPUD for their mitigation requirements through the HCP. DCPUD and CCPUD have a species trade agreement, where DCPUD raises spring Chinook for CCPUD at their Methow Hatchery and CCPUD raises Summer Chinook for DCPUD at the Carlton acclimation pond.

The broodstock for the Methow and Okanogan programs are collected at Wells Dam, and it is an admixture of hatchery and naturally produced fish that originate upstream of Wells Dam, and "strays" from other, down-river stocks. Fish are initially raised at the Eastbank Hatchery, which is immediately upstream of Rocky Reach Dam, and then acclimated at the acclimation ponds beginning in October and February at Similkameen and Carlton, respectively. Fish are volitionally released in April-May. The target release goals for the Okanogan and Methow basins are 576,000 and 400,000 yearling smolts respectively.

4.3.3 Mainstem Columbia River hatchery programs

Mainstem Columbia River Releases at Turtle Rock Island

Rocky Reach hatchery is made up of two components; Turtle Rock Island and the "Annex." Both are adjacent to Rocky Reach Dam. These facilities were built as mitigation for the construction of Rocky Reach Dam. Broodstock for this program are taken at Wells Dam. Fish are initially reared at the Annex and final rearing and release is on Turtle Rock Island. The program consists of releases of subyearling and yearling Chinook. The target release goals for Turtle Rock releases is 200,000 yearlings and 1.6 million subyearling SUS. The subyearling releases are split between a standard and accelerated rearing cycle. CCPUD has been unable to meet the target subyearling release goal because of space and water limitations (Table 4.1). CCPUD and the co-managers have agreed through the HCP process to modify this program to 600,000 yearlings, with most acclimated at a new facility on the Chelan River.

Releases at Wells Dam

Hatchery operations and production goals are outlined in the DCPUD HCP, and broodstock is made up of "volunteers" that enter the hatchery. Fish are raised and released at the facility. The program consists of releases of subyearling and yearling fish. The current target release goal for Wells Dam releases is 320,000 yearling and 484,000 subyearling fish.

4.3.4 Yakima summer/fall Chinook program

Managers generally believe the historical spawning distribution of fall Chinook occupied the lower 100 miles of the Yakima River ranging from areas just below Sunnyside Dam and extending to the mouth of the Yakima. The genetic stock identification of the historical Yakima fall Chinook population is currently unknown. Furthermore, it is unclear whether a distinct stock of fall Chinook historically existed in the Yakima subbasin or weather fall Chinook in the Yakima have always been a satellite population of Hanford Reach Upriver Brights (HSRG 2009). Based on an electrophoretic analysis of allozyme samples collected from spawning fish in Marion Drain and the mainstem near Benton City in 1989 and 1990, Busack et al. (1991) concluded that there were two genetically distinct stocks in the basin: the Marion Drain stock and the “mainstem stock.” Subsequent analyses of allozymes from fish collected in the mainstem above Prosser Dam were indistinguishable from the Benton City samples. Therefore, all mainstem spawners appear to belong to the same genetic population, which is indistinguishable from Hanford Reach URBs. A recent analysis of microsatellite baseline data also suggests Yakima River mainstem fall Chinook are genetically very similar to the Hanford Reach URB population. Dr. Shawn Narum found no significant differences in allele frequencies between the two populations (Shawn Narum, CRITFC, pers comm, October 8, 2009). The Marion Drain spawning aggregate, on the other hand, genetically resembles Snake River fall Chinook and Deschutes River (OR) fall Chinook more than the Hanford Reach population, and spawns only in Marion Drain. Recent genetic work has suggested some level of introgression having occurred between the Yakima population and the Marion Drain spawning aggregate but the degree of homogenization between the two populations is yet to be determined. Todd Kassler, a WDFW geneticist, wrote a memo to Yakima/Klickitat Fisheries Project staff in August of 2007 describing the results of a genetic analysis of Marion Drain broodstock collected in 2005. In it he says, "The individual assignments of the 2005 Marion Drain samples were to the lower Yakima River instead of Marion Drain." Mr. Kassler speculated that this might mean mainstem fish in some numbers in fact do stray 6.7 miles inside Marion Drain to the fish wheel, and/or that the Marion Drain and mainstem populations had already introgressed to the point where they are indistinguishable.

Releases of hatchery URB fall Chinook juveniles have been made annually into the Yakima subbasin since 1983. A majority of annual releases have consisted of an out-of-basin "Mid Columbia Bright" (MCB's) stock founded in 1977 when upriver bright fall Chinook were trapped from the Bonneville Dam fish ladder and spawned at Bonneville Hatchery. In addition, juveniles from a local broodstock program have been released in the Yakima River since 1999. Managers are in the process of transitioning the MCB releases from the Little White Salmon Hatchery to the use of the URB stock propagated at Priest Rapids Hatchery. Collection of adults for the local program is confounded by trapping infrastructure, thus limiting the number of natural origin fish being incorporated into the program. The Yakama Nation began releasing hatchery URB fall Chinook into the Yakima subbasin in 1983. The program started with an initial release of 324,000 Little White Salmon hatchery sub-yearlings. Releases have been a mixture of direct plants into the Yakima River, and acclimation in net pens (Wapato Canal), various sloughs and irrigation waste return canals. In 1996, the Yakama Nation constructed the Lower Yakima Supplementation and Research Facility at Prosser dam. Three ponds were constructed for acclimation and release of fall Chinook at that facility. The purpose of these releases has been primarily targeted harvest. Releases of Little White Salmon (LWS) hatchery sub-yearlings have a release goal of about 1,700,000, and averaged 1,453,803 from 1983 through 2008. Beginning in 1998, the Yakama Nation has collected adult broodstock at Prosser Dam and used their progeny for juvenile releases to augment releases from LWS brood stock. Roughly 10% of hatchery-origin releases have been marked annually with CWT and adipose fin clip for evaluation purposes. Efforts to mark-sample sufficient numbers of returning fish in terminal areas have been inconsistent. Thus, enumeration of hatchery- and natural-origin adult returns to Prosser, in the escapement, and used for local broodstock at Prosser has not been possible.

The release of summer Chinook into the Yakima River began in 2009. Juveniles obtained from the upper Columbia Wells hatchery stock are currently being acclimated and released within the assumed areas of historical distribution. When sufficient numbers of hatchery and/or natural origin adults are returning to the Yakima to support broodstock needs of the program, importation of the out-of-basin stock will be terminated. The manager's primary conservation goal of the reintroduction effort is to restore a natural producing population of summer Chinook. Roughly 250,000 green eggs are collected annually from the Wells Hatchery summer Chinook stock and transferred to the Prosser facility where eggs are isolated while pathology screening is being conducted, and will continue into the near future as part of a feasibility study on the reintroduction of summer Chinook into the Yakima River.

4.3.5 Federal programs (Hanford Reach & Yakima)

Fall Chinook production within the ESU occurs primarily in the Hanford Reach area of the Columbia River mainstem as well as the Yakima Basin. Priest Rapids Hatchery rears and releases 6.7 million zero age Chinook, of which 1.9 are adipose fin clipped with 200,000 also being CWT marked. Of the 1.9 million adipose fin clipped fall Chinook reared and released at Priest Rapids Hatchery, 1.7 million are part of the John Day Dam mitigation program funded through the Army Corp of Engineers. Ringold Springs Hatchery, another federally funded facility releases another 3.5 million zero aged fall Chinook. All are adipose fin clipped and representative portion are CWT marked as part of the John Day Dam mitigation. Prosser Hatchery, operated by the Yakama Nation within the Yakima Basin, rears and releases up to 2.1 million zero aged fall Chinook. These fish are also part of the John Day mitigation package. 200K of this production group are adipose fin clipped and CWT marked.

4.4 Harvest regimes

4.4.1 Description of model used to estimate harvest and exploitation rates[2]

The Summit participants' summer/fall Chinook model was built to estimate harvest rates (HR) and exploitation rates (ER) for Columbia River fisheries; for current conditions, near-term conditions, where hatchery production increased by 122%, and long-term conditions where there was a 122% increase in hatchery production and a corresponding 44% increase in wild production (Appendix B). The three populations that HR and ER were estimated for were the Wenatchee, Methow and Okanogan. For each population, there were three scenarios modeled with three run sizes for each scenario (Table 4.2).

Table 4.2. Description of Scenarios Used in Modeling Harvest and Exploitation Rates.

Scenario	**Range of run sizes**	**Small**	**Medium**	**Large**
Current Conditions	Range of current Columbia River run sizes Since 2000	35,000	52,000	57,300
Near-term Conditions	Range of run sizes that would be expected with increased hatchery production primarily from Chief Joe Hatchery	61,500	104,000	114,500
Long-Term Conditions	Range of run sizes with increased hatchery production and increased natural production	90,000	156,000	172,000

For each of the three scenarios a total of six harvest options were modeled. The treaty Indian fishery was modeled as non-MSF in all options.

1. Sport and Colville (MSF)
2. Sport below Priest Rapids and Colville MSF

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[2] This group defines *Exploitation rate* as the proportion of the total stock or population harvested (more pertinent to a stock) and *Harvest rate* as the proportion of population that is available to a fishery that is taken by a fishery (more pertinent to a fishery).

3. Sport above Priest Rapids and Colville MSF
4. Colville MSF
5. No MSF
6. All non-treaty fisheries MSF including non-Indian commercial.

The mark rates used in each of the fishing areas are shown in Table 4.3. The mark rates for current conditions (Scenario 1) were from observations of current fisheries or mark rates from dam counts. Mark rates for Scenario 2 and 3 were based on assumptions of increased hatchery production (about 120%) in the near term and increased natural production (about 40%) and hatchery production in the long-term (Scenario 3). It was assumed that mark rates decreased in the fisheries upstream because of hatchery fish removal downstream.

Table 4.3. Mark Rates by Fishing Area.

Scenario	**Below Bonn.**	**Bonn. to PR Dam**	**PR Dam to CJ Dam**	**Colville Fishery**
Current Conditions	60%	59%	48%	50%
Near-term Conditions	72%	71%	60%	62%
Long-term Conditions	64%	63%	52%	54%

4.4.2 Harvest rate

The model uses the harvest sharing formulas from the *U.S. v Oregon* 2008-2017 Management Agreement (MA) and the Agreement between WDFW and the Colville Tribes (CA) (Appendix C). It was assumed that all fisheries would harvest all of the fish that are allocated except the sport MSF fishery above Priest Rapids Dam. Sport harvest from Bonneville to Priest Rapids was estimated at 2% of the non-Indian allocation below Priest Rapids Dam. The sport harvest above Priest Rapids Dam was estimated to be comprised of 9.2% Wenatchee fish, 16.5% Methow fish and 48.9% Okanogan fish (H. Bartlett, WDFW, personal communication). For MSF options the release mortality estimates were 10% for sport fisheries, 5% for Colville fisheries and 20% for the non-Indian commercial fishery. The harvest rate for Columbia River fisheries was the sum of harvest rates by stock for each of the three populations, using the MA and the CA to determine the harvestable numbers of fish.

4.4.3 Exploitation rate

The ER is calculated as the total catch mortality divided by the total abundance. The total abundance was calculated as the river mouth run size divided by (1- ocean ER). The total ER for ocean and Columbia River fisheries was calculated as the Columbia River harvest rate divided by the river mouth run size divided by the total abundance.

4.4.3.1 Ocean exploitation rate

The Pacific Salmon Commission's Chinook Technical Committee (CTC) provides annual analysis of exploitation rates (ER) for key salmon stocks, including upper Columbia summer Chinook. The CTC uses Wells stock coded-wire tags (CWT) in their analysis of ER. The 2001-2006 average ER from the CTC analysis is 47.87% for fisheries outside the Columbia River. The new U.S./Canada Treaty is expected to provide savings in ER to many Columbia River salmon stocks. The reduction in the ER for upper Columbia summer Chinook is projected to be 6.44%, which would equate to a 43.41% ER for fisheries outside the Columbia River.

One of the questions raised during the Summit was whether the ER analysis from the CTC represented the populations in the Wenatchee, Methow and Okanogan. An independent CWT analysis was conducted using CWTs from each of the three populations and comparing them with Wells (Table 4.4). This analysis shows that the Wenatchee population is exploited at the highest rate in the ocean (55% average) with Okanogan at 48% and Methow at 44%. The Wells stock had an average ER of 45%.

Table 4.4. Percent of CWT Recoveries in Ocean Fisheries.

	Release Site				
Brood Year	**Wells**	**Methow**	**Okanogan**	**Wenatchee**	**Grand Total**
1996	47%	16%	13%	33%	45%
1997	58%	33%	67%	66%	61%
1998	66%	45%	------	74%	65%
1999	61%	6%	47%	63%	58%
2000	50%	47%	54%	52%	52%
2001	46%	35%	43%	44%	44%
2002	39%	34%	41%	50%	43%
2003	37%	------	41%	57%	48%
2004	53%	60%	58%	70%	59%
2000-2004 average	45%	44%	48%	55%	49%
With savings from US/Canada (6.4%)					
		41.21%	44.60%	51.03%	

Because of the apparent differences in ER between the three populations, the Summit members agreed to use the results in Table 4.4 for the analysis of total ER on the individual populations, including the expected reduction in ER from the new treaty. The ocean ER for the Methow population used in modeling was 41.21%, for the Okanogan was 44.60% and for the Wenatchee was 51.03%.

4.5 Escapement goals

In US v OR (page 40), it states that the interim escapement management goal is for 29,000 hatchery and natural origin fish as measured at the Columbia River mouth. The interim spawning escapement goal is 20,000 at Priest Rapids Dam, and is divided as shown in Table 4.5.

Table 4.5. Upper Columbia Summer Chinook Interim Goals at PRD from US v OR (page 40)

Stock Group	**Spawning Objective Components**
Wenatchee/Entiat/Chelan Natural spawners	13,500
Methow/Okanogan Natural spawners	3,500

Hatchery	3,000

4.6 Summary of all of the factors above in context of potential future adjustments

When the goals for the populations were initially developed and fisheries implemented, the escapement goals and fishery objectives were achieved annually. As more scientific information comes available on hatchery programs and overall forecast capability and fishery management, the population goals should reflect management at this new scale. The additional information available to the managers today allows for management of the population at a finer scale e.g. hatchery to wild ratio on the spawning grounds to optimize productivity. Escapement can be adjusted relative to the prioritization of population and risks to be acceptable for hatchery programs.

5.0 Future conditions

In the near future, hatchery production will be significantly increasing in the UCR for summer Chinook salmon. As such, Columbia River harvest rates and overall exploitation will increase as more hatchery origin fish return. In this section, we explore some potential changes that could occur and offer some potential conservation designations for future consideration.

5.1 Conservation objectives

5.1.1 Definition of ESU components

Population definitions were established in the VSP guidance document by McElhany et al. (2000). The key concepts within the definition are that independent populations are reproductively isolated enough that they are genetically distinct and that exchanges of individuals among the populations do not “substantially affect the population dynamics or extinction risk of the independent populations”. Also key to this definition is that, in order to be considered an independent population, the population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals from other populations. In other words, if one independent population were to go extinct, it would not have much impact on the 100-year extinction risk experienced by other independent populations. Therefore, stocks or spawning aggregates in areas that could not meet this expectation based on their historical habitat potential should be grouped with upstream populations (via ICTRT methodology).

5.2 MPG viability

The ICTRT (2007) defined viability criteria for MPGs that included a series of objectives including:

- At least ½ the populations historically within the MPG (with a minimum of 2) should meet viability standards.
- At least one population should be “Highly Viable”
- Viable populations should include large and very large populations in proportions consistent with their historical fraction.
- All major life history strategies should be represented.

- Populations not meeting viability standards should be maintained with sufficient productivity so that overall productivity of the MPG does not fall below replacement and with sufficient spatial structure and diversity demonstrated by achieving “Maintained” standards.

The proposed MPG and population designations in Table 5.1 are intended to meet the MPG viability criteria of the ICTRT (outlined above) and are based upon the technical information provided in the first series of summer Chinook Summit meetings including updated EDT analyses, HSRG recommendations, SaSI evaluations, overview of ESU and original biological review team summary, and ICTRT guidance on other Chinook ESUs. For simplicity and clarity, we have excluded other spawning aggregates from Table 5.1 that were not deemed to be independent populations and, until more or better information is available, consider those spawning aggregates to be spatial structure within the independent populations.

Table 5.1 Proposed ESU substructure and population status for Upper Columbia summer/fall Chinook salmon.

ESU	MPG	Population	Run Timing	Status Objective	Current Status
Upper Columbia summer / fall Chinook	Hanford/ Yakima	Hanford Reach	Fall	Primary	Primary
		Yakima Fall	Fall	Contributing	Stabilizing
	Upper Columbia	Wenatchee	Summer/fall	Primary	Primary
		Okanogan	Summer/fall	Primary	Contributing
		Methow	Summer/fall	Contributing	Stabilizing

The Hanford Reach fall Chinook spawning aggregate and the Yakima River fall Chinook spawning aggregate likely form a separate MPG due to spatial segregation, the lack of summer run timing component to their life history, and a near exclusive subyearling “ocean type” juvenile life history strategy. This assumption should be confirmed as more detailed genetic information becomes available, followed by an evaluation that mimics the efforts of the ICTRT when they determined MPGs in the other Interior Columbia ESUs. The second MPG in the ESU would then be comprised of the Upper Columbia populations including at the Wenatchee, Methow, and Okanogan populations, and additional spawning aggregates in the Upper Mainstem and Entiat Rivers (Table 4.1).

5.2.1 Hanford Reach and Yakima River MPG

Conservation objectives include *Primary* population status for the Hanford Reach and Contributing status for the Yakima River Fall Chinook population (Table 5.1). Reintroduction efforts are underway for a summer Chinook population in the Yakima. The long-term objective is to achieve a viable population. This MPG includes the recently discovered spawning aggregate in Crab Creek and the spawning aggregate in Marion Drain, which has a longer data history. Given the uncertainties in the historical and current potential production from these areas we did not consider them independent populations and therefore did not assign a target conservation objective.

5.2.1.1 Yakima River fall run Chinook population

Recent habitat modeling suggests the lower Yakima River is capable of supporting a natural population of fall Chinook with a rather high spawner capacity and low intrinsic productivity. Numerous limiting factors are likely affecting the productivity of the natural population including both abiotic and biotic factors, current hatchery practices, and harvest. The current Proportionate Natural Influence (PNI) of the composite population is unknown due primarily to unknown proportions of hatchery fish on the natural spawning grounds but also from unknown, but assumed to be low, indefinite numbers of natural origin fish used for broodstock in the local program. Due to low natural productivity, high pHOS levels and current pre-terminal harvest rates, the HSRG concluded this population cannot currently meet the standards of a *Contributing* population (HSRG 2009). It is the managers' intention to improve the status of Yakima fall Chinook to the criteria standards of a *Contributing* population by implementing foreseeable changes to the hatchery program as outlined in the Yakima summer/fall Chinook Master plan.

Proposed changes scheduled to occur under this plan include a broodstock source transition and release location for the 1.7 million sub-yearlings (*U.S. v. Oregon* releases), and a change in broodstock composition and collection point for the conservation program. The 1.7 million sub-yearlings imported annually from the Little White Salmon hatchery will be terminated and replaced with eyed-egg transfers from Priest Rapids Hatchery (1.7M release maintained). This is a near term strategy currently being negotiated) scheduled for implementation in the fall of 2010. This management action terminates the last exogenous source of hatchery origin fish imported and released within the Hanford/Yakima MPG. The release location will shift from an on-site hatchery release located at Prosser Dam (rkm 75.6) to a lower River acclimation facility below Horn Rapids Dam (rkm 29). The intention of this management action is to increase the spatial and temporal segregation between this programs hatchery fish spawning naturally, and the natural population spawning above Prosser Dam. The construction of a lower river acclimation facility will also include an adult capture and holding facility, barring any logistic and funding constraints. If the adult facility is built, broodstock will be collected locally, and the eyed egg transfers from Priest Rapids Hatchery will be terminated. In addition to providing a local source and collection point for broodstock, trapping surplus adults in the lower river will reduce hatchery escapement and spawning interactions with the natural population.

The conservation program will change the collection point of adults for the purpose of increasing the proportion of NORs use in the broodstock. The number and origin of adults collected for broodstock will not be based on achieving a fixed juvenile release number but instead, achieving conservation objectives (i.e. PNI) based on the abundance of wild and hatchery fish in the aggregate run. If feasible, this type of program flexibility will assist the managers' ability to achieve long-term conservation goals for the natural population. Probable release numbers for the conservation program will range from 200,000 to 400,000.

5.2.1.2 Yakima River summer-run Chinook

Little is known about the historical abundance and distribution of summer Chinook although managers generally believe the production area was confined to the middle Yakima River, from areas just below Sunnyside Dam upstream into areas above Roza Dam; and in the Lower Naches River, from the mouth to the Tieton River. A Yakima Herald article from October of 1944 reported a "volunteer run" of summer/fall Chinook over Roza Dam and into the Naches River as far as Wapatox Dam (located just below the mouth of the Tieton River). Similarly, Roza Dam counts from 1941 through the 1950's record a handful of Chinook in September and October (WDF Annual Report, 1964) some of which were likely summer/fall Chinook. From 1962 to 1970, the Washington Department of Fisheries conducted aerial redd surveys in the Yakima River from the Yakima/Union Gap area to Granger (Schwartzberg and Roger 1986). Within this period, the average redd count was 12 redds, and flights were discontinued in 1970. Extirpation of Yakima River summer Chinook likely occurred soon after as no redds were observed since the aerial surveys were conducted.

Efforts to restore a summer Chinook population in the Yakima are in the early stages of implementation. Juveniles obtained from the upper Columbia Wells hatchery stock are currently being acclimated and released within the assumed areas of historical distribution. When sufficient numbers of hatchery and/or natural origin adults are returning to the Yakima to support broodstock needs of the program, importation of the out-of-basin stock will be terminated. The managers' primary conservation goal of the reintroduction effort is to restore a natural producing population of summer Chinook in the Yakima River that meets viability criteria based on the principles outlined in McElhany et al. (2000). Similar to fall Chinook, habitat modeling suggests the mid Yakima is capable of supporting a natural population with a rather high spawner capacity but somewhat low intrinsic productivity, of which also implies a fully adapted local population. Many critical uncertainties exist with the summer Chinook reintroduction effort. Among them is the potential for spatial and temporal overlap between spawners from summer and fall-run stocks. While the management intention is to create a separate population of summer-run Chinook, it is not currently possible to predict the degree of introgression or homogenization if it were to occur.

Based on large historical run size estimates of summer Chinook in the Yakima (Kreeger and McNeil 1993), the amount of intrinsic habitat potential is undoubtedly large. This would likely translate into *Primary* population status designation if this was the sole consideration. However, given the extirpation of the legacy stock and the many uncertainties associated with the reintroduction effort, a population status of *Primary* may be difficult to achieve. Nevertheless, with conservation goals and objectives acknowledged for the reintroduced stock, it makes sense to designate a long-term status objective of at least *Contributing* for this population. In a broader context of conservation, establishing a viable summer Chinook population has the potential of contributing to the spatial structure and diversity of the Hanford Reach/Yakima River MPG. Though much uncertainty exists concerning reintroduction efforts, the long-term addition of a third and viable population has the potential of contributing to MPG viability and sustainability of the ESU. The ICTRT states that, "In the long-term, as naturally-produced and locally-adapted populations become established, they can contribute to overall ESU abundance, productivity, and diversity.

5.2.2 Crab Creek

Recent monitoring has revealed a spawning aggregate of late spawn timing Chinook and juvenile outmigrants in Crab Creek (WDFW unpublished data). Little is known about their viability, historical presence, or potential contribution to productivity and spatial structure of the MPG. We assume that they belong in the Hanford Reach / Yakima River MPG due to geographic proximity, but there is uncertainty regarding their status as an official stock, population, or if they are just a spawning aggregate.

The focus of this document and the Summer Chinook Summits were on Upper Columbia summer/fall Chinook, so the remainder of our discussion will focus on the populations upstream of Rock Island Dam.

5.2.3 Upper Columbia MPG

5.2.3.1 Wenatchee and Okanogan

The Wenatchee and Okanogan populations both had relatively high certainty of historical populations (Craig and Suomela 1941) and were already achieving or could readily achieve *Primary* population objectives, and Fish Managers all agreed that these subbasins can and should support strong and healthy populations of summer Chinook.

5.2.3.2 Methow

There was considerable discussion regarding the appropriate population status designation for the Methow population. Early reports did not include any affidavits from local residents regarding the presence of a late run Chinook population in the Methow (Craig and Suomela 1941). However, it is difficult to judge the thoroughness of the effort to find the appropriate people to comment on the timing of the historical fish runs in the Methow. Additionally, the timing of that effort would not have pre-dated the very high lower Columbia River harvest rates that occurred prior to the turn of the century. Recent population performance suggests that the Methow is capable of supporting an independent population of summer Chinook. Although the natural origin abundance (12 year geomean = 1,008) has been less than the Wenatchee and Okanogan, the productivity of naturally spawning fish in the Methow population (12 year geomean NRR = 2.7) has been higher than the other tributary populations (Hillman et al. 2009). The ICTRT intrinsic potential model estimates a similar quantity of potential Chinook habitat in the Methow as is in the Wenatchee (ICTRT 2007). A refinement of that analysis for this report limited the intrinsic potential assessment to the Wenatchee and Methow mainstem areas and again, there were similar quantities of potential habitat (Table 4-2). The Methow population presently meets the attributes of a *Stabilizing* population due primarily to mixed stock management at Wells Dam and relatively high pHOS. The population is currently mixed hatchery/natural with no ability to collect brood nor a ready means of removing hatchery adults not needed for natural reproduction.

Currently, the high ELISA (Enzyme Linked Immunosorbant Assay) hatchery fish from the Eastbank program are acclimated and released at the Carlton acclimation ponds. The effects of this management action on the viability of the natural population are not well understood, but the management is not considered BMP. The HSRG concluded that with the current habitat productivity, hatchery management and harvest exploitation rate the population could not achieve viable status. Despite these management challenges in the Methow, it was determined that a population status of *Contributing* was desired for Methow Summer Chinook. This decision was based largely on the desire to meet MPG level objectives of the ICTRT of at least ½ the populations with viable status and the remainder being maintained at a level with sufficient productivity, spatial structure and diversity that they are not “sinks” for the ESU (ICTRT 2007).

5.2.3.3 Entiat

There was considerable uncertainty regarding the potential for a historically independent population of summer/fall Chinook in the Entiat River. Early reports and associated affidavits from area residents did not indicate that there was likely a late run component to the Entiat Chinook population (Craig and Suomela 1941). Although natural origin summer Chinook have consistently been found in the Entiat River in recent years this is likely an artifact of previous hatchery production of summer Chinook salmon at Entiat NFH (1941-1964) and the straying of hatchery origin adults from programs outside the Entiat River basin. Given the watersheds small size and the lack of a historical independent population we believe the best scenario is to manage summer Chinook in the Entiat River as a *Stabilizing* stock. More important in the Entiat River is to not impose a risk to the endangered spring Chinook population with summer Chinook management.

5.2.3.4 Upper Mainstem

As discussed further below, there are historical accounts of Chinook spawning in the mainstem Columbia River between Rock Island and Grand Coulee Dams (Chapman 1943; Fish and Hanavan 1948; Edson 1958; Fulton 1968; Meekin 1963). There is consistently a large proportion of the run escapement above Wells Dam that does not show up on the spawning grounds in the Methow and Okanogan or can be accounted for in harvest. Some of this difference is likely due to a high prespawn mortality, but Ashbrook et al. (2008) found that 41% of the natural-origin fish that passed Wells Dam did not ascend into the Methow or Okanogan and they hypothesized that there could be some mainstem spawning areas between the Okanogan and Chief Joseph Dam. They also found that “Earlier-arriving Chinook were more likely to migrate to the upper Okanogan and Similkameen rivers while later-arriving Chinook were more likely to migrate to the lower Okanogan River or remain in the mainstem Columbia River” (Ashbrook et al. 2008).

There is considerable uncertainty regarding whether or not fish in this area are currently able to reproduce successfully, if fish in the mainstem historically constituted an independent population separate from the tributary populations, how much gene flow there is with the tributary populations, and how much gene flow there is between areas of the mainstem, or if there is any unique genetic substructure of fish in the mainstem. Due to these uncertainties and challenges, along with the lack of ability to effectively manage and monitor fish in the mainstem, the Upper Mainstem was not classified as an independent population, but as a potential spawning aggregate that comprises a spatial structure component of the nearby Okanogan population.

5.3 Population viability and conservation objectives

The ICTRT established population viability by applying the principles outlined in McElhany et al. (2000). Further detail was developed that included developing viability curves for each ESU and establishing minimum abundance thresholds. These thresholds began with a minimum long-term geomean of at least 500 NOR based on genetic and demographic considerations (ICTRT 2007). Minimum abundance thresholds were then scaled upwards based on the quantity of intrinsic potential habitat in each population area (ICTRT 2007). The ICTRT did not develop conservation objectives for populations of summer/fall Chinook in the Upper Columbia River basin. However, we can apply the principles from the ICTRT effort and do have a subset of the intrinsic potential analysis to help justify minimum abundance thresholds for a subset of the populations (Wenatchee, Methow, and Okanogan). It is important to note that minimum abundance thresholds are not based on carrying capacity or maximum sustainable yield and therefore can be considerably different than management objectives. The intrinsic potential analysis did not consider stream temperature, sediment, or other habitat features that are known to effect fish productivity at the reach and habitat unit scale.

A subset of the ICTRT intrinsic potential data set was analyzed in the Wenatchee, Methow, and Okanogan rivers (D. Holzer and C. Baldwin, personal communication). The spatial extent of the summary was from the mouth of the Wenatchee to Lake Wenatchee, from Winthrop to the mouth of the Methow, and from Zosel Dam (Okanogan) and Enloe Dam (Similkameen) to rkm 27 in the Okanogan (the lower 27 km of the Okanogan was excluded from the analysis due to inundation from the Wells Dam pool).

The Wenatchee and Methow had a very similar quantity of weighted intrinsic potential habitat and were consistent with populations in the "large" category as designated by the ICTRT (2007; Figure 5.1). These populations would have an associated minimum abundance threshold of 1,000 spawners (Table 4.2). The Okanogan/Similkameen had approximately twice as much intrinsic potential habitat and would have been more consistent with a population in the "very large" category. The associated minimum abundance threshold for Okanogan summer/fall Chinook would be 2,000 spawners. Conservation objectives for productivity (R/S) were made by evaluating the minimum productivity needed to meet or exceed viability standards for other Chinook ESUs in the Interior Columbia Basin. We evaluated the viability curves to find minimum productivity estimates that would exceed the viability curve for minimum abundance thresholds of 1,000 and 2,000 spawners in both the Upper Columbia spring Chinook and Snake River spring/summer Chinook ESUs (ICTRT 2007; Figures 5.2 and 5.3). To be conservative we chose a productivity value that would exceed the viability standards in both of the ESUs. However, since viability curves can vary depending on age structure, variance, and autocorrelation it is possible that higher (or lower) productivity values could still meet viability standards for Upper Columbia summer/fall Chinook.

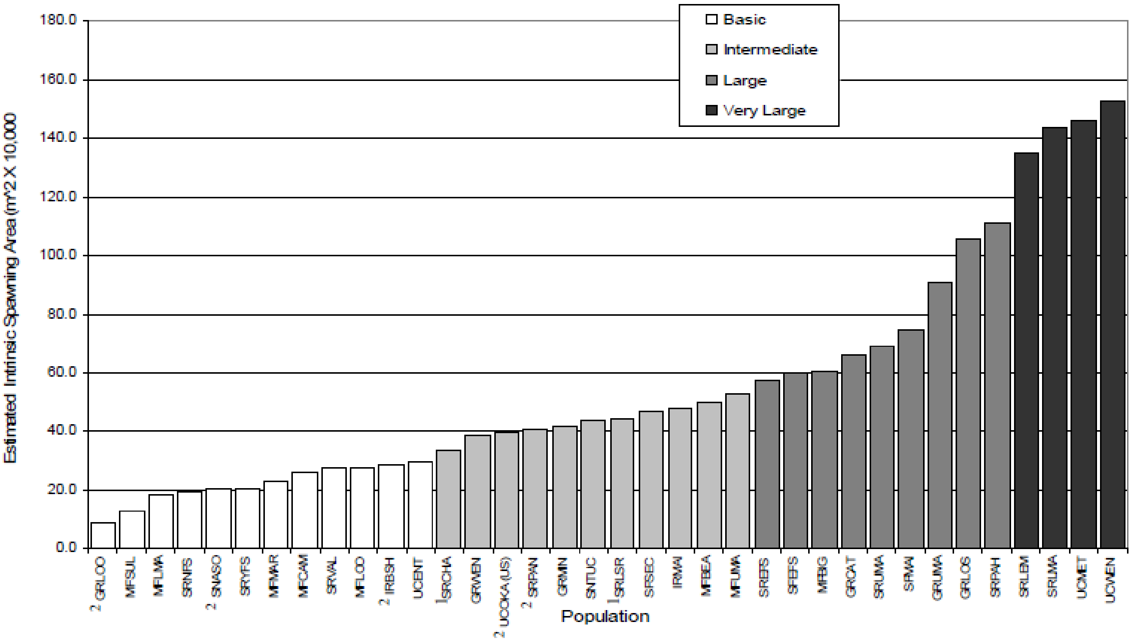
Table 5.2. Summary of intrinsic potential habitat model estimates for three populations of summer Chinook in the Upper Columbia and the abundance threshold and estimated productivity necessary to meet viability standards established for other Chinook ESUs in the Interior Columbia Basin.

MPG	**Population**	**ICTRT Intrinsic Potential Habitat**	**Minimum Abundance Threshold[1] for Viability**	**Productivity[2] (R/S)**
Upper Columbia	Wenatchee	6.05E+05	1,000	2.0
	Methow	6.11E+05	1,000	2.0
	Okanogan	1.19E+06	2,000	1.75
Hanford / Yakima[3]	Hanford Fall	?	?	?
	Yakima Fall	?	?	?
	Yakima Summer	?	?	?

[1] Estimated based on comparisons with Figure 5.1

[2] Estimated based on comparisons with Figures 5.2 and 5.3.
[3] Intrinsic potential analyses have not been generated for the Mainstem Columbia or Yakima Basin and therefore similar estimates cannot be generated for the populations in that MPG.

It is important to note that the values in Table 5.2 do not represent management objectives; rather they are a conservation minimum population size, below which the ESU may have a higher risk of becoming threatened. In section 2 of this document we present the potential management objectives that should be the basis for establishing spawning escapement goals.



[1]Abundance and productivity for these populations can be evaluated against the minimum abundance threshold for the next lowest size category level based on the amount of historical habitat in the core tributary area.
[2]Population is extirpated or functionally extirpated.

Figure 5.1. Interior Columbia Basin Stream Type Chinook populations ordered by intrinsic potential (km of weighted spawning/rearing habitat). Bar shading distinguishes the different size categories (Basic, Intermediate, Large, Very Large; Figure B-1 from Appendix C of ICTRT 2007).

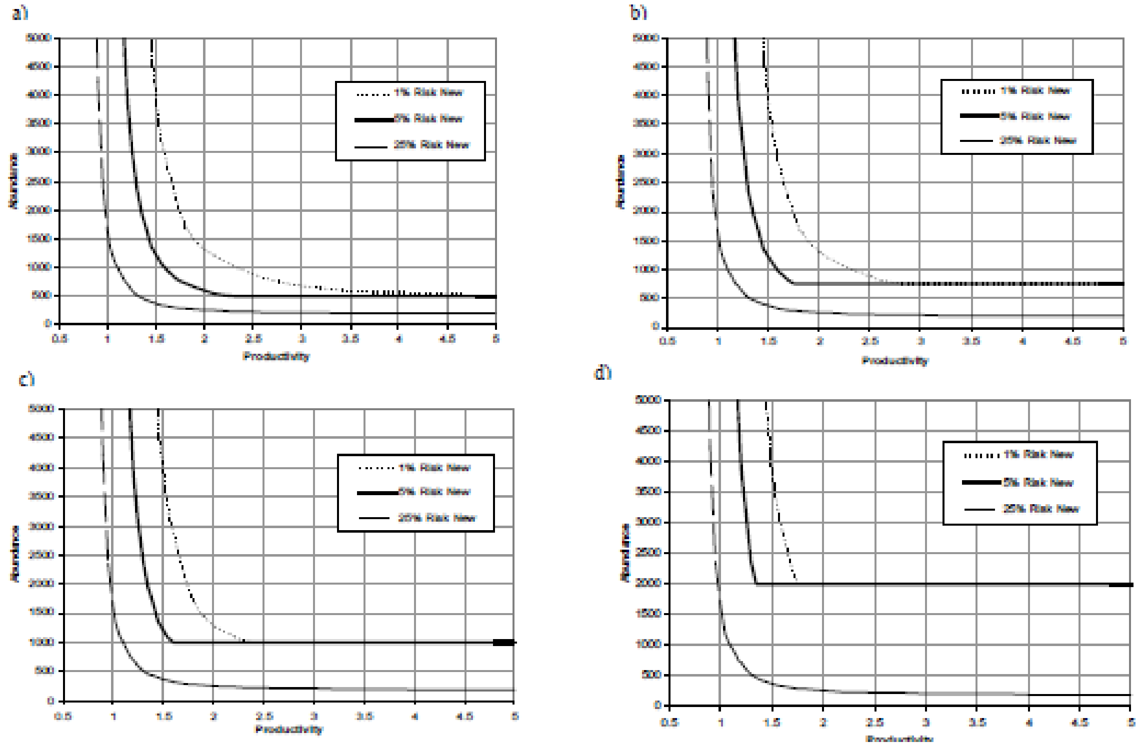


Figure 5.2. Snake R. spring/summer Chinook ESU viability curves. Variance and autocorrelation parameters used were 0.89 and 0.53, respectively. Age distribution was 0.57 age 4, 0.43 age 5. Minimum abundance thresholds are set for basic, intermediate, and large populations, respectively (Figures a-d) (Figure A-12, Appendix A from ICTRT 2007).

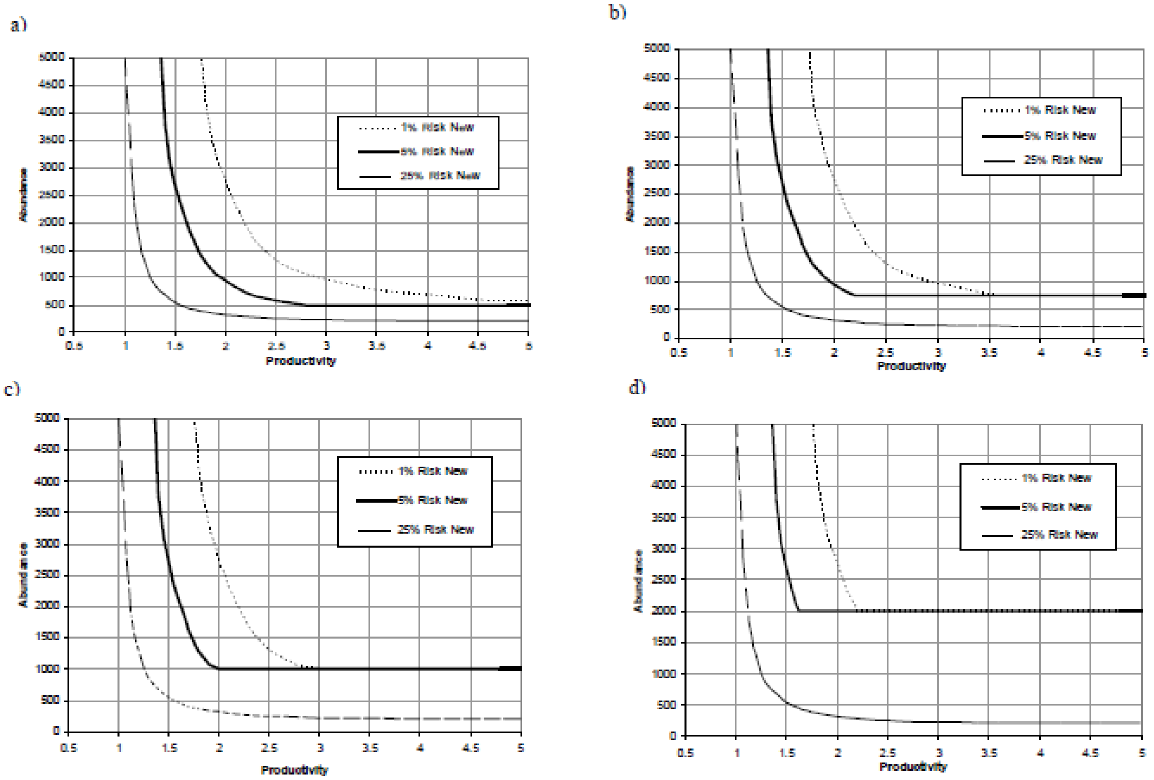


Figure 5.3. Upper Columbia Chinook ESU viability curves. Variance and autocorrelation parameters used were 0.51 and 0.68, respectively. Age distribution was 0.60 age 4, 0.40 age 5. Minimum abundance thresholds are set for basic, intermediate, and large populations, respectively (Figures a-d) (Figure A-13, Appendix A from ICTRT 2007).

5.4 MPG level spatial structure and diversity

The ICTRT emphasized the importance of spatial structure and diversity at several spatial scales. At the ESU scale it is important to have all extant MPGs viable. At the MPG scale it is important to have viable populations that cover all major life history types (diversity) and to have good geographical representation of viable populations within the MPG (spatial structure). The population designations outlined in Table 1 meet both requirements, assuming that the Yakima Fall Chinook are a Contributing population that meets the viability standards of less than 5% extinction risk in 100 years.

5.5 Population level spatial structure and diversity

Conservation objectives for spatial structure and diversity are often difficult to define quantitatively. Genetic analyses are in process by WDFW and will be important in understanding the current state of diversity within the ESU. There has been a recent shift in the proportion of returning adults that were true ocean-type juvenile migrants compared with those that were “reservoir reared” (i.e. finishing their first year of rearing in the Columbia River) (Appendix D). Understanding the mechanisms of early life history selection and survival is an information gap and the causes and consequences of this shift are not well understood (see section 7.9 for additional discussion of this uncertainty). Regardless, the maintenance of diverse life history pathways for adults and juveniles should be a priority for these populations.

Summer/fall Chinook tend to have inherently simpler spatial structure (i.e. non-branched, less patchy) than other salmonid populations. Despite the lack of a formal spatial structure analysis, we offer several recommendations related to spatial structure that can serve as conservation guidelines for specific populations. In the Wenatchee, it is important that summer Chinook continue to have access to productive spawning areas above and below Tumwater Canyon. In the Okanogan, it is important that summer Chinook continue to use spawning areas in both the Similkameen and Okanogan Rivers and that they expand their distribution into suitable habitats downstream of current spawning concentrations and into significant reconnected spawning and rearing habitats in Canada.

5.6 Changes in hatchery production

Future releases from existing programs and new programs will significantly increase abundance of hatchery origin adults and aggregate run size returning to the UCR. The following summarizes anticipated changes and new hatchery programs that are planned to occur.

5.6.1 Chief Joseph Hatchery program

At full production, the Chief Joseph Hatchery Program (CJHP) will rear and release 2 million Upper Columbia River summer/fall Chinook. The CJHP will consist of two components, a segregated, stepping-stone component releasing juveniles directly from the hatchery into the Columbia River, and an integrated conservation component releasing acclimated juveniles into the Okanogan River. The hatchery will be constructed in 2010 and 2011; broodstock collection initiated in the fall of 2011; and initial sub-yearling releases in the spring of 2012.

5.6.1.1 Segregated, stepping-stone component

At full production, this program component will initially release 500,000 yearlings and 400,000 sub-yearlings. Broodstock will be 534 hatchery-origin summer/fall Chinook collected in the Okanogan River, adults of the integrated component. Based on performance evaluation of the yearling and sub-yearling releases, the production could shift to 600,000 yearlings starting in about 2017. All juveniles will be adipose fin clipped and coded wire tagged for harvest purposes. Pending returns from the integrated conservation component, initial broodstock will be hatchery-origin adults returning from the existing Similkameen Pond program.

5.6.1.2 Integrated, conservation component

At full production, this program component will initially release 400,000 yearlings at Riverside Pond, river mile 41 on the Okanogan River; 400,000 yearlings at Omak Pond, river mile 32 on the Okanogan River; and 300,000 sub-yearlings at Omak Pond (total CJHP of 1.1 million). This production is in addition to the existing Similkameen Pond program of 576,000 yearlings. In the future, the Similkameen program will be split to release 376,000 yearlings from Similkameen Pond (river mile 3.1 on the Similkameen River) and 200,000 yearlings from Bonaparte Pond, river mile 56 on the Okanogan River.

Broodstock protocols for the CJHP integrated component and the Similkameen program should be identical, or nearly so. The Similkameen program requires 330 adults while the CJHP component requires 656 adults at full production. CJHP broodstock will initially be 100% natural-origin summer/fall Chinook returning to, and collected in, the Okanogan River. In later phases of the program, pNOB will vary from 75% to 30% depending on the abundance of natural-origin Chinook in the terminal run.

To meet criteria as a primary population, annual CJHP production will vary based on the abundance of natural-origin Chinook in the terminal run. The integrated component of the CJHP will be initiated at terminal runs of natural-origin Chinook greater than 800 and reach full production at a natural-origin run of 1,400.

Based on performance evaluation of the yearling and sub-yearling releases, the production could shift to 900,000 yearlings starting in about 2017, with sub-yearling releases eliminated.

5.6.1.3 CJHP initiation and Okanogan River Chinook management

The critical need for initiation of the CJHP and subsequent management of the Okanogan River as a primary population is sufficient escapement of natural-origin Chinook past Wells Dam and terminal fisheries. Under the CJHP to meet full production starting in 2011, a minimum escapement of 2,400 Okanogan River natural-origin Chinook would be required as follows:

Natural escapement -	1,400 NORs
Similkameen Pond Program –	330 NORs
CJHP integrated component -	656 NORs
CJHP segregated component -	534 HORs
Minimum NORs	2,386 NORs

To be able to capture these broodstock initially using live-capture, selective fishing gears will likely require an NOR escapement of nearly 5,000 Chinook.

5.6.2 Anticipated PUD obligations

The bulk of the current summer Chinook hatchery production in the Upper Columbia River Basin is conducted as partial mitigation for mainstem hydro facilities owned and operated by Public Utility Districts throughout Upper Columbia River region (Table 4.1). Most of this production will remain with a few minor changes and adjustments expected. Mitigation goals outlined in the HCP agreements that are related to achieving “no net impact” to upstream runs are reevaluated on a 10 year cycle and may be adjusted up or down related to factors such as survival through the hydro system. In 2013 the mitigation goals for the operation of Rocky Reach, and Rock Island Dams (CCPUD) as well as Wells Dam (DCPUD) are scheduled to be reevaluated. This may result in changes to summer Chinook production goals. It is likely that the production numbers for CCPUD’s hydroprojects will change substantially, since they agreed to maintain the production numbers based on previous settlement agreements and stipulations after signing the HCPs (which developed a different formula for determining production numbers). Production numbers based on mainstem survival and SARs will likely reduce the number of summer Chinook released from their facilities, although the magnitude of this change cannot be determined presently. DCPUD adjusted their numbers of fish released at the signing of the HCPs, and while their production numbers will change, it is unlikely to change to the same degree as CCPUD’s. There is an additional change in summer Chinook production that is part of the of Grant County PUD (GCPUD) obligations for the impacts of Priest Rapids Dam on Upper Columbia River summer Chinook. This change is described in the following section.

5.6.2.1 Grant County PUD programs

Grant County PUD mitigation measures are detailed in the latest FERC issued license for Priest Rapids Dam and in the Priest Rapids Salmon and Steelhead Settlement Agreement (Grant PUD et al. 2005). As part of the management of GCPUD hatchery mitigation activities these documents directed the formation of a Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC-HSC). This committee has members from each of the signatories to the agreement and oversees GCPUD implementation and evaluation of hatchery mitigation activities.

To partially meet GCPUD mitigation responsibilities the PRCC-HSC is planning the initiation of three new summer Chinook programs in the Upper Columbia River Basin. These programs have a target release goal of 834,000 yearling summer Chinook split evenly between the Wenatchee, Methow, and Okanogan River Basins. The Okanogan River portion of this obligation will be fulfilled by funding a part of the new summer Chinook production slated for the Chief Joe Hatchery Program (see section 5.6.1). Specific details for the Wenatchee and Methow program are given below:

Wenatchee River

A total of 278,000 smolts will be released into the Wenatchee River Basin. At this time facility plans have not been fully developed, GCPUD is in the design and assessment phase for out of basin hatchery facilities to be sited at Gloyd Seeps Hatchery located on Crab Creek. Other possibilities include the use of available hatchery facilities at existing State, Federal or PUD hatchery facilities. The current proposed facility locations are:

- Broodstock capture: Dryden Weir and Tumwater Dam
- Rearing: Proposed at Gloyd Seeps Hatchery located on Crab Creek
- Acclimation: Existing Dryden Acclimation Facility (Left Bank) and/or development of a new Dryden Right Bank facility.

This program will be managed as an integrated hatchery program utilizing NOR and HOR returning to the Wenatchee River. Fish will likely be reared out of basin and moved to in basin facilities for final acclimation and release as yearling smolts.

Methow River

A total of 278,000 smolts will be released into the Methow River Basin. At this time facility plans have not been fully developed, GCPUD is in the design and assessment phase for out of basin hatchery facilities to be sited at Gloyd Seeps Hatchery located on Crab Creek. Other possibilities include the use of available hatchery facilities at existing State, Federal or PUD hatchery facilities. The current proposed facility locations are:

- Broodstock capture: new Methow River weir or trapping facilities
- Rearing: Proposed at Gloyd Seeps Hatchery located on Crab Creek
- Acclimation: Carlton Acclimation Facility or development of new facilities.

This program will be managed as an integrated hatchery program utilizing NOR and HOR returning to the Methow River. Fish will likely be reared out of basin and moved to in basin facilities for final acclimation and release as yearling smolts.

5.6.3 US Bureau of Reclamation and USFWS summer Chinook salmon programs

There will be new segregated program at Entiat NFH that was initiated in brood year 2009. This program is funded by the US Bureau of Reclamation and is operated by the US Fish and Wildlife Service. The goal of this program is to compensate for lost fish production due to the construction of Grand Coulee Dam by producing summer Chinook salmon for commercial, sport and tribal harvest. This program is transitioning from an initial program of 200,000 yearling smolts released annually to a full program of around 350,000-400,000 yearling smolts. The first releases from this program are planned for spring of 2011.

5.6.4 Yakima summer Chinook

The Yakima River summer Chinook reintroduction effort was initiated in 2008. Approximately 240,000 green eggs and milt were collected from the Wells Hatchery stock producing about 200,000 sub-yearlings which were released in the Yakima River in the spring of 2009. This reintroduction effort is currently in a feasibility stage and many critical uncertainties exist. Future changes to the program will be evaluated as information becomes available. Conceptually, the program will progress through multiple phases and experience changes in broodstock source, origin (NOB vs HOB), and magnitude. Anticipated release numbers are expected to range from 200,000 to 500,000.

6.0 Potential effects of future conditions

6.1 Description of analysis

The results for PNI, pHOS and NOR escapement, and total escapement described in this report were generated using the "All H Analyzer" (AHA) analytical tool (version 13.3 single population AHA). Original inputs were taken from the HSRG data files for these populations (www.hatcheryrefrom.us) and modified according to work products from other groups (habitat and harvest) involved in this summit (see below).

The AHA tool is a Microsoft Excel-based application to evaluate salmon management options in the context of the four "Hs"—Habitat, [passage through the] Hydroelectric system, Harvest, and Hatcheries.

The AHA calculator integrates the four "Hs" using the methods described previously to estimate equilibrium natural escapement, broodstock requirements, and harvest by fishery for natural- and hatchery-origin fish. Most importantly, AHA estimates reflect a measure of hatchery influence on natural populations that is a function of both the percent hatchery-origin spawners in the natural escapement and the percent of natural-origin broodstock incorporated into the hatchery program. The assumptions underlying these fitness impacts are based on recently published work (Ford 2002, Lynch and O'Hely, 2001) and further development of these ideas by Campton, Busack, and Currens (personal communication 2002).

The AHA tool consists of a battery of interconnected modules for each H incorporating the equations described previously to estimate total recruits, escapement, and harvest for populations and hatchery programs. A critical feature of the analytical tool is the distribution of hatchery recruits to harvest, those recovered back at the point of release, and those straying to spawn in natural populations in the Columbia Basin. In turn, the number of strays to natural populations affects the degree of hatchery influence in all natural populations receiving strays, and thus the fitness, abundance, and harvest potential for each population.

The purpose of the AHA tool is to allow managers to explore the implications of alternative ways of balancing hatcheries, harvest, habitat, and hydro-system constraints in meeting conservation and harvest objectives. This tool is not used to make decisions nor to judge the "correctness" of management policies. Rather, it illustrates the implications of alternative ways of balancing the four "Hs" so that informed decisions can be made.

AHA should not be viewed as a new tool to predict habitat, harvest, or hydro effects to populations, but rather as a platform for integrating existing analyses and elucidating key assumptions. AHA makes relatively few new assumptions; instead, it brings together the results of other models, such as EDT for habitat, SIMPASS, or CRiSP for Columbia River hydroelectric passage, and others. It does not replace these other models but instead relies on them for input. AHA is thus a relatively simple, yet comprehensive, aid to regional decision making which, by incorporating the results of other models, can rapidly explore the impacts of very detailed scenarios relating to one or more of the "Hs". (Columbia River Hatchery Reform Project Final Systemwide Report, 2009 – Appendix C, Analytical Methods and Data Sources).

6.1.1 Specific modifications to data sets

Hatchery strays from outside the individual sub-basins were removed from the data sets prior to analysis. This was done to remove the uncertainty of the contribution of estimates from out of basin hatchery programs and allow for a clearer picture of the contribution of in basin hatchery returns and the status of concurrent natural populations; so pHOS estimations are minimum levels.

Three scenarios were analyzed for each population. Modification were made to the smolt to adult return rate (SAR) for each population to simulate the outcome of "Low", "Medium" and "Large" run sizes. This was done by adjusting the average estimated SAR by +/- 50%. In addition, the "Vary? (Y/N)" input was switched to "N" to prevent AHA from varying the SAR over the course of the Pacific Decadal Oscillation (PDO). This was done to achieve a single point estimate of natural and hatchery origin returns to each watershed and was felt to best represent the outcome of a single year. (Columbia River Hatchery Reform Project Final Systemwide Report, 2009 – Appendix D, AHA Users Guide).

These actions were required in order to apply exploitation rates derived from the current *U.S. v Oregon* agreement that are scaled to run sizes.

6.1.2 Specific standards used

The following standards were applied during the analysis of each natural population:

- HSRG criteria for hatchery influence on Primary populations:
    - The proportion of effective hatchery-origin spawners (pHOS) should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
    - For integrated programs, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI (proportionate natural influence) value of 0.67 or greater and pHOS should be less than 0.30.
- HSRG criteria for hatchery influence on Contributing populations:
    - The proportion of effective hatchery-origin spawners (pHOS) should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
    - For integrated programs, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of one, corresponding to a PNI value of 0.50 or greater and pHOS should be less than 0.30.
- HSRG criteria for hatchery influence on Stabilizing populations;
    - The current operating conditions are considered adequate to meet conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI. (Columbia River Hatchery Reform Project Final Systemwide Report, 2009)

1. Assumptions
    a. Ensure that harvest rates used in the model are clearly articulated (see Section 4.4.2 and Appendix C)
    b. Ocean exploitation is independent of UCR summer Chinook population size (Appendix E)
    c. All US v OR fisheries catch their full allocation, except the sport MSF above Priest Rapids Dam (see section 4.4.2).

6.2 Results

Results-Tables 6.1, 6.2, and 6.3 display the results of the AHA analysis for the Wenatchee, Methow and Okanogan, respectively. Color coding has been applied to provide a course guide to achievement of standards.

6.2.1 Wenatchee

Wenatchee- Current conditions— under current conditions of hatchery production the population does meet standards for all metrics in all years except for pHOS during low run sizes.

Wenatchee- Near term conditions—under predicted near term conditions of increased hatchery production and higher exploitation rates, the population meets all standards at large runs sizes but fails to meet pHOS standards at medium run sizes without the application of mark selective fisheries (MSF). At low run sizes, the population falls critically below the standards for pHOS and natural origin escapement (NOR), even with the application of all non-treaty fisheries in the Columbia River mark selective.

Wenatchee- Long term conditions—under predicted long term conditions of increased hatchery production and higher exportation rates, the population meets all standards at large run sizes but fails to meet pHOS standards at medium run sizes without the application of mark selective fisheries. A large increase in NOR abundance is noted as the level of mark selective fisheries are implemented. At low run sizes, none of the standards are achieved, regardless of the level of MSF employed in Columbia River non-treaty fisheries.

Table 6.1. Summary of Wenatchee AHA modeling exercise (detailed model runs are available from WDFW).

Management Scenario	**Indicator**	**Run Size at Columbia River Mouth**		
		Low	**Medium**	**High**
Current no MSF	PNI	0.72	0.77	0.79
	pHOS	39%	29%	26%
	NOR Esc.	1213	2721	4130
	ER (NOR/HOR)	56.5/56.2	69.5/68.8	73.9/73.1
Current sport & Colville MSF	PNI	0.72	0.79	0.8
	pHOS	39%	26%	22%
	NOR Esc.	1234	3062	4844
	ER (NOR/HOR)	56.2/56.4	67.3/70.2	70.9/75.1
Current all non-treaty MSF	PNI	0.72	0.81	0.84
	pHOS	38%	23%	18%
	NOR Esc.	1248	3312	5445
	ER (NOR/HOR)	56/56.6	65.7/71.6	68.4/77.2
Near-term no MSF	PNI	0.6	0.74	0.78
	pHOS	65%	35%	28%
	NOR Esc.	327	1728	3208
	ER (NOR/HOR)	65.9/65.1	75.5/74.4	77.7/76.5
Near term sport and Colville MSF	PNI	0.61	0.73	0.76
	pHOS	62%	37%	31%
	NOR Esc.	378	1708	3153
	ER (NOR/HOR)	64.7/65.4	72.1/75.8	74.0/78.0
Near term all non-treaty MSF	PNI	0.64	0.81	0.84
	pHOS	57%	23%	19%
	NOR Esc.	465	2680	4783
	ER (NOR/HOR)	64/65.7	69.4/77.1	71.1/79.4
Long term no MSF	PNI	0.53	0.74	0.78
	pHOS	87%	35%	28%
	NOR Esc.	83	1657	3158
	ER (NOR/HOR)	68.1/67.3	75.9/75.0	77.9/76.9
Long term sport and Colville MSF	PNI	0.57	0.78	0.82
	pHOS	75%	27%	22%
	NOR Esc.	184	2179	4033

Management Scenario	Indicator	Run Size at Columbia River Mouth		
		Low	Medium	High
	ER (NOR/HOR)	66.3/68.2	72.5/76.9	74.2/79.0
Long term all non-treaty MSF	PNI	0.59	0.82	0.85
	pHOS	68%	22%	18%
	NOR Esc.	257	2617	4752
	ER (NOR/HOR)	65/69.2	69.7/78.9	71.2/81.1

NOTE: Color coding is intended to provide a coarse guide to achievement of standards.

RED - well below standard
YELLOW – below standard; level of concern
GREEN - meets or exceeds standards

Standards based on Primary Population designation:
PNI: goal >0.67,
pHOS: goal < 30% for integrated; 5%< for segregated,
NOR Esc.: goal > 1,000

NOR escapement of 1,000 considered a floor for ESA viability, does not imply a target.

6.2.2 Methow

Methow current conditions— under current conditions of hatchery production the population meets all standards at large run sizes, but during medium run sizes, fails to meet the NOR standards unless mark selective fisheries are employed. At persistent low run sizes, the Methow population is predicted to be extirpated.

Methow- near term conditions—under predicted near term conditions of increased hatchery production and higher exploitation rates, the population meets all standards at large run sizes, but fails to meet all standards at medium run sizes unless MSF are employed. The application of MSF allows PNI and pHOS standards to be meet at medium run sizes, but NOR escapement is still below the standard. At persistent low run sizes, the Methow population is predicted to be extirpated.

Methow- long term conditions—under predicted long term conditions of increased hatchery production and higher exportation rates, the population meets all standards at large run sizes but fails to meet any of the standards at medium run sizes unless MSF are employed. As was seen under near term conditions, while application of MSF allowed the PNI and pHOS standards to be achieved, the NOR abundance fell below the standard even with the application of the most aggressive MSF scenario analyzed. At persistent low run sizes, the Methow population is predicted to be extirpated.

Table 6.2. Summary of Methow AHA modeling exercise (detailed model runs are available from WDFW).

Management Scenario	**Indicator**	**Run Size at Columbia River Mouth**		
		Low	**Medium**	**High**
Current no MSF	PNI	0	0.56	0.57
	pHOS	0%	20%	19%
	NOR Esc.	62	863	2043
	ER (NOR/HOR)	46.6/46.4	60.0/59.1	64.4/63.5
Current sport & Colville MSF	PNI	0	0.62	0.62
	pHOS	0%	15%	15%
	NOR Esc.	69	1167	2569
	ER (NOR/HOR)	46.4/46.6	57.5/60.5	61.1/65.5
Current all non-treaty MSF	PNI	0	0.66	0.66
	pHOS	0%	13%	13%
	NOR Esc.	77	1361	2975
	ER (NOR/HOR)	46.2/46.7	55.9/61.9	58.6/67.5
Near-term no MSF	PNI	0	0.38	0.52
	pHOS	0%	42%	23%
	NOR Esc.	1	260	1503
	ER (NOR/HOR)	56.4/55.4	66.0/64.8	68.2/66.9
Near term sport and Colville MSF	PNI	0	0.53	0.6
	pHOS	0%	23%	16%
	NOR Esc.	1	617	2130
	ER (NOR/HOR)	54.9/55.8	62.3/66.1	64.2/68.4
Near term all non-treaty MSF	PNI	0	0.62	0.65
	pHOS	0%	15%	13%
	NOR Esc.	1	970	2595
	ER (NOR/HOR)	54.2/56.1	59.6/67.4	61.3/69.8
Long term no MSF	PNI	0	0.36	0.52
	pHOS	0%	44%	23%
	NOR Esc.	1	234	1477
	ER (NOR/HOR)	58.5/57.7	66.4/65.4	68.4/67.3
Long term sport and Colville MSF	PNI	0	0.52	0.61
	pHOS	0%	23%	16%
	NOR Esc.	1	571	2182
	ER (NOR/HOR)	56.5/58.6	62.7/67.3	64.4/69.4
Long term all non-treaty MSF	PNI	0	0.63	0.66
	pHOS	0%	15%	13%
	NOR Esc.	1	949	2603

Management Scenario	Indicator	Run Size at Columbia River Mouth		
		Low	Medium	High
	ER (NOR/HOR)	55.2/59.5	59.9/69.2	61.4/71.5

NOTE: Color coding is intended to provide a coarse guide to achievement of standards.

RED - well below standard
YELLOW - below standard; level of concern
GREEN - meets or exceeds standards

Standards based on Contributing Population designation:
PNI: goal >0. 50
pHOS: goal < 30% for integrated; 5%< for segregated,
NOR Esc.: goal > 1,000

NOR escapement of 1,000 considered a floor for ESA viability, does not imply a target.

6.2.3 Okanogan

Okanogan current conditions— under current conditions of hatchery production the population fails to meet all standards even at large run sizes unless MSF are employed and then only at medium and large run sizes. During low run sizes, without MSF, the NOR abundance falls well below the established standards.

Okanogan- near term conditions—under predicted near term conditions of increased hatchery production and higher exploitation rates, the population fails to meet any standards without the application of MSF and values for each metric are well below those seen in the current scenario (above) under the no MSF analysis. At medium run sizes, the application of MSF allows for the PNI standards to be met and the "all non-treaty" MSF option allows for the pHOS standards to be achieved, but NOR abundance is still significantly low. At low run sizes, none of the population standards can be achieved using the MSF analyzed.

Okanogan- long term conditions—under predicted long term conditions of increased hatchery production and higher exploitation rates, the population fails to meet any standards without the application of MSF. The values for each metric are similar to those seen in the near term scenario (above) under the "no MSF" analysis. At medium run sizes, the application of MSF allows for the PNI standards to be met and the "all none treaty" MSF option allows for the pHOS standard to be achieved, but NOR abundance is still low. At low run sizes, none of the population standards can be achieved, using the MSF analyzed.

Table 6.3. Summary of Okanogan AHA modeling exercise (detailed model runs are available from WDFW).

Management Scenario	Indicator	Run Size at Columbia River Mouth		
		Low	Medium	High
Current no MSF	PNI	0.59	0.6	0.61
	pHOS	48%	47%	44%
	NOR Esc.	838	1073	1467

Management Scenario	Indicator	Run Size at Columbia River Mouth		
		Low	Medium	High
	ER (NOR/HOR)	61.9/59.8	79.3/75.3	84.2/79.9
Current sport & Colville MSF	PNI	0.65	0.77	0.82
	pHOS	38%	21%	15%
	NOR Esc.	1132	2496	3982
	ER (NOR/HOR)	56.5/63.6	67.9/82.2	71.4/87.7
Current all non-treaty MSF	PNI	0.65	0.79	0.86
	pHOS	38%	19%	11%
	NOR Esc.	1144	2728	4487
	ER (NOR/HOR)	56.3/63.8	66.2/83.6	69.0/89.8
Near-term no MSF	PNI	0.42	0.49	0.52
	pHOS	96%	73%	64%
	NOR Esc.	24	263	500
	ER (NOR/HOR)	77.7/72.5	86.7/81.5	89.9/84.3
Near term sport and Colville MSF	PNI	0.58	0.7	0.73
	pHOS	51%	33%	19%
	NOR Esc.	435	829	2774
	ER (NOR/HOR)	65.4/76.7	72.7/86.6	74.7/89.7
Near term all non-treaty MSF	PNI	0.53	0.79	0.79
	pHOS	49%	20%	17%
	NOR Esc.	576	1423	3257
	ER (NOR/HOR)	64.7/77.1	70.1/87.9	71.8/91.1
Long term no MSF	PNI	0.41	0.49	0.53
	pHOS	99%	74%	62%
	NOR Esc.	4	243	533
	ER (NOR/HOR)	78.5/74.1	86.8/82.1	89.6/84.6
Long term sport and Colville MSF	PNI	0.54	0.69	0.73
	pHOS	60%	34%	19%
	NOR Esc.	259	932	2752
	ER (NOR/HOR)	66.9/80.0	73.1/89.2	74.8/92.3
Long term all non-treaty MSF	PNI	0.57	0.77	0.8
	pHOS	54%	22%	12%
	NOR Esc.	313	1425	3431
	ER (NOR/HOR)	65.6/80.9	70.3/91.1	71.9/94.3

NOTE: Color coding is intended to provide a coarse guide to achievement of standards.

RED - well below standard
YELLOW - below standard; level of concern

Management Scenario	Indicator	Run Size at Columbia River Mouth		
		Low	Medium	High
GREEN - meets or exceeds standards Standards based on Primary Population designation: PNI: goal >0.67 pHOS: goal < 30% for integrated; 5%< for segregated NOR Esc.: goal > 2,000 NOR escapement of 2,000 considered a floor for ESA viability, does not imply a target.				

7.0 Critical uncertainties and M&E needs to address them

There are currently many uncertainties regarding UCR summer/fall Chinook. In this section, we attempt to outline what those uncertainties are and potential methods to obtain the information needed.

7.1 Pre-spawning mortality

7.1.1 Summary of issue and existing information

Counts past mainstem dams on the Columbia River offer an index of the number of fish escaping in a given year. Many of the fish that are counted passing mainstem dams in the Upper Columbia are not accounted for during subsequent spawning ground surveys and fisheries. As an example, between 1989 and 2008, an average of 49.8% of the summer and fall run Chinook salmon (adults and jacks) passing Wells Dam were not accounted for in the Methow and Okanogan Basin spawning ground surveys (Figure 7.1).

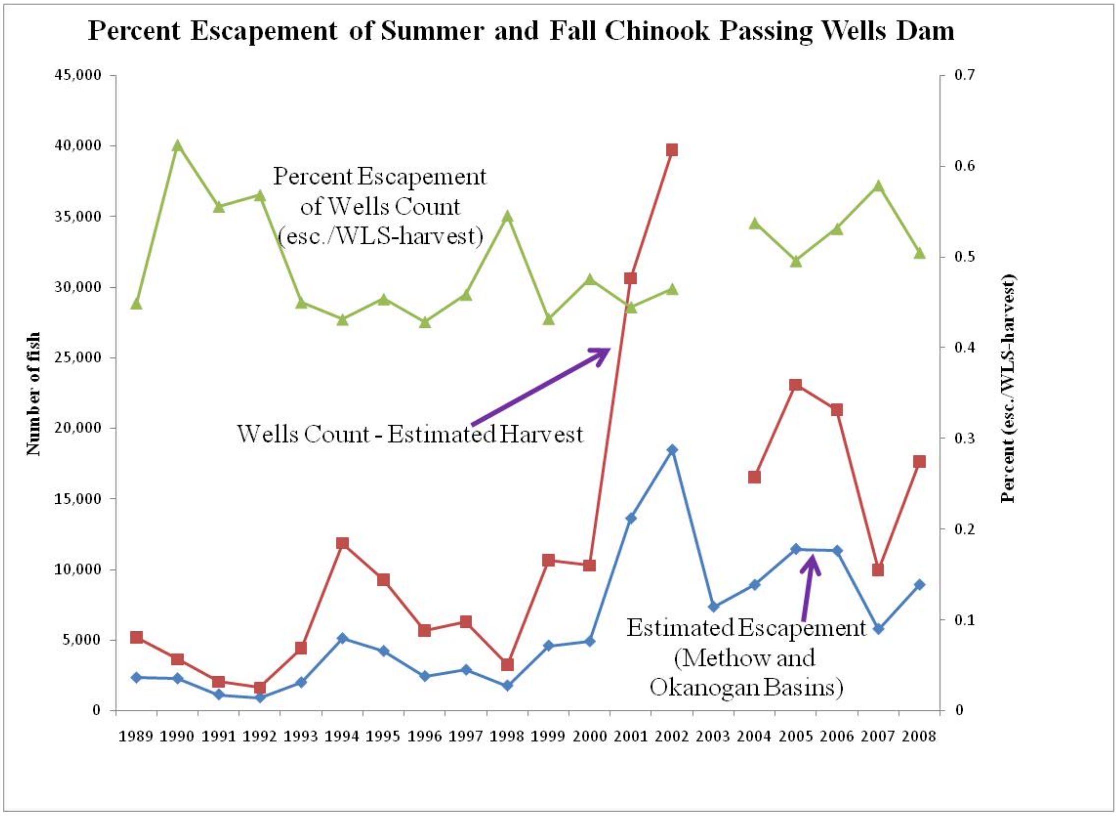


Figure 7.1. The estimated escapement of summer/fall Chinook upstream of Wells Dam compared to Wells Dam counts (estimated harvest numbers taken from Hillman et al. (2009) for 1989-2002 and from various creel surveys from 2004-2008 (Viola, personal communication).

There are various reasons why this discrepancy may exist:

- High pre-spawner mortality;
- Inaccuracies of dam counts, including overlapping of runs;
- Inaccuracies of redd counts;
- Inaccuracies in harvest estimation;
- Inaccuracies of escapement estimation, and
- High spawning activity in the mainstem Columbia River.
- Increasing passage into Canada

7.1.2 High pre-spawner mortality

There is a real possibility that a large segment of the late-run Chinook salmon population may be dying prior to spawning. These fish pass the UC mainstem dams beginning in June and hold over the summer primarily in the mainstem Columbia River prior to spawning beginning in late September. Many Chinook enter the Okanogan River at high water temperatures and may succumb prior to spawning. This time period coincides with the warmest water temperatures, which increases stress on the fish.

7.1.3 Inaccuracies of dam counts

Review of dam counts for different species routinely shows that some dams have higher counts for a specific species/race of fish than the dam that is sequentially downstream. As such, dam counts should be used primarily as indexes, and caution should be used when dam counts are to be utilized in any type of quantitative analysis. The inaccuracies can also be due to the artificial time limits to which managers allocate Chinook to the three race runs (spring, summer and fall).

7.1.4 Inaccuracies of redd counts

In general, it is reasonable to assume that most redds are visible for summer Chinook salmon because they occur during times of low, clear water. However, in some areas (parts of the Wenatchee and Similkameen rivers), the density of redds is extremely high and superimposition may occur, which makes accurate counting difficult. In addition, in some years, freshets cause the tailing end of the spawning impossible to see.

7.1.5 Inaccuracies of escapement estimation

Current methods used in the UC derive a sex ratio from broodstock capture and multiply that to the redd counts to estimate escapement. This methodology may or may not be accurate, but the accuracy has not been estimated.

7.1.6 High spawning activity in the mainstem Columbia River

Another potential account of the fish that are missing is that they are spawning in deep areas of the mainstem Columbia River, historical spawning habitat that is now inundated.

7.1.7 Potential solutions (additional data needs)

We recommend that the first part of determining management actions would be to determine if there is truly a problem with pre-spawning mortality. Efforts to increase our understanding of potential spawning sites that are currently unknown would increase our knowledge of spawning distribution and would most likely explain some of the “losses” that we currently see. A collaborative effort, for example with the USFWS, to use their underwater video counting equipment to scan what are believed to be historic spawning areas in the mainstem Columbia would be a good first step.

In addition, the use of an active tag study (acoustic tags may allow us better resolution than a radio tag study) to determine exactly where fish are ending up should be investigated if initial searches for fish on historical spawning grounds is not successful.

Additional information will also be gained from additional PIT tagging and installation of remote detection weirs in the tributaries. The proposed weir on the Okanogan River by the CCT will also increase recapture of fish ascending the Okanogan.

In addition, validation of redd counts and escapement estimates need to occur (regardless of the issue of pre-spawning mortality).

If there are issues with pre-spawning mortality, then additional research may be warranted to understand the mechanisms that cause the mortality before management actions can be recommended.

7.2 Population size of Upper Mainstem “population” and spawning distribution and their relationship to tributary populations

7.2.1 Summary of issue and existing information

As previously stated, there is consistently a large proportion of the run escapement above Wells Dam that does not show up on the spawning grounds or estimated harvest in the Methow and Okanogan. Some of this difference may be due to pre-spawn mortality, but Ashbrook et al. (2008) found that 41% of the NOR fish that passed Wells Dam did not ascend into the Methow or Okanogan (see Figure _) and they hypothesized that there could be some mainstem spawning areas between the Okanogan and Chief Joseph Dam.

There is uncertainty regarding whether or not fish in this area are currently able to reproduce successfully, although the Ashbrook data (41% of NOR Chinook stay in the mainstem river) would indicate such. There is uncertainty as to whether fish in the mainstem constitute a separate reproductive unit, how much gene flow there is with the tributary populations, and how much gene flow there is between areas of the mainstem, or if there is any unique genetic substructure of fish in the mainstem.

7.2.2 Potential solutions (additional data needs)

7.2.2.1 Understanding of historical distribution

Spawning ground surveys of the Columbia River showed extensive spawning activity in the mainstem between the Chelan River and Grand Coulee Dam before the completion of Chief Joseph (1955) and Wells (1967) dams (Fish and Hanavan 1948; Meekin 1963). Between 1957 and 1966, an average of 561 redds (1959 survey not included because of poor visibility) were observed between the Wells Dam site and Chief Joseph Dam (Horner and Bjornn 1979).

The Columbia River in the vicinity of the confluence of the Okanogan River and Washburn Island was considered to be the most important area of naturally spawning summer/fall Chinook salmon upstream of Rock Island Dam prior to inundation from Wells Dam in 1967 (French and Wahle 1965; Meekin et al. 1966; Meekin 1967; Chelan PUD 1966).

The ICTRT used an intrinsic potential analysis to evaluate the quantity and quality of spawning habitat in the Snake River for fall Chinook. If this method was initiated in the UCR, it would require some technical analyses to define potential gravel recruitment sites based on historical island complexes, unconfined areas, and pre-inundation sinuosity.

We need a better understanding of where fish are spawning and what proportion of the run escapement does not enter a tributary throughout the Upper Mainstem. Once potential spawning locations are identified then studies can be conducted to estimate the quantity of available spawning habitat.

Efforts to increase our understanding of potential spawning sites that are currently unknown would increase our knowledge of spawning distribution. A collaborative effort, for example with the USFWS, to use their underwater video counting equipment to scan what are believed to be historic spawning areas in the mainstem Columbia would be a good first step.

In addition, the use of an active tag study (acoustic tags may allow us better resolution than a radio tag study) to determine exactly where fish are ending up should be investigated if initial searches for fish on historical spawning grounds is not successful.

This study could also add to our knowledge about MPG and population spatial structure and diversity. Ashbrook et al. (2008) was a very good start towards this kind of analysis but was limited spatially (only above Wells Dam) and temporally (only 1 year). Information can be gained regarding:

- Populations boundaries
- Spatial structure
- Run/spawn timing
- Stray rates
- Pre-spawn mortality
- Redd distribution

7.2.2.2 Gene flow between segments of the populations

If spawning areas were/are associated with tributary gravel deposits then it is likely that there was more gene flow with the tributary population than between areas in the mainstem. If that was/is the case then the mainstem should not be separated into a distinct population.

- The current situation should become clearer as details are available on genetics of UC summer/fall Chinook.
- Additional studies examining spawner movement will help define: the current distribution for fish that do not spawn in a tributary, stray rates between populations, spatial structure, and life history characteristics such as run timing versus spawn timing.
- An intrinsic potential analysis, similar to the ICTRT analysis in the Snake River could help define where likely spawning areas were historically and how extensive it might have been. This would help define the historic spatial complexity and perhaps inform us about the possibility of an independent population versus some patchy groups of spawners that were not necessarily independent populations.

7.3 Determine tools, feasibility, and requirements for indicator stocks of the Pacific Salmon Treaty (PST). Evaluate if one or more wild stocks should be an indicator stock under the PST.

7.3.1 Summary of issue and existing information

One of the major concerns raised during the summer Chinook Summit was that the upcoming Chief Joseph Hatchery, Yakima, Entiat and Chelan River production programs would increase the harvest rate in the Columbia River and overall exploitation rate of the wild stocks. Currently, ocean exploitation averages 42% with future predictions going as high as 80% for total exploitation rate once all the Columbia River harvest is included. There is concern that the wild populations would not be able to sustain themselves with such high exploitation. Currently, the Wells hatchery stock is the indicator stock for the UC. Questions have arisen on whether the Wells hatchery stock is really representative of the wild stocks. The question was raised that perhaps one or more of the natural origin UC stocks would be a better candidate as an "indicator stock" for the PST.

In addition, as previously described, there is a portion of the UCR summer/fall Chinook that is not accounted for on the spawning grounds and may be spawning in the mainstem Columbia River. This could also affect the exploitation rates by artificially inflating the estimated number of fish not reaching the spawning grounds, and subsequent total exploitation rates.

7.3.2 Potential solutions (additional data needs)

7.3.2.1 Additional information about indicator stocks is needed, such as:

What are the implications for designating an indicator stock?
Answer: we will get harvest, exploitation, and ocean distribution for the wild stock. May not gain much if we use CJH fish since Wells is already a hatchery indicator stock.

What are the monitoring and tagging requirements?
Answer: tagging is generally implemented as double index tagging (DIT) with a minimum of 200k for each group (CWT clipped versus CWT unclipped)(not sure this makes sense for our wild stock). We also need to have the tag recovery tools for local escapement such as weirs, carcass recoveries, etc. If we decide to move forward with it a workgroup will need to evaluate tagging and tag recovery options. Good escapement estimates are required. We do have a good composite estimate of wild returns based on dam counts, but tag recovery would be biased to the tributaries because carcass surveys would be our primary method of tag recovery (I'm not clear of the implications of that bias). I assume that we would have to treat the whole UC wild summers as a composite stock in order to mark enough fish.

Is there PST funding available to pay for the increased tagging and M&E?
Answer: If the CTC (Chinook Technical Committee) is convinced it is critical there could be some start up money via letter of agreement (LOA), but there must be long-term local commitment to the marking program.

Do we have the tools to make it an indicator stock?
Answer: Part of the effort to determine if it is feasible (see ii above) would be to estimate the number of smolts handled at each smolt trap and their size to determine if we could mark 200 k wild fish. Perhaps mainstem seining or other methods down through Wanapum could be employed to mark fish as they grow during migration (or to mark the reservoir-rearing fish). BPA and/or the PUDs would have to fund the long-term tagging program and the additional recovery efforts that would be needed.

Summary thoughts based on several e-mails and phone conversations: Becoming an official "indicator stock" of the PST is generally not something you just start up from scratch with a wild stock. For example, it takes at least 2 complete brood cycles of tag return information in order for the Chinook Technical Committee (CTC) to use information from an indicator stock. There are other "escapement CWT indicator groups" that are often wild stocks of particular interest and concern. We may want to put together a research project that evaluates the feasibility of using CWT for marking and recovering UC wild summer Chinook and utilize the CWT recovery program associated with the PST to answer the question regarding how representative the Wells indicator stock is for the wild population(s).

7.4 Adult management needs

7.4.1 Summary of issue and existing information

7.4.1.1 Management of hatchery and natural origin escapement

A number of recent studies on the impact of hatchery programs on natural populations have highlighted the need to control the escapement of hatchery adults into natural spawning areas (insert citations e.g. Chilcote et al. 1986, Chilcote 2003; Araki et al. 2008). To minimize the deleterious impact of hatchery over-escapement the Hatchery Scientific Review Group has provided a set of recommendations for both segregated and integrated hatchery programs. For reference these are summarized and provided in Table 7.1 (HSRG 2009 System-wide Report):

Table 7.1. Management guidelines for the operation of segregated and integrated hatchery programs in relation to conservation goal of the natural population (i.e. Primary, Contributing, Stabilizing populations).

Program Type	pNOB	pHOS	PNI
Segregated-Primary	≈0	<0.05	NA
Segregated-Contributing	≈0	<0.1	NA
Segregated-Stabilizing[1]			
Integrated-Primary	pNOB≥2·pHOS	<0.3	≥0.67
Integrated-Contributing	pNOB>pHOS	<0.3	≥0.50
Integrated-Stabilizing[1]			

[1] The HSRG assumed that current management guidelines would be maintained and were sufficient.

The ability of summer Chinook salmon hatchery programs in the Wenatchee, Methow and Okanogan basins to meet these guidelines is limited by available infrastructure and differs between the three basins. To illustrate this discrepancy data reported by Hillman et al (2009) are summarized in Table 7.2:

Table 7.2. The most recent 12 year mean (±SE) pHOS, pNOB, and PNI for summer Chinook salmon hatchery programs in major tributaries of the Upper Columbia River basin. Averages are calculated from data presented in Hillman et al. (2009) for brood years 1995 to 2006. The designation of population status (i.e. primary, contributing, stabilizing) is as proposed elsewhere in this document.

Basin	**Proposed Program type**	**pHOS**	**pNOB**	**PNI**
Wenatchee	Integrated-Primary	0.17±0.02	0.86±0.05	0.83±0.03
Methow	Integrated-Contributing	0.38±0.03	0.59±0.07	0.59±0.04
Okanogan	Integrated-Primary	0.53±0.05	0.59±0.07	0.51±0.05

The success of hatchery programs in the Wenatchee basin to meet HSRG management guidelines is largely based on the relative health of the natural population in the Wenatchee basin. Since spawning ground surveys began in the late 1950s, the overall trend in the natural population has been increasing. The ability to control adult escapement at fishways located in the basin at Dryden and Tumwater dams also aids in managers' ability to control pHOS. Natural productivity in the Methow and Okanogan has not been as good as in the Wenatchee, and subsequently pHOS has been greater in these basins, which ultimately leads to a lower PNI value. In addition, the type of infrastructure available in the Wenatchee is absent from the Methow and Okanogan basins which reduces managers' ability to control pHOS.

The judicious use of selective fisheries in the Upper Columbia River Basin could be used as an additional tool for the management of hatchery escapement. The Confederated Tribes of the Colville Reservation are actively investigating new and innovative ways to operate selective fisheries within the Mainstem Columbia River below Chief Joseph Dam (M. Rayton, in press). These methods may provide an additional tool (alongside selective hook and line fisheries) to help manage the escapement of hatchery origin adults into tributaries of the Upper Columbia River Basin.

7.4.1.2 Broodstock collection and stock composition

Broodstock collection in the Wenatchee basin is conducted in-basin at fishways located at Dryden and Tumwater Dam; this is converse to the situation in the Methow and Okanogan basins where broodstock collection occurs in the mainstem Columbia River at Wells Dam. Broodstock collected at Wells Dam are a composite of Methow and Okanogan origin resulting in a loss of population structure and diversity.

The practice of compositing brood at Wells Dam is identified as a key management shortcoming by the HSRG (2009) and efforts to shift brood collection to in-basin sites were recommended. Furthermore this shift is key requirement for meeting HSRG guidelines for the operation of hatchery programs integrated with natural populations designated as having either Primary or Contributing conservation goals.

7.4.2 Potential solutions (additional data needs)

As hatchery production in the Upper Columbia River Basin increases in the coming years the ability to effectively manage hatchery fish on the spawning grounds and meet HSRG management guidelines will be increasingly difficult. Because of the lack of infrastructure in the Methow and Okanogan basins this will be especially challenging for hatchery programs located above Wells Dam. Though selective fisheries may play an important role in helping manage HOR escapement, the installation and operation of weirs for the management of adults in the lower Methow and Okanogan River basins is likely the most effective way to fully address this need. Accomplishing this task will require a collaborative effort between all of the stakeholders including fishery co-managers, hatchery operators, regulatory entities (especially those charged with ESA enforcement), local watershed councils, as well as County and local governments. This process could take years to complete and individuals and concerned agencies need to a more active leadership role if this issue is to be fully addressed. The Colville Tribes are currently at 50% design stage for a proposed weir in the Okanogan River to be used for broodstock collection, harvest, RM&E, and managing pHOS.

7.5 There is a lack of detailed information concerning the genetic population structure of summer Chinook salmon populations in the Upper Columbia. The HSRG recommended that managers investigate this issue.

7.5.1 Summary of issue and existing information

Utter (1993) considered the summer-run and fall-run Chinook salmon of the main Columbia River to consist of one evolutionarily significant unit (ESU) from the Hanford Reach through upriver areas, based on biochemical genetic traits. Thus, the summer/fall unit would include fish that managers have termed *upriver bright fall Chinook* (URB) and *summer Chinook* that spawn as far upstream as the middle reaches of the Wenatchee River, Methow River, and the lower Similkameen River. A few summer/fall Chinook spawn in the Okanogan, Chelan, and Entiat rivers. The downstream limit of the ESU was considered by Utter to lie at the lower end of the Hanford Reach, in absence of evidence that might distinguish fish in the lower Hanford Reach from those in the upper portion. We conclude that hatchery operations since the 1940s effectively reduced the likelihood that separate evolutionarily significant units (ESUs) exist in the summer/fall Chinook salmon of the mid-Columbia River.

Waknitz et al. (1995) in their review of the existing genetic information at the time concluded that there was a close genetic relationship between summer and fall run fish from the Hanford Reach throughout the tributaries upstream from there where late-run Chinook spawn. For example, citing Marshall (1993), genetic samples from the Wenatchee River, Wells Hatchery, and the Similkameen River were not significantly different from one another. Further, Priest Rapids Hatchery fish were not significantly different from the Hanford Reach, Wells Hatchery, or the Similkameen River samples, and it differed only slightly from the Wenatchee River samples. Other researchers found similar results (Schreck et al. 1986; Utter et al. 1987; Hershberger et al. 1988.

7.5.2 Potential solutions (additional data needs)

Regardless of the previous work that has been done, additional samples have been taken in more recent years as part of the hatchery evaluation program of the PUDs. Additional results from an analysis of these samples should be available in 2010 (H. Bartlett, personal communication).

In addition, if the information is available, specific samples from mainstem spawners should be analyzed.

7.6 Hatchery summer Chinook released from Carlton have a considerably lower SAR than fish released from other programs. Why?

7.6.1 Summary of issue and existing information

Summer Chinook acclimated and released in the Methow River Basin (Carlton Pond) have had consistently lower smolt to adult ratios (SAR) as compared to fish from the same stock that are acclimated and released in the Okanogan River Basin (and from the Wenatchee Basin). What is the explanation for this discrepancy?

Summer Chinook salmon are reared and released into both the Methow and Okanogan basins as partial fulfillment of Chelan and Douglas County PUDs mitigation requirements for the operation of Rocky Reach and Rock Island Dams. Broodstock for both programs are collected as a composite broodstock at Wells Dam and have in recent years been mostly of natural origin. Spawning, incubation and hatchery rearing for both programs occurs at Eastbank Fish Hatchery. Fish destined for Okanogan releases are transferred in the fall to Similkameen Pond for over winter acclimation (150-200 days) and volitional release. Methow releases are not acclimated over winter but are instead transferred to Carlton Pond in the early spring prior to release and are acclimated for around 30-50 days. Both programs release yearling smolts, with a release goal in the Methow of 400,000 fish, and a release goal in the Okanogan of 576,000 fish.

Overwinter acclimation is not possible at Carlton Pond due to an inability to control for freezing conditions at the water intake and subsequent loss of flow. Since Methow fish are held in the hatchery over winter they can more easily be treated for BKD and other disease occurrences. The formation of ice on the surface of Similkameen Pond prevents disease treatment and monitoring activities. To best manage for BKD, fish with the lowest prevalence of the pathogen have been selectively used for the Okanogan program, whereas the Methow program has received higher prevalence juveniles.

Despite the many similarities between the Methow and Okanogan releases, adult return rates have consistently differed between the programs with the Okanogan releases having a markedly higher SAR as compared to the Methow releases (Table 7.3). This is despite the fact that hatchery survival is considerably lower for fish in the Okanogan program as compared to hatchery survival rates seen for Methow program fish (Table 7.4).

Table 7.3. Smolt to Adult ratios (SAR) for summer Chinook salmon acclimated and released in the Methow and Okanogan River Basins. Both hatchery programs use the same broodstock source and hatchery rearing occurs at Eastbank Fish Hatchery. Data is taken from Hillman et al. (2009).

Brood Year	**SAR-Methow**	**SAR-Okanogan**	**Magnitude Different**
1989	0.00804	0.02126	2.64
1990	0.00099	0.00265	2.68
1991	0.00034	0.00271	7.97
1992	0.00035	0.00428	12.23
1993	0.00031	0.00031	1.00
1994	0.00174	0.00703	4.04
1995	0.00061	0.00495	8.11
1996	0.00025	0.00006	0.24
1997	0.00169	0.03271	19.36
1998	0.01892	0.02640	1.40
1999	0.00008	0.00452	56.50
2000	0.00229	0.01277	5.58
2001	0.00359	0.01596	4.45
2002	0.00188	0.00797	4.24
Average	*0.00293*	*0.01026*	*3.50*

Table 7.4. Hatchery survival rates (egg to release) for summer Chinook salmon reared at Eastbank Fish Hatchery and acclimated and released into the Methow and Okanogan River Basins. Data was taken from Hillman et al. (2009).

Brood Year	**Methow**	**Okanogan**
1989	87	48.7
1990	84.4	77.6
1991	92.2	76.8
1992	82.8	75.2
1993	81.5	73.5
1994	68.3	60.1
1995	71.9	79.7
1996	66.7	75.6
1997	95.9	98
1998	52.7	50.2
1999	87.7	86.9
2000	83.5	82.5
2001	89	6.4
2002	85.7	54.1
2003	74.9	81.5
2004	74.6	80.2
2005	86.2	81.8
2006	82.4	79.8
Average	*80.4*	*70.5*

There appear to be at least two factors that differ between the two programs that may explain the observed differences in SAR. Given that fish used for the Methow program have consistently had a higher prevalence of BKD than the Okanogan program it is reasonable to assume that the difference in SAR is likely due to increased mortality due to BKD occurrence. Another contributing factor may be the difference in acclimation time and conditions between the two basins.

7.6.2 Potential solutions (additional data needs)

It is recommended that the HCP hatchery committee implement changes to the summer Chinook program for Carlton Ponds. This could be accomplished when new HGMPs are developed within the next year or two. These changes could include:

- Reduce or eliminate the use of medium to high prevalence of the BKD pathogen fish at the Carlton site,

- Investigate options for alternative rearing that would increase the amount of time the fish are in the Methow Basin,

- Initiate comparative studies to increase our understanding of the potential factors that affect SAR between to the two programs.

7.7 Juvenile life history pathways

7.7.1 Summary of issue and existing information

7.7.1.1 Ocean and reservoir rearing strategies.

The great majority of natural origin summer Chinook salmon depart their natal tributaries as subyearling migrants. A portion of these complete their first year of juvenile rearing within the reservoirs of the Columbia River, whereas others emigrate to the ocean as a subyearling. The proportion of fish that chose these two different life history pathways have not been consistent over time, including a recent shift in the proportion of adults that were subyearling migrants versus those that were reservoir reared (Appendix D) (WDFW unpublished data). The biotic and abiotic factors that are critical to determining juvenile life history pathways in Upper Columbia River summer Chinook salmon is largely unknown at this time. The proportion of the population expressing each life history pathway is based on scale analysis of returning adults. Therefore, we do not know what proportion of each smolt migration attempts each pathway or the respective mortality rates for each pathway. Likewise, little is known about the mechanisms that drive the selection and success of each juvenile life history pathway. Answers to these uncertainties could lead to restoration or management efforts that would increase survival of natural origin summer Chinook.

7.7.2 Potential solutions (additional data needs)

A study needs to be designed and conducted to determine the proportion of juveniles that attempt each juvenile life history pathway. Then, in conjunction with the adult sampling already in place, we can determine differential survival rates and form hypothesis regarding limiting factors and potential restoration or management strategies to improve survival.

7.7.2.1 Differentiating between subyearling spring and summer Chinook salmon emigrants

In general, the juvenile migration life history of spring Chinook is a yearling smolt whereas summer Chinook are predominately a subyearling smolt. However, a portion of the natural origin spring Chinook salmon in the Upper Columbia River Basin migrate out of their natal tributary as subyearlings and rear in the mainstem reservoir until (presumably) migrating to the ocean in the following spring as yearling smolts. Juvenile emigration from natal streams is typically monitored using either PIT tag technology or collection in a rotary screw trap.

Typically, in the Upper Columbia basin, yearling emigrants are considered to be spring Chinook salmon and sub-yearling smolts are summer/fall Chinook salmon. For yearling fish this assumption is largely valid as only a small percentage of juvenile summer Chinook emigrate as yearlings (Figure B1) from tributaries. Early in the year, distinct morphological differences between yearling spring Chinook and sub-yearling summer Chinook make identification relatively easy. Spring Chinook salmon are much larger in size (90-150 mm) in comparison to newly emergent summer Chinook fry (32-45 mm). However, later in the year, differentiating between subyearling summer and subyearling spring Chinook is more problematic. This is especially apparent in late summer and early fall as sub-yearling emigrants representing both the spring and summer Chinook life histories overlap each other. This makes it difficult to estimate the population size and juvenile output in streams where both spring and summer Chinook salmon populations are present. Given the ESA listing status (Endangered) of Upper Columbia River spring Chinook salmon the ability to accurately differentiate the race of subyearling juveniles is especially important.

Genetically test a representative sample to determine the proportion of subyearling migrants that are spring Chinook in each basin. This information can be used to go back and correct the proportion initially designated for each run component.

Review scales of spring Chinook adults to determine the juvenile migration pattern to ensure there were no subyearling migrants (those that entered the ocean in their first year of life).

7.8 Process – combine all of the critical uncertainties that have been identified within various local and regional RM&E plans.

7.8.1 Summary of issue and existing information

Recently, the Upper Columbia Regional Technical Team (RTT) completed an assessment of the informational and data gaps primarily related to recovery of spring Chinook, steelhead, and bull trout (Peven and Murdoch 2010). The gaps identified by Peven and Murdoch (2010) that relate to summer/fall Chinook appear in Table 7.5 below. In addition, the uncertainties and informational needs identified above are also included.

Table 7.5. Data and information gaps identified by Peven and Murdoch (2010) that relate to summer/fall Chinook. In addition, informational needs identified through this process are added at the bottom of this table.

Wenatchee	Entiat	Methow	Okanogan	Mainstem Columbia	Area	Description	Category (Effectiveness, S&T, Research, Implementation)	Source
X	X	X	X	X	Upper Columbia	Determine relative performance (survival and productivity) and reproductive success of hatchery and naturally produced fish in the wild.	Research	Upper Columbia Salmon Recovery Plan (UCSRP)
X	X	X	X	X	Upper Columbia	Determine the effects of exotic species and predatory native species on (recovery of) salmon and trout and the feasibility to eradicate or control their numbers	Research	UCSRP
X	X	X	X	X	Upper Columbia	A reference condition for genetic variation for steelhead and spring Chinook is needed so that we can determine what the goal is and how to track progress	S&T	Appendix P Review
X	X	X	X	X	Upper Columbia	Estimate precision and accuracy of redd counts wherever these counts are used to estimate spawning escapement.	S&T	RPA workgroup
X	X	X	X	X	Upper Columbia	Mechanistic link between habitat creation, restoration and fish use and productivity is unknown.	Effectiveness	UCSRP & Revised Biological Strategy
X	X	X	X	X	Upper Columbia	Spring Chinook and steelhead redd surveys and spawning escapement expansion estimates are un-validated. Need to validate number of fish per redd and redds per female.	S&T	Appendix P Review
X	X	X	X	X	Upper Columbia	Assess if hatchery programs increase the incidence of predation on naturally produced fish	Research	UCSRP
X	X	X	X	X	Upper Columbia	Assess if hatchery programs increase the incidence of disease on naturally produced fish	Research	UCSRP
X	X	X	X	X	Upper Columbia	A reference condition for the phenotypic variation metric for both steelhead and spring Chinook is needed	S&T	Appendix P Review
X	X	X	X	X	Upper Columbia	Assess the interactions between hatchery and naturally produced fish: a) Competition and behavioral anomalies	Research	UCSRP &Regional Objective in HCP Hatchery M&E Plans
X	X	X	X	X	Upper Columbia	Understand the need and magnitude of adding nutrients as part of an ESU wide plan to determine where, how, and how much nutrient supplementation is required	Research	Revised Biological Strategy

Wenatchee	Entiat	Methow	Okanogan	Mainstem Columbia	Area	Description	Category (Effectiveness, S&T, Research, Implementation)	Source
			X		Okanogan	Study the effectiveness of actions to reduce water temperature.	Effectiveness	New
X	X	X	X	X	Upper Columbia	Examine water balance and surface/groundwater relations	Research	UCSRP & BS
			X		Okanogan	Develop temperature models to predict benefits or to properly size projects proposed to reduce water temperatures	Research	New
X	X	X	X	X	Upper Columbia	Increase understanding of estuarine ecology of Upper Columbia stocks	Research	UCSRP
X	X	X	X	X	Inundated zone at the Confluence of Wenatchee, Entiat, Methow, and Okanogan Rivers with the Columbia	Conduct predator index studies to determine amount and extent of smallmouth bass, walleye, and northern pike minnow predation on listed salmonids.	Research	New
X	X	X	X	X	Upper Columbia	Increase genetic research to identify genotypic variations in habitat use	Research	UCSRP
X	X	X	X	X	Upper Columbia	Assess the interactions between hatchery and naturally produced fish: c) predation	Research	UCSRP &Regional Objective in HCP Hatchery M&E Plans
X	X	X	X	X	Upper Columbia	Level and effect of poaching in the upper Columbia is unknown.	Effectiveness	Appendix P Review
X	X	X	X	X	Upper Columbia	Study the effects of climate change on the water temperature of the Okanogan, Methow, Entiat, and Wenatchee Rivers and ways to mitigate for increased water temps	Research	New
	X				Lower Entiat	Extent of irrigation water withdrawal on instream flows and temperatures is not known	Research	Revised Biological Strategy
		X			Middle Mainstem Methow	Effects of irrigation water withdrawal on stream flows are not fully understood	Research	Revised Biological Strategy
X	X	X	X	X	Upper Columbia	Test assumptions and sensitivity of EDT model runs	Research	UCSRP
X	X	X	X	X	Upper Columbia	Develop better methods to estimate harvest of naturally produced fish and indirect harvest mortalities in freshwater and ocean fisheries	S&T	UCSRP
			X		Lower Canadian Mainstem Okanogan	Assess sediment inflows to develop a sediment budget for this portion of the subbasin	Research	Revised Biological Strategy
X	X	X	X	X	Upper Columbia	Increase understanding of linkages between physical and biological processes so mangers can predict changes in survival and productivity in response to selected recovery actions	Effectiveness	UCSRP

Wenatchee	Entiat	Methow	Okanogan	Mainstem Columbia	Area	Description	Category (Effectiveness, S&T, Research, Implementation)	Source
			X		Upper Canadian Mainstem Okanogan	Summer steelhead and summer/fall Chinook spawning distribution uncertainties need to be addressed.	S&T	Revised Biological Strategy
			X		Upper US Mainstem Okanogan	Develop a fish water management tool to help manage water releases from Zosel Dam to enhance spawning, incubation and rearing of summer steelhead and summer/fall Chinook.	Research	Revised Biological Strategy
			X		Upper US Mainstem Okanogan	Assess sediment inflows to develop a sediment budget for this portion of the subbasin	Research	Revised Biological Strategy
		X			Upper Mainstem Methow	Effect of surface water and groundwater withdrawal on the dewatered reach is not fully understood.	Research	Revised Biological Strategy
X	X	X	X	X	Upper Columbia	Determine the interactions of shad on Upper Columbia stocks in the lower Columbia River	Research	UCSRP
			X		Similkameen	TDG levels are unknown but believed to be higher than established standards	Effectiveness	Revised Biological Strategy
		X			Middle Mainstem Methow	Contribution of tributaries and mainstem bank erosion to sediment levels in the mainstem Methow River is not understood	Research	Revised Biological Strategy
		X			Lower Mainstem Methow	Habitat surveys have not been completed on the lower privately owned areas	Research	Revised Biological Strategy
		X			Lower Mainstem Methow	Habitat in the lower mainstem Methow River and lower reaches of its tributaries has not been surveyed. Some recommendations are based on professional judgment.	Research	Revised Biological Strategy
	X				Lower Entiat	Extent of riparian cover and channel shape on anchor ice formation is not known	Effectiveness	Revised Biological Strategy
			X		Upper US Mainstem Okanogan	Develop PIT tagging technology at Zosel Dam to improve understanding of habitat use by anadromous fish	S&T	Revised Biological Strategy
x	x	x	x	x	Upper Columbia	Determine fate of summer/fall Chinook passing dams; many are not accounted for in tributary spawning areas.	Research, S&T	Summer Chinook Summit
				x	Upper Columbia	Determine whether mainstem spawners constitute a separate reproductive unit.	Research	Summer Chinook Summit
x	x	x	x	x	Upper Columbia	Need understanding of genetic population structure of summer/fall Chinook in Upper Columbia.	Research	Summer Chinook Summit

Wenatchee	Entiat	Methow	Okanogan	Mainstem Columbia	Area	Description	Category (Effectiveness, S&T, Research, Implementation)	Source
x	x	x	x	x	Upper Columbia	Determine the factors that affect the freshwater life history choice (subyearling or yearling entry into ocean) of summer/fall Chinook of the UCR.	Research, S&T	Summer Chinook Summit

7.8.2 Potential solutions (additional data needs)

Many of the data gaps and informational needs will be addressed through the implementation of the UCR salmon and steelhead recovery plan implementation process. However, since summer/fall Chinook are not ESA listed, other processes will need to be used to address some of these concerns.

Some of the information will likely be collected through hatchery R,M&E programs (e.g., genetic structure) present throughout the Upper Columbia River region. To address all of these uncertainties additional funding will need to be obtained from other funding sources

8.0 Recommended management strategies and outstanding issues

Based on information presented above, the WDFW and CCT present potential management strategies to be considered by the various management processes. These recommendations were developed by individual parties to this document and should not be viewed as having consensus of all of the parties. These recommendations should be viewed as a starting point for a more expansive discussion concerning the management and conservation of UCR summer / fall Chinook salmon. In some cases it will make sense to immediately adopt some of these recommendations and the parties are encouraged when feasible to do so; however in many cases these recommendations will need further evaluation and consideration in arenas outside of the parties to this document. As stated earlier in this document these recommendations are not intended to supersede or replace previous agreements between any of the parties to this document.

8.1 Management recommendations from WDFW

The following management recommendations from WDFW are based on the analyses and information above:

1) Beginning in 2011 and extending through at least 2014 if not longer, harvest rates on Okanogan natural origin summer Chinook will need to be reduced in order to provide both natural escapement and start-up broodstock need for the Chief Joseph Hatchery. Presently, the only practical way to affect this harvest rate reduction is the use of mark-selective fisheries (MSF) by recreational and Colville Tribal fishers. WDFW will work with the Oregon Department of Fish and Wildlife (ODFW) to incorporate MSF for non-

Indian sport fisheries. MSF by sport and Colville tribal fishers will help meet CJH broodstock needs without undue impact on Okanogan River natural escapement.

2) The *US v Oregon* escapement goal for summer Chinook should be increased beginning in 2011 to accommodate the Chief Joseph Hatchery broodstock needs[3]. The *US v Oregon* Technical Advisory Committee should determine whether the increased goal needs to incorporate passage loss, as there appears to be less passage loss between Bonneville Dam and Priest Rapids Dam than estimated in the current escapement goal.

3) Non-treaty fishery managers should adopt the population structure for Upper Columbia summer Chinook recommendation from the 2009 Summit (Table 5.1), with the understanding that the Methow classification as a Contributing population is a conservation objective that has several major management hurdles that are likely to limit the ability to achieve that objective. Classifying the Methow as Contributing is a conservative approach which the non-treaty fishery managers believe is warranted, despite its limitations and historical uncertainty, because the ESU has lost so many other populations and entire MPG's upstream of Chief Joseph Dam. The most risk-averse conservation strategy is to have a viable Methow population contributing to the MPG in a productive way to support the two primary populations.

4) Participants in the 2009 Summit conducted extensive simulation modeling of the long-term impacts of different harvest and management strategies for the summer Chinook populations, particularly with regard to the parameters that are used to determine whether this ESU might be a candidate for future ESA listing. This simulation modeling found several potential concerns with the proposed management framework, and summit participants agreed that the concerns could be addressed through precautionary management measures.

    a) The overall management framework in the *US v Oregon* agreement is based on an aggregated natural/hatchery escapement goal, which could result in overharvest of some of the wild populations. This concern can be addressed by establishing 'trigger points' for each of the natural populations (Wenatchee, Methow and Okanogan) in order to monitor their status and trends. A downward trend or chronic escapement below the minimum population size will serve as triggers to re-evaluate the management framework. The Chief Joseph Hatchery plan has already incorporated some low escapement trigger points; some of those are recently developed and need additional review from all of the managers. After review, they may be useful as reference points or even as a starting point to establish others.

    b) The Upper Columbia River summer Chinook major population group is characterized by high levels of hatchery releases in all tributaries as well as several mainstem locations. While these levels of hatchery production provide a strong safety net function during periods of low productivity, they

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[3] The goal should be measured at Rock Island Dam instead of Priest Rapids Dam because the Rock Island accounting is more accurate.

can be challenging to manage relative to achieving population specific conservation criteria. This increases the reliance on MSF; managers should conduct research to verify assumed mortality rates in MSF in order to ensure this strategy achieves the conservation objectives.

c) In-river harvest management options are limited since the majority of the harvest has and will continue to occur in the ocean. Estimates of recent-year ocean exploitation rates appear to be independent of summer Chinook run size, which is not surprising since the summer Chinook are one of the Aggregate Abundance Stocks in the Pacific Salmon Commission framework for managing Canadian and Alaskan ocean fisheries. In-river harvest must compensate for density independent ocean exploitation as well as marine survival factors.

d) Weirs in the Methow and Okanogan would greatly improve our ability to manage pHOS and pNOB and perhaps to effectively segregate programs if that becomes necessary to meet management objectives.

e) Additional changes may need to be made in the Methow to facilitate collection of local broodstock.

8.2 Management recommendations from CCT

The Colville Tribes have assessed the analyses conducted and views represented in the Summer Chinook Summit. Based on this best available scientific information, the Tribes' findings and recommendations are presented here, organized by subbasin and system.

YAKIMA RIVER

Assessment Summary:

1. The future 500,000 yearling smolt release planned for the Yakima River will increase aggregate adult returns to the Columbia River and therefore *US v OR* harvest rates in Zones 1-6. This action will therefore increase harvest of Okanogan hatchery-origin fish (HOR) and natural-origin fish (NOR). Current *US v OR* harvest rates (added to ocean exploitation) are already too high for management of the Okanogan as a Primary population and the Methow as a Contributing population. Higher *US v OR* harvest rates will also likely threaten the ability of the Colville Tribes to achieve a fair and equitable share (~50:50) of its reserved harvest of Okanogan and future Chief Joseph Hatchery summer Chinook production.
2. Future ocean and river exploitation of summer Chinook will not return sufficient escapement to the Yakima River to approach its estimated habitat capacity.
3. The ability to establish a natural population of summer Chinook in the Yakima subbasin is threatened by excessive harvest of future Yakima NORs in the ocean and Columbia River.

Management Recommendation: Greater harvest selectivity is required in the ocean and Columbia River to bolster expected NOR returns to the Yakima River. All non-treaty harvest below the confluence of the Yakima should be selective. At least ocean fisheries off Washington should be selective. The Yakama Tribe should consider shifting some portion of its non-selective summer Chinook harvest from the Columbia River to the Yakima River.

WENATCHEE RIVER

Assessment Summary:

1. The Wenatchee River Primary population appears viable under the current ocean and *US v OR* management framework.
2. In the future, this population could benefit from lower harvest of NORs at lower run sizes.

Management Recommendation: Non-treaty selective fishing in Zones 1-6 may be sufficient to protect this population in lower run years. A higher escapement goal at Rock Island Dam (RID) (replacing that at Priest Rapids Dam (PRD)) would also serve to ensure sufficient escapement into the Wenatchee River at all run sizes.

ENTIAT RIVER

Assessment Summary:

1. The Entiat population would be managed as a Stabilizing population. Under future, higher harvest rates, this outcome would not be possible without a hatchery program.
2. The planned ~300,000 release of yearling summer Chinook from Entiat Hatchery should be sufficient to ensure a stabilizing status for the Entiat population.
3. The future 300,000 yearling smolt release from Entitat Hatchery will increase aggregate adult returns to the Columbia River and therefore *US v OR* harvest rates in Zones 1-6. This action will therefore increase harvest of Methow and Okanogan HORs and NORs. Current *US v OR* harvest rates (added to ocean exploitation) are already too high for management of the Okanogan as a Primary population and the Methow as a Contributing population. Higher *US v OR* harvest rates will also likely threaten the ability of the Colville Tribes to achieve a fair and equitable share (~50:50) of its reserved harvest of Okanogan and future Chief Joseph Hatchery summer Chinook production.

Management Recommendation: A higher escapement goal at RID would also serve to ensure sufficient escapement into the Entiat River at all run sizes.

METHOW RIVER

Assessment Summary:

1. Currently the Methow population is not viable due to management as an aggregate MEOK population, excessive ocean and river exploitation, and habitat degradations. Under future, higher harvest rates, population viability is further minimized. The Methow population will not achieve even a Stabilizing population status.
2. For ESU viability, management of the Methow population should be as a Contributing population.

3. Current broodstock collection at Wells Dam for the Methow hatchery program takes mostly Okanogan population NORs, further exacerbating the lack of NORs needed for the Okanogan population and Chief Joseph Hatchery program.
4. The Methow population and a reformed hatchery program requires significantly greater return of NORs to the Methow subbasin.
5. The pHOS in the Methow River is too high and will need to be reduced.

Management Recommendation: To achieve a Contributing population status, the Methow hatchery program must be promptly reformed to use only local broodstock. A Methow weir should be considered for installation in the near future. In the immediate future, the live capture gears (as demonstrated by the Colville Tribes) should be applied immediately to collect local broodstock. A plan should be developed for local broodstock and escapement management.
The pHOS in the Methow River will need to be managed and a terminal, selective fishery should be assessed and considered in combination with other non-treaty selective fisheries.
A higher escapement goal at RID would serve to increase escapement into the Methow River at all run sizes. Establishing this new aggregate escapement goal should specifically consider the needs of the Methow River population and hatchery program.
All non-treaty Columbia River and Washington coastal fisheries should be selective to return greater NORs.

OKANOGAN RIVER

Assessment Summary:

1. The Okanogan population is to be managed as a Primary population.
2. Hatchery programs need to take only local broodstock. This is planned for the Chief Joseph Hatchery Program, but such local collections for the Similkameen Program are also needed, thereby ending collections at Wells Dam.
3. Ocean and *US v OR* exploitation is too high to provide sufficient NORs for escapement to the Okanogan River and for Chief Joseph and Similkameen Pond hatchery programs, at low to medium run sizes.

Management Recommendation: To achieve a Primary population status, the Similkameen hatchery program must be promptly reformed to use only local broodstock. The Colville Tribes live capture gears should be applied immediately to collect local broodstock starting in 2010 following the protocols developed for the Chief Joseph Hatchery Program.
The pHOS in the Okanogan River will need to be managed and a terminal, selective fishery should be assessed and considered in combination with other non-treaty selective fisheries. The Colville Tribes should consider intensifying its terminal selective fishery, now, to reduce pHOS.
A higher escapement goal at RID would serve to increase escapement into the Okanogan River at all run sizes. Establishing this new aggregate escapement goal should specifically consider the needs of the Okanogan River population and hatchery programs.
All non-treaty Columbia River sport and commercial fisheries and Washington coastal fisheries should be selective to return greater NORs.

SYSTEM ISSUES AND RECOMMENDATIONS

PRD/RID Escapement Goal – The *US v OR* management goal is 20,000 summer Chinook at PRD. This is an aggregate goal of all populations within the ESU and includes both HOR and NOR Chinook. This goal determines, in large part, harvest levels in Zones 1-6.
This goal now needs to be increased for many reasons as discussed above. The most pressing need is to ensure sufficient escapement to the Okanogan River and for the Chief Joseph Hatchery and Similkameen Pond broodstocks, while still ensuring the Colville Tribes a fair share of harvest as provided in the WDFW/CCT Management Agreement. The Colville Tribes' harvest share would be threatened by future increased *US v OR* harvest rates in Zones 1-6.
The escapement goal for summer Chinook should be moved from PRD to RID for a more accurate accounting of UCR summer Chinook and summer Chinook escapement.
An RID escapement goal also needs to be increased to ensure sufficient escapement for:

1. NORs to the Methow River for natural escapement and broodstock,
2. NORs and HORs to the Entiat River for Entiat NFH broodstock,
3. NORs to the Wenatchee River at lower run sizes for natural escapement.
4.

Increasing the aggregate escapement goal at RID reduces exploitation at lower aggregate run sizes which is needed for all populations to achieve the necessary status for a healthy and sustainable ESU.

Non-Treaty Selective Fishing – Sport and non-treaty commercial fisheries for summer Chinook are currently non-selective. Analyses indicate that NOR escapement to all populations, but particularly the Okanogan, can be increased by converting these non-treaty fisheries to selective. This action is needed not only to provide sufficient NORs for the Chief Joseph Hatchery Program's broodstock, but for immediately improving the viability of all populations, particularly the Methow. This action should be implemented for ESU health, not just to support the requirements of the Chief Joseph Hatchery Program.

System Recommendations:

Management actions to ensure a viable and healthy Upper Columbia River Summer/Fall Chinook ESU and to increase treaty and non-treaty harvests could be implemented in phases
Phase I

1. All non-treaty fisheries should be selective. The Colville Tribes should continue to develop alternative, selective fishing opportunities to its snag fishery in the Chief Joseph Dam tailrace. All non-treaty fisheries should be immediately transitioned to selective until viability objectives are achieved for each population. Application of selective gears should be immediately promoted and incentivized for the non-treaty commercial fishery. Sport gears should be restricted to those that should allow for safe release of NOR Chinook, pending studies quantifying release mortalities.
2. Only local broodstocks should be used for Methow and all Okanogan hatchery programs. Broodstock collections should be promptly reformed.
3. The aggregate escapement goal at PRD of 20,000 summer Chinook should be promptly increased and shifted to RID for measurement. The aggregate escapement goal should be sufficient to ensure necessary broodstock needs for planned hatchery

programs and natural escapement levels necessary to achieve viability objectives for the Primary and Contributing populations.

4. Results of these Phase I actions should be evaluated relative to objectives for natural population management, hatchery programs and harvest sharing, If objectives are not being achieved, then managers should consider phase II actions.

Phase II

1. Reduce ocean exploitation of summer Chinook and/or institute selective fishing in Washington coastal waters.
2. Further increase the escapement goal upon initiation of Yakima and Entiat hatchery programs.

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Appendix A. Run timing of adult Chinook salmon at Priest Rapids and Rock Island dams on the mainstem Columbia River and Prosser Dam on the Yakima River.

Appendix B. Exercise to determine effects on run size from increases in hatchery and eventually natural production of summer/fall Chinook upstream of Priest Rapids Dam.

Appendix C. Harvest rate schedule for US v OR and the WDFW and CCT agreement.

Appendix D. Summer Chinook smolt life history patterns.

Appendix E. Comparison of total abundance of Upper Columbia summer Chinook and the total exploitation rate.

Appendix A. Run timing of adult Chinook salmon at Priest Rapids and Rock Island dams on the mainstem Columbia River and Prosser Dam on the Yakima River.

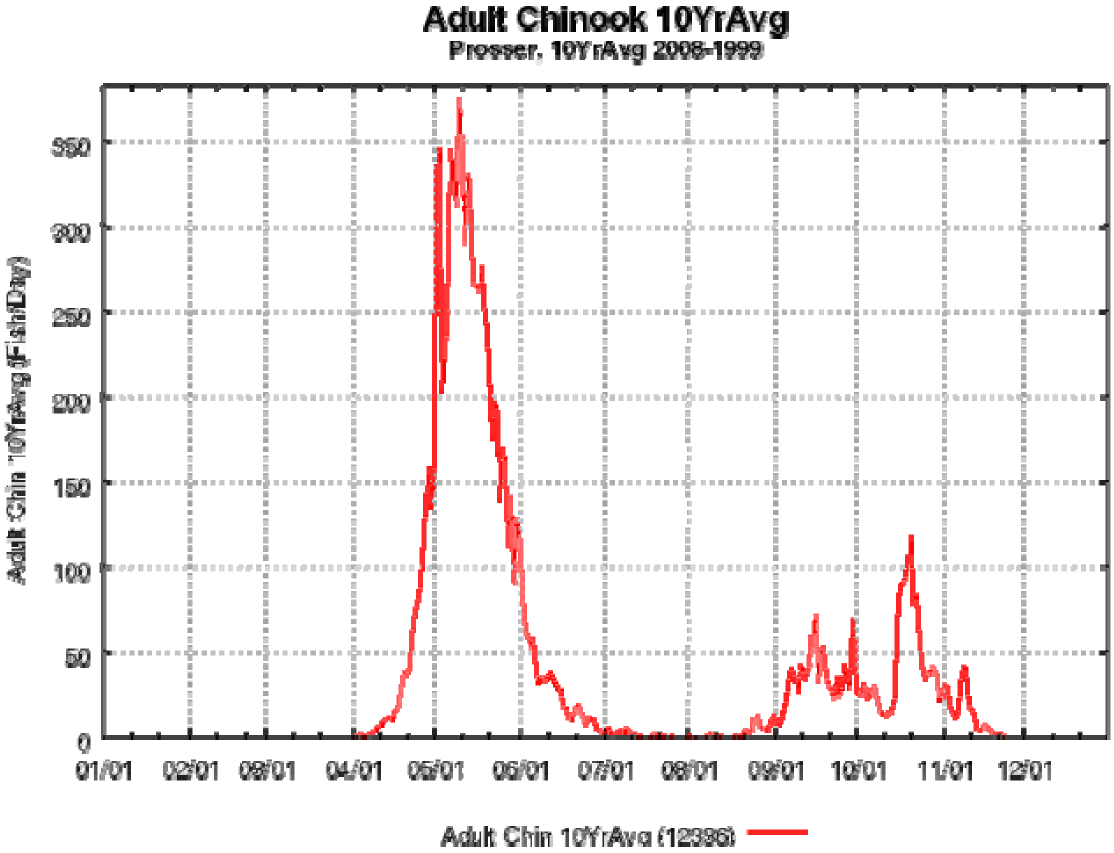


Figure A1. Run timing for adult Chinook at Prosser Dam (Yakima River) showing the presence of spring and fall run timing for Chinook. Graphic taken from the Columbia River Data Access in Real Time website http://www.cbr.washington.edu/dart/adultpass.html).

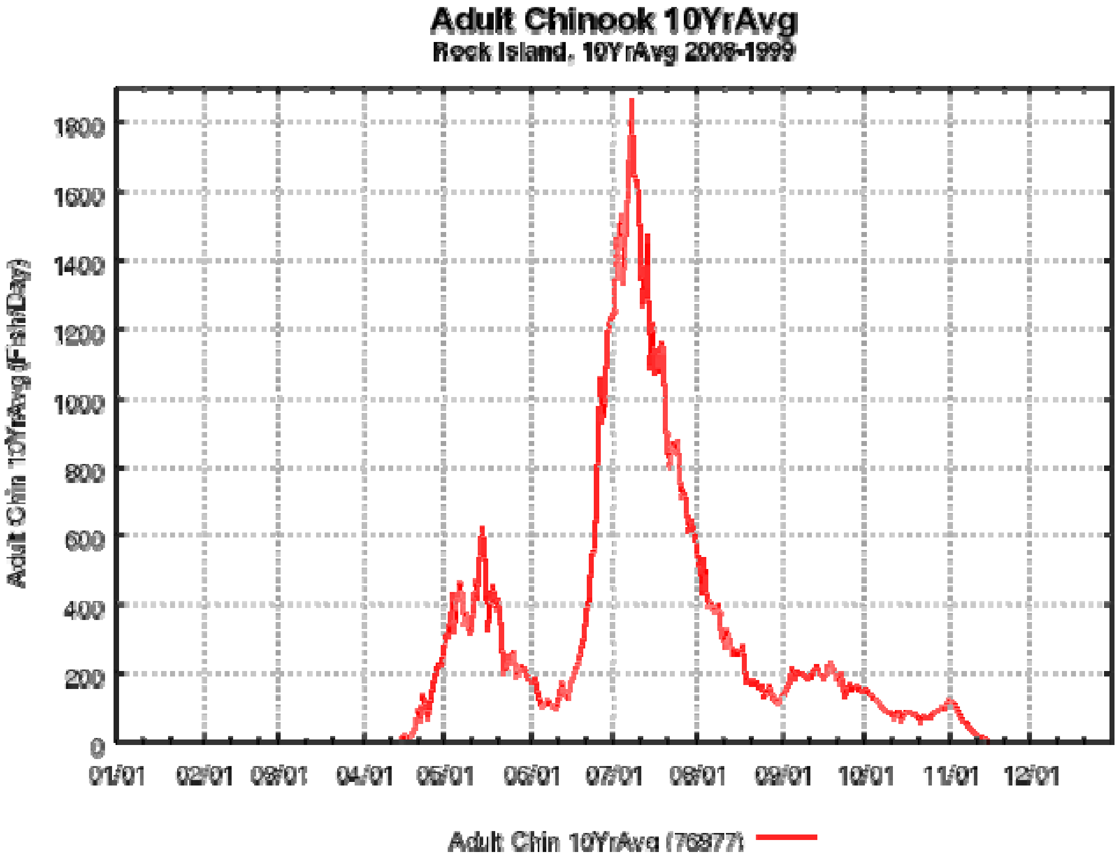


Figure A2. Run timing for adult Chinook at Rock Island Dam showing the dominance of spring and summer run timing with the less pronounced fall run timing. Graphic taken from the Columbia River Data Access in Real Time website http://www.cbr.washington.edu/dart/adultpass.html).

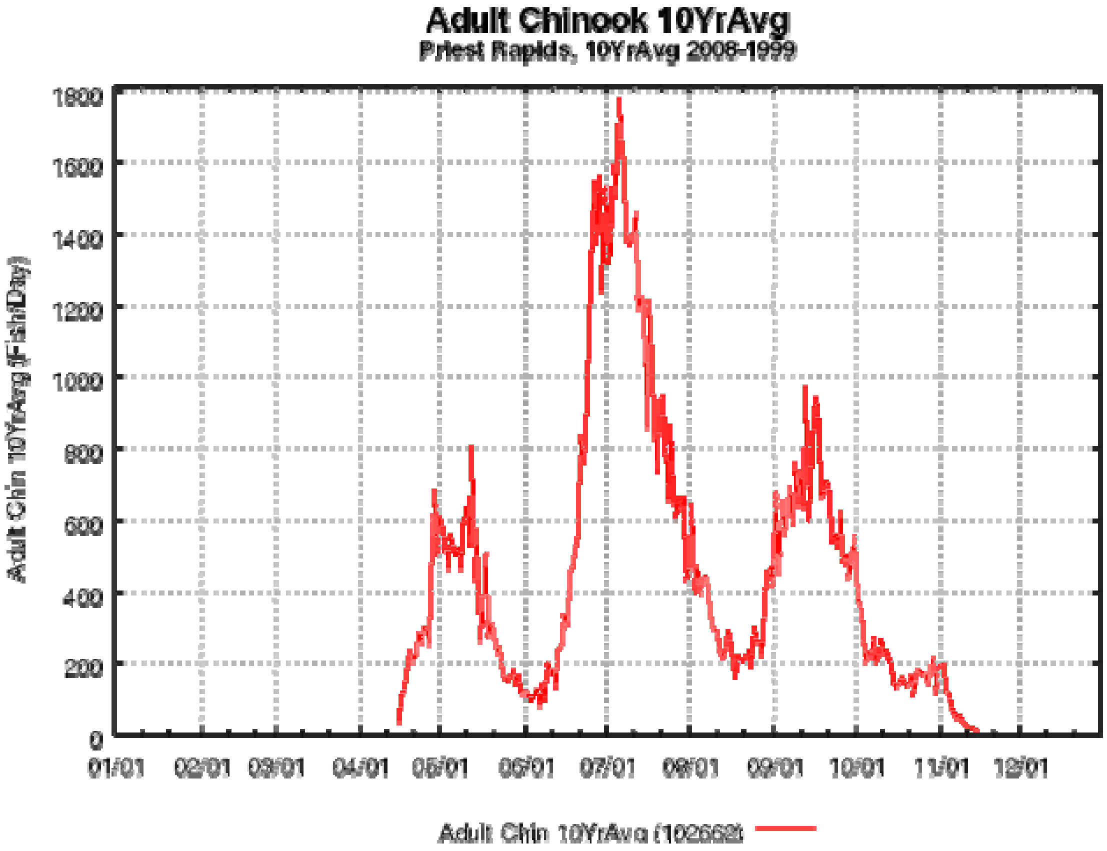


Figure A3. Run timing for adult Chinook (not race specific) at Priest Rapids Dam showing the presence of spring, summer, and fall run timing. Note the much stronger component of the fall run timing when compared to Rock Island (previous graph A2). Graphic taken from the Columbia River Data Access in Real Time website http://www.cbr.washington.edu/dart/adultpass.html).

Appendix B. Exercise to determine effects on run size from increases in hatchery and eventually natural production of summer/fall Chinook upstream of Priest Rapids Dam.

August 3, 2009

Summer Chinook Summit

CURRENT CONDITION

Based on recent runs since 2000:

Average run = 60,000 low run = 30,000 high run = 90,000

mark rate at mouth = 60%

Run Distribution:

Run Segment	From Table 4
< PRD	0
PRD to Wenatchee	58%
>Wenatchee to Wells	1%
Wells and Methow	17%
> Methow to CJD	24%

August 3, 2009

Summer Chinook Summit

NEAR-TERM FUTURE CONDITION
(w/122% increased hatchery production)

Average run = 104,000 low run = 52,000 high run = 156,000

mark rate at mouth = 77%

Run Distribution:

Run Segment	Increase in run at mouth from New hatchery production	new run distribution
< PRD	+10,600	10%
PRD to Wenatchee	-5,800	29%
>Wenatchee to Wells	+13,270	14%
Wells and Methow	+2,650	13%
> Methow to CJD	+20,770	34%
Total	41,490 ~ 44,000	100%

August 3, 2009

Summer Chinook Summit

LONG-TERM FUTURE CONDITION

(w/122% increased hatchery production and w/44% increased wild production)

Average run = 114,500 low run = 57,300 high run = 172,000

mark rate at mouth = 70%

Run Distribution:

Run Segment	Increase in run at mouth from new Natural production	new run distribution
< PRD	3,456	12.3%
PRD to Wenatchee	4,630	30.4%
>Wenatchee to Wells	185	12.9%
Wells and Methow	704	12.4%
> Methow to CJD	1,583	32.3%
Total	~10,560	100.3%

(60,000 x .4 unmark rate = 24,000 24,000 x .44 = 10,560
10,560 – 3,456 = 7,104 to be distributed amongst trib populations)

Appendix C. Harvest rate schedule for US v OR and the WDFW and CCT agreement.

Harvest rate schedule from US v OR.

Upper Columbia Summer Chinook Fishery Framework Matrix

Run Size at River Mouth	Allowed Treaty Harvest	Allowed Non-Treaty Harvest
<5,000	5%	<100 Chinook
5,000-<16,000	5%	<200 Chinook
16,000-<29,000	10%	5%
29,000-<32,000	10%	56%
32,000- <36,250 (125% of 29,000 goal)	10%	7%
36,250-50,000	50% of total harvestable[1]	50% of total harvestable[1]
>50,000	50% of 75% of margin above 50,000 plus 10,500[2]	50% of 75% of margin above 50,000 plus 10,500[2]

[1] *The total number of harvestable fish is defined as the run size minus 29,000 for run sizes of 36,250 to 50,000.*

[2] *For the purposes of this Agreement, the total number of harvestable fish at run sizes greater than 50,000 is to be determined by the following formula: (0.75 * (run size-50,000)) + 21,000.*

Harvest rate schedule from WDFW and CCT agreement.

Upper Columbia Management Agreement:
Non-treaty Harvest Framework for Upper Columbia Summer Chinook

River mouth run size	Percentage of allowable catch upstream of Priest Rapids Dam	Harvest regime downstream of Priest Rapids Dam	Description of expected fisheries upstream of Priest Rapids Dam
0 – 29,000	> 90%	No directed harvest	C&S for Colville and Wanapum, potential selective recreational
29,001 – 50,000	90%	Recreational and/or commercial	C&S for Colville and Wanapum, limited recreational
50,001 – 60,000	90% - 70%	Recreational and/or commercial	C&S for Wanapum and Colville, recreational
60,001 – 75,000	70% - 65%	Recreational and/or commercial	C&S for Wanapum and Colville, recreational
75,001+	65% - 60%	Recreational and/or commercial	C&S Wanapum and Colville, recreational

Appendix D. Summer Chinook smolt life history patterns.

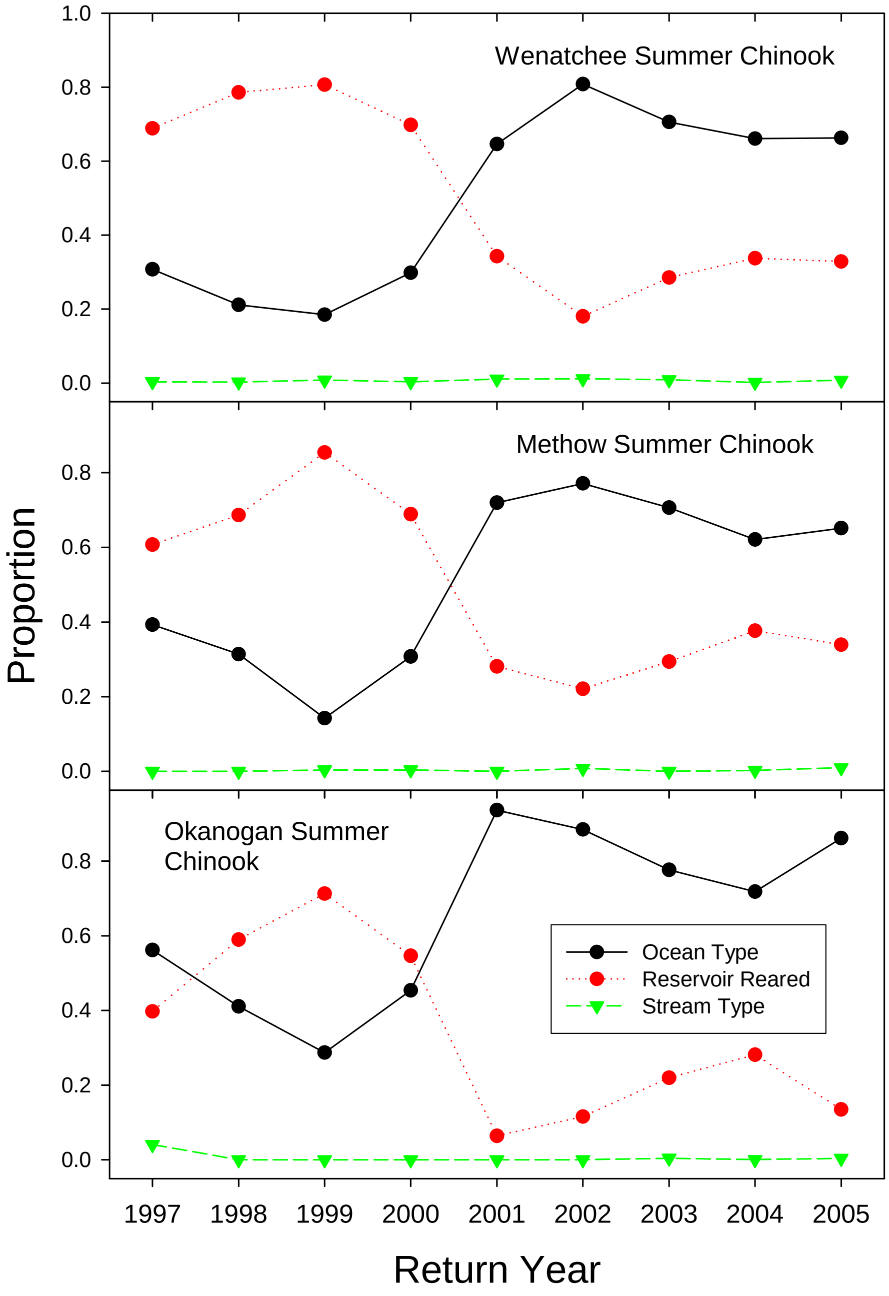
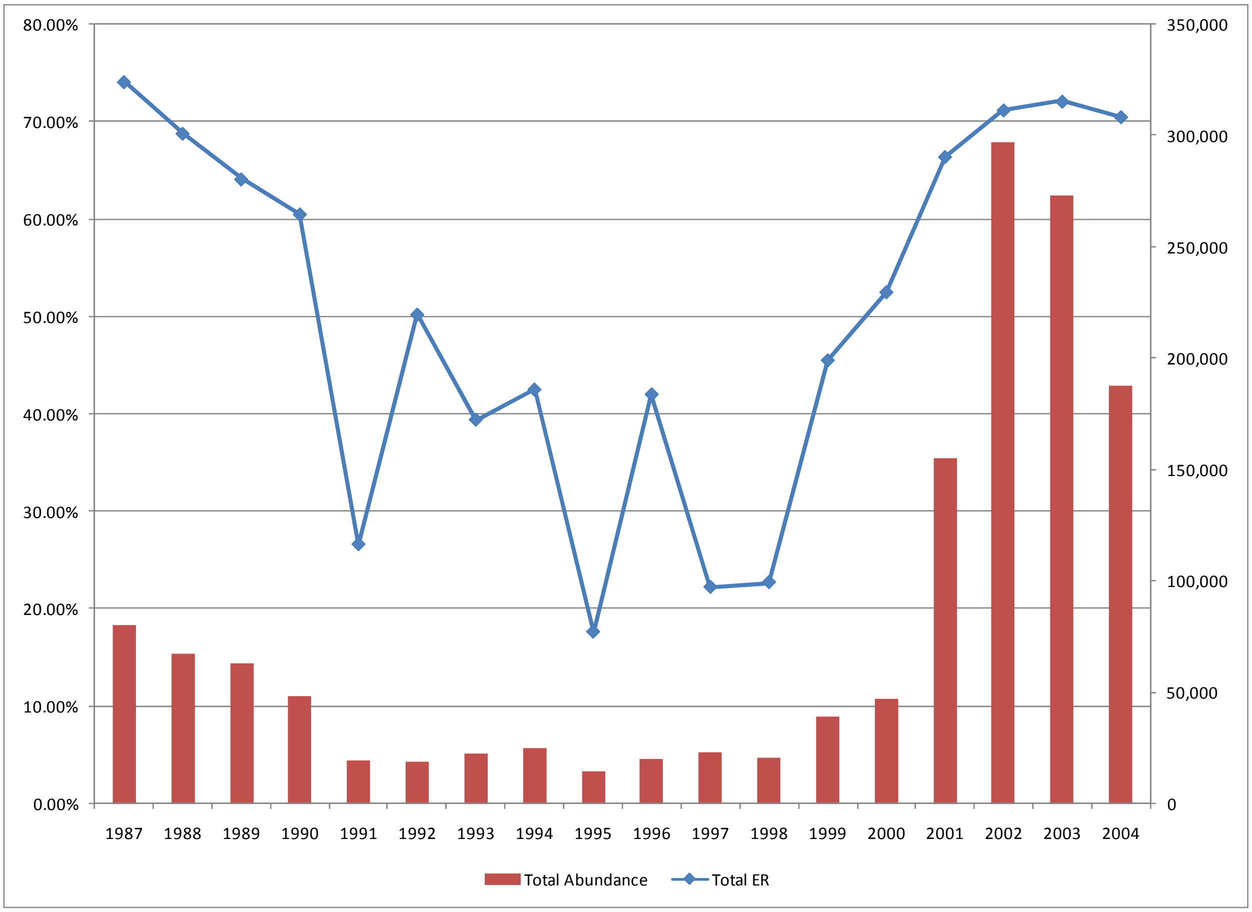


Figure C1. Summer Chinook smolt life history patterns determined by scale analysis of recovered carcasses of natural origin adults. Data previous to 1997 was not included due to a change in the scale analysis procedures. Ocean type smolts are true "subyearling" migrants, reservoir reared spend approximately 1 year in the Columbia River mainstem, and stream type spend approximately 1 year in the tributary.

Appendix E. Comparison of total abundance of Upper Columbia summer Chinook and the total exploitation rate.



Appendix D. Comparison of total abundance of Upper Columbia summer Chinook and the total exploitation rate (ER).