External Review Draft of Chapters One and Two

ESA Recovery Plan

Snake River Fall Chinook Salmon
(*Oncorhynchus tshawytscha*)

Prepared by
National Marine Fisheries Service
Northwest Region

DISCLAIMER

Endangered Species Act (ESA) recovery plans delineate ~~reasonable~~ actions which the best available information indicates are necessary for the conservation and survival of listed species. Plans are developed~~published~~ by the National Marine Fisheries Service (NMFS), usually with the assistance of recovery teams, state agencies, tribal governments, local governments, salmon recovery boards, non-governmental organizations, interested citizens of the affected area, contractors, and others. ~~ESA~~ R~~r~~ecovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in the plan formulation, other than NMFS. They represent the official position of NMFS only after they have been signed by the respective~~Northwest Regional~~ Administrator. ~~ESA~~ R~~r~~ecovery plans are guidance and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new information, changes in species status, and the completion of recovery actions.

~~ESA~~ r~~r~~ecovery plans provide important context for NMFS determinations pursuant to section 7(a)(2) of the Endangered Species Act. However, recovery plans do not place any additional legal burden on NMFS or the action agency when determining whether an action would jeopardize the continued existence of a listed species or adversely modify critical habitat. The procedures for the section 7 consultation process are described in 50 CFR 402 and are applicable regardless of whether or not the actions are described in a recovery plan.

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ACRONYMS AND ABBREVIATIONS

A/P	abundance and productivity
AHA	All-H-Analyzer
BiOp	Biological Opinion
BOR	US Bureau of Reclamation
BPA	Bonneville Power Administration
BRT	Biological Review Team
CA	Comprehensive Analysis of Federal Columbia River Power System and Mainstem Effects of Upper Snake and Other Tributary Actions
C	Celsius
CBFWA	Columbia Basin Fish & Wildlife Authority
COE	US Army Corps of Engineers
Council	Northwest Power and Conservation Council
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CTWSRO	Confederated Tribes of the Warm Springs Reservation of Oregon
CWT	coded-wire-tagging
DPS	distinct population segment
EDT	Ecosystem Diagnosis and Treatment
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FCRPS	Federal Columbia River Power System
FCRPS	Confederated Tribes of the Warm Springs Reservation of Oregon
FERC	Federal Energy Regulatory Commission
FMEP	Fisheries Management and Evaluation Plan
FR	Federal Register
ft	**Feet**
GIS	Geographic Information System
GNRO	Governor’s Natural Resources Office (Oregon)
GSRO	Governor's Salmon Recovery Office (Washington State)
HCP	Habitat Conservation Plan
HGMP	Hatchery and Genetic Management Plan
IDFT	**Idaho Department of Fish and Game**
ICBTRT	Interior Columbia Basin Technical Recovery Team
ICTRT	Interior Columbia Technical Recovery Team
IPC	**Idaho Power Company**
kg	**Kilogram(s)**
LCREP	**Lower Columbia River Estuary Partnership**
m	**meters**
mm	**millimeters**
MPG	major population group
MSA	major spawning areas
N/A	Not Applicable

NGO	non-governmental organizations
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPCC or NWPCC	Northwest Power and Conservation Council
NPT, NPTH	Nez Perce Tribe, Nez Perce Tribal Hatchery
ODFW	Oregon Department of Fish and Wildlife
OR	**Oregon**
pHOS	proportion of hatchery origin spawners
PNI	**proportion of natural influence (in hatchery broodstock)**
RIST	Recovery Implementation Science Team
RM	river mile
SCA	Supplemental Comprehensive Analysis
SRSRB	Snake River Salmon Recovery Board
SS/D	spatial structure and diversity
TBD	To Be Determined
TRT	Technical Recovery Team
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
v or vs	**versus**
VSP	viable salmonid population
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area

Recovery Planning Glossary

abundance: In the context of salmon recovery, unless otherwise qualified, abundance refers to the number of adult fish returning to spawn, measured over a time series.

adaptive management: Adaptive management in salmon recovery planning is a method of decision making in the face of uncertainty. A plan for monitoring, evaluation, and feedback is incorporated into an overall implementation plan so that the results of actions can become feedback on design and implementation of future actions.

anadromous fish: Species that are hatched in freshwater, migrate to and mature in salt water, and return to freshwater to spawn.

baseline monitoring: In the context of recovery planning, baseline monitoring is done before implementation, in order to establish historical and/or current conditions against which progress (or lack of progress) can be measured.

biogeographical region: an area defined in terms of physical and habitat features, including topography and ecological variations, where groups of organisms (in this case, salmonids) have evolved in common.

broad sense recovery goals: Goals defined in the recovery planning process, generally by local recovery planning groups, that go beyond the requirements for delisting, to address, for example, other legislative mandates or social, cultural, economic, and ecological values.

compliance monitoring: Monitoring to determine whether a specific performance standard, environmental standard, regulation, or law is met.

delisting criteria: Criteria incorporated into ESA recovery plans that define both biological viability (biological criteria) and alleviation of the causes for decline (threats criteria based on the five listing factors in ESA section 4[a][1]), and that, when met, would result in a determination that a species is no longer threatened or endangered and can be proposed for removal from the Federal list of threatened and endangered species. These criteria are a NMFS determination and may include both technical and policy considerations.

distinct population segment (DPS): A listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NMFS policy. A population is considered distinct (and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range.

diversity: All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. Variations could include anadromy vs. lifelong residence in freshwater,

fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology, molecular genetic characteristics, etc.

domain: An administrative unit for recovery planning defined by NMFS based on ESU boundaries, ecosystem boundaries, and existing local planning processes. Recovery domains may contain one or more listed ESUs

endangered species: A species in danger of extinction throughout all or a significant portion of its range.

effectiveness monitoring: Monitoring set up to test cause-and-effect hypotheses about recovery actions: Did the management actions achieve their direct effect or goal? For example, did fencing a riparian area to exclude livestock result in recovery of riparian vegetation?

ESA recovery plan: A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the maximum extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site-specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.

evolutionarily significant unit (ESU): A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species.

extinct: No longer in existence. No individuals of this species can be found.

extirpated: Locally extinct. Other populations of this species exist elsewhere.

factors for decline: Five general categories of causes for decline of a species, listed in the Endangered Species Act section 4(a)(1)(b): (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or human-made factors affecting its continued existence.

hyporheic zone: Area of saturated gravel and other sediment beneath and beside streams and rivers where groundwater and surface water mix.

implementation monitoring: Monitoring to determine whether an activity was performed and/or completed as planned.

independent population: Any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations.

indicator: A variable used to forecast the value or change in the value of another variable.

interim regional recovery plan: A recovery plan that is intended to lead to an ESA recovery plan but that is not yet complete. These plans might address only a portion of an ESU or lack other key components of an ESA recovery plan.

intrinsic potential: The estimated relative suitability of a habitat for spawning and rearing of anadromous salmonid species under historical conditions inferred from stream characteristics including channel size, gradient, and valley width.

intrinsic productivity: The expected ratio of natural-origin offspring to parent spawners at levels of abundance substantially below carrying capacity.

large woody debris (LWD): A general term for wood naturally occurring or artificially placed in streams, including branches, stumps, logs, and logjams. Streams with adequate LWD tend to have greater habitat diversity, a natural meandering shape, and greater resistance to flooding.

legacy effects: Impacts from past activities that continue to affect a stream or watershed in the present day.

limiting factor: Physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) experienced by the fish that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity). Key limiting factors are those with the greatest impacts on a population's ability to reach a desired status.

locally developed recovery plan: A plan developed by state, tribal, regional, or local planning entities to address recovery of a species. These plans are being developed by a number of entities throughout the region to address ESA as well as state, tribal, and local mandates and recovery needs.

maintained status: Population status in which the population does not meet the criteria for a viable population but does support ecological functions and preserve options for ESU/DPS recovery.

major population group (MPG): A group of salmonid populations that are geographically and genetically cohesive. The MPG is a level of organization between demographically independent populations and the ESU or DPS.

major spawning area (MaSA): A river system with~~of~~ one or more branches that contain sufficient spawning and rearing habitat to support more than 500 spawners. For Interior Columbia salmonid populations, defined using results from intrinsic potential analysis.

management unit: A geographic area defined for recovery planning purposes on the basis of state, tribal or local jurisdictional boundaries that encompass all or a portion of the range of a listed species, ESU, or DPS.

metrics: A metric is something that quantifies a characteristic of a situation or process; for example, the number of natural-origin salmon returning to spawn to a specific location is a metric for population abundance.

minor spawning area (MiSA): A river system with~~of~~ one or more branches that contains sufficient spawning and rearing habitat to support 50 – 500 spawners (defined using intrinsic potential analysis).

morphology: The form and structure of an organism, with special emphasis on external features.

natural-origin fish: Fish that were spawned and reared in the wild, regardless of parental origin.

parr: The stage in anadromous salmonid development between absorption of the yolk sac and transformation to smolt before migration seaward.

phenotype: Any observable characteristic of an organism, such as its external appearance, development, biochemical or physiological properties, or behavior.

piscivorous: (Adj.) Describes animals that habitually feed ~~fish that eat other~~on fish.

productivity: The average number of surviving offspring per parent. Productivity is used as an indicator of a population's ability to sustain itself or its ability to rebound from low numbers. The terms "population growth rate" and "population productivity" are interchangeable when referring to measures of population production over an entire life cycle. They c~~C~~an be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner.

recovery domain: An administrative unit for recovery planning defined by NMFS based on ESU boundaries, ecosystem boundaries, and existing local planning processes. Recovery domains may contain one or more listed ESUs.

recovery goals: Goals incorporated into a locally developed recovery plan, which may include delisting (i.e. no longer considered endangered or threatened), reclassification (e.g., from endangered to threatened), and/or other goals. Broad sense goals are a subset of recovery goals (see glossary entry above).

recovery plan supplement: A NMFS supplement to a locally developed recovery plan that describes how the plan addresses ESA requirements for recovery plans. The supplement also proposes ESA delisting criteria for the ESUs addressed by the plan, since a determination of these criteria is a NMFS decision.

recovery scenarios: Scenarios that describe a target status for each population within an ESU, generally consistent with TRT recommendations for ESU viability.

recovery strategy: Statements that identify the assumptions and logic – the rationale – for the species' recovery program.

recruit: An individual fish that survives into a defined life stage, for example spawner recruit.

redd: A nest constructed by female salmonids in streambed gravels where eggs are fertilized and deposited.

riparian area: Area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland.

salmonid: Fish of the family *Salmonidae*, including salmon, trout, chars, grayling, and whitefish. In general usage, the term usually refers to salmon, trout, and chars.

smolt: A juvenile salmonid that is undergoing physiological and behavioral changes to adapt from freshwater to saltwater as it migrates toward the ocean.

spatial structure: Characteristics of a fish population's geographic distribution. Current spatial structure depends upon the presence of fish, not merely the potential for fish to occupy an area.

stakeholders: Agencies, groups, tribes, or private citizens with an interest in recovery planning, or those who will be affected by recovery planning and actions.

Technical Recovery Team (TRT): Teams convened by NMFS to develop technical products related to recovery planning. Planning forums unique to specific states, tribes, or regions may use TRT and other technical products to identify recovery actions.

threatened species: A species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

threats: Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, volcanoes) that cause or contribute to limiting factors. Threats may exist in the present or be likely to occur in the future.

viability criteria: Criteria defined by NMFS-appointed Technical Recovery Teams to describe a viable salmonid population, based on the biological parameters of abundance, productivity, spatial structure, and diversity. These criteria are used as technical input into the recovery planning process and provide a technical foundation for development of biological delisting criteria.

viability curve: A curve describing combinations of abundance and productivity that yield a particular risk of extinction at a given level of variation over a specified time frame.

viable salmonid population (VSP): an independent population of Pacific salmon or steelhead trout that has a negligible risk of extinction over a 100-year time frame.

VSP parameters: Abundance, productivity, spatial structure, and diversity. These describe characteristics of salmonid populations that are useful in evaluating population viability. See NOAA Technical Memorandum NMFS-NWFSC-42, *Viable salmonid populations and the recovery of evolutionarily significant units* (McElhany et al. 2000).

EXECUTIVE SUMMARY

1. Introduction

This is an Endangered Species Act (ESA) recovery plan for Snake River fall Chinook salmon (Snake River fall Chinook), an evolutionarily significant unit (ESU) of Chinook salmon (*Oncorhynchus tshawytscha*). NOAA's National Marine Fisheries Service (NMFS) first listed Snake River fall Chinook as threatened on April 22, 1992 (57 FR 14658), reaffirmed the listing status in June 28, 2005 (70 FR 37160), and reaffirmed the status again in NMFS' 2010 Five-Year Review of Snake River listed species (NMFS 2011a).

Snake River fall Chinook spawn in the Snake River basin and migrate to the ocean through the Snake River and Columbia River basins. The listed ESU includes all natural~~ly~~origin ~~spawned~~ fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam, and in the Clearwater River, Tucannon River, Grande Ronde River, Imnaha River, and Salmon River, as well as four artificial propagation programs: the Lyons Ferry Hatchery, Fall Chinook Acclimation Ponds Program, Nez Perce Tribal Hatchery, and Oxbow Hatchery. Prior to the construction of impassable mainstem dams on the upper Snake River, mainstem reaches upstream of~~above~~ the current production areas were the primary spawning areas for this ESU. Two populations, ~~extirpated~~ the Snake River Middle Mainstem and Snake River Upper Mainstem populations that formerly spawned in the mainstem Snake River above the Hells Canyon Complex were extirpated by the three Hells Canyon dams (Figure 1-1) (ICTRT 2005;~~,~~ 2010). These two populations represented approximately 60 percent of all historic production. Furthermore, inundation of spawning areas by reservoirs associated with the Hells Canyon complex ansd also lower Snake dams has reduced spawning habitat to 17 to 20 percent of the spawning area historically available (Chandler et al 2001 and Dauble et al 2003), respectively..

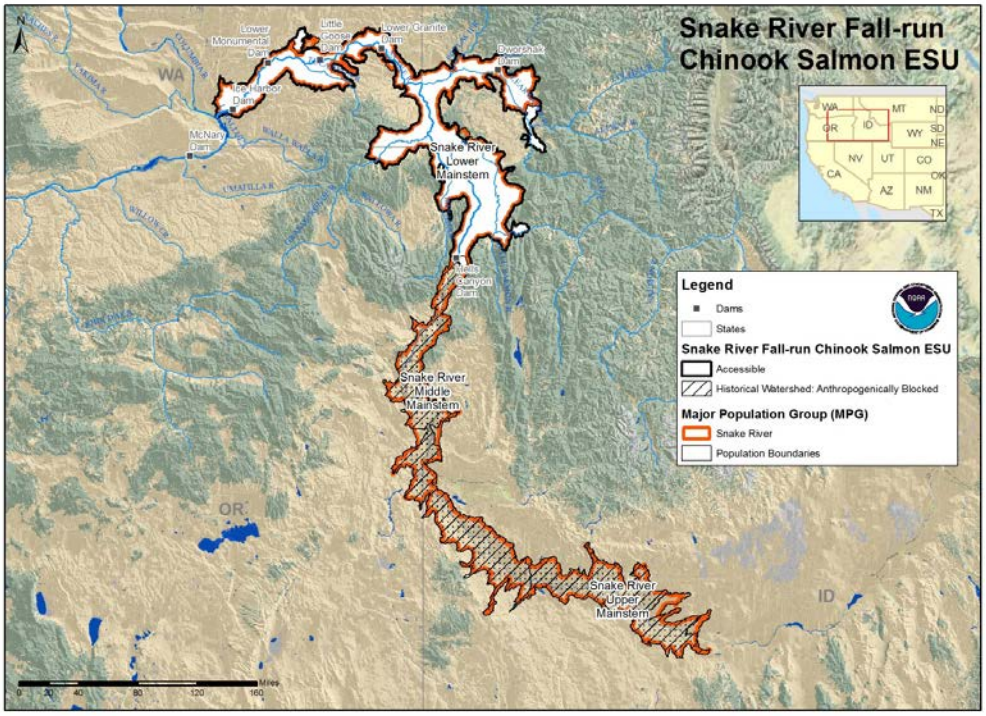

Figure 1-1. Snake River fall Chinook ESU spawning range.

1.1 Purpose of the Plan

NMFS goal is to improve the viability of Snake River fall Chinook to the point that ESA protection is no longer required. The purpose of this recovery plan is to provide a roadmap for Snake River fall Chinook's recovery—it lays out where we need to go and how best to get there, based on best available science. ~~It first describes the conditions that led to the listing of Snake River fall Chinook salmon as a threatened species under the ESA. It then overviews recent improvements since the listing. It summarizes the species' current status and provides criteria for determining that the species has recovered. It describes ongoing threats and limiting factors and highlights key information needs that could help us determine how best to further its survival. Finally, it provides a recovery strategy that incorporates site specific actions already underway, including research, monitoring and evaluation, and additional actions that may be taken to achieve the species recovery.~~ The plan contains the following major elements:

- Description of the context and process of plan development and how NMFS intends to use the plan (Chapter 1);
- Background information on the Snake River fall Chinook life history, historic and current distribution, and relationship of this plan to other programs and processes (Chapter 2);
- Recovery Goals and delisting criteria (Chapter 3);

- Assessment of the current status of listed Snake River fall Chinook and gaps between the current status and viability criteria (Chapter 4);
- An assessment of the current threats and limiting factors that affect viability (Chapter 5);
- Key Information needs for understanding the status of the species and the role of the multiple threats (Chapter 6);
- Recovery strategy and strategic prioritization framework;
- Research, monitoring and evaluation;
- Site specific management actions that include actions to address the threats and also actions to address key information needs; and
- Implementation and coordination including approach to adaptive management and implementation infrastructure.

The plan also includes several modules with details of conditions that affect Snake River fall Chinook, including the hydropower system, estuary, harvest, and nearshore ocean and plume.

1.2 ESA Requirements

Section 4(f) of the ESA requires NMFS to "develop and implement plans for the conservation and survival…" of species listed as endangered or threatened under the statute. Section 4(f) refers to these plans for conservation and survival as recovery plans.

ESA section 4(a)(1) lists five factors for determining whether a specie is an endangered or a threatened species. Elimination of these factors must be addressed ~~re-classification or delisting that are to be addressed~~ in recovery plans:

A. The present or threatened destruction, modification, or curtailment of [the species'] habitat or range
B. Over-utilization for commercial, recreational, scientific or educational purposes
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting its continued existence

ESA section 4(f)(1)(B) directs that the Secretary of Commerce (i.e. NMFS) ~~recovery plans~~, to the extent practicable, incorporate in each recovery plan:

1. a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
2. objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this chapter, that the species be removed from the list; and;
3. estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

Once a species is ~~deemed~~ recovered and ~~therefore~~ removed from a listed status, section 4(g) ~~of the ESA~~ requires the monitoring of the species for a period of not less than five years to ensure that it retains its recovered status.

1.3 Recovery Domains and Technical Recovery Teams

Currently, 19 Evolutionarily Significant Units (ESUs) ~~species~~and Distinct Population Segments (DPSs) of Pacific salmon and steelhead in the Pacific Northwest are listed under the ESA as endangered or threatened.[1] ~~NMFS Northwest Region shares jurisdiction of an additional ESU, Southern Oregon/Northern California coho, with NMFS Southwest Region.~~ For the purpose of recovery planning for these species, NMFS ~~Northwest Region~~ designated five geographically based "recovery domains": Interior Columbia; Willamette-Lower Columbia; Puget Sound and Washington Coast; the Oregon Coast; and the Southern Oregon/Northern California Coast (Figure 1-2). The range of the Snake River fall Chinook is in the Snake River sub-domain of the Interior Columbia domain. Three other ESA-listed species also spawn and rear in the Snake River basin: the Snake River spring-summer Chinook salmon ESU, the Snake River steelhead distinct population segment (DPS), and the Snake River sockeye salmon ESU.

For each domain, NMFS appointed teams of scientists, called Technical Recovery Teams (TRTs), ~~nominated for their geographic, species, and/or topical expertise,~~ to provide a solid scientific foundation for recovery plans. These scientists were nominated for their geographic, species, and/or topical expertise. The Interior Columbia TRT includes biologists from NMFS<states, tribes, entities, and academic institutions.[2] The charge of each TRT was to define species structures;~~,~~ develop recommendations on biological viability criteria for each species and its component populations;~~,~~ provide scientific support to local and regional recovery efforts;~~,~~ and provide scientific evaluations of proposed recovery plans. The Interior Columbia Technical Recovery Team (ICTRT) addressed the four listed Snake River species. ~~The ICTRT includes biologists from NMFS, states, tribal entities, and academic institutions.~~[3]

All the TRTs used a common set of ~~the same~~ biological principles in developing their recommendations for ~~species and population~~ viability criteria. ~~— criteria to be used, along with criteria based on mitigation of the factors for decline, to determine whether a species has recovered sufficiently to be down-listed or delisted~~. The biological principles are described in NMFS' technical memorandum, "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units" (McElhany et al. 2000). Viable salmonid populations (VSP) are defined in terms of four population parameters: abundance, population productivity or growth rate, population spatial structure, and diversity. ~~A viable ESU (evolutionarily significant unit) or DPS (distinct population segment) (hereafter referred to as species) is naturally self-sustaining, with a high probability of persistence over a 100-year time period.~~ Each TRT made recommendations using the VSP framework. Their recommendations were also based on data availability, the unique biological characteristics of the species and habitats in the domain, and the members' collective experience and expertise. NMFS has encouraged the TRTs to develop

[1] Footnote describing why we have to use both ESUs and DPSs

[2] ICTRT members were Thomas Cooney (NMFS Northwest Fisheries Science Center) (co-chair), Michelle McClure, (NMFS Northwest Fisheries Science Center) (co-chair), Casey Baldwin (Washington Department of Fish and Wildlife), Richard Carmichael (Oregon Department of Fish and Wildlife),Peter Hassemer (Idaho Department of Fish and Game), Phil Howell (U. S. Forest Service), Howard Schaller (U.S Fish and Wildlife Service), Paul Spruell (University of Montana), Charles Petrosky (Idaho Department of Fish and Game), Dale McCullough (Columbia River Inter-tribal Fish Commission) and Fred Utter (University of Washington).

[3] ~~ICTRT members were Thomas Cooney (NMFS Northwest Fisheries Science Center) (co-chair), Michelle McClure, (NMFS Northwest Fisheries Science Center) (co-chair), Casey Baldwin (Washington Department of Fish and Wildlife), Richard Carmichael (Oregon Department of Fish and Wildlife),Peter Hassemer (Idaho Department of Fish and Game), Phil Howell (U. S. Forest Service), Howard Schaller (U.S Fish and Wildlife Service), Paul Spruell (University of Montana), Charles Petrosky (Idaho Department of Fish and Game), and Fred Utter (University of Washington.~~

~~domain specific and~~ species-specific approaches to evaluating viability, while using the common VSP scientific foundation.

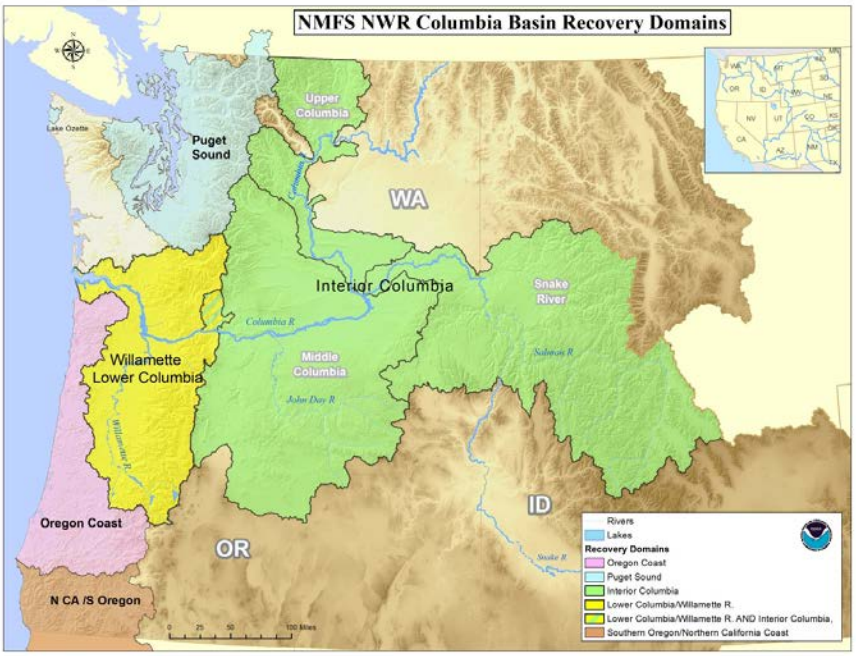

Figure 1-2. Columbia Basin Recovery Domains for NMFS Northwest Region.

1.4 Tribal Trust and Treaty Responsibilities

The salmon and steelhead that were once abundant in the watersheds throughout the Snake River Basin were critically important ~~ucial~~ to- Native Americans throughout the region. Pacific Northwest Indian tribes today retain strong economic, cultural, education, and spiritual ~~and cultural~~ ties to salmon and steelhead, based on thousands of years of use for tribal subsistence, religious and/cultural ceremonies, ~~subsistence,~~ and commerce. Many Northwest Indian tribes have treaties reserving their right to fish in usual and accustomed fishing places, including the geographic areas covered by this recovery plan. Additionally, four Washington coastal tribes, the Makah, Quileute, Quinault and Hoh, have treaty rights to ocean salmon harvest that may include some that are destined for the Snake River Basin. These Columbia Basin and Washington coast treaty tribes are co-managers of salmon stocks, and participate in management decisions including those related to hatchery production and harvest. Some ~~other~~ tribes in the Columbia River Basin, whose reservations were created by Executive Order, do not have reserved treaty rights but do have a trust relationship with the Federal government and an interest in salmon and steelhead management, including harvest and hatchery production.

~~Native American treaty-reserved fishing rights in the Columbia basin are under the continuing jurisdiction of the U.S. District Court for the District of Oregon in the case of *United States v. Oregon*, No. 68-513 (filed inU.S. District Court 1968). In *U.S. v. Oregon*, the Court affirmed that the treaties reserved for the tribes up to 50 percent of the harvestable surplus of fish destined to pass through their usual and accustomed fishing areas.~~

" Much of the management related to the treaty-reserved fishing rights for the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, Nez Perce Tribe and the Confederated Tribes of the Warm Springs Reservation of Oregon in the Columbia River basin is under the continuing jurisdiction of the U.S. District Court for the District of Oregon in the case of *United States v. Oregon*, No. 68-513 (U.S. District Court 1968)[DL1].. In *U.S. v. Oregon*, the Court affirmed that language in the "Stevens treaties," eg., " … the right of taking fish at all usual and accustomed places, in common the citizens of the Territory …", (Article III, Treaty with the Yakama, 1855; 12 Stat., 951) reserved for these tribes up to 50 percent of the harvestable surplus of fish passing through their usual and accustomed fishing areas. The language in the Treaty with the Eastern Band of Shoshoni and Bannock (1868) (15 Stat., 673). addressing the Shoshone Bannock tribes rights is different. The Shoshone Bannock tribes have a reserved right under the treaty to, " … hunt on the unoccupied lands of the United States so long as game may be found thereon …." (Article 4).

Restoring and sustaining a sufficient abundance of salmon and steelhead for harvest while achieving viable escapements is important in fulfilling tribal fishing needs.~~aspirations~~. It is NMFS's policy to promote restoration of salmon and steelhead runs sufficient for tribal harvest. ~~This policy is described in a July 21, 1998, letter from Terry D. Garcia, Assistant Secretary for Oceans and Atmosphere, U.S. Department of Commerce, to Mr. Ted Strong, Executive Director of the Columbia River Inter-Tribal Fish Commission. This letter states that~~ NMFS believes that recovery ~~"~~must achieve two goals: 1) the recovery and delisting of salmonids listed under the provisions of the ESA; and 2) the restoration of salmonid populations over time, to a level to provide a sustainable harvest sufficient to allow for the meaningful exercise of tribal fishing rights.~~"~~

Thus, it is appropriate for recovery plans to acknowledge Treaty reserved rights, and tribal harvest goals and to include strategies that support those goals in a manner that is consistent with recovery of naturally spawning populations~~.~~ NMFS believes that our relationship with the Pacific Northwest tribes is critically important to the region's future success in recovery of listed Pacific salmon. ~~The NMFS Regional Administrator, in testimony before the U.S. Senate Indian Affairs Committee (June 2003), emphasized the importance of our co-manager relationship:~~

> ~~"We have repeatedly stressed to the region's leaders, tribal and non-tribal, the importance of our co-management and trust relationship to the tribes. NMFS enjoys a positive working relationship with our Pacific Northwest tribal partners. The relationship as crucial to the region's future success in recovery of listed salmon."~~

1.5 ~~How NMFS Intends to~~ Use of This ~~the~~ Recovery Plan

Although recovery plans are not regulatory and their implementation is voluntary, the ESA clearly envisions recovery plans as the central organizing tool for guiding each species' recovery process. They help to do the following:

- Provide context for regulatory decisions;
- Guide decision making by Federal, state, tribal, and local jurisdictions;
- Provide criteria for species status reporting and delisting decisions;
- Organize, prioritize, and sequence recovery actions;
- Organize, prioritize, and sequence research, monitoring, and evaluation actions.
- Set a framework for adaptive management that uses the results of research, monitoring and evaluation to update priority actions.
- Provide motivation for implementing recovery actions

NMFS encourages Federal agencies and non-Federal jurisdictions to use recovery plans as they make the following sorts of decisions and allocate their resources. For example:

- Actions carried out by Federal agencies to meet ESA section 7(a)(1) obligations to use their programs in furtherance of the purposes of the ESA and to carry out programs for the conservation of threatened and endangered species;
- Actions that are subject to ESA sections 4d, 7(a)(2), or 10;
- Hatchery and Genetic Management Plans and permit requests;
- Harvest plans and permits;
- Selection and prioritization of habitat protection and restoration actions;
- Development of research, monitoring, and evaluation programs;
- Revision of land use and resource management plans;
- Other natural resource decisions at the Federal, state, Tribal, and local levels.

NMFS emphasize~~s~~ this recovery plan information in ESA section 7 (a)(2) consultations, section 10 permit development, and application of the section 4(d) rule by considering:

- The importance of affected individuals and populations to listed species viability;
- The importance of the action area to affected populations and species viability;
- The relation of the action to threats recovery strategies and management actions; and,
- The relation of the action to the research, monitoring, and evaluation plan for the affected species.

In implementing these programs, recovery plans are used as a reference and a source of context, expectations, and goals. NMFS staff will encourage the Federal "action agencies" to describe in their biological assessments how their proposed actions will affect specific populations, threats and limiting factors identified in the recovery plans, and to describe any mitigating measures and voluntary recovery activities in the action area.

2. Background

Geographic setting, patterns of life history, recent history, and current distribution provide context for understanding the issues associated with~~facing recovery efforts for the~~ Snake River fall Chinook. This chapter also describes the critical habitat designation, recent programs and processes since listing and the relationship of this plan to those programs. processes.~~includes a description of the critical habitat designated for the ESU.~~

2.1 Geographic Setting

Snake River fall Chinook historically~~once~~ spawned ~~all the way up~~throughout the mainstem Snake River upstream to the natural barrier at Shoshone Falls, near Twin Falls, Idaho (RM 614.7) (Figure 2-1). The river flows southwest, west, and then northwest along the southern portion of the Snake River plain, a broad topographic depression in southern Idaho. ~~that curves like a 400 miles mile necklace across Idaho~~. The Snake River plain is a broad, basaltic plateau formed from successive layers of sediment and lava flows. This geological formation allows for a unique hydrological feature in the vicinity of Hagerman, Idaho, known as the Thousand Springs, an extensive spring complex totaling about 5,300 cubic feet per second of clean, 58ºF water, which historically created prime spawning conditions for fall Chinook. The southwestern and western portions of the Snake River Plain consist of undulating rangeland called the Owyhee Uplands, a warped plateau of volcanic deposits that dips north into the plain (Meatte 1990). The Snake River and its tributaries to the west and south, such as the Owyhee and Bruneau rivers, have cut deep, terraced canyonlands through these layers (Chapman 200~~3~~1).

Comment [EG1]: Kurt Tardy asks if this is still accurate

Hells Canyon, carved by the Snake River at the far western end of the Snake River plain, is the deepest canyon in the U.S., nearly 8,000 feet deep and 10 miles wide. Its terraces are repetitive incursions of weathered basalt alternating with sedimentary soils. The Seven Devils Mountains to the east and the Wallowa Mountains to the west form the upper reaches of the canyon walls. These mountains form a series of jagged peaks reaching nearly 10,000 feet (Brown 2003). In the free flowing reach through Hells Canyon, the Snake River is steep and swift (1.8 meters/kilometer [m/km]), with numerous large rapids, shallow riffles, and deep pools, surrounded at the upstream end by nearly vertical cliff faces. The canyon becomes somewhat wider near Johnson Bar (RM 230), with moderate to steep topography continuing to the northern boundary of the Hells Canyon National Recreation Area (at RM 176) (IPC 1999). Hells Canyon is accessible only on foot or by boat. No roads cross it, and the few roads that reach the Snake River between Hells Canyon Dam and the Oregon–Washington state boundary are rough or close to impassable.

The climate in Hells Canyon~~the canyon~~ is hot and dry in the summer, with relatively mild winters. Seasonal temperatures range from about minus 5°C in January to about 35°C in July. At elevations above 1,000 m (3,280 ft), mean temperatures range from 0°C in January to between 28°C and 33°C in July (Johnson and Simon 1987). Precipitation is bimodal, with intense, short duration summer storms and milder, longer duration winter storms (Abramovich et al. 1998). The average annual precipitation for the Brownlee Dam and Lewiston, Idaho weather stations ranges from about 12 to 18 inches (Miller et al. 2003).

The Snake River in Hells Canyon forms the border between Oregon and Idaho; at the tri-state convergence point it continues north for about 30 miles as the border between Idaho and Washington before turning west (Figure 2-1). As the river~~it~~ courses between three states, the western Snake River flows along a moasaic ~~checkerboard~~ of state, local, tribal, and ~~f~~Federal jurisdictions. As summarized in Brown 2003: The Bureau of Land Management (BLM) and U.S. Forest Service~~FS~~ manage most of the public land in Hells Canyon, which includes parts of the Wallowa-Whitman National Forest in Oregon and the Payette and Nez Perce National Forests in Idaho. Other state and F~~f~~ederal government agencies with natural resource jurisdiction in the area include the Idaho Department of Lands, National Marine Fisheries Service, Bureau of Indian Affairs, and U.S. Fish and Wildlife Service. Several special management areas also exist in the Hells Canyon area and are directly administered by the USFS. These include the Eagle Cap Wilderness in Oregon, the Hells Canyon Wilderness in Idaho and Oregon, the HCNRA in Idaho and Oregon, the Wild and Scenic Imnaha River in Oregon, the Seven Devils Scenic Area in Idaho, and the Wild and Scenic Snake River in Idaho and Oregon.

~~The mainstem Snake River upstream of the Hells Canyon Complex historically contained two major areas of good spawning habitat for fall Chinook: (1) The area downstream of Shoshone Falls (RM 614.7), which was historically the natural barrier to salmon. The most productive reaches here were downstream of Upper Salmon Falls (RM 580.8) to approximately the current site of C.J. Strike Dam (RM 494) (Dauble et al. 2003); and (2) The area downstream of Swan Falls (RM 457), to the current town of Marsing, Idaho (RM 425) (Chandler et al. 2001; and Dauble et al. 2003).~~

Approximately 60 percent of all the fall Chinook adults in the Snake River Basin returned to areas upstream of the Hells Canyon complex (NMFS 2006). This upstream area historically contained two major areas of good spawning habitat for fall Chinook: (1) the area downstream of Shoshone Falls (RM 614.7), and (2) the area downstream of Swan Falls (RM 457) to the town of Marsing, Idaho (RM 425) (Chandler et al. 2001 and Dauble et al. 2003). Shoshone Falls was historically the natural barrier to salmon. The most productive reaches were downstream of Upper Salmon Falls (RM 580.8) to approximately the current site of C.J. Strike Dam (RM 494) (Dauble et al. 2003).

The historical spawning production areas in the mainstem river reaches above the Hells Canyon complex up to Shoshone Falls were best characterized as low gradient, relatively shallow areas with abundant potential spawning and rearing habitat. According to Dauble et al. 2003, "historic spawning areas for fall Chinook salmon occurred primarily within wide alluvial floodplains, which were once common in the mainstem Columbia and Snake R~~r~~ivers. These areas possessed more unconsolidated sediment and more bars and islands and had lower water surface slopes than did less extensively used areas." In contrast, the Hells Canyon reach, from the mouth of the Salmon River to the Hells Canyon complex (about 60 miles of the 99 mile reach) is best characterized as high gradient, with narrow channels and scattered pockets of spawning and rearing habitat.

There are historical accounts of fall Chinook salmon in the Clearwater and Grande Ronde Rivers (e.g., Van Dusen 1903; Chapman 1940; Fulton 1968). ~~Clearwater River may have historically~~

~~supported Snake River fall Chinook spawning.~~ However, the construction in 1927 of Lewiston Dam six miles upstream from Lewiston led to the extirpation of Chinook in the Clearwater Basin. The dam was constructed with a fish ladder that only steelhead could navigate. Lewiston Dam was removed in 1973 when it became obsolete. Also In 1973, the U.S. Army Corps completed construction of Dworshak dam, on the North Fork Clearwater River, 2 miles from its confluence with the mainstem Clearwater. Dworshak Dam is a complete barrier to upstream migration of adult salmon. Its construction extirpated upstream populations of steelhead, and prevented the restoration of Chinook salmon upon removal of Lewiston Dam because its ladder was dry after spring runoff as a result of routing all of the water through the powerhouse (Chapman 1940). This was remedied by 1939, but the fall Chinook run had already become extinct. ~~, cutting off Chinook access to the North Fork Clearwater~~.

2.2 Historical Context

Numbers of naturally spawning Snake River fall Chinook have fallen drastically since early European-American settlement in the region. Although there are no direct estimates of Snake River fall Chinook numbers in the 19th century, it is known that they were extremely abundant and were distributed throughout the mainstem Snake River and likely the lower reaches of many of its major tributaries, from its confluence with the Columbia River upstream more than 600 miles to Shoshone Falls, Idaho (Waples et al. 1991). Based on recent assessments of habitat suitability (Dauble and Geist 2000~~,~~; Dauble et al. 2003), NMFS estimates that between 416,000 and 650,000 adults historically returned to the Snake River annually, and that of these, at least 58 percent (241,000 to 377,000) spawned upstream of Hells Canyon Dam (NMFS 2006).

European-American commercial harvest of Columbia River salmon turned to fall Chinook toward the end of the 19th century, as spring and summer Chinook declined, with annual catches of fall Chinook ranging from 3 million to nearly 9 million kilograms (kg.) (~~Waples et al 1991 citing Fulton 1968~~Fulton 1968 cited in Waples et al. 1991). Chapman and Chandler (~~2001) and (~~2003) estimated a probable peak commercial harvest of 80% of the returning adults. This rate~~pace~~ of harvest resulted in a steady decline in adult abundance~~numbers~~.

In this same period, development of the Snake River basin for mining, timber harvest, agriculture, livestock production, and other human uses altered habitat in the river's mainstem. Tributaries were dredged and dammed, reducing access to spawning and rearing areas and contributing sediment to the streams. Irrigation systems reduced instream flows, increased stream temperatures, increased fine sediment inputs into aquatic habitats, and created partial or complete migration barriers (Chandler et al. 2003). ~~And l~~Livestock grazing reduced riparian vegetation, ~~raised~~increased stream temperatures, and altered stream banks and channels. As summarized by Murray (1964), "[F]rom tributary headwaters to the confluence of the Salmon River . . .. Every drainage has been changed or influenced by domestic livestock, farming, timber cutting, fire and controlled burning, dam building and water diversion."

Swan Falls Dam, constructed in 1901 to generate electricity for mines in the Owyhee Mountains,

. . . became the upstream terminus for salmon in the Snake River. [It] blocked approximately 157 miles~~;~~ of mainstem Snake River, or approximately 25 percent of the entire anadromous section of the mainstem Snake River. In addition, the dam blocked fish access to Salmon Falls and Rock

creeks, which were the uppermost basins to support spring/summer chinook in the Snake River basin. Also, many smaller tributaries were blocked with construction of Swan Falls Dam. (Chandler et al. 2003)

Returns of Snake River fall Chinook continued to diminish in the early 20th century. Settlers fishing in the lower portions of the Columbia River, where harvest was regulated, had moved upstream to Celilo Falls in 1904 and installed mechanized fish wheels in the vicinity of the falls that markedly increased catch. Concern over this unregulated fishery was expressed by Van Dusen (1907). In 1908 after several years of lobbying by Van Dusen, the State of Oregon passed a law that banned fish wheels in the portion of the Columbia River that included Celilo Falls and limited fishing after 08/25 near the falls to hook and line (McAllister 1909). Thereafter, use of fish wheels declined over time and were eventually outlawed by the States of Washington and Oregon during 1925 and 1934, respectively (OHS 2013). The parties also agreed to the fall season recommended above, and the construction of hatcheries below all power plants and obstructions in the lower and mid-Columbia River (McCallister 1911). Irving and Bjornn (1981) estimated that the mean number of fall Chinook returning to the Snake River declined from 72,000 in the period between 1938- and 1949. to 29,000 during the 1950s.

The construction of hydropower dams on the mainstem Snake River below Shoshone Falls, which began in the mid 1950s when the Federal Power Commission (the predecessor agency to the current Federal Energy Regulatory Commission (FERC)) issued a license to the mid-1950s with Idaho Power Company's (IPC) for the construction of Brownlee Dam, completed in 1958. IPC completed Oxbow Dam, 12 miles downstream of Brownlee Dam, in 1961, and Hells Canyon Dam, 26 miles downstream from Oxbow Dam, in 1967. These projects (the Hells Canyon Complex) inundated much of the productive spawning area for Snake River fall Chinook. None of the dams had fish passage, even though fish passage was in the original plans. , Oxbow, and Hells Canyon dams (the Hells Canyon Complex), blocked access and/or inundated the most productive remaining spawning area for fall Chinook. . Adult fish were passed around the dams by trap and haul, but juvenile fFish passage facilities proved unsuccessful at these damsGraban 1964; Haas, J.B. 1965. , thereby extirpating the Snake River fall Chinook that spawned upstream of Hells Canyon. For a more complete overview of the events leading to this extirpation, see the Northwest Power and Conservation Council's website http://www.nwcouncil.org/history/HellsCanyon .

Table 2-1 lists the eight dams on the mainstem Snake River from below Shoshone Falls to Hells Canyon.

Table 2-1. Mainstem Snake River dams operated by Idaho Power Company.

River Mile (RM)	Idaho Power Company Project	Type of Project
580.8	Upper Salmon Falls Dam	Run-of-the river
575.3	Lower Salmon Falls Dam	
560.3	Bliss Dam	Run-of-the river
494	C.J. Strike Dam	Storage, hydro
457.7	Swan Falls Dam	Run-of-the river
284.6	Brownlee Dam	Storage, flood control, hydro
272.5	Oxbow Dam	Storage, flood control, hydro
247.6	Hells Canyon Dam	Storage, flood control, hydro

Table 2-1. Mainstem Snake River dams operated by Idaho Power Company.

Four F~~f~~ederal dams on the Lower Snake, constructed in the 1960s and early 1970s (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams), further inundated a total of 135 mi (217.3 km) of the lower mainstem habitat formerly used by Snake River fall Chinook. By 1975, the total loss in Snake River mainstem habitat, based on river miles, was approximately 83 percent. Although the four Lower Snake dams had fish passage, returns of adult fall Chinook to the Snake River declined to very small numbers: an average of 12,720 from 1964 through 1968; 3,416 from 1969 through 1974; and 610 from 1975 through 1980 (Waples et al. 1991). Only about 78 natural-origin adults~~individuals~~(Lavoy and Mendel 1996) returned to the Snake River in 1990, which precipitated the ESA-listing of the species. Snake River fall Chinook salmon spawn in the tailraces of the lower Snake River dams (Dauble et al. 1999) and the juveniles rear, as well as migrate, in each of the eight reservoirs formed by 8 FCRPS dams (e.g., Tiffan et al. 2009; Tiffan and Connor 2011; PTAGIS 2013). The upper end (tailrace) of the Lower Granite Dam reservoir is now the downstream limit of the ESU's spawning habitat and the reservoir is the downstream end of ~~and~~ early (pre-smolt) rearing habitat. Figure 2-1~~2~~ shows the dams on the length of the Snake River from the current accessible habitat to the historical extent of the fall Chinook.

Comment [EG2]: BIA, what was historical downstream extent?

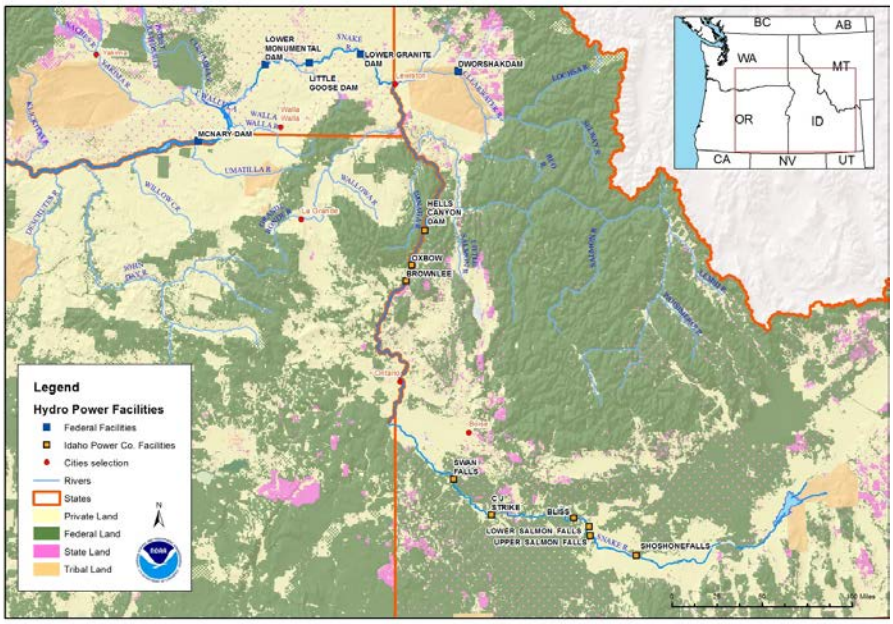

Figure 2-1~~2~~. Snake River hydropower facilities from the historical limit of fall Chinook access to the confluence with the Columbia River.

2.3 Life History

~~Fall Chinook salmon in the Columbia River Basin can be divided into two physiologically distinct types: "tules" and "upriver brights." Tules are sexually mature when they enter fresh water as adults, as indicated by their dark coloration, and generally spawn in the lower Columbia River tributaries. Fall-run fish, destined to spawn in upriver areas such as the Snake River, are known as "brights" because, having a greater distance to travel upriver before spawning, they mature more slowly, and retain their silvery oceanic coloration well into their freshwater migration (Waples et al. 1991).~~

~~Most adult Snake River fall Chinook salmon spend three years in the ocean before returning between August and October (Waples et al. 1991). Most adults migrate past Lower Granite Dam between early September and mid-October. Spawning occurs in the mainstem Snake and Clearwater Rivers and in the lower-most portions of its major tributaries between mid-October and early December. In recent years, spawning in the mainstem Snake River has peaked in late October or early November, but individuals may be found spawning any time between mid-October and mid-December (Garcia et al. 2004a; Groves 2004).~~

The number of years Snake River basin fall Chinook salmon spend in the Pacific Ocean is dependent on gender and age-at-ocean entry (Connor et al. 2005). Natural-origin females that had entered the ocean as subyearlings typically spend three years in saltwater (80% of the 1998–2003 returns), whereas females that had entered the ocean as yearlings typically spend three to four years in saltwater (1998–2008 returns; 44% III-Salt; 54% IV-Salt). Natural-origin males that entered the ocean as subyearlings largely return to freshwater after three years in saltwater (47% of the 1998–2003 returns). Males that entered saltwater as yearlings have a relatively even ocean-age class distribution (1998–2008 returns; 29% II-Salt; 31% III-Salt; 24% IV-Salt). Most adults enter the Snake River mouth between early September and mid-October (DART 2013). The Snake River upper reach, Snake River lower reach, and the lower Grande Ronde, lower Clearwater, and lower Tucannon rivers are presently recognized as the five major spawning areas for Snake River basin fall Chinook salmon (described in section 2.4 below). In recent years, adults in the Snake, Grande Ronde, and Tucannon rivers spawned from late October through early December and spawning peaked about the first week in November (Connor et al. 2011; D. Milks, unpublished data). Adults spawn about a week or two earlier in the lower Clearwater River compared to the adults in the other four major spawning areas (Connor et al. 2011).

~~Water temperatures are generally warmer in the upper Hells Canyon reach (Salmon River confluence upstream to Hells Canyon Dam) compared to the lower reach (Lower Granite reservoir upstream to the Salmon River confluence) (Connor et al. 2002; Connor and Burge 2003). This temperature difference affects the timing of fry emergence (Connor et al. 2003a). Fry emergence occurs between mid-April and mid-June (median emergence dates range from late April to late May) in the upper reach and between early April and mid-July (median emergence dates range from mid-May to mid-July) in the lower reach of Hells Canyon, respectively (Connor et al. 2002).~~

Comment [CW3]: **Elizabeth, here is where I started. All the new text is in blue. The old text is deleted in track changes.**

Note the differences in terminology used here to describe the major spawning areas compared to what is used in section 2.4. The terminology here is our project standard, Cooney and I have chatted about standardizing it, but if you want to change it to the ICRT terminology that works for me too.

After reading all of the comments, this is what I did to address them.

(1) Brought in all the information I could on life history across the five major spawning areas including as many actual values as possible for context.

(2) Threw in some historical information to address the BIA comment EG10 (below).

(3) Updated Figure 2-4 and its description including information for all five major spawning areas.

(4) Provided references in the comment boxes.

Comment [CW4]: **Connor, W.P., J.G. Sneva, K.F. Tiffan, R.K. Steinhorst, and D. Ross. 2005. Two alternative juvenile life histories for fall Chinook salmon in the Snake River basin. Transactions of the American Fisheries 134:291-304.**

Comment [CW5]: **DART (Data Access Real Time). 2013. Available http://www.cbr.washington.edu/dart/query/adult_annual_sum. (July 2013).**

Comment [CW6]: **Connor, W. P., A. P. Garcia, S. Bradbury, B. D. Arnsberg, and P. A. Groves. 2011. Fall Chinook spawning ground surveys in the Snake River basin upriver of Lower Granite Dam, 2010. Chapter one *in* W. P. Connor and K. F. Tiffan, editors. Research, monitoring, and evaluation of emerging issues and measures to recover the Snake River fall Chinook salmon ESU. 2009 annual report to the Bonneville Power Administration, project 199102900.**

Comment [EG7]: Billy, can you please help with this and Kurt Tardy also asked for some actual values for context…

Comment [EG8]: BIA asked can we clarify whether this is existing or historic (i.e. pre-dam) and whether that has changed over time?

The early life history timing and growth of naturally produced juveniles in riverine habitat is dependent on growth opportunity, which in turn is largely related to water temperature. Taylor (1990) found that relatively warm streams produced juvenile Chinook salmon that migrated seaward as subyearlings, whereas relatively cool streams produced juvenile Chinook salmon that migrated seaward as yearlings. This growth opportunity paradigm can be used to depict early life history timing and growth of juvenile fall Chinook salmon prior to the anthropogenic perturbations caused by settlers in the 19th century, and to help understand variation in early life history among fish of the five major contemporary spawning areas.

Comment [CW9]: Taylor, E. B. 1990. Environmental correlates of life-history variation in juvenile chinook salmon, *Oncorhynchus tshawytscha* (Walbaum). Journal of Fish Biology 37:1-17.

As described in sections 2.1 and 2.2, the core population of fall Chinook salmon spawned along the Middle Snake River that was historically supplied with relatively warm spring water. The observational studies reviewed in sections 2.1 and 2.2 also suggest that fall Chinook salmon spawned in the lower Snake River and at least seven of its major tributaries including the lower Clearwater River, and the Middle Fork Clearwater and Selway rivers. The unperturbed habitat in these rivers likely fostered phenotypic diversity in spawn timing, rearing, and initial seaward migration as temperature varied among the rivers. The progression through the life stages that precede downstream dispersal from natal riverine habitat was likely earliest in the relatively warm, spring-fed spawning areas of the Middle Snake River that fostered rapid incubation and growth. Juveniles of subpopulations that were locally adapted to the relatively cool habitats in the Clearwater River drainage likely progressed through the juvenile stages latest and grew the slowest. Once downstream dispersal began, the seaward migrants had unrestricted access to pristine, abundant, and diverse habitats along the Columbia River and Estuary. Thus, the juveniles had the opportunity to either enter the Pacific Ocean as subyearlings, or overwinter in fresh or brackish water and enter the ocean as yearlings.

Of the five major contemporary spawning areas, the lower Tucannon River is the warmest during egg incubation followed closely by the Snake River upper reach (e.g., mean incubation temperatures, 6.4, 6.7, and 6.6°C versus 6.0, 5.9, and 6.4°C), whereas the lower Clearwater River remains the coolest (e.g., mean incubation temperatures 5.0, 5.1, and 5.0°C; brood year1992–1994 from Connor et al. 2003a). The developmental timing of juveniles in the Tucannon River and upper Snake River Reach are similar to what was observed historically in the Middle Snake River (Connor et al. 2002, 2003a), but hypoliminetic releases from Dworshak Reservoir have warmed the winter thermal regime in the lower Clearwater River and accelerated egg incubation compared to historical conditions in that river. Emergence timing estimates for brood years 1992–1994 ranged from April 8 to April 18 for the Tucannon River, April 16 to April 27 for the Snake River upper reach, and May 28 to June 2 for the lower Clearwater River (Connor et al. 2003a).

Comment [CW10]: Connor, W.P., C.E. Piston, and A.P. Garcia. 2003. Temperature during incubation as one factor affecting the distribution of Snake River fall Chinook salmon spawning areas. Transactions of the American Fisheries Society 132:1236-1243.

Comment [CW11]: Connor, W.P., H.L. Burge, R. Waitt, and T.C. Bjornn. 2002. Juvenile life history of wild fall Chinook salmon in the Snake and Clearwater rivers. North American Journal of Fisheries 22:703-712.

Most young fall Chinook salmon presumably locate the shoreline in riverine habitat after emerging from the gravel (e.g., Connor et al. 2002; but see Tiffan and Connor 2011). Temperature during shoreline rearing continues to influence growth opportunity hence the timing of dispersal from riverine habitat into downstream reservoirs. For example in spring 1995, the Snake River upper reach averaged 11.8°C and fall Chinook salmon parr rearing along the shorelines grew an average (± SD) of 1.2 ± 0.3 mm/d compared to parr rearing along the Snake River lower reach that experienced a mean spring temperature of 10.9°C and grew an average of 1.0 ± 0.3 mm/d (Connor and Burge 2003). The dates of peak dispersal from the Snake River

Comment [CW12]: Tiffan, K. F., and W. P. Connor. 2011. Seasonal use of shallow water habitat in the lower Snake River reservoirs by juvenile fall Chinook salmon. 2010–2011 final report of research to the U.S. Army Corps of Engineers, Walla Walla District.

Comment [CW13]: Connor, W.P., and H.L. Burge. 2003. Growth of wild subyearling Chinook salmon in the Snake River. North American Journal of Fisheries Management 23:594-599.

upper and lower reaches into Lower Granite Reservoir were May 28 and June 4 in 1995 (Connor et al. 2002). Compared to the parr in the Snake River reaches, the factors affecting growth and downstream dispersal of young fall Chinook salmon in the lower Clearwater River are poorly understood. It is known, however, that lower Clearwater River parr grow more slowly (e.g., 1995, 0.8 ± 0.5 mm/d; W. Connor, unpublished data) and linger in riverine habitat longer (e.g., 1995 date of peak dispersal July 2; Connor et al. 2002) than parr in the Snake River reaches.

The behavior of parr after the initiation of downstream dispersal from riverine habitat has not been fully investigated in the Tucannon River and Grande Ronde rivers, but this behavior has been a large topic of research in the two Snake River reaches and the lower Clearwater River. Connor et al. (2003b) deduced that downstream dispersal through the Snake River and into Lower Granite Reservoir was rapid due to high riverine velocities. Tiffan et al. (2009a) found that young fall Chinook salmon become disoriented, and their downsteam progress is delayed, as they pass through the lower 10 km of the Snake River lower reach where the river transitions and forms the south arm of Lower Granite Reservoir. The parr then move downstream slowly while feeding and growing until they become actively migrating smolts. The behavior of natural parr after the initiation of downstream dispersal from riverine habitat of the lower Clearwater River is heavily dependent on when the parr begin to move downstream. Those parr that begin downstream dispersal in about June likely move downstream rapidly until they are delayed in lower 6 km of the lower Clearwater River where the river transitions and forms the east arm of Lower Granite Reservoir (Tiffan et al. 2009b). These early dispersing fish have the opportunity to enter Lower Granite Reservoir, grow, and then become actively migrating smolts along with their Snake River counterparts. However, the average parr in the lower Clearwater River does not begin downstream dispersal before a partial thermal barrier forms in July when the warm Snake River water from the south arm of Lower Granite Reservoir meets the cool lower Clearwater River water from the east arm of the reservoir (Cook et al. 2006). Natural parr can be delayed in the east arm until the thermal barrier dissipates in September (B. Arnsberg, unpublished data). Such fish continue to grow (e.g., 103 mm fork length in August) but it is unlikely that many resume active migration as subyearlings because their late schedule of development coincides with environmental conditions that do not favor smoltification (e.g., declining photoperiod and temperature).

Time of passage at Lower Granite Dam is closely associated with growth and juvenile development in Lower Granite Reservoir, which in turn are dependent on many factors including juvenile abundance in the reservoir. Juveniles from the Snake River upper and lower reaches share a common temperature environment in the reservoir that is regulated by summer flow augmentation, thus the growth differences observed between fish from the two reaches in riverine habitat diminishes (Connor and Burge 2003). Tiffan et al. (2009c) found that young fall Chinook salmon move up and down in the water column of the reservoir to maintain an optimum body temperature for growth.

As a result of the environment and fish behavior in the reservoir, smolt growth was once one of the highest reported in the peer-reviewed literature (1995–1998 means ± SD, range 1.2–1.4 mm/d; Connor and Burge 2003). However, as a result of the expanding ~~recoveryprogram~~ improvements in ESA protections combined with increased hatchery production, estimated abundance of fall Chinook salmon (natural and hatchery combined) subyearlings in the reservoir

Comment [CW14]: Connor, W.P., R.K. Steinhorst, and H.L. Burge. 2003. Migrational behavior and seaward movement of wild subyearling fall Chinook salmon in the Snake River. North American Journal of Fisheries Management 23:414-430.

Comment [CW15]: Tiffan, K.F., T.J. Kock, C.A. Haskell, W.P. Connor, and R.K. Steinhorst. 2009a. Water velocity, turbulence, and migration rate of subyearling fall Chinook salmon in the free-flowing and impounded Snake River. Transactions of the American Fisheries Society 138:373-384.

Comment [CW16]: Tiffan, K. F., W. P. Connor, G. A. McMichael, M. C. Richmond, B. J. Bellgraph, W. A. Perkins, P. S. Titzler, I. D. Welch, J. A. Carter, K. A. Deters, J. R. Skalski, and R. A. Buchanan . 2009. Chapter one *in* Snake River fall Chinook Salmon life history investigations. Annual Report 2007 to the Bonneville Power Administration. Project 200203200.

Comment [CW17]: Cook, C.B., Richmond, M.C., Titzler, S.P., Dibrani, B., Bleich, M.D. and Fu, T. (2006). Hydraulic characteristics of the lower Snake River during periods of juvenile fall Chinook salmon migration. Final Report to the Bonneville Power Administration, Contract DE-AC05-76RL01830, Portland, Oregon.

Comment [CW18]: Tiffan, K.F., T.J. Kock, W.P. Connor, R.K. Steinhorst, and D.W. Rondorf. 2009c. Behavioural thermoregulation by subyearling fall (autumn) Chinook salmon Oncorhynchus tshawytscha in a reservoir. Journal of Fish Biology 74:1562-1579.

increased from a low of 13,777 in 1992 to a high of 3,764,636 in 2005 (Connor et al. in press). Connor et al. (in press) expressed growth in g/d, and they found that during the "low abundance period" 1992–1999 growth in the reservoir for Snake River upper and lower reach fish combined averaged 0.6 ± 0.4 g/d, compared to 0.2 ± 0.3 g/d for fish during the "high abundance period" 2000–2011. Smolt fork length fell from an average of 137 ± 8 mm during the low abundance period to an average of 94 mm ± 0.7 mm during the high abundance period. The inter-annual mean of the median days of passage at Lower Granite Dam for Snake River upper and lower reach fish combined was 14 d later during the low abundance period (July 14 ± 10 d) than during the high abundance period (June 30 ± 6 d). A similar response in smolt growth and passage timing has not been documented for fish from the lower Clearwater River, noting that juveniles from that river do not experience high levels of smolt abundance for two reasons. The increase in abundance of subyearling smolts is highly correlated with the number of subyearling hatchery smolts released (r^2 = 0.67; Connor et al. in press), and the large majority of hatchery smolts pass Lower Granite Dam before natural-origin parr from the lower Clearwater River enter the reservoir (e.g., Connor et al. 2012). Nevertheless, across the major spawning areas, juveniles from the Clearwater River pass Lower Granite Dam the latest. For example in 2011, the median dates of passage for fish from the Snake River upper reach, Snake River lower reach, and lower Clearwater River were June 16, July 12, and September 28 (Connor et al. 2012).

Mains and Smith (1964) provided a relatively narrow but informative historical perspective on smolt migration timing through the lower Snake River. They sampled juvenile anadromous salmonids 41 km downstream from the present location of Lower Granite Dam (constructed in 1973) in 1954 and 1955 after the locally adapted Clearwater River subpopulation had been driven to extinction (Rich 1940), but when brood year 1953 and 1954 natural-origin fall Chinook salmon juveniles from the Middle and Lower Snake rivers were migrating seaward. Based on daily catch data, passage of the entire Chinook salmon smolt run was complete by the end of June (Mains and Smith 1964). During the low abundance period, only 25% of the smolts from the Snake River reaches had passed Lower Granite Dam by the end of June compared to 50% during the high abundance period. Since it is unlikely that the construction of the Hells Canyon Complex caused a net reduction in cumulative temperature units between spawning and downstream dispersal from natal riverine habitat, the protracted nature of passage through Lower Granite Reservoir presently observed must be the result of impoundment. Migrants pass much faster through free-flowing stretches of river than through reservoirs (e.g., means ± SDs for subyearling smolts, 107 ± 6 km/d versus 19 ± 3 km/d; Tiffan et al. 2009a).

Some contemporary smolts from the five major spawning areas sustain active migration after passing Lower Granite Dam and enter the ocean as subyearlings, whereas some delay seaward migration and enter the ocean as yearlings (Connor et al. 2005; McMichael et al. 2008). Those fish that discontinue active seaward migration continue to move downstream slowly throughout winter while growing to fork lengths above 170 mm before increasing their rate of downstream movement and entering saltwater in spring (Connor et al. 2005; Tiffan et al. 2012). This alternative pathway to the ocean was first observed in Brownlee Reservoir in 1958 (Durkin et al. 1970), and is referred to as the "reservoir-type" juvenile life history or tactic (Connor et al. 2005).

Comment [CW19]: Connor, W. P., K. F. Tiffan, J. M. Plumb, and C. M. Moffitt. In press. Evidence for density-dependent changes in growth, downstream movement, and size of Chinook salmon subyearlings in a large river landscape. Transactions of the American Fisheries Society (accepted May 2013).

Comment [CW20]: Connor, W. P. B. D. Arnsberg, S. G. Smith, D. M. Marsh, and W. D. Muir. 2012. 2011 Post-release performance of natural and hatchery subyearling fall Chinook salmon in the Snake and Clearwater rivers. Report of the U. S. Fish and Wildlife Service, Nez Perce Tribe, and National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Comment [CW21]: Mains, E. M. and J. M. Smith. 1964. The Distribution, size, time and current preferences of seaward migrant chinook salmon in the Columbia and Snake Rivers. Washington Department of Fisheries, Fisheries Research Papers 2(3):5-43.

Comment [CW22]: Rich, W. H. 1940. Report on the Snake River basin including the Umatilla River. Reproduction from the University of Washington Libraries, Seattle Washington.

Elizabeth, if you have a copy of this and a better citation I would appreciate both. I just have a very old copy of part of it.

Comment [CW23]: McMichael, G. A., M. C. Richmond, W. A. Perkins, J. R. Skalski, R. A. Buchanan, J. A. Vucelick, E. E. Hockersmith, B. R. Beckman, P. N. Westhagen, K. D. Ham, I. D. Welch, B. J. Bellgraph, P. S. Titzler, B. P. Sandford. 2008. Lower Monumental Reservoir juvenile fall Chinook Salmon behavior studies, 2007. Final report to the U.S. Army Corps of Engineers, Walla Walla District.

Comment [CW24]: Tiffan, K.F., T.J. Kock, W.P. Connor, F. Mullins, and R.K. Steinhorst. 2012. Downstream movement of fall Chinook salmon juveniles in the lower Snake River reservoirs during winter and early spring. Transaction of the American Fisheries Society 141:285-293.

Comment [CW25]: Durkin, J.T., D.L. Park, and R.F. Raleigh. 1970. Distribution and movement of juvenile salmon in Brownlee Reservoir, 1962-65. U.S. Fish and Wildlife Service Fishery Bulletin 68:218-243.

Although the proportion of the natural-origin juvenile population that exhibits the reservoir-type tactic is not known, its importance to adult returns has been widely discussed and documented. Haas (1965) speculated that the fish that survived in Brownlee Reservoir to become yearling migrants were sustaining production in the Middle Snake River that was historically sustained by subyearling migrants. Connor et al. (2005) reported that an overall average of 41% of the natural-origin adults they collected at Lower Granite Dam during 1998–2003 had entered the ocean as yearlings. Hegg et al. (2013) conducted otolith microchemistry on a sample of adults collected at Lower Granite Dam presumed to be of natural origin during 2006–2008. Of the adults sampled, 16 were determined to be from the Snake River upper reach, 58 were from the Snake River lower reach, 2 were from the Grande Ronde River, and 44 were from the Clearwater or Salmon rivers (water chemistry signals did not vary between these rivers). The percentage of the returning adults estimated to have entered the ocean as yearlings was 13% for fish from the Snake River upper reach, 62% for fish from the Snake River lower reach, 50% for fish from the Grande Ronde River, and 77% for fish from the Clearwater-Salmon River grouping. Of these adults, it was estimated that 97% had inhabited the lower Snake River reservoirs during winter.

Comment [CW26]: Haas, J. B. 1965. Fishery problems associated with Brownlee, Oxbow, and Hells Canyon dams on the Middle Snake River. Investigational report no. 4. Fish Commission of Oregon, Portland, Oregon.

Comment [CW27]: Hegg, J. C., B. P. Kennedy, P. M. Chittaro, and R. W. Zabel. 2013. Spatial structuring of an evolving life history strategy under altered environmental conditions. Oecologia DOI 10.1007/s00442-012-2564-9

~~Snake River fall Chinook typically exhibit an "ocean" type juvenile life history pattern, usually rearing in freshwater for only a few months before migrating to the ocean. For this reason, fall Chinook salmon smolts are sometimes referred to as "subyearling." However, close to half of Snake River fall Chinook juveniles now overwinter in the reservoirs and migrate downstream as yearlings (Appendix H of Milks et al. 2009, appendix H, as cited in Ford et al. 2010~~2011~~, appendix H). Because of cold water releases from Dworshak Dam, Today, j~~Juvenile fall Chinook incubating and rearing in the lower Clearwater River, (the coolest of the five major spawning areas), are more likely to emerge later, grow more slowly, and migrate later than was occurred true historically. Juveniles from the lower Clearwater are much more likely to overwinter in one or more Lower Snake River or Columbia River reservoirs and outmigrate as yearlings than are juveniles rearing in even the lower Hells Canyon Reach (Connor et al. 2002; Connor and Burge 2003). Yearling migrants contribute substantially to the population as a whole; that is, juveniles that survive the summer and winter return at very high rates compared to the traditional subyearling migrants (Connor et al. 2005, Marsh et al. 2007).~~

~~While rearing, juveniles feed in shallow, nearshore areas and grow quickly (from 1.1 to 1.3 mm and from 0.8 to 1.1 mm per day in the upper and lower reaches of Hells Canyon, respectively) (1995 to 2000 data presented in Connor and Burge 2003). Upon reaching sufficient size or physiological status (smoltification), or when water temperature or food availability becomes limiting, juveniles abandon these feeding areas and begin migrating downstream (Tiffan et al. 2000; Connor et al. 2002; Connor and Burge 2003). As the number of spawners and redds has increased over the past decade (Garcia et al. 2004a), the date at which the peak number of rearing juveniles are caught in Hells Canyon monitoring areas has gotten progressively earlier (from late May/early June to late April/mid-May for the upper and lower reaches, respectively), and these fish have become increasingly smaller in both reaches as well (Connor 2005).~~

~~The pattern of earlier juvenile outmigration in recent years is also observed in the passage timing of juvenile fall Chinook salmon at Lower Granite Dam, the first mainstem dam downstream of Hells Canyon Dam. Since 1996, the peak of the naturally produced subyearling fall Chinook~~

~~salmon smolt migration at this point has occurred between mid-June and mid-July, with the great majority of the smolts passing between early June and mid-August.~~

Juvenile fall Chinook salmon also rear in the lower Columbia River and estuary (Waples et al. 1991). Migration timing to the estuary is critical as there is a finite window of opportunity during which juveniles are physiologically able to survive the transition from fresh water to salt water (Tiffan et al. 1997). Previous research indicated that upon entering the Pacific Ocean, most Snake River fall Chinook salmon smolts appeared to migrate northward along the continental shelf where they fed in the cool, productive coastal waters of the North Pacific until becoming adults and beginning their migration to their natal waters (Myers et al. 1998). However, a 2012 synthesis of U.S. and Canadian ocean research since 1998 indicates that Snake River fall Chinook smolts "disperse slowly both south and north of the Columbia River following a protracted period of ocean entry that begins in spring and continues into autumn (~~Brodeur et al. 2004; Teel 2004; Trudel et al. 2004, 2009; Tucker et al. 2011; Fisher et al. in revision~~Jacobsen et al. 2012). These subyearlings reside in coastal areas off Oregon and Washington throughout summer and fall. A few are caught off Vancouver Island, but only in fall; in winter, they appear to initiate a northward migration (Tucker et al. 2011)~~"~~ (Jacobson et al. 2012).

Comment [EG28]: CTUIR comment - More detail here would be good,i.e. how many smolts pass between mid-August and October? Are they hatchery origin or natural? Percentages? Billy or someone, can you help? From EG, can one of the scientists please help respond

Comment [EG29]: Ritchie points out, make sure you don't mix up Snake River proper vs. Clearwter reared fish here. The great majority of the Snake River fish are now migrating past lower Granite dam by mid-July-the peak isnow typically mid to late June.

Comment [EG30]: Will update this section with new data and analyses from Ocean Science Program including maps of ocean distribution.

2.4 Distribution

The Snake River fall-run Chinook salmon ESU is one of three fall Chinook ESUs that spawn and rear in the Interior Columbia basin (figure 2-2)(NMFS 1999a, 64 FR 50394). The other two are the Upper Columbia River summer- and fall-run Chinook salmon ESU and the Deschutes River summer-and fall-run Chinook salmon ESU. The Upper Columbia summer- and fall-run Chinook salmon ESU, which spawns in the Hanford Reach and in the lower reaches of major tributaries to the Middle Columbia, is considered viable and self-sustaining~~relatively healthy~~ and therefore is not ESA-listed. It is considered to have the closest affinity to the Snake River fall Chinook ESU, but genetic differences also indicate "significant, long-term reproductive isolation of the two groups." (Waples et al. 1991; NMFS 1999a).

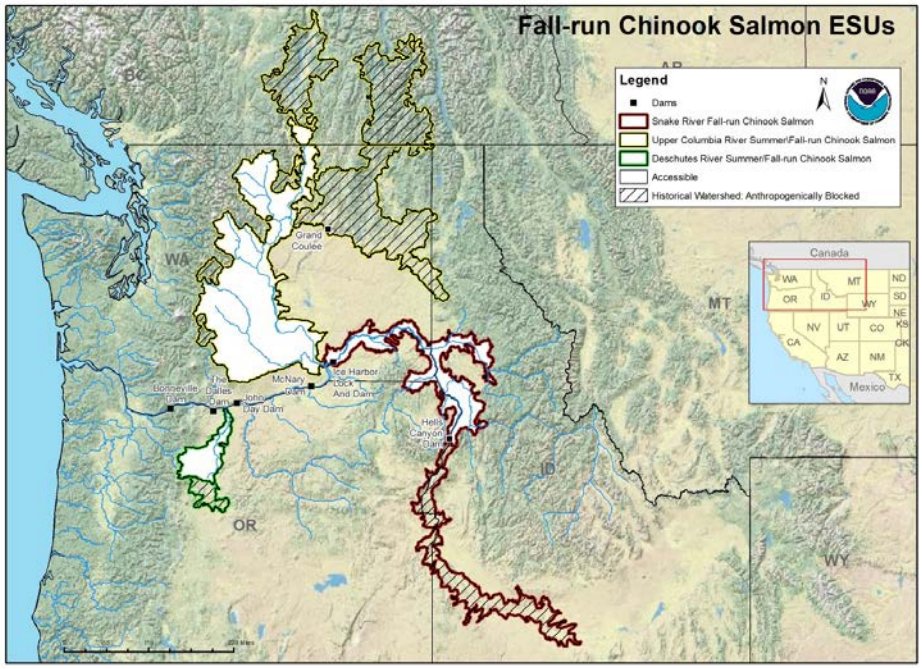

Figure 2-2. Distribution of Interior Columbia River fall Chinook ESUs. The Deschutes River ESU is considered a single population and is also not ESA-listed. Genetic and life-history data for the current population indicate a closer affinity to fall Chinook in the Snake River than to those in the Columbia River (Myers et al. 1998). The 1998 Biological Review Team[4] considered several hypotheses and a majority of the team concluded that the Deschutes River population should be included in the Snake River fall Chinook ESU (Busby et al. 1999). One hypothesis was that the Deschutes River fall-run population was part of a larger historical ESU that included the John Day, Umatilla, and Walla Walla Rivers. If so, these intermediate populations, which are now extirpated, could have represented a linked set of populations extending from the Deschutes up through the Snake River Basin. However, NMFS subsequently reviewed all the available scientific information and found the evidence inconclusive. The ecological distinctiveness of the historical Snake River, Umatilla, and Walla Walla Rivers and Deschutes River spawning habitats argued against their being included in the same ESU. NMFS concluded that the Deschutes population should be considered a separate ESU (NMFS 1999a).

The Interior Columbia Technical Recovery Team~~CTRT~~ concluded that the Snake River historically supported an ESU of fall-run Chinook with a single MPG made up of three populations: the Lower Mainstem, Middle Mainstem, and Upper Mainstem (ICTRT 2005, ~~and ICTRT~~ 2010). At present, only the Lower Mainstem population (including tributaries below

[4] Because the ESA stipulates that listing determinations should be made on the basis of the best scientific information available, NMFS formed teams of scientists with diverse backgrounds in salmon biology to conduct the status review for Chinook salmon and called these teams Biological Review Teams.

Hells Canyon) is extant (Figure 1-1). The great majority of Snake River fall Chinook production was associated with the two populations that were centered on the mainstem Snake River in island/channel habitats above the Hells Canyon ~~Dam~~ complex.

The Upper Mainstem population extended some 157 miles from Shoshone Falls (a natural barrier to upstream fish passage) downstream to Swan Falls. This was an area of high production, particularly, as described below, downstream of Thousand Springs and Upper Salmon Falls. This population was extirpated by the Swan Falls Dam in 1901.

The Middle Mainstem population extended from Swan Falls more than 200 miles downstream into Hells Canyon and was particularly productive upstream of RM 425, the current town of Marsing ("the Marsing reach") (Dauble et al. 2003). This is believed to have been the primary spawning and rearing area for Snake River fall Chinook after Swan Falls Dam was completed (Haas 1965; Irving and Bjornn 1981~~; Haas 1965~~). These two extirpated populations likely made up approximately 60 percent of all production in the ESU before the Hells Canyon Complex and lower Snake dams were completed (Chandler et al. 2001; ~~see also~~ Dauble et al. 2003). After the inundation of the lower Snake River spawning areas by Federal and private hydropower development~~reservoirs~~, the remaining spawning habitat in the Hells Canyon Reach has been estimated at 17 to 20 percent of the spawning area historically available (Chandler et al. 2001; ~~and~~ Dauble et al. 2003)~~, respectively.~~

The only extant Snake River fall Chinook population, the Lower Mainstem Snake River population, occupies 100 miles of the mainstem Snake River from the Hells Canyon Dam downstream to the upper end of the Lower Granite Dam pool (near Lewiston, Idaho). ~~, a distance of 100 miles)~~, plus the lower reaches of major tributaries (ICTRT 2010). The Lower Mainstem area has historically been substantially less productive than the areas that supported the two extirpated populations in the ESU (Dauble et al. 2003). The historical metapopulation of Snake River fall Chinook included a core population in the middle Snake River centered around Marsing, as well as functionally dependent or locally adapted subpopulations that spawned in numerous locations including the lower Snake, Grande Ronde, Clearwater, and Selway rivers. ~~On the other hand, the~~ However, the extant l~~L~~ower Mainstem population has multiple spawning areas in diverse tributary habitats that are important for ~~, which gives this extant population more~~ diversity and potential resilience. ~~than the extirpated populations, which spawned only in the mainstem.~~

Comment [EG31]: From WConnor: "I think we can make the case the historical (or pre-historical) metapopulation of fish that spawned during the fall included a core population in the middle Snake River centered around Marsing, as well as functionally dependent or locally adapted subpopulations that spawned in numerous locations including the lower Snake, Grande Ronde, Clearwater, and Selway rivers. Thus, the contemporary (i.e., extant population) is not more diverse than the historical metapopulation---but the existing phenotypic diversity and spatial distribution will be important to recovery. "

For the extant Lower Mainstem population, the ICTRT identified the following five major spawning areas (MaSAs), in a trellis-structured arrangement (Figure 2-3).

1. *Upper Mainstem Snake River reach* - Hells Canyon Dam downstream to the mouth of the Salmon River and including the lower mainstem of the Imnaha and Salmon rivers
2. *Lower Mainstem Snake River reach* - mouth of the Salmon River downstream to the upper end of Lower Granite Reservoir;
3. *Grande Ronde River*;
4. *Clearwater River*:*and*
5. *Tucannon River* (and contiguous mainstem Snake River habitat)

~~Four of the five MaSAs are currently occupied. The Tucannon MaSA is unoccupied.~~ The method for delineating these MaSAs differed from that used for Snake River steelhead and

spring/summer Chinook salmon ~~and is~~ (summarized in: ICTRT 2007). Based on redd distributions and habitat capacity estimates, the ICTRT determined that the Upper Mainstem ~~two~~ Snake River ~~mainstem~~ reach MaSA~~major spawning areas~~ (above the Salmon River) and the Lower Mainstem Snake River reach MaSA~~and~~(below the Salmon River) each have the physical capacity to support more than the 500-spawner minimum criterion used by the ICTRT for other interior Columbia ESUs ~~(ICTRT 2007) for a~~ MaSAs (ICTRT 2007) (~~extrapolated from habitat analyses in Connor et. al 2001 and Groves & Chandler 1999)~~. The "core" spawning area for the population is in ~~was~~ the mainstem Snake River; spawning areas in lower reaches of the larger tributaries provided additional sources of production.

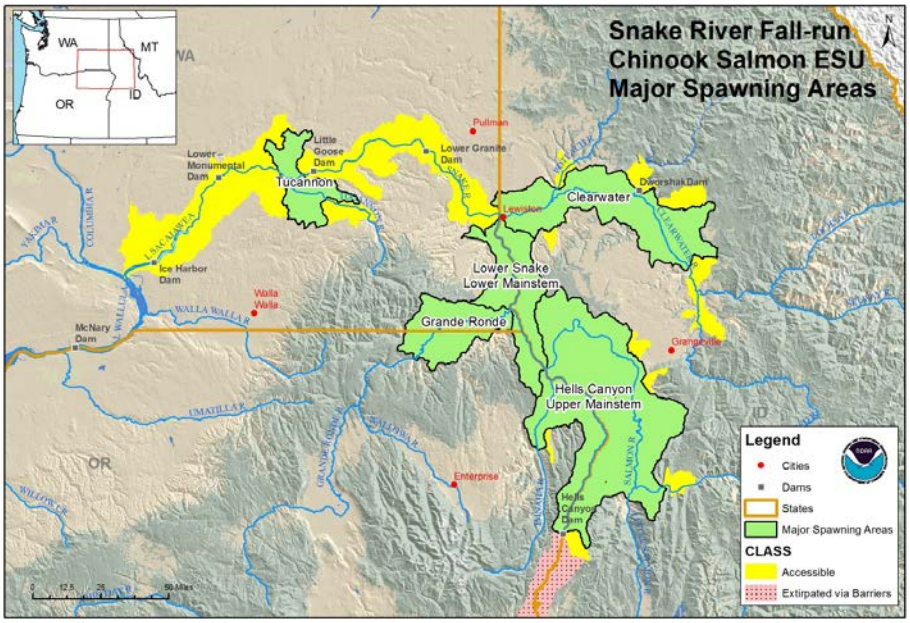

Figure 2-3. Current Snake River Fall Chinook Major Spawning Areas (MaSAs). Note: Designation of MaSAs for this population were based on consistent spatial patterns in annual redd counts and USGS spawning habitat modeling specific to mainstem spawning chinook.. Snake River fall chinook MaSAs reflect geographic separation in spawning habitat patches, current spawning densities and unique habitat conditions in adjoining lower tributary reaches. (Source: ICTRT 2010)

~~Most of the spawning of Snake River fall Chinook occurs in the mainstem Snake River (Figure 2-4). In recent years, where spawning surveys have expanded, more than 50 percent of the redds are counted in the Snake River, followed by the Clearwater, then the Grande Ronde.~~

Redd survey effort increased after the Snake River fall Chinook salmon ESU was petitioned and listed under the Endangered Species Act. Redd counts provide a general depiction of the spatial distribution of spawning in the wild. Since 1991 the majority of the redds have been counted in the Snake River upper reach (mean ± SE, 30 ± 2%) followed closely by the lower Clearwater

River (24 ± 2%) and Snake River lower reach (23 ± 2%), and the Tucannon (11 ± 2%) and Grande Ronde (7 ± 1%) rivers (Figure 2-4).

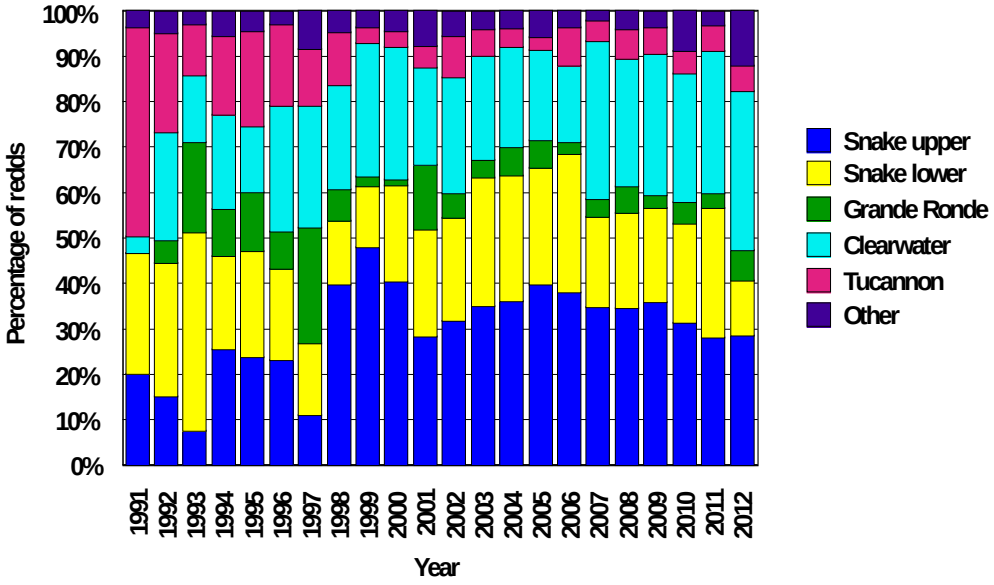

Figure 2-4. Percent of Snake River basin fall Chinook salmon redds counted in the five major spawning areas and in other adjacent areas surveyed since the population was petitioned for listing in 1991 (data from the Idaho Power Company, Nez Perce Tribe, U.S. Fish and Wildlife Service, and Washington Department of Fish and Wildlife).

2.5 Critical Habitat

The ESA requires the Federal government to designate "critical habitat" for any species it lists under the ESA. The Act defines critical habitat as areas that contain physical or biological features that are essential for the conservation of the species, and that may require special management or protection. Critical habitat designations must be based on the best scientific information available, in an open public process, within specific timeframes.

A critical habitat designation does not set up a preserve or refuge, and critical habitat requirements do not apply to citizens engaged in activities on private land that do not involve a Federal agency. The designation applies only when Federal funding, permits, or projects are involved. Under section 7 of the ESA, all Federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat. Before critical habitat is designated, careful consideration must be given to its economic impacts, impacts on national security, and other relevant impacts. The Secretary of Commerce may exclude an area from

critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area will result in the extinction of the species concerned.

The physical and biological elements, also called "primary constituent elements," or PCEs, that support one or more life stages and are considered essential to the conservation of the species are described in detail in the final rule designating critical habitat for 12 West Coast salmon and steelhead ESUs (NMFS, September 2, 2005, 70 FR 52630)

Essential salmon habitat consists of four components: (1) spawning and juvenile rearing areas: (2) juvenile migration corridors; (3) areas for growth and development to adulthood; and (4) adult migration corridors.

Essential features of spawning and rearing areas include adequate (1) spawning gravel; (2) water quality; (3) water quantity; (4) water temperature; (5) food; (6) riparian vegetation; and (7) access (58 FR 68543).

Essential features of juvenile migration corridors include adequate: (1) substrate; (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions (58 FR 68543). The adult migration corridors are the same areas, and the essential features are the same with the exception of adequate food (adults do not eat on their return migration to natal streams).

The Pacific Ocean areas used by listed salmon for growth and development to adulthood are not well understood, and essential areas and features in the ocean have not been identified (58 FR 68543). However, recent data and analyses are starting to provide information which is summarized in the plume and nearshore ocean module (Appendix X)

(Table 2-2) is a summary of the physical and biological features considered essential for anadromous salmon and steelhead.

~~Table 2-2. Types of sites and essential physical and biological features designated as PCEs for anadromous salmonids, and the life stage each PCE supports (Bambrick 2004).~~

Site	Essential Physical and Biological Features	ESU/DPS Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover[a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[b]	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover,[a] forage,[b] and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover,[a] and forage[b]	Growth and maturation, survival
Offshore marine areas	Water quality and forage[b]	Growth and maturation

Table 2-2 Types of sites and essential physical and biological features designated as PCEs for anadromous salmonids, and the life stage each PCE supports (Bambrick 2004).

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

Critical habitat for Snake River fall Chinook was designated on December 28, 1993 (58 FR 68543) and is encompassed by critical habitat designated for all four listed Snake River salmonid species. Designated critical habitat for the four listed Snake River species includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers, and all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam (NMFS 1999). Critical habitat also includes river reaches presently or historically accessible (except those above impassable natural falls and Dworshak and Hells Canyon dams).

The lower Columbia River corridor is among the areas of high conservation value to these species because it connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats.

Designated areas consist of the water, waterway bottom, and the adjacent riparian zone (defined as an area 300 feet from the normal high water line on each side of the river channel) (NMFS 1999). Specific watersheds for each species were listed in the respective final rules (58FR68543, 64FR57399, and 70FR52630).

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2.6 Recent History and Programs Since Listing

The drastic declines in Snake River fall Chinook runs in the late 1980s through ~~and~~ early 1990s [5] prompted harvest managers to implement significant harvest reductions and hatchery managers undertook egg bank programs to conserve the gene pool. Then, in 1992,w~~W~~hen NMFS listed Snake River fall Chinook under the ESA ~~took effect~~, all activities that influenced salmon survival became subject to ESA regulatory reviews and programs. These regulatory reviews and actions have contributed substantially to the conserving the species since the listing. For example, thee~~e~~se ESA prohibits the take of listed species with some exemptions for activities ~~authorized~~ pursuant to ESA section 4, section 7 and section 10. Regulations that apply to Snake River fall Chinook today include NMFS' December 28, 1993 ESA section 4(b)(2) critical habitat designation (58 FR 68543) and ~~our~~ the July 10, 2000 4(d) rule (65 FR 42422) that contains regulations ~~we~~ deemed necessary and advisable for the conservation of the species. The 4(d) rules address habitat, harvest, hatchery, and research and monitoring activities. Furthermore, upon listing, all Federal activities~~-~~ authorized, funded, or carried out by Federal agencies that may ~~that~~ affect~~ed~~ the species require~~d~~ ESA section 7 consultations to ensure that they did not jeopardize the continued existence of the species nor adversely modify its critical habitat. And, section 10(a) mandates regulatory reviews and permits for any take for scientific purposes or to enhance the propagation of the species. The objective of all ESA regulatory actions is to conserve the listed species and its ecosystems. Thus, even though a recovery plan has not been in place to provide context, many changes have collectively led to substantially improved survival. The following sections ~~skim~~ summarize ~~more~~ the recent history of programs and processes that have influenced Snake River fall Chinook survival since listing.

2.6.1 Federal Columbia River Power System

~~The Federal Columbia River Power System (FCRPS)~~ The Federal Columbia River Power System (FCRPS) is managed as a collaboration among three F~~f~~ederal agencies, - the Bonneville Power Administration (BPA), the U.S. Army Corps of Engineers (Corps) and the Bureau of Reclamation (USBR) (hereinafter the FCRPS agencies). Collectively, the FCRPS agencies maximize the use of the Columbia River by generating power, protecting fish and wildlife, controlling floods, providing irrigation and navigation, and sustaining cultural resources. The 31 F~~f~~ederally owned multipurpose dams on the Columbia and its tributaries that comprise the FCRPS provide about 60 percent of the region's hydroelectric generating capacity. The FCRPS supplies irrigation water to more than a million acres of land in Washington, Oregon, Idaho and Montana. As a major river navigation route, the Columbia-Snake Inland Waterway provides shipping access from the Pacific Ocean to Lewiston, Idaho, 465 miles inland. Water storage at all projects on the major tributaries and mainstem of the Columbia totals 55.3 million acre-feet, much of which enhances flood control.

~~includes fourteen dams and associated reservoirs, eight of which~~ Snake River fall Chinook must navigate 8 of the FCRPS dams as both out-migrating juveniles and returning adults. In 1993, NMFS~~NOAA Fisheries~~ and the ~~agencies that manage~~ the FCRPS agencis - the Bonneville Power Administration (BPA), U.S. Army Corps of Engineers (COE~~orps~~) and the U.S. Bureau of Reclamation (BOR)~~USBR~~) (referred to hereinafter as the FCRPS agencies) - completed their first ESA section 7 consultation on the FCRPS and NMFS~~NOAA~~ issued a biological opinion.

[5] As described in section 2.2 adult returns averaged 12,720 from 1964 through 1968; 3,416 from 1969 through 1974; and 610 from 1975 through 1980 (Waples et al. 1991). Only about 78 natural-origin adults (Lavoy and Mendel 1996) returned to the Snake River in 1990, which precipitated the ESA-listing of the species.

NMFS~~NOAA~~ and the FCRPS action agencies were sued on that biological opinion. Judge Marsh, the presiding judge declared, "The situation literally cries out for a major overhaul" (Marsh 1994). Two decades ~~ensued~~ of ESA consultations ensued, biological opinions, and ongoing litigation involving multiple diverse plaintiffs - including environmental organizations, river users, states and tribes. NMFS~~NOAA Fisheries~~ issued the most recent FCRPS biological opinion (FCRPS BiOp) in 2008 (~~National Marine Fisheries Service (NMFS) 2008a) (FCRPs Biological Opinion)~~ and a supplemental biological opinion in 2010 (NMFS 2008a;NMFS 2010).[6] We are presently under court order to provide an updated biological opinion by 2014. ~~before the end of 2013that will be in place until 2018.~~

2.6.1.2 Structural and ~~O~~operational Improvements

Since 1994, the FCRPS agencies made significant changes, including a number of improvements and additions to fish passage facilities, operational changes in flow, spill, a juvenile transportation program, and predator control. Primarily through the COE's ~~orps~~ '~~U.S. Army Corps of Engineers' (Corps') Co~~Col~~l~~umbia River Fish Mitigation Project, structural improvements have been added to improve fish passage at all eight dams that Snake River fall Chinook navigate ~~have been added to improve fish passage~~. Over $1 billion has been invested ~~from~~ since the mid-1990s ~~through 2006~~ in baseline research, development and testing of prototype improvements, and construction of new facilities and upgrades.

The configurational and operational improvements at the mainstem dams, along with improved flow management programs ~~(~~and temperature control operations at Dworshak Dam~~)~~ - in concert with other measures ~~like hatchery supplementation and stable spawning flows~~ described in this section- have substantially increased both juvenile survival rates (see Figure 2-5 below) and the number of returning adults. A useful detailed summary of structural and operational changes to the FCRPS since 1994 is provided in Appendix A to the, "Biological Assessment for Effects of Federal Columbia River Power System and Mainstem Effects of other Tributary Actions on Anadromous Salmonid Species Listed under the Endangered Species Act" (2007 Biological Assessment(~~;~~ ~~U.S. Army Corps of Engineers, et al. 2007~~) ~~(2007 Biological Assessment)~~ COE et al 2007. Appendix A is aptly titled, "Overhaul of the System." The FCRPS action agencies provide updates beyond the 2007 Biological Assessment in their Endangered Species Act Federal Columbia River Power System Annual Progress Reports (Annual Progress Reports) that detail the implementation and progress of the 2008 Biological Opinion actions ~~(Bonneville Power Administration (~~BPA~~)~~ et al. 2009; BPA et al. 2010; BPA et al. 2011; ~~and~~ BPA et al. 2012). Current configurations and operations are designed to achieve the 2008 FCRPS BiOP's~~Biological Opinion's~~ hydro dam passage performance standard of 93~~ percent~~% survival at each project for summer migrating fish (NMFS 2008a). In 2012, a~~A~~dult survival rates from Bonneville Dam to Lower Granite Dam are expected to be maintained at about 81% (about a 3% loss per dam and reservoir).[7] The Annual Progress reports also provide the most recent

[6] It is the position of the State of Oregon that additional or alternative actions to the FCRPS BiOP should be taken in mainstem operations of the FCRPS for ESA-listed salmon and steelhead. Some additional or alternative actions recommended by Oregon, while considered, were not included in NMFS'~~NOAA's~~ FCRPS BiOP~~Biological Opinion~~. At this time, Oregon is a plaintiff in litigation against the FCRPS agencies and NMFS~~NOAA~~, challenging the adequacy of the measures contained in the current (2008 as supplemented in 2010) FCRPS BiOps~~Biological Opinion~~.

[7] . Overall project survival as measured in 2012 by PNNL for subyearling Chinook salmon: Little Goose: 95% Lower Monumnetal: 98% McNary: 97% John Day: 94% Dalles: 94% Bonneville: 97%. In addition to the 93% survival requirement, NMFS also requires specific precision

information ~~updated status reports~~ on how the fish are responding to these configurational and operational improvements.~~doing in meeting these targets~~. Also, NMFS has prepared a module that summarizes the effects of the FCRPS BiOp operations on listed Snake River salmon and steelhead (Hydro Module) and which is an appendix to this recovery plan (Appendix ##)

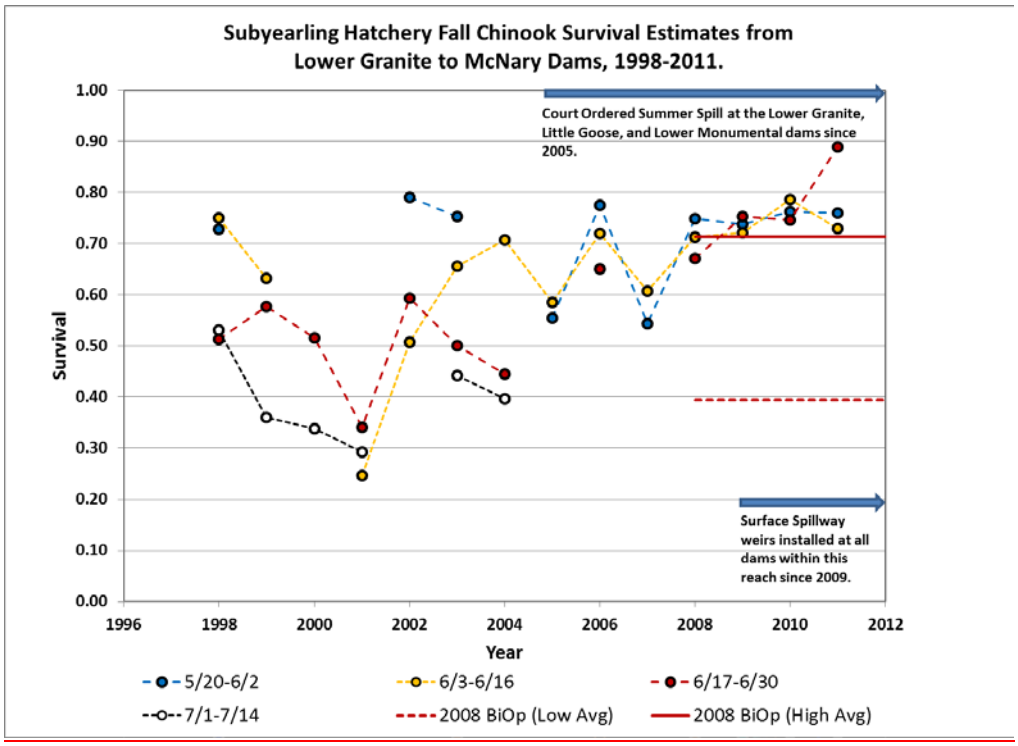

Figure 2-5 Estimated survival rates of subyearling hatchery fall Chinook salmon (2-week cohorts) from Lower Granite to McNary Dams, 1998-2011.

2.6.1.3 Transportation Studies

Transporting juvenile fall Chinook in barges or trucks past the lower Snake River dams has been a management action since the late 1970's. This action consists of collecting juvenile fish at the projects with transport capabilities (Lower Granite, Little Goose, Lower Monumental, and McNary Dams) and barging or trucking them to release locations below Bonneville Dam. The objective is to increase survival of the fish by fish transporting them past known areas of high

levels around the survival estimates. Those requirements were also met in 2012 for each of the projects above. Lower Granite and Ice Harbor were not tested in 2012.

mortality. The survival of transported juveniles is about 98%, but in-river migrants are estimated to survive at less than 50%.

Transport of juveniles was considered an essential management measure when no voluntary spill was provided at the Snake River dams during the summer migration season. Beginning in 2005 spill was provided at the Snake River projects during the summer months and in 2007 a study was initiated to assess the benefit of transporting Snake River fall Chinook juveniles. The design of the study was a collaborative effort between NMFS, USFWS, the Nez Perce Tribe, and the states of Idaho and Oregon. It involved marking over 500,000 fish annually for a five year period. The results would be based on the difference in adult rates between fish that were transported or migrated in-river as juveniles. The results of this study will inform future management decisions on transport actions.

2.6.1.4 Additional FCRPS action agencies' offsite mitigation addressing habitat, predation and hatchery reform

Since 2000, the FCRPS consultations have included actions to provide offsite mitigation for hydro impacts that remain after dam operations and structural improvements. Thus, the FCRPS agencies have been implementing and funding substantial tributary and estuary habitat programs, predator control for avian predators and northern pikeminnow and hatchery reform actions. The FCRPS offsite mitigation program is summarized in the Annual Progress Reports (BPA et al. 2009; BPA et al. 2010; BPA et al. 2011; ~~and~~ BPA et al. 2012)

2.6.2 Columbia Basin Fish Accords

Many of the 2008 FCRPS BiOP~~Biological Opinion~~ actions depend on cooperation with states and tribes. To promote regional collaboration and supplement the ~~ensure implementation of~~ the 2008 FCRPS BiOp ~~Biological Opinion and promote regional collaboration~~, the FCRPS Agencies entered into the 2008 Columbia Basin Fish Accords with three States (Idaho, Montana and Washington),~~and~~ five Tribes (Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Colville Reservation, and the Shoshone-Bannock Tribes), and the Columbia River Inter-Tribal Fish Commission. ~~The Accords are designed to supplement the FCRPS BiOp~~. They provide firm commitments to hydropower performance standards and operations, habitat and hatchery actions, greater clarity regarding~~about~~ biological benefits and they secure funding. The Accords directly addressed long standing issues between the tribes and the FCRPS agencies, including adequate spill regimes, which are particularly important for outmigrating Snake River fall Chinook juveniles. A provision in the "2008 Columbia Basin Fish Memorandum of Agreement between the Three Treaty Tribes and FCRPS Action Agencies," expresses that the tribes' willingness to accept the negotiated spill operations is directly related to their expectation that the Lyon's Ferry Snake River fall Chinook production program remains stable and substantially unaltered as designed for the term of the Agreement (through 2018) (~~cite~~BPA et al. 2008). The Lyons Ferry fall Chinook production program is overviewed in the Hatchery Program section (2.6.8) below. Other co-

management parties, specifically the Nez Perce Tribe and State of Oregon, did not accept the configuration and operational changes as adequate and, as such, continue as plaintiffs in ongoing FCRPS BiOp~~Biological Opinion~~ litigation.

2.6.3 Columbia Basin Fish and Wildlife Program

The Northwest Power and Conservation Council (Council), an interstate compact agency of Idaho, Montana, Oregon and Washington, was established under the authority of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act or Act). The Act directs the Council to develop a program to "protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries … affected by the development, operation, and management of [hydroelectric projects] while assuring the Pacific Northwest an adequate, efficient, economical, and reliable power supply." The Act also directs the Council to ensure widespread public involvement in the formulation of regional power and fish and wildlife policies. As a planning, policy-making and reviewing body, the Council develops the Program, and then monitors its implementation by BPA, the U.S. Army Corps of Engineers, and the Federal Energy Regulatory Commission (FERC) and its licensees. The Council is presently implementing its 2009 Fish and Wildlife Program (~~Northwest Power and Conservation Council~~NWPCC~~,~~ 2009). The Council is required to update the Fish and Wildlife Program every five years. ~~and has announced plans to initiate a Program amendment in mid-2013.~~

The Council emphasizes implementation of fish and wildlife projects based on needs and actions described in the FCRPS BiOP ~~biological opinion~~, ESA recovery plans, and the 2008 Columbia Basin Fish Accords. The Council also sponsors independent science review of Columbia Basin Fish and Wildlife Program actions proposed for funding and follows up with science reviews of the actions from the Independent Science Review Panel. It also sponsors the Independent Science Advisory Board which serves NMFS, Columbia River Indian Tribes, and the Council by providing independent scientific advice and recommendations regarding specific scientific issues.

2.6.4 Hells Canyon Project Federal Power Act Relicensing

The existing license for IPC's Hells Canyon Complex (Hells Canyon, Oxbow, and Brownlee dams) expired in 2005. Following a lengthy ~~relicensing~~ process, ~~the~~ Federal Energy Regulatory Commission (FERC), ~~–~~the F~~f~~ederal agency responsible for the licensing non-~~f~~Federal hydropower projects,~~)~~ issued a Final Environmental Impact Statement for the project in 2007 (~~Federal Energy Regulatory Commission~~FERC 200~~5~~~~)~~7). Since 2005, FERC has issued annual licenses to allow the project to operate while remaining issues are resolved. The annual licenses for the Hell's Canyon Project are identical to the original license which was issued in 1955. Upon expiration of the original license, FERC can issue annual licenses indefinitely. In the interim, IPC has agreed, through negotiations with the state and F~~f~~ederal fishery agencies (who are, in turn negotiating with stakeholders as described below), to ~~voluntarily~~ operate the project to maintain or improve spawning, incubating, and rearing conditions for fall Chinook salmon downstream of Hells Canyon Dam.

To complete the relicensing process, IPC~~the Hells Canyon Project~~must obtain needs Clean Water Act 401 water quality certifications from ~~the~~ Oregon~~'s~~ and Idaho~~'s~~ Departments of Environmental Quality, and FERC must complete~~d~~ ESA~~ndangered Species Act~~ Section 7(a)(2) consultations with the U.S. Fish and Wildlife Service (for listed bull trout) and NMFS ~~the National Marine Fisheries Service~~. For more than a year, representatives of F~~f~~ederal and state agencies have been working ~~meeting~~ with one another, as well as with IPC~~daho Power Company~~ and affected tribes, to resolve ~~the~~ remaining water quality, fish passage, and ESA ~~issues so that the natural resources are protected and~~ FERC can decide whether to issue a new license. ~~a final license can be granted by FERC.~~ However, it is not clear ~~at present~~ when this process will be completed.

2.6.5 Additional Mainstem and Estuary Activities

In addition to the FCRPS consultation, many section 7 consultations have addressed the effects of Federal actions on mainstem and estuary habitats in the Snake River fall Chinook's migration and estuary rearing areas. Individually, these consultations have resulted in ~~federal~~ actions that avoided jeopardy to the species and adverse modification of its critical habitat within the individual action areas. Collectively, these consultations have protected mainstem and estuary habitats from getting worse and in many cases have improved the habitat. Examples ~~actions covered by such section 7 consultations~~ include dredging for navigation; docks and other overwater structures; port development; Clean Water Act permits for National Pollution Discharge Elimination Systems (NPDES permits), Clean Water Act 401 water quality certifications, pilings, dikes, and other urban and agricultural activities.

Many voluntary and regulatory actions other than those prompted by the~~e~~ ESA have also protected and improved habitats, particularly in the estuary. These actions are overviewed in the ESA Recovery Plan Estuary Module for Salmon and Steelhead (~~National Marine Fisheries Service,~~NMFS 2011b~~a~~) and in the Lower Columbia River Estuary Partnership's Years in Review, since 1999. (need help with appropriate cites from LCREP)

2.6.6 Tributary Habitat Activities

While Snake River fall Chinook are predominantly mainstem spawners, they also spawn in the lower reaches of the Salmon, Grande Ronde, Tucannon, Imnaha and Clearwater Rivers. Furthermore, tributary habitat conditions contribute to mainstem habitat parameters such as sediment and gravel recruitment, water quality and water quantity and also provide cold water refugia that are important for Snake River fall Chinook salmon ~~spawning and rearing~~. Since the listings, NMFS has reviewed hundreds of F~~f~~ederal actions through section 7 consultations and also issued section 10 permits on non-F~~f~~ederal activities in the tributaries. These consultations and permits have reduced threats of further impacts associated with mining, dredging, agriculture, grazing, forestry and industry, and in many cases, contributed to healing ecosystem functions in the tributaries. Furthermore, numerous voluntary activities on private lands have improved riparian management, water management and water quality, all of which have influenced, at least indirectly, Snake River fall Chinook spawning and rearing habitat quality.

2.7~~6~~.7 Harvest Management

Due to their patterns of ocean distribution (Good et al. 2005; Weitkamp ##) and the timing of their spawning run up the Columbia River, Snake River fall Chinook are subject to harvest in a

wide range of fisheries. They are harvested by both ocean and in-river fisheries. Coastal fisheries in California, Oregon, Washington, British Columbia, and southeast Alaska have reported recoveries of tagged fish from the Snake River. Snake River fall Chinook are caught incidentally in fisheries that target harvestable hatchery and non-listed natural-origin fish. Historically incidentally Snake River fall Chinook were subject to total exploitation rates approaching~~on the order of~~ 80 percent. Since ESA listing, harvest impacts in both ocean and inriver fisheries have been substantially reduced. The harvest rate has been relatively stable at 40 to 50 percent since the mid-1990s (Figure 5-6) (~~Cooney in~~ Ford et al. 201~~0~~1). More detail on harvest rates is provided in Chapter 5. The fisheries are managed by multiple jurisdictions interacting through several institutional processes:

- Ocean fisheries in Southeast Alaska, British Columbia (B.C.), and off the coasts of Washington and most of Oregon are managed pursuant to the provisions of the Pacific Salmon Treaty (PST) between the U.S. and Canada. The Pacific Salmon Commission (PSC) negotiates, facilitates and monitors implementation of fishing regimes. The PSC does not regulate; regimes are implemented by the Parties' domestic management entities. In the U.S., the Pacific Fishery Management Council (PFMC) regulates fisheries on the West Coast south of the Canadian border. The North Pacific Fisheries Management Council (NPFMC) has jurisdiction for ocean fisheries off Alaska, although the NPFMC has delegated management authority to the state of Alaska. The PSC reached agreement on new fishing regimes in May of 2008. ~~-~~Pursuant to the procedural terms of the Treaty, the Commission recommended that the Parties (Canada and the United States) adopt and implement these new regimes through their respective domestic management authorities (Koenings and Sprout 2008). In December 2008 the Parties approved the new regimes that came into effect on January 1, 2009 and will continue through 2018. NMFS~~NOAA~~ completed an ESA biological opinion on these regimes on December 22, 2008~~.~~ (NMFS 2008b~~)).~~

- Fisheries in the Pacific south of the U.S./Canada border and between three~~3~~ and 200 miles from the coast are managed subject to the provisions of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (revised and reauthorized in 2006) (Magnuson-Stevens Act), through the PFMC process. The PFMC is one of eight fishery management councils established by the Magnuson-Stevens Act. NMFS~~NOAA Fisheries~~ has considered the effect of PFMC fisheries on ESA listed species through a series of biological opinions as species were first listed and subsequently as new information became available. NMFS~~NOAA Fisheries~~ consulted on the effect of ocean fisheries on Snake River fall Chinook in a March 8, 1996 (~~NMFS 1996b~~) biological opinion and subsequently in an opinion on the 1999 Pacific Salmon Treaty Agreement dated November 11, 1999 (NMFS 1999~~f~~b). These opinions set the standards regarding harvest impact for Snake River fall Chinook that continue to apply to the combined effect of all ocean fisheries. NMFS~~NOAA Fisheries~~ requires that the Southeast Alaskan, Canadian, and Council fisheries, in combination, achieve a 30.0% reduction in the age-3 and age-4 adult equivalent total exploitation rate relative to the 1988-1993 base period.

- Ocean fisheries between Cape Falcon (on the north Oregon coast) and the Canadian border are coordinated with fisheries in the Columbia River, Puget Sound, and coastal

rivers through the North of Falcon (NOF) process. This process was established by the states and the member tribes of the Northwest Indian Fisheries Commissino~~Pacific Northwest treaty tribes~~; it occurs largely coincident with the PFMC process. In the NOF process, the co-managers develop preseason fishing plans that are coordinated between ocean and river fisheries to ensure that conservation and various allocation objectives are met. Allocation objectives include treaty Indian/non-treaty allocations and allocations between various non-treaty user groups, such as commercial and recreational fisheries.

- Fisheries in the Columbia Basin, particularly in the mainstem of the Columbia River, are managed pursuant to harvest~~fishing~~ plans developed by the parties to *U.S. v. Oregon*, under the continuing jurisdiction of the Federal district court. Parties to this process include the Federal government, the states of Oregon, Washington, and Idaho, and the four Columbia River Treaty Tribes and the Shoshone-Bannock Tribes. A negotiated long-term Management Agreement for 2008–2017 (~~U.S. v. Oregon Parties~~U.S. District Court 2008) includes management provisions for fall fisheries that affect Snake River fall Chinook salmon. NMFS~~NOAA Fisheries~~ provided ESA compliance ~~review of the Management Agreement~~ in a biological opinion dated May 5~~8~~, 2008~~.~~ (NMFS 2008c).

- Regulations for recreational fisheries in the tributaries of the Columbia and Snake Rivers are developed by ~~the Fish and Wildlife Commissions of~~ Idaho, Washington, and Oregon for their respective waters. Each Tribe regulates tributary fisheries under their respective jurisdictions.NMFS ~~NOAA Fisheries~~ has reviewed various terminal area state and tribal fisheries through provisions of ESA section 4(d), 7 or 10, depending on the ~~nature of the~~ action being proposed. Management provisions of the *U.S. v. Oregon* Agreement apply to state and tribal fisheries that affect Snake River fall Chinook salmon in the mainstem Columbia and Snake Rivers up to Lower Granite Dam. Additional harvest impacts to Snake River fall Chinook occur in fisheries in the mainstem Snake River above Lower Granite Dam and in lower reaches of the associated tributaries, but these are limited primarily to incidental catches that occur in fisheries directed at steelhead. ~~(Cites?)~~

A more detailed summary of harvest is provided in Appendix X, NMFS Draft Snake River Harvest Module.

2.6.8 Hatchery Programs

The Snake River fall Chinook ESU includes four hatchery programs: the Lyons Ferry Hatchery, Fall Chinook Acclimation Ponds Program, Nez Perce Tribal Hatchery, and IPC Oxbow Hatchery (70 FR 37160 2005). The relationship between fish from these programs and listing and delisting decisions is described in Chapter 3, section ##[8]

[8] As stated in NMFS Hatchery Listing Policy (70 FR 37204, 2005), a key feature of the ESU concept is the recognition of genetic resources that represent the ecological and genetic diversity of the species. These genetic resources can reside in a fish spawned in a hatchery (hatchery fish) as well as in a fish spawned in the wild (natural fish). Hatchery stocks with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU are considered part of the ESU. In assessing the status of an ESU, NMFS applies the hatchery listing policy in support of the conservation of naturally spawning salmon and the ecosystems upon which they depend. Hatchery fish will be included in assessing an ESU's status in the context of their contributions to conserving natural self-sustaining populations. The effects of hatchery fish on the status of an ESU will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery fish within the ESU affect each of the attributes.

-Fall Chinook hatcheries have a long history in the Snake River. Gilbert and Everman (1892) first visited the middle Snake River to look for sites to construct a hatchery. The first experimental station was constructed at Swan Falls Dam in 1901 (Van Dusen 1903). The first full scale hatchery was constructed in 1902 and operated until 1909. Oxbow Hatchery was operated from 1962 until 1973. th
e
The large-scale hatchery effort that exists today began in 1976 when Congress authorized the Lower Snake River Compensation Plan (LSRCP) to compensate for fish and wildlife losses caused by the construction and operation of the four Lower Snake dams. The LSRCP called for a large fall Chinook salmon program at a new hatchery——Lyons Ferry Hatchery——to be constructed. At the time, the Snake River fall Chinook salmon run was so small that an egg-bank program was considered necessary to prevent extinction before the new hatchery could be completed. To implement the egg- bank program, adult fish were collected at Ice Harbor Dam and juveniles were released in the lower Columbia and the Snake rivers. As egg-bank fish returned to the lower Columbia, they were also used as broodstock along with the fish from Ice Harbor Dam. This program ceased in the fall of 1984, when Lyons Ferry Hatchery FH (operated managed by WDFW) became operational.

In the early years of the Lyons Ferry Hatchery program, fall Chinook were collected by trapping for broodstock at Lower Snake River dams (Bugert and Hopley, 1989). It is likely that some level of non-ESU strays were incorporated into the Lyons Ferry Hatchery program and posed risks to ESU diversity (Good et al. 2005). Straying of out-of-ESU hatchery fall Chinook salmon from outside the Snake River Basin was a major risk factor in the late 1980s to mid-1990s, when the extant Snake River fall Chinook population was down to approximately one hundred natural adult returns (Waples et al., 1991). Out-of-ESU hatchery strays have since been much reduced due to the removal of hatchery strays at downstream dams and a reduction in the number of hatchery fish released into the Umatilla River, where the majority of out-of-ESU strays originated. Furthermore, the potential effects of any lingering out-of ESU hatchery strays is reduced given the significant rebound in the naturally spawning population of the Snake River fall Chinook ESU.

Comment [EG32]: Is this correct? CTUIR…unaware of any place CHF are being removed from the system below LGD

The hatchery effort has grown in size and complexity. When the initial focus of Snake River fall Chinook salmon hatchery operations was to provide fish for harvest as mitigation for the losses caused by the construction and operation of the four Lower Snake River Dams, fish were released only at Lyons Ferry Hatchery, which is well below most of the area available for natural spawning. Over time, and as it has grown, the hatchery effort has focused more on supplementation, with an increasing proportion of fish released above Lower Granite Dam. A major change in this direction was the 1995 implementation of the Fall Chinook Acclimation Program (FCAP), which involves acclimated releases at sites on the Snake and the Clearwater Rivers at facilities operated by the Nez Perce Tribe. Acclimated releases increase the likelihood that the juveniles will return as adults to those areas, reduce straying rates, and spawn where they acclimated. The current hatchery effort has four integrated programs: the Lyons Ferry Hatchery program, the FCAP, the IPC program, and the Nez Perce Tribal Hatchery program.

In 2002, the Nez Perce Tribal Hatchery began culture of fall Chinook salmon to supplement the Clearwater River, with releases at four locations, and a direct (non-acclimated) stream release by WDFW near Couse Creek on the Snake River began. Direct releases of fall Chinook salmon into the Grande Ronde River began in 2005 as an effort to boost returns to that area. Coincident with these supplementation releases, added mitigation releases have also occurred. The IPC

Oxbow Hatchery program, which releases fish near Hells Canyon Dam, began in 2000. The expansion of releases has resulted in satellite hatcheries operated by the Oregon Department of Fish and Wildlife (ODFW) and Idaho Department of Fish and Game (IDFG) being used for rearing juvenile fish.

Of the 5.5 million fish released at full program capacity, 88% are released above Lower Granite Dam (where the majority of accessible natural production habitat remains), and of these, 75% are acclimated before release. Production goals, release sizes, release locations, release priorities, life stage and marking of released fish for all four Snake River fall Chinook salmon hatchery programs are all established through the *U.S. v. Oregon* management process. Figure 2-5 shows the location of the facilities used for Snake River fall Chinook salmon culture

In October 2012, NMFS issued a biological opinion that provides ESA compliance~~authorization~~ through 2018 for the Snake River fall Chinook salmon hatchery programs described here (Hatchery BiOp) (NMFS 2012a) ~~(Hatchery BiOp)~~. The Hatchery BiOp~~biological opinion~~ includes a detailed research, monitoring and evaluation program to address key knowledge needs and gaps that are described in ~~later c~~Chapters X and Y of this recovery plan.

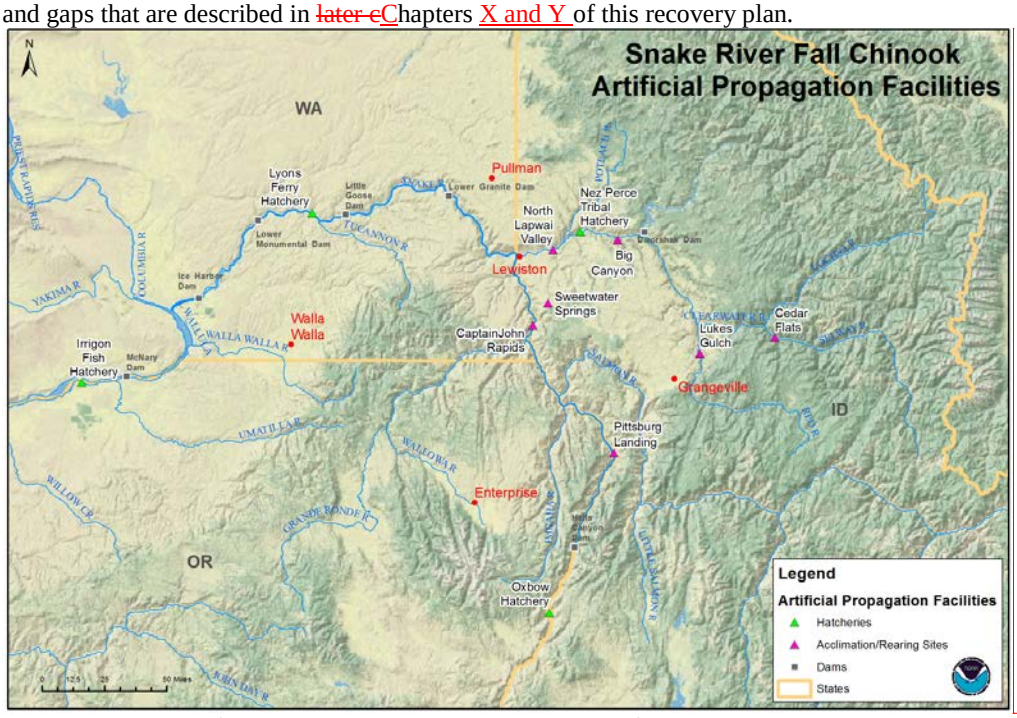

Figure 2-5. Snake River fall Chinook salmon hatcheries and acclimation facilities

Comment [EG33]: Needs inset locator map

2.7 Relationship of Existing Programs to Recovery Plan

This recovery plan outlines the necessary management actions and recovery strategies across the species life cycle to achieve recovery. While the recovery plan is not intended to be regulatory

or binding, it does incorporate~~s~~ existing programs described above that have undergone ESA section 7 consultation or section 10 permit review or that NMFS has otherwise formally agreed to. This is because those programs play a significant role in conserving the species. This recovery plan also describes the actions that go beyond existing programs in order to achieve the plan's goals. ~~These existing programs represent the best current approaches for addressing threats and implementing site specific actions to protect and improve survival in several phases of the species' life cycle.~~ More details about specific actions which are incorporated into this recovery plan are described in Chapter ~~#~~ (Recovery Strategy). ~~and Appendix X (site-specific actions).~~