Chapter 8

Effects Analysis for Salmonids

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Effects Analysis for Salmonids

This Chapter builds upon the description of effects in the Environmental Baseline (Chapter 5), describes and adds the anticipated effects of the Prospective Actions and all identified Cumulative Effects (Chapter 6), and; considering the current status of each species and its MPGs (Chapter 3), estimates the likely combined effects on the future status of the species. Wherever possible, these effects are presented in quantitative terms, including the quantitative survival and recovery metrics described in Chapter 7. In those instances where detailed quantitative information is not available for a given species, information is used from other species with similar life histories and geographic ranges. In some instances, where quantitative data is lacking, professional judgment guides this analysis.

Except as noted below, effects identified in the Environmental Baseline (Chapter 5) are expected to continue throughout the life of this opinion.

8.1 General Considerations for Multiple ESUs

One or more life stages of each species considered in this analysis occurs within the action area and is affected by the Prospective Actions. Those species with spawning and rearing habitat upstream from one or more of the FCRPS dams are affected in more direct ways than those which spawn downstream from Bonneville Dam (e.g. Columbia River chum, Upper Willamette River spring Chinook). Similarly, those species which must navigate through eight or more dams are more directly affected by dams and reservoirs than those which pass only one or two.

Though proposed RPA actions in tributary habitat areas may affect multiple ESUs, the anticipated effects of such measures are detailed in the ESU-specific analyses in Sections 8.2 through 8.14 and are not presented here.

8.1.1 Juvenile Migrant Survival Improvement Strategies

The Prospective Actions are expected to continue to adversely affect juvenile migrant survival. Given the substantial effect of hydrosystem passage on juvenile migrant survival, improving juvenile passage survival has been a focus of FCRPS fish protection efforts for at least 30 years. This effort involves:

- efforts to improve dam passage survival (e.g. spill program, turbine bypass systems),
- juvenile collection and transportation systems,

- efforts to improve in-river conditions (e.g. flow management, water temperature control, TDG abatement, and predator control), and

- research, monitoring, and evaluation that inform an adaptive management program to further improve juvenile survival.

The RPA continues each of these strategies. Where hydro measures aimed at improving juvenile migrant survival have the potential to affect adult migrants, or spawning and rearing life stages, the anticipated effects on those life stages is also discussed.

8.1.1.1 Dam Passage Survival Improvements

Improved Juvenile Passage

Dam passage improvements, detailed in the hydropower section of the RPA will increase the survival and reduce the delay of listed juvenile salmon and steelhead. These improvements include both configuration and operation changes at each dam.

Configuration changes proposed in the RPA include structural alterations to the routes used by juveniles to pass through the hydroelectric dams during their migration to the ocean. Juveniles follow the water flow pathways through each dam, which routes them through spillways, sluiceways and powerhouses.

Spillway & Sluiceway Passage

In recent years some FCRPS project spillways have been reconfigured to provide a surface water flow outlet for juvenile migrants to pass through. These surface routes (such as the removable spillway weirs (RSWs) at Lower Granite, Lower Monumental, and Ice Harbor dams; the temporary spillway weirs (TSWs) at McNary and John Day dams; and the corner collector at Bonneville dam) are designed specifically to quickly attract juveniles arriving in the dam forebay and to safely pass them through the dam to the tailrace. Also, sluiceways originally designed to facilitate trash removal from turbine intakes, have been recently modified to provide surface passage routes. For instance, the Bonneville 2nd powerhouse sluiceway was recently altered to provide a safe passageway for juveniles. Studies have confirmed that these surface passage routes provide high survival rates (generally equivalent to spillways) and substantially reduce juvenile delay in the forebays (compared to operating without these structures). Reducing delay decreases the exposure of juvenile migrants to sources of mortality (e.g. predation, disease, thermal stress, metabolic stress), thereby increasing survival. To provide higher passage survival and to reduce migration delay, the RPA calls for continued evaluation of surface passage structures (and related project operations) at Lower Monumental, McNary and John Day dams and the design and implementation of a similar structure at Little Goose dam. NOAA Fisheries expects these future surface passage routes to ultimately perform as well as those already installed.

While surface flow routes are expected to provide the majority of in-river juvenile migrants a safe and quick passage route through many of the FCRPS dams, substantial numbers of fish are expected to continue passing these projects through the unmodified (subsurface) spillbays. At some projects, The Dalles dam for instance, where nearly 80% of the juveniles pass through the spillbays), passage through unmodified spillbays will continue to serve as the primary passage route through the dams for migrating smolts. At the remaining projects, where surface passage routes have been installed or are under development, substantial levels of spill will continue to be necessary to provide "training" spill to ensure quick egress and high survival of smolts through the tailrace.[1] Other elements of the RPA, including improved operations and spillbay modifications developed through the project Configuration and Operations Plans (COPs), will ensure there is continued effort to achieve high rates of survival for all fish passed through the spillway bays, regardless of whether they pass through the modified surface routes or the unmodified spillbays.

Powerhouse Passage

While spillways and surface passage routes are the preferred routes for juveniles to pass through the dams, fish also follow the water flowing into the powerhouse turbine intakes. Intake screen bypass systems are installed at seven of the eight dams in the FCRPS migratory corridor to reduce the number of juveniles passing through the turbine units. These bypass systems consist of large screens, located in the turbine intakes, that guide a high percentage of the fish safely away from (bypassing) the turbine entrance, upward into the gatewell, and from there into a collection channel that routes fish either to the river downstream from the powerhouse or, at those projects where fish transportation is available, to raceways where they are held for transportation (see Section 8.1.1.2). Bypassed fish avoid the relatively high mortality and injury rates experienced by turbine-passed fish

The RPA includes measures to improve the survival and reduce the stress to migrants passing through bypass systems. For instance, the bypass outfall site at McNary dam will be relocated to provide better egress conditions (e.g. less conducive to predators). Also, improvements to the outdated bypass system at Lower Granite Dam are expected to reduce the stress of fish passing through that system. Fish tag detection will be provided in the full flow channels at Lower Granite, Little Goose and Lower Monumental dams, so that fish can be routed directly to the tailrace outfall, further reducing any stress that occurs as a result of the existing dewatering and separation systems.

Inevitably, some juveniles pass through hydroelectric generating turbines and their draft tubes to the tailrace. These juveniles generally experience lower survival rates and higher injury rates than their cohorts which pass through the alternative routes. Engineering efforts combined with biological research in recent years have designed and installed new turbines

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[1] A substantial level of juvenile predation often occurs in project tailraces. Spill patterns are designed to 1) minimize the formation of eddies or other hydraulic features in the tailrace that are advantageous to fish or birds preying on salmon and steelhead smolts, and 2) provide tailrace conditions where flows move quickly downstream, away from the dams, reducing the exposure of juveniles to these predators.

with higher fish survival rates, such as the minimum gap runner at the Bonneville Dam 1st powerhouse. The RPA includes continuation of the turbine passage survival improvement work with the development of a fish friendlier replacement unit at Ice Harbor dam. Also, the RPA includes biological index testing at all of the dams to identify how to operate the powerhouse for higher passage survival.

8.1.1.2 Spill & Transportation Programs

Voluntary spill of water and fish through spillways (fish spill) reduces turbine passage and as such is a primary method of improving dam passage survival. The RPA includes an initial spill program, with planning dates and spill rates that may be adjusted through the implementation planning and adaptive management processes as fish survival data become available (Corps et al. 2007b, Table 2.1-15). The RPA also includes additional surface passage actions such as RSWs or similar surface bypass devices, where feasible. These configuration modifications, combined with operational spill levels based on biological performance, are expected to improve juvenile survival, improve forebay and tailrace egress, reduce the potential for predation, and decrease the potential for injury and delayed mortality at Federal dams compared with existing conditions for all ESUs with populations that spawn upstream from Bonneville Dam.

At FCRPS projects without fish collection and transportation facilities (i.e., Ice Harbor, John Day, The Dalles, and Bonneville dams) RPA efforts are aimed at improving dam passage survival. At the collector projects (i.e., Lower Granite, Little Goose, Lower Monumental, and McNary dams) the spill program is integrated with the fish transportation program to best manage both juvenile dam passage survival and the likelihood of adult returns (Corps et al. 2007b, Tables 2.1-15 and 2.1-16). Collection and transportation primarily benefit SR steelhead and SR spring/summer Chinook. The Snake River fall Chinook ESU is also transported, especially in low water flow years. However, the benefits of transportation are more equivocal for this ESU, as discussed below.

Juvenile collection and transportation improves juvenile migrant survival by avoiding both reservoir and dam passage effects. Collection occurs when juveniles are deflected by screens from the turbine intakes and delivered to collection systems at Lower Granite, Little Goose, and Lower Monumental dams.[2] By avoiding dam and reservoir passage, collection and transportation substantially improves direct juvenile survival to release points downstream from Bonneville Dam. Schaller et al. (2007) concluded that wild and hatchery steelhead respond most positively to transportation with average T:M ratio for wild steelhead ~1.7 and average T:M for hatchery steelhead ~1.5. The relatively high transport SARs seen for steelhead suggest that full season transportation would optimize steelhead survival under the current configuration and operation of the hydrosystem (Schaller et al. 2007). Recent smolt-to-adult return data indicates that transported steelhead always benefit from transportation.

[2] Collection and transportation facilities are also available at McNary Dam but these facilities are expected to be only rarely used – see RPA table.

However, under some conditions for some species (e.g. early migrating SR spring/summer Chinook), transported fish return as adults at lower rates than in-river migrants that survive passage to below Bonneville Dam (Williams et al. 2005). While the causes of this difference in smolt-to-adult return rates are not well understood,[3] the effect suggests that while survival through the hydrosystem is improved by transportation, that survival improvement does not always translate into a higher rate of adult returns. The RPA spill and transportation schedules at FCRPS collector projects are designed in consideration of this effect (Corps et al. 2007 BA, Attachment B.2.1-1).

Collection and transportation require that smolts enter the turbine intakes. Fish attracted by spill to pass the dam via the spillway are not available for collection and transportation. Therefore, the higher the percentage of water spilled at a collector project, the fewer the fish transported. Thus, the decisions whether to spill or transport fish at collector projects are tightly integrated to optimize juvenile survival and the likelihood of adult returns. Factors affecting the numbers of fish collected in the juvenile bypass systems are: operations (e.g. percent spill), the effectiveness of turbine intake screens, and the effectiveness of spill. The effectiveness of spill is a function of the percentage of spill at the dam as well as how spill is configured—i.e., whether the spill is through an RSW, height of spill gate openings, location of gates that are providing spill, and proximity of gates providing spill relative to the power house as well as the combined effects of these parameters.

The RPA includes both initial transportation and spill operations schedules (Corps et al 2007 BA, Tables 2.1-15 and 2.1-16) and an adaptive management strategy to modify those schedules as new information warrants. Under some circumstances, the RPA would direct the Action Agencies to pass as many juvenile fish as possible downstream via the spillway and juvenile bypass systems. Under other circumstances, all bypassed fish would be transported, and under some river conditions, spill would be curtailed to maximize collection and transportation. The conditions and seasons under which each of these strategies would be employed under the initial program are specified based on currently available data (Corps 2007 BA Attachment B.2.1-1). When the anticipated likelihood of adult return of transported smolts (SAR) clearly exceeds that expected for in-river migrants, operations favoring collection and transportation are preferred. When the anticipated survival of in-river migrants exceed those of transportation, operations favoring in-river migration, including spill operations, are preferable. Available information shows that the relative efficacy of in-river migration versus collection and transportation is affected by one or more of the following considerations:

- species,
- flow and water temperature,

[3] Hypothesis range from transportation-induced stress and disease to straying rates and changes in the timing of ocean entrance.

- time of year,
- fish condition,
- status of the migration,
- biological productivity in the estuary/nearshore ocean environment,
- predator status.

A computer simulation of the RPA initial spill and transportation program (known as COMPASS) applied to a 70-year record of river flow conditions predicts that an average of about 83% of SR steelhead and 74% of SR spring/summer Chinook would be transported. Although the COMPASS model does not simulate SR fall Chinook passage, the initial transportation program would also collect and transport a large percentage of SR fall Chinook. Available SAR data suggest that transportation neither harms nor helps SR fall Chinook survival, although it clearly improves juvenile survival to below Bonneville Dam (Williams et al. 2005).

Choosing whether to operate in a manner that favors in-river migration (e.g., spill), or transportation, to maximize SARs for multiple species can be difficult. For example, available dam passage survival and SAR data for SR steelhead passing Lower Granite Dam show that transportation improves survival to adulthood under all observed river conditions (Scheuerell and Zabel 2007). This suggests that collection and transportation would always be the best strategy to improve SR steelhead survival. However, under some observed river conditions, SR spring/summer Chinook show a survival benefit from in-river migration early in the migration season. Later in the season (~early to mid-May) and in low-water years, the SARs of transported Chinook generally exceed those of in-river migrants (Scheuerell and Zabel 2007). Both of these species steelhead and Chinook are migrating at the same time and there is currently no technology available that can physically separate them so that steelhead go into the barge and Chinook are returned to the river. Further, there is considerable variation in the relative survival effects between years, complicating the planning process. Thus, there is no management scheme that would always maximize the benefit to both species.

NOAA Fisheries used the COMPASS model to evaluate the effectiveness of an array of transportation strategies and selected the transportation strategy that best balanced the benefits to SR spring/summer Chinook and SR steelhead.

The anticipated effects of various spill and transportation scenarios are captured in the COMPASS modeling results for Snake River salmon and steelhead. As discussed in Chapter 7, inferences to these results are applied to other species in the species-specific analyses in Sections 8.2 through 8.14.

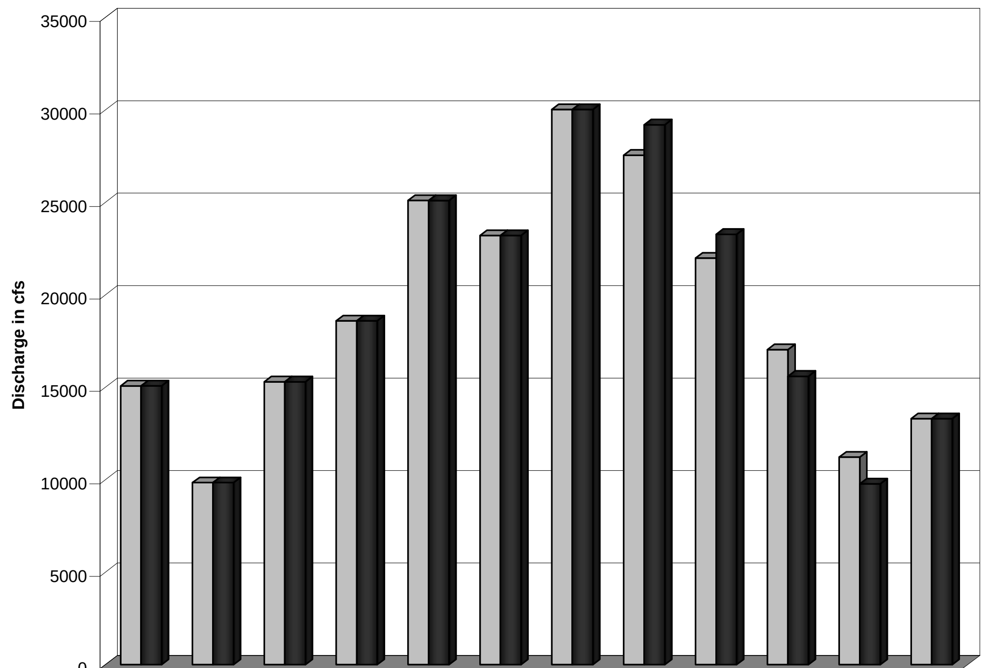
8.1.1.3 Mainstem Flow Effects

The magnitude of flows in the mainstem Snake and Columbia rivers influences water velocity, turbidity, fish travel time, project operations, the amount of spawning habitat and shallow-water rearing habitat below Bonneville Dam for some species, as well as the size and physical characteristics of the Columbia River plume. These effects primarily influence juvenile migrant survival, which generally improves as flows increase, although survival of some species declines during very high flow years (e.g., 1996). Where appropriate, these flow-survival effects are captured in the species-specific juvenile survival modeling presented in Sections 8.2 through 8.14.

Dam and reservoir management to improve flow-related fish survival has been a major aspect of fish protection efforts since the late 1970s. Storage reservoir operations were further revised in successive consultations (1995, 2000, and 2004). In total, 5 to 6 Maf of stored water are annually devoted to enhancing flow conditions in the Snake and Columbia rivers during the juvenile migrations. Winter drafts are also limited to minimize the reduction of flows that occurs each spring while the storage reservoirs are being refilled. Water management was a key component of the collaborative process used to develop the Prospective Actions.

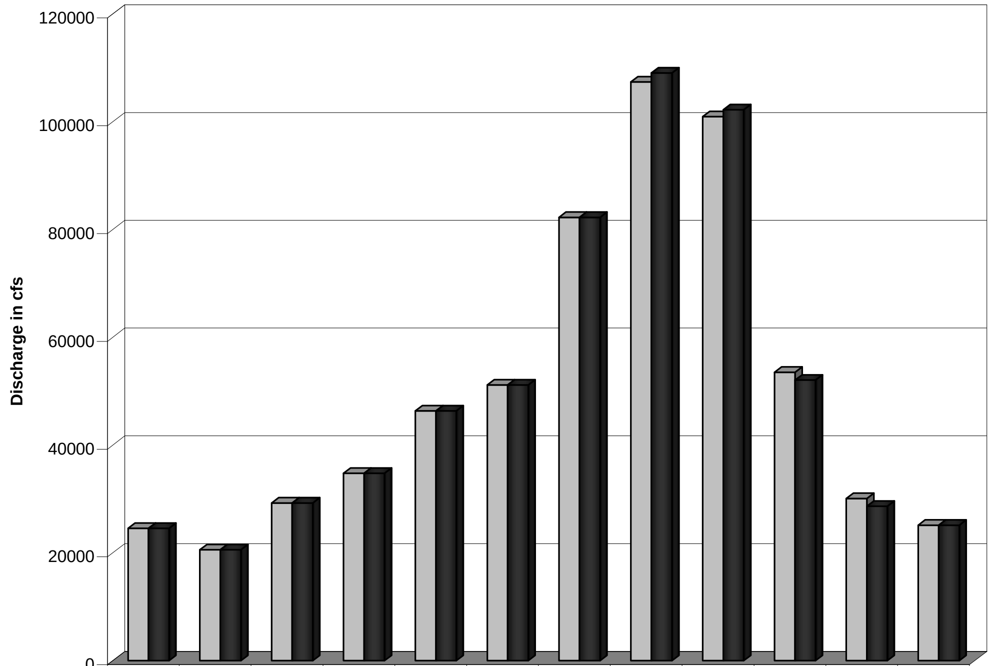
Although the Prospective Action includes modifications of system operating criteria aimed at further improving flow-related survival, the overall changes in flow are modest because much of the potentially beneficial changes in water management have already been accomplished and are part of the environmental baseline (Figures 8.1-1, 8.1-2, 8.1-3, and 8.1-4). By slightly improving flows in April and June compared to current conditions, the Prospective Action slightly improves the functioning of the migration corridor and mainstem juvenile rearing habitat during those months. All ESUs of spring and spring-summer Chinook and steelhead have spring juvenile emigrations.

July and August flows would be slightly reduced at Brownlee, Lower Granite, McNary, and Bonneville dams compared to current conditions. In some years, a substantial fraction of the annual juvenile fall Chinook migration takes place in July and this small reduction in July flows may slightly increase travel time for fall Chinook. If viewed independently, this flow reduction would be expected to slightly decrease juvenile SR fall Chinook survival. However, recent research is showing that the proclivity of juvenile SR fall Chinook to continue migrating as subyearlings diminishes during July (Cook et al. 2006) and through the summer an increasing fraction of SR fall Chinook entering Lower Granite reservoir residualize and migrate during the following year as yearlings. Thus, water temperature, which affects the survival of both migrating and residualized fish, becomes increasingly important. During the hot summer months of July and August, operations at Dworshak Dam, designed to release sufficient cold water to maintain Lower Granite Dam tailrace water temperatures at or below 20 degrees C, likely become the most important factor affecting juvenile SR fall Chinook survival through Lower Granite reservoir.



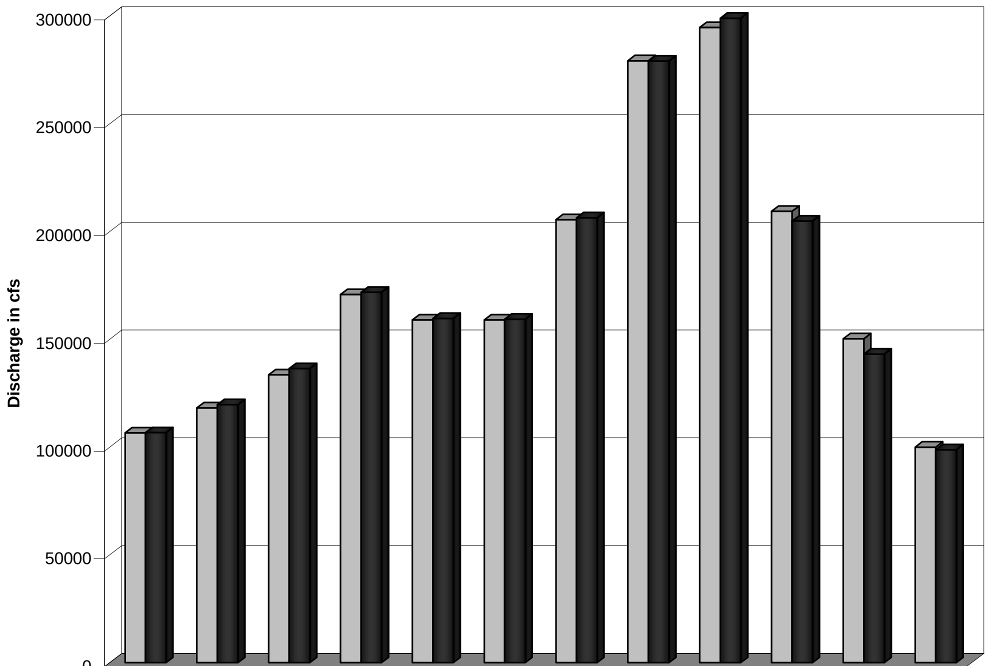
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Current	15074	9849	15305	18597	25110	23217	30028	27555	21987	17045	11228	13303
Prospective	15079	9848	15305	18597	25105	23217	30028	29199	23275	15599	9784	13303

Figure 8.1-1. Mean monthly Snake River discharge (cfs) at Brownlee Dam under the current operations and under the Prospective Action. Sources: Current Operations, BPA HYDSIM Model run FRIII_07Rerun2004BiOp, dated 4-28-08; Prospective Action, BPA HYDSIM Model run FRIII_final2008BiOp dated 4-28-08.



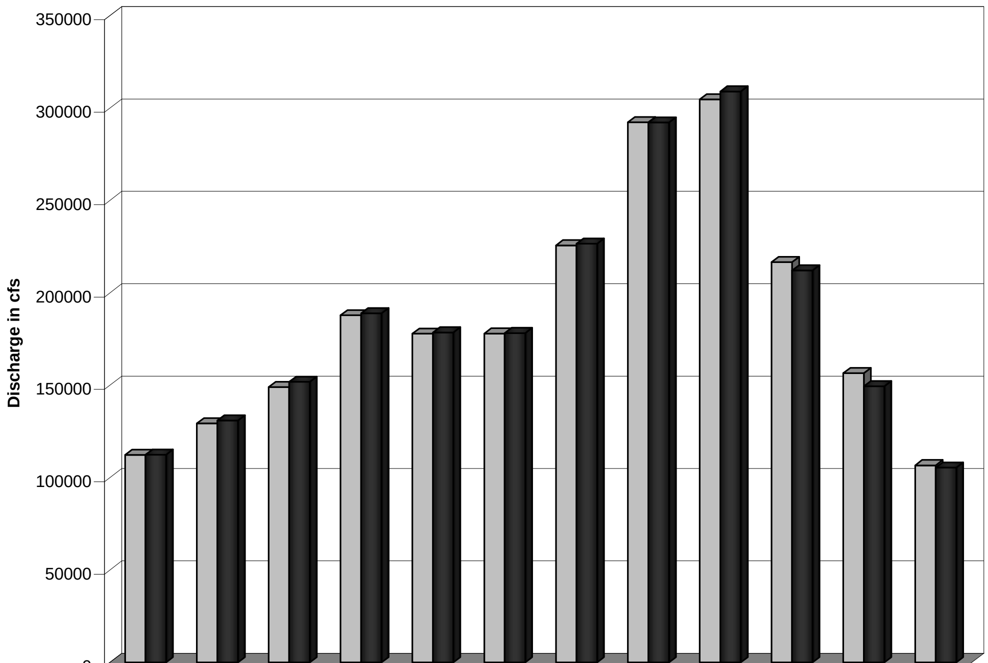
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Current	24556	20597	29272	34779	46372	51182	82279	107413	100950	53523	30097	25148
Prospective	24561	20596	29272	34779	46367	51180	82281	109057	102237	52076	28653	25148

Figure 8.1-2. Mean monthly Snake River discharge (cfs) at Lower Granite Dam under the current operations and under the prospective operations. Sources: Current Operations, BPA HYDSIM Model run FRIII_07Rerun2004BiOp, dated 4-28-08; Prospective Action, BPA HYDSIM Model run FRIII_final2008BiOp dated 4-28-08.



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Current	106627	118241	133601	170812	159009	159004	205522	279283	294689	209431	150342	100033
Prospective	106735	119727	136488	171856	159717	159331	206450	279127	298988	204884	143205	98799

Figure 8.1-3. Mean monthly Snake River discharge (cfs) at McNary Dam under the current operations and under the prospective operations. Sources: Current Operations, BPA HYDSIM Model run FRIII_07Rerun2004BiOp, dated 4-28-08; Prospective Action, BPA HYDSIM Model run FRIII_final2008BiOp dated 4-28-08.



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Current	112388	129482	149044	187950	177970	178014	225751	292407	304775	216748	156612	106743
Prospective	112493	130971	151932	188995	178678	178341	226681	292261	309062	212199	149473	105505

Figure 8.1-4. Mean monthly Snake River discharge (cfs) at Bonneville Dam under the current operations and under the prospective operations. Sources: Current Operations, BPA HYDSIM Model run FRIII_07Rerun2004BiOp, dated 4-28-08; Prospective Action, BPA HYDSIM Model run FRIII_final2008BiOp dated 4-28-08.

8.1.1.3 Total Dissolved Gas Effects

Following completion of the ongoing flow-deflector construction project at Chief Joseph Dam, TDG conditions throughout the Columbia River migration corridor will be improved during all years that require involuntary spill at that project. In some years this measure would improve smolt survival conditions at both Federal and non-Federal projects in the lower Columbia River. This measure is expected to be completed and totally operational by the 2009 runoff season.

Not only will gas-abatement at Chief Joseph improve downstream water quality, during higher flow years it may also allow increased voluntary spill at downstream projects (e.g. Rock Island, Wanapum) without exceeding state TDG limits. No quantitative estimates of this anticipated benefit are currently available, nevertheless it is reasonable to assume that juvenile migrant survival benefits would accrue during about half of all years with the largest benefits occurring during high and very high flow years when high rates of involuntary spill occur.

All spring migrants will benefit from this reducing TDG concentrations in outflows at Chief Joseph Dam but steelhead smolts, particularly those from the UCR and MCR steelhead DPSs, which are not transported, will likely benefit more than other spring migrants. Steelhead smolts tend to migrate higher in the water column, where gas levels are higher, and are therefore slightly more susceptible to GBT. However, all spring migrants will benefit from increased spill made possible by reducing ambient TDG concentrations.

8.1.1.4 Juvenile Research Monitoring & Evaluation Program

A thoroughly developed and implemented program of research, monitoring, and evaluation (RM&E) can lead to improved fish survival techniques and a greater likelihood of recovery. RM&E inform both in-season and planning decision processes and are integral to adaptive management of the system. The proposed hydrosystem RM&E program is designed to answer the following questions:

- Are salmon and steelhead meeting juvenile and adult hydrosystem passage performance standards and targets?
- Is each project in the hydropower system safely and efficiently passing adult and juvenile migrants?
- What are the most effective configurations and operations for achieving desired performance standards and targets in the FCRPS?
- What is the post-Bonneville mortality effect of changes in fish arrival timing and transportation to below Bonneville?
- Under what conditions does in-river passage provide greater smolt-to-adult return (SAR) rates than transport?

This action is expected to benefit all ESUs by providing information to support effective adaptive management of the FCRPS throughout the life of the RPA.

8.1.1.5 Other Effects on Juvenile Migrants

Predator Control

The RPA continues the expanded Northern Pikeminnow (*Ptychocheilus oregonensis*) Management Program, which will benefit all species. This program has proven effective in reducing pikeminnow numbers and predation rates and is expected to reduce the total number of smolts lost to pikeminnow predation by about 25% throughout the life of this opinion. These effects are included in the species-specific analyses below.

The proposal to form and coordinate a workshop to review, evaluate, and develop strategies to reduce the impacts of non-indigenous predatory fish such as bass and walleye is an important first step toward assessing and managing predation on salmonids by these species. However such a step is too preliminary for NOAA to predict that a predation reduction is likely to occur as a result. An increasing body of information shows that both walleye and smallmouth bass predation can be locally and seasonally significant. Because NOAA Fisheries cannot yet clearly identify a benefit from this initiative, it has not included any likely benefit in its analysis of effects.

The relocation of the East Sand Island Caspian tern (*Sterna caspia*) colony is expected to benefit all spring migrants and especially all steelhead DPSs. These effects have been quantified and are included in the species-specific analyses below.

RPA Action 47 requires the development of management plans for controlling salmonid predation by double-crested cormorant (*Phalacrocorax auritus*) and Caspian tern nesting at inland sites upstream of Bonneville Dam. Control of these predators would benefit in-river salmonid migrants of all species that spawn upstream from McNary Dam. Developing a plan is only the first necessary step toward achieving benefits for migrating salmon. As this plan is not yet developed, NOAA Fisheries cannot now quantify its likely benefits and has not assigned any benefit to this action in its fish survival modeling.

The proposal to continue avian deterrent actions at all lower Snake and Columbia River dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces. This program continues actions included in the environmental baseline and thus its effects are included in the reach survival estimates base-to-current adjustments used in NOAA Fisheries' quantitative analyses.

8.1.2 Adult Migrant Survival Effects

After accounting for known harvest and estimated stray rates, it appears that the FCRPS has a slight to modest effect on the survival of known origin returning adults. Adult migrant survival through the four to seven dams and reservoirs the interior basin populations must pass ranges from 80% to 90% (see Adult Survival Estimates Appendix).[4]

Downstream of Bonneville dam, the presence of the dam, in combination with increasing numbers of predacious marine mammals (especially California sea lions) in the tailrace of this project, has resulted in a substantial impact to adult spring-run Chinook and winter-run steelhead populations (see SCA – Marine Mammal Predation Appendix). Non-lethal means of managing this impact (exclusion devices, land-and water-based harassment efforts, etc.), though required to continue by the RPA, have proved largely ineffective, as sea lions have proven adept at evading and ignoring such measures. However, current impacts will be substantially reduced as a result of NOAA Fisheries' authorization of the states of Oregon, Washington, and Idaho to remove certain individually identifiable sea lions from this area.[5] NOAA Fisheries expects, that as a result of these activities, sea lion predation rates will be reduced to a continuing average annual impact of about 3.0% for spring Chinook salmon and 7.6% for winter steelhead migrating upstream of Bonneville dam.

Not all adult anadromous salmonids die after spawning. Steelhead adults that survive the rigors of spawning migrate downstream to the ocean soon after spawning. Downriver dam passage survival for these adults, known as kelts, is poor. NOAA Fisheries considers improvement in kelt survival a key element to improving the survival of all steelhead ESUs.

RPA Action 42 requires the Action Agencies to fund the kelt reconditioning program on the Yakima River for MCR steelhead; RPA Action 55 requires the monitoring of kelt passage to improve our understanding; and several configuration and operation improvements of RPA Hydropower Strategy Two (Actions 18 – 28) provide downstream juvenile passage improvements that would also improve kelt dam passage survival. Proposed passage improvements for juvenile salmon and steelhead, including surface passage routes such as RSWs and sluiceways, are likely to also benefit downstream migrating kelts. This should lead to improved survival through the FCRPS. Reduced forebay residence times which lead to a reduction in total travel time may also contribute to an improvement in kelt return rates. It is not possible to calculate the precise amount of improvement expected, because the interactions between improved surface passage and improved kelt survival and return rates are poorly known. However, some improvement is likely.

The RPA (Action 33) requires the Action Agencies to develop, in cooperation with regional salmon managers, and to then implement a Snake River steelhead kelt management plan. The plan would be designed to provide at least a 6% improvement in B-run population productivity. This goal would be achieved by a combination of collection, reconditioning, downstream transport, and dam passage

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[4] These estimates may include losses not associated with the hydrosystem such as: unreported or unauthorized harvest, the deaths of fish injured but not killed by marine mammals downstream of Bonneville Dam, as well as natural mortalities.

[5] NOAA Fisheries recently completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho for lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook and winter-run steelhead in the tailrace of Bonneville Dam (Section 5.4.1.3). This action is expected to increase the absolute survival of migrating adult spring-run Chinook by 5.5% and of winter-run steelhead by 14.2%.

survival improvements. Reconditioning programs capture kelts and hold them in tanks where they are fed and treated with antibiotics to enhance survival. Current programs either hold kelts for 3-5 weeks and release them below Bonneville, or hold kelts until they are ready to spawn and release them into their natal streams. Short-term reconditioning efforts have produced average survival rates of 82% (from capture to downstream release) and subsequent kelt returns of 4% to the Yakima River (Branstetter et al. 2006) Long-term reconditioning has produced average survival rates of 35.6%, and all these fish are returned to their natal stream for spawning (Hatch et al. 2006).

There is some concern over the viability of the offspring from long-term reconditioned kelts. Laboratory studies found high rates of post hatching mortality (Branstetter et al. 2006), and studies using DNA analysis to identify the parentage of outmigrating steelhead smolts (Stephenson et al. 2007) have failed to identify any offspring of reconditioned kelts among the juvenile steelhead collected from streams where reconditioned kelts were released. These studies suggest that long-term reconditioning may reduce gamete viability. It is not known if short-term reconditioned kelts may have the same problems with offspring viability; however, because they feed and mature under natural conditions it seems less likely.

Transportation of kelts involves capturing kelts, transporting them to a point downstream of Bonneville Dam, and releasing them. Kelt transportation studies in the Snake River found that not only was there an improvement in FCRPS survival from 4-33% to approximately 98% in transported kelts, transported kelts returned to Lower Granite dam at a rate of 1.7% versus in-river migrating kelts which returned at a rate of 0.5% (Boggs and Peery 2004).

Downstream migrating kelts must be captured before they can be transported and reconditioned. Given kelt preference for surface passage and the potential for future implementation of surface passage routes, the number of kelts which can be collected is limited. Upper and mid-Columbia species present significant challenges to successfully collecting kelts. Existing bypass systems and transportation facilities on the Snake River dams make successful collection of Snake River steelhead more likely. An analysis by Dygert (2007) estimated that 7% (during spill) to 22% (no spill) of the upstream steelhead run could be captured at LGR as downstream migrating kelts. RPA Action 33 would employ collection at both LGR and LGS. NOAA Fisheries' analysis of the likely effects of this RPA action (Steelhead Kelt Appendix) suggests that employing a combination of transportation, reconditioning, and in-stream passage improvements could increase kelt returns enough to increase the number of Snake River B-run steelhead spawners by about 3%. If logistical difficulties associated with capture of upper Columbia River steelhead kelts can be overcome, similar benefits could be expected for that species as well.

8.1.3 Climate Change Considerations

In addition to describing the potential effects of climate change in the Columbia basin, as described in Section 5.7.3 of this document, the ISAB provides a series of mitigation recommendations to address these anticipated effects (ISAB 2007c). These recommendations were taken into consideration in the development of NOAA Fisheries' reasonable and prudent alternatives and by tracking the limiting factors that affect listed species, the Action Agencies will be able to adjust their selection of projects. The ISAB recommendations include:

Planning Actions

1. Assessing potential climate change impacts in each subbasin and developing a strategy to address these concerns should be a requirement in subbasin plan updates. Providing technical assistance to planners in addressing climate change may help ensure that this issue is addressed thoroughly and consistently in the subbasin plans.

2. Tools and climate change projections that will aid planners in assessing subbasin impacts of climate change are becoming more available. Of particular interest for the Columbia Basin is an online climate change streamflow scenario tool that is designed to evaluate vulnerability to climate change for watersheds in the Columbia Basin. Models like this one can be used by planners to identify sensitivities to climate change and develop restoration activities to address these issues.

3. Locations that are likely to be sensitive to climate change and have high ecological value would be appropriate places to establish reserves through purchase of land or conservation easements. Landscape-scale considerations will be critical in choice of reserve sites, as habitat fragmentation and changes of habitat will influence the ability of such reserves to support particular biota in the future. These types of efforts are already supported by the Fish and Wildlife Program, but actions have not yet been targeted to address climate change concerns."

Tributary Habitat

1. Minimize temperature increases in tributaries by implementing measures to retain shade along stream channels and augment summer flow
   - Protect or restore riparian buffers, particularly in headwater tributaries that function as thermal refugia
   - Remove barriers to fish passage into thermal refugia

2. Manage water withdrawals to maintain as high a summer flow as possible to help alleviate both elevated temperatures and low stream flows during summer and autumn
   - Buy or lease water rights
   - Increase efficiency of diversions

3. Protect and restore wetlands, floodplains, or other landscape features that store water to provide some mitigation for declining summer flow
   - Identify cool-water refugia (watersheds with extensive groundwater reservoirs)
   - Protect these groundwater systems and restore them where possible
   - May include tributaries functioning as cool-water refugia along the mainstem Columbia where migrating adults congregate
   - Maintain hydrological connectivity from headwaters to sea

Mainstem and Estuary Habitat

1. Remove dikes to open backwater, slough, and other off-channel habitat to increase flow through these areas and encourage increased hyporheic flow to cool temperatures and create thermal refugia

Mainstem Hydropower

1. Augment flow from cool/cold water storage reservoirs to reduce water temperatures or create cool water refugia in mainstem reservoirs and the estuary

- May require increasing storage reservoirs, but must be cautious with this strategy
- Seasonal flow strategy

2. Use of removable spillway weirs (RSW) to move fish quickly through warm forebays and past predators in the forebays.

- Target to juvenile fall Chinook salmon

3. Reduce water temperatures in adult fish ladders

- Use water drawn from lower cool strata of forebay
- Cover ladders to provide shade

4. Transportation

- Develop temperature criteria for initiating full transportation of juvenile fall Chinook salmon
- Explore the possibility of transporting adults through the lower Snake River when temperatures reach near-lethal limits in later summer
- Control transportation or in-river migration of juveniles so that ocean entry coincides with favorable environmental conditions

5. Reduce predation by introduced piscivorous species (e.g., smallmouth bass, walleye, and channel fish) in mainstem reservoirs and the estuary

Harvest

1. Harvest managers need to adopt near-and long-term assessments that consider changing climate in setting annual quotas and harvest limits

- Reduce harvest during favorable climate conditions to allow stocks that are consistently below sustainable levels during poor phase ocean conditions to recover their numbers and recolonize areas of freshwater habitat
- Use stock identification to target hatchery stocks or robust wild stocks, especially when ocean conditions are not favorable

- Control juvenile migration to ensure that ocean entry coincides with favorable ocean conditions[6]

Addressing ISAB Recommendations

NOAA Fisheries considered many of the ISAB's recommendations in its development of its reasonable and prudent alternatives and applied the recommendations, where applicable, to the actions committed to in this Opinion.

Planning Actions

The RPA contains an array of planning actions, from implementation plans (RPA Action 1) to annual configuration and operations plans (RPA Actions 18-25) to tributary habitat enhancement project identification process (RPA Action 35). The Action Agencies will be required to provide technical assistance to these planning processes, including extensive water quality and fish population modeling (RPA Actions 15, and 53-57). The anticipated effects of climate change will be considered in all applicable planning processes prescribed by this RPA (e.g. those areas where climate change may affect the results).

Tributary Habitat Mitigation

Under RPA Action 34, the Action Agencies will implement an array of habitat improvement projects including, but not limited to: enhancing riparian habitat conditions (e.g. fencing) that would improve stream shading, and the acquisition of water for the purpose of improving summer flows. These actions should improve tributary water temperature conditions. RPA Action 35 requires periodic evaluations of the effectiveness of these tributary habitat enhancement measures and the identification of additional habitat projects in the event that the projected performance of these projects does not meet the specified objectives. The criteria for such additional projects will include consideration of the anticipated effects of global climate change.

For example, the Action Agencies are funding the Methow Salmon Recovery Board to reconnect a side channel of the Methow River. This project will increase off-channel rearing and over-wintering habitat; restore and improve riparian habitat; increase instream complexity; restore natural floodplain processes; restore natural channel process; reestablish side channel rearing habitat; restore-improve riparian forest habitat; add wood complexes in the mainstem; install a rock structure to keep a majority of flow in the mainstem; breach an existing levee; and connect side channels (Fender Mill floodplain restoration) (Corps et al. 2007b, Attachment B.2.2-2).

Additionally, the Action Agencies are funding the John Day Fish Habitat Enhancement Program to enhance production of indigenous wild stocks of spring Chinook and summer steelhead through habitat protection, enhancement and fish passage improvements. During the 2008 to

[6] If the ocean condition becomes less productive, density dependence will be intensified, resulting in increased competition among species and stocks in the ocean. This may result in lower growth and survival rates for wild salmon in the ocean. Reduction in hatchery releases during poor ocean conditions may enhance survival of wild stocks, but more research is necessary (ISAB 2007c).

2009 time period this project will protect riparian areas by installing approximately 15 miles of fencing along tributaries of the John Day River (Corps et al. 2007b, Attachment B.2.2-2).

The Action Agencies are also funding a project to enhance riparian buffers on streams in the Fifteen Mile subbasin and other direct tributaries to the Columbia River in northern Wasco County. A 3-year project goal is to protect riparian areas on approximately 872 acres, covering an estimated 40 miles of anadromous fish streams. Buffer widths will be between 35 and 180 ft. on each side of the stream (Corps et al. 2007b, Attachment B.2.2-2).

Mainstem & Estuary Habitat Mitigation

The RPA requires the Action Agencies to fund estuary habitat programs to achieve estimated species survival benefits (RPAs 36 & 37). For the 2008 to 2009 period, these actions include, but are not limited to: improving mainstem and side channel habitat; acquiring, protecting and restoring off-channel habitat; restoring tidal influence and improving hydrologic flushing; restoring floodplain connectivity by removing or breaking dikes or installing tide gates; removing invasive plants and weeds; replanting native vegetation; protecting and restoring emergent wetland habitat and riparian forest habitat; and restoring channel structure and function. For the remaining term of the Biological Opinion, the Action Agencies will increase the funding for habitat projects. Flexibility is embedded in the RPA to allow the Action Agencies to evaluate the effects of the actions implemented in the 2008 to 2009 period and adaptively tailor projects to better address effects of evolving climatic variation.

Mainstem Hydropower Mitigation

In order to mitigate for the impending effects of climate change on the mainstem hydropower systems of the Snake and Columbia River basins, RPA actions address outflow temperatures, development and implementation of fish passage strategies, transportation, and predation management. These actions are as follows:

- RPA Actions 10 and 11 involve negotiations between the United States and Canada for the management of the Columbia River. To the extent practical the U.S. entity will work to ensure that at least the current level of stored water is delivered to the river during the juvenile salmon migration season (April through August) and will explore opportunities to improve migration season flows.
- RPA Actions 4 and 15 relate to Dworshak releases in July and August for Snake River migrants. These RPAs require that the Action Agencies regulate outflow temperatures at Dworshak in order to maintain Lower Granite tailwater temperatures at or below the water quality standard of 20 degrees C. In addition, they require the expansion of a water temperature modeling program.
- RPA Actions 15, 22 and 23 require the development and completion of effective passage strategies and ensure that RSWs will be implemented at Little Goose and Lower Monumental dams. These measures will provide for efficient passage, ensuring that salmonids are not delayed in forebays nor exposed to increased rates of predation.

- In very dry years, RPA 14 requires the Action Agencies to maximize transport for Snake River migrants in early spring through May 31. Dry years correspond to high temperature years and maximizing transport ensures that migrants are not exposed to near lethal conditions.
- RPA 44 further reduces predation rates by committing the Action Agencies to develop strategies to reduce non-indigenous piscivorous predation by 2009. Beginning in 2010, the Action Agencies will provide annual progress reports detailing the implementation and progress of the actions decided upon.

In addition to these RPA Actions, the Action Agencies are currently implementing projects to maintain/augment summer flow by managing water withdrawals. This is done in order to help alleviate both elevated temperatures and low stream flows during the summer and autumn. For example, the Action Agencies, in the Okanogan subbasin, are funding a project to restore and enhance anadromous fish populations and habitat in Salmon Creek. This project will reconnect Salmon Creek, a productive tributary of the Okanogan River, and involves a water lease with the Okanogan Irrigation District and construction of a low flow channel within the lower reach (Corps et al. 2007b, Attachment B.2.2-2).

Harvest Mitigation

RPA Actions 62, 63, and 64 address harvest and hatchery information needs to improve our ability to both manage and recover these fish. RPA 62 is intended to improve our understanding of the fate of adult migrants, including unreported harvest, straying and other factors contributing to adult conversion rates (i.e., the fraction observed at one dam that passes the next). RPA Action 63 investigates the effectiveness of conservation and safety net hatcheries on species survival and recovery. RPA Action 64 investigates the critical uncertainties if hatchery effects on listed populations (e.g., does the presence of hatchery fish on the spawning grounds reduce population fitness?).

Summary and Conclusion

The full breadth of long-term climate change (ISAB 2007c; Crozier et al. 2008) is unlikely to be realized in the ten-year term of this Opinion. For instance, as stated in Chapter 7, the Crozier et al. (2008) study is based on instantaneous attainment of expected 2040 climate conditions and its affect on life-stage survival, abundance, and population growth rate. The term of this Biological Opinion ceases in 2018. Following completion of the initial set of tributary habitat actions, the Action Agencies, in selecting projects, will focus their efforts on the most recent limiting factors. If, during this time period, various climatic alterations are determined to be limiting factors, the Action Agencies will allocate their projects accordingly. This allows the Action Agencies to address specific, localized impacts of climate change. Measures are in place to ensure that as climatic variation arises, the Action Agencies will be able to adaptively manage to these conditions. NOAA Fisheries concludes that sufficient actions have been adopted to meet current and anticipated climate changes and that sufficient flexibility is available to ensure that those projects yet to be satisfied (2010 to 2018 habitat projects) will take advantage of any new information that may become available, including climate change effects.

8.1.4 Effects of Prospective Research and Monitoring Actions

Effect on Species Status

Under the RPA, numerous measures will be implemented to protect and enhance salmon and steelhead populations and their habitat in the Columbia River Basin. These measures include restoration actions to address, in part, habitat factors limiting the viability of salmonid populations. These altered habitat conditions will affect the distribution and abundance of Chinook, coho, chum, and steelhead, as well as other native and non-native species.

Research and monitoring actions that the FCRPS Action Agencies implement for the FCRPS are of utmost importance because, without sufficient data, it will be impossible to determine whether the RPA performance is as effective as expected. Fish habitat and population monitoring is often conducted to determine if environmental measures, like those included in the proposed action, provide the desired level of protection and enhancement for target fish species and aid in the development of responsive adaptive management strategies. Monitoring is also a necessary tool for providing data critical to adaptive management. Its implementation will ensure that managers have information to determine the effectiveness of the RPA. This monitoring information will also allow adaptive management decisions to be made to ensure the long-term persistence of listed fish species in the Columbia River Basin, as well as the ability to respond to significant changes in environmental conditions.

Under the Research, Monitoring, and Evaluation RPAs, (RPA Actions 50 through 73) the FCRPS Action Agencies will monitor and evaluate the effectiveness of various aquatic measures including fish passage compared to performance standards; adult anadromous salmonid migration, spawning, distribution, productivity and abundance; water quality; habitat quality and quantity, especially when involved in habitat restoration/conservation actions; and hatchery supplementation programs. The FCRPS Action Agencies will prepare annual monitoring reports that include the raw monitoring data complying with regional standards (including, but not limited to: limiting factor data dictionary, protocol manager, habitat project tracking metrics, FGDC metadata). Work will be conducted by the FCRPS Action Agencies, or those hired by the FCRPS Action Agencies to conduct the work (their contractors).

The various monitoring and evaluation activities for anadromous fish measures would cause many types of take (as defined by ESA §3(19) - The term ‘‘take’’ means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct The first part of this Section is devoted to a discussion of the general effects known to be caused by the general potential proposed activities—regardless of where they occur or what species are involved. All of the types of take that would occur during RM&E activities have been considered in previous ESA consultations. Many of the proposed activities that are continuations of research or monitoring projects have been specifically analyzed in annual or multi-year consultation or ESA section 10 permits. They are included here as a programmatic consideration of RM&E activities within the RPA.

Research and monitoring programs identified in the RPA will be funded and/or conducted by the FCRPS Action Agencies. These programs are expected to take listed salmon and steelhead. The activities include: (1) Determining the abundance, distribution, growth rate, and condition of adult and juvenile fish; (2) conducting disease and genetic studies; (3) determining diet composition; (4) evaluating salmonid production (i.e., smolt-to-adult survival rates); (5) determining stock composition, population trends, and life history patterns; (6) evaluating habitat restoration projects; (7) evaluating salmon carcass nutrient restoration and enhancement projects; (8) assessing effectiveness of mine cleanup activities and the bioaccumulation of contaminants; (9) evaluating effects artificial production and supplementation have on listed fish; (10) investigating migration timing and migratory patterns; (11) moving fish beyond impassable barriers; (12) evaluating fish passage facilities, screens, and other bypass systems; (13) investigating fish behaviors in reservoirs and off-channel areas; (14) evaluating salmon spawning below dams; (15) monitoring and mitigating the effects of dam modification and removal; (16) assessing potential impact of a proposed hydroelectric project on fishery resources; (17) assessing point source discharge effects on fish communities; (18) removing non-native fish and excluding hatchery fish to create wild fish sanctuaries; and (19) rescuing and salvaging fish from isolated pools, side channels, project facilities, or other dewatered areas.

The following subsections describe the types of activities that NOAA Fisheries expects the FCRPS Action Agencies will implement in carrying out the research and monitoring requirements of the Prospective Action. The types of activities are organized into the following categories: observation, capture/handle/release, tagging/marking, biological sampling, and sacrifice. Each is described in terms broad enough to apply to every relevant plan informed by previous experience. The activities would be carried out by trained professionals using established protocols and have widely recognized specific impacts. The FCRPS Action Agencies are required to incorporate NOAA Fisheries' uniform, pre-established set of minimization measures, including training, protocol standardization, data management, and reporting for these activities (e.g. electrofishing). These measures will be included in the specific monitoring plans subject to NOAA Fisheries' approval.

Observation

For some studies, fish will be observed in-water (i.e., snorkel surveys). Direct observation is the least disruptive and simplest method for determining presence/absence of the species and estimating their relative abundance. Its effects are also generally the shortest-lived among any of the research activities discussed in this Chapter. Typically, a cautious observer can obtain data without disrupting the normal behavior of a fish. Fry and juveniles frightened by the turbulence and sound created by observers are likely to seek temporary refuge behind rocks, vegetation, and deep water areas. In extreme cases, some individuals may temporarily leave a particular pool or habitat type when observers are in their area. Researchers minimize the amount of disturbance by slowly moving through streams, thus allowing ample time for fish to reach escape cover; though it should be noted that the research may at times involve observing adult fish—which are more sensitive to disturbance. There is little a researcher can do to mitigate the effects associated with observation activities because those effects are so minimal. In general, all they can do is move with care and attempt to avoid disturbing sediments, gravels, and, to the extent possible, the fish themselves.

Monitoring of population status and the effects of programs and actions will include conducting redd surveys to visually inspect and count the nests or redds of spawning salmon and steelhead. Harassment is the primary form of take associated with these observation activities, and few if any injuries or deaths are expected to occur—particularly in cases where the observation is to be conducted solely by researchers on the stream banks or from a raft rather than walking in the water. Fish may temporarily move off of a redd and seek cover nearby until the observer has past. There is little a researcher can do to mitigate the effects associated with observation activities because those effects are so minimal. In general, all researchers can do is move with care and attempt to avoid disturbing sediments, gravels, and, to the extent possible, the fish themselves.

Capture/Handle/Release

Capturing and handling fish causes them stress—though they typically recover fairly rapidly from the process and therefore the overall effects of the procedure are generally short-lived. The primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures (between the river and the point where fish are held), dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18 degrees C or dissolved oxygen is below saturation. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps if the traps are not regularly emptied. Debris buildup at traps can also kill or injure fish if the traps are not monitored and regularly cleared of debris.

The use of capture/handling/release protocols, which are generally standardized throughout the Columbia basin and include maintaining high quality water (appropriate temperature, oxygen levels, anesthetic concentrations) and keeping fish in water to the maximum extent possible, serve to minimize potential adverse impacts on individual fish. Based on experience with the standard protocols that would be used to conduct the research and monitoring, no more than five percent and in most cases, less than two percent of the juvenile salmonids encountered are likely to be killed as an unintentional result of being captured and handled. In any case, researchers will employ the standard protocols and thereby keep adverse effects to a minimum. Finally, any fish unintentionally killed by the research activities in the proposed permit may be retained as reference specimens or used for other research purposes.

Smolt, rotary screw (and other out-migration) traps

Smolt, rotary screw (and other out-migration) traps, are generally operated to gain population specific information on natural population abundance and productivity. On average, they achieve a sample efficiency of four to 20% of the emigrating population from a river or stream, depending on the river size, although under some conditions traps may achieve a higher efficiency for a relatively short period of time (NMFS 2003b). Based on experience in Columbia River tributaries the mortality of fish captured/handled/released at rotary screw type juvenile fish traps would be expected to be two percent or less on target species.

The trapping, capturing, or collecting and handling of juvenile fish using traps is likely to cause some stress on listed fish. However, fish typically recover rapidly from handling procedures. The primary factors that contribute to stress and mortality from handling are excessive doses of anesthetic, differences in water temperature, dissolved oxygen conditions, the amount of time that fish are held out of water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 64.4 degrees F (18 degrees C) or if dissolved oxygen is below saturation. Additionally, stress can occur if there are more than a few degrees difference in water temperature between the stream/river and the holding tank. The potential for unexpected injuries or mortalities to ESA-listed fish will be reduced in a number of ways.

Study protocols and ITS terms and conditions define how the potential for stress will be minimized. The action specifies that the trap would be checked and fish handled in the morning. This would ensure that the water temperature is at its daily minimum when fish are handled. Fish may not be handled if the water temperature exceeds 69.8 degrees F (21 degrees C). Sanctuary nets must be used when transferring fish to holding containers to avoid potential injuries. The investigator's hands must be wet before and during fish handling. Appropriate anesthetics must be used to calm fish subjected to collection of biological data. Captured fish must be allowed to fully recover before being released back into the stream and will be released only in slow water areas.

Electrofishing

Electrofishing is a process by which an electrical current is passed through water containing fish in order to stun them—thus making them easy to capture. It can cause a suite of effects ranging from simple harassment to actually killing the fish. The amount of unintentional mortality attributed to electrofishing may vary widely depending on the equipment used, the settings on the equipment, and the expertise of the technician. Electrofishing can have severe effects on adult salmonids. Spinal injuries in adult salmonids from forced muscle contraction have been documented. Sharber and Carothers (1988) reported that electrofishing killed 50% of the adult rainbow trout in their study. The long-term effects electrofishing has on both juveniles and adult salmonids are not well understood, but long-term experience with electrofishing indicates that most impacts occur at the time of sampling and are of relatively short duration.

The effects electrofishing may have on the threatened species would be limited to the direct and indirect effects of exposure to an electric field, capture by netting, holding captured fish in aerated tanks, and the effects of handling associated with transferring the fish back to the river (see the previous subsection for more detail on capturing and handling effects). Most of the studies on the effects of electrofishing on fish have been conducted on adult fish greater than 300 mm in length (Dalbey et al. 1996). The relatively few studies that have been conducted on juvenile salmonids indicate that spinal injury rates are substantially lower than they are for large fish. Smaller fish intercept a smaller head-to-tail potential than larger fish (Sharber and Carothers 1988) and may therefore be subject to lower injury rates (e.g., Hollender and Carline 1994, Dalbey et al. 1996, Thompson et al. 1997). McMichael et al. (1998) found a 5.1% injury rate for juvenile Middle Columbia River steelhead captured by electrofishing in the Yakima River subbasin. The incidence and severity of electrofishing damage is partly related to the type of equipment used and the waveform produced (Sharber and Carothers 1988; McMichael 1993; Dalbey et al. 1996; Dwyer and White 1997). Continuous direct current (DC) or low-frequency (30 Hz) pulsed DC have been recommended for electrofishing (Fredenberg 1992; Snyder 1995; Dalbey et al. 1996) because lower spinal injury rates, particularly in salmonids, occur with these waveforms (Fredenberg 1992; McMichael 1993; Sharber et al. 1994; Dalbey et al. 1996). Only a few recent studies have examined the long-term effects of electrofishing on salmonid survival and growth (Dalbey et al. 1996; Ainslie et al. 1998). These studies indicate that although some of the fish suffer spinal injury, few die as a result. However, severely injured fish grow at slower rates and sometimes they show no growth at all (Dalbey et al. 1996).

NOAA Fisheries' electrofishing guidelines (NMFS 2000d) will be followed in all surveys using this procedure. The guidelines require that field crews be trained in observing animals for signs of stress and shown how to adjust electrofishing equipment to minimize that stress. Electrofishing is used only when all other survey methods are not feasible. All areas for stream and special needs surveys are visually searched for fish before electrofishing may begin. Electrofishing is not done in the vicinity of redds or spawning adults. All electrofishing equipment operators are trained by qualified personnel to be familiar with equipment handling, settings, maintenance, and safety. Operators work in pairs to increase both the number of fish that may be seen and the ability to identify individual fish without having to net them. Working in pairs also allows the operators to net fish before they are subjected to higher electrical fields. Only DC units will be used, and the equipment will be regularly maintained to ensure proper operating condition. Voltage, pulse width, and rate will be kept at minimal levels and water conductivity will be tested at the start of every electrofishing session so those minimal levels can be determined. Due to the low settings used, shocked fish normally revive instantaneously. Fish needing to be revived will receive immediate, adequate care.

The preceding discussion focused on the effects of using a backpack unit for electrofishing and the ways those effects will be mitigated. It should be noted, however, that in larger streams and rivers electrofishing units are sometimes mounted on boats. These units often use more current than backpack electrofishing equipment because they need to cover larger (and deeper) areas, and as a result, can have a greater impact on fish. In addition, the environmental conditions in larger, more turbid streams can limit the operators' ability to minimize impacts on fish. For example, in areas of lower visibility it is difficult for operators to detect the presence of adults and thereby take steps to avoid them. Because of its greater potential to harm fish, and because NOAA Fisheries has not published appropriate guidelines, boat electrofishing has not been given a general authorization and all boat electrofishing projects will be evaluated on a case by case basis.

Angling

Fish that are caught and released alive as part of an RM&E project may still die as a result of injuries or stress resulting from the capture method or handling. The likelihood of mortality varies widely, based on a number of factors including the gear type used, the species, the water conditions, and the care with which the fish is released. As detail for the effects analysis below, general catch-and-release effects for steelhead and Chinook salmon are discussed here.

Catch and Release mortality –The available information assessing hook and release mortality of adult steelhead suggests that hook and release mortality is low. Hooton (1987) found catch and release mortality of adult winter steelhead to average 3.4% (127 mortalities of 3,715 steelhead caught) when using barbed and barbless hooks, bait and artificial lures. Among 336 steelhead captured on various combinations of popular terminal gear in the Keogh River, the mortality of the combined sample was 5.1%. Natural bait had slightly higher mortality (5.6%) than did artificial lures (3.8%), and barbed hooks (7.3%) had higher mortality than barbless hooks (2.9%). Hooton (1987) concluded that catch and release of adult steelhead was an effective mechanism for maintaining angling opportunity without negatively impacting stock recruitment. Reingold (1975) showed that adult steelhead hooked, played to exhaustion, and then released returned to their target spawning stream at the same rate as steelhead not hooked and played to exhaustion. Pettit (1977) found that egg viability of hatchery steelhead was not negatively affected by catch-and-release of pre-spawning adult female steelhead. Bruesewitz (1995) found, on average, fewer than 13% of harvested summer and winter steelhead in Washington streams were hooked in critical areas (tongue, esophagus, gills, eye). The highest percentage (17.8%) of critical area hookings occurred when using bait and treble hooks in winter steelhead fisheries.

The referenced studies were conducted when water temperatures were relatively cool, and primarily involve winter-run steelhead. Data on summer-run steelhead and warmer water conditions are less abundant (Cramer et al. 1997). Catch and release mortality of steelhead is likely to be higher if the activity occurs during warm water conditions. In a study conducted on the catch and release mortality of steelhead in a California river, Taylor and Barnhart (1999) reported over 80% of the observed mortalities occurred at stream temperatures greater than 21 degrees C. Catch and release mortality during periods of elevated water temperature are likely to result in post-release mortality rates greater than reported by Hooton (1987) because of warmer water and extended freshwater residence of summer fish which make them more likely to be caught. As a result, NOAA Fisheries expects steelhead hook and release mortality to be in the lower range discussed above.

Juvenile steelhead occupy many waters that are also occupied by resident trout species and it is not possible to visually separate juvenile steelhead from similarly-sized, stream-resident, rainbow trout. Because juvenile steelhead and stream-resident rainbow trout are the same species, are similar in size, and have the same food habits and habitat preferences, it is reasonable to assume that catch-and-release mortality studies on stream-resident trout are similar for juvenile steelhead. Where angling for trout is permitted, catch-and-release fishing with prohibition of use of natural or synthetic bait will reduce juvenile steelhead mortality more than any other angling regulatory change. Many studies have shown trout mortality to be higher when using bait than when angling with artificial lures and/or flies (Taylor and White 1992; Schill and Scarpella 1995; Mongillo 1984; Wydoski 1977; Schisler and Bergersen 1996). Wydoski (1977) showed the average mortality of trout, when using bait, to be more than four times greater than the mortality associated with using artificial lures and flies. Taylor and

White (1992) showed average mortality of trout to be 31.4% when using bait versus 4.9 and 3.8% for lures and flies, respectively. Schisler and Bergersen (1996) reported average mortality of trout caught on passively fished bait to be higher (32%) than mortality from actively fished bait (21%). Mortality of fish caught on artificial flies was only 3.9%. In the compendium of studies reviewed by Mongillo (1984) mortality of trout caught and released using artificial lures and single barbless hooks was often reported at less than 2%.

Most studies have found little difference (or inconclusive results) in the mortality of juvenile steelhead associated with using barbed versus barbless hooks, single versus treble hooks, and different hook sizes (Schill and Scarpella 1995; Taylor and White 1992; Mongillo 1984). However, some investigators believe that the use of barbless hooks reduces handling time and stress on hooked fish and adds to survival after release (Wydoski 1977). In summary, catch-and-release mortality of juvenile steelhead is expected to be less than 10% and approaches 0% when researchers are restricted to use of artificial flies and lures.

Only a few reports are available that provide empirical evidence showing what the catch and release mortality is for Chinook salmon in freshwater. The ODFW has conducted studies of hooking mortality incidental to the recreational fishery for Chinook salmon in the Willamette River. A study of the recreational fishery estimates a per-capture hook-and-release mortality for wild spring Chinook in Willamette River fisheries of 8.6% (Schroeder et al. 2000), which is similar to a mortality of 7.6% reported by Bendock and Alexandersdottir (1993) in the Kenai River, Alaska.

A second study on hooking mortality in the Willamette River, Oregon, involved a carefully controlled experimental fishery, and mortality was estimated at 12.2% (Lindsay et al. 2004). In hooking mortality studies, hooking location and gear type is important in determining the mortality of released fish. Fish hooked in the jaw or tongue suffered lower mortality (2.3 and 17.8% in Lindsay et al. (2004) compared to fish hooked in the gills or esophagus (81.6 and 67.3%). A large portion of the mortality in the Lindsay et al. (2004) study was related to deep hooking by anglers using prawns or sand shrimp for bait on two-hook terminal tackle. Other baits and lures produced higher rates of jaw hooking than shrimp, and therefore produced lower hooking mortality estimates. The Alaska study reported very low incidence of deep hooking by anglers using lures and bait while fishing for salmon.

Based on the available data, the *U.S. v. Oregon* Technical Advisory Committee has adopted a 10% rate in order to make conservative estimates of incidental mortality in fisheries (NMFS 2005c). For similar reasons, NOAA Fisheries currently applies the 10% rate to provide conservative estimates of the hook and release mortality when evaluating the impact of proposed RM&E activities using angling as a monitoring technique.

Tagging and Marking

Techniques such as passive integrated transponder tagging, coded wire tagging, fin-clipping, and the use of radio transmitters are common to many scientific research efforts using listed species. All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or even kill the marked fish. This section discusses each of the marking processes and its associated risks.

Passive Integrated Transponder (PIT) tag

A passive integrated transponder (PIT) tag is an electronic device that relays signals to a radio receiver; it allows salmonids to be identified whenever they pass a location containing such a receiver (e.g., any of several dams) without researchers having to handle the fish again. The tag is inserted into the body cavity of the fish just in front of the pelvic girdle. The tagging procedure requires that the fish be captured and extensively handled; therefore, any researchers engaged in such activities will follow the conditions listed previously in this Opinion (as well as any permit-specific conditions) to ensure that the operations take place in the safest possible manner. In general, the tagging operations will take place where there is cold water of high quality, a carefully controlled environment for administering anesthesia, sanitary conditions, quality control checking, and a carefully regulated holding environment where the fish can be allowed to recover from the operation.

PIT tags have very little effect on growth, mortality, or behavior. The few reported studies of PIT tags have shown no effect on growth or survival (Prentice et al. 1987; Jenkins and Smith 1990; Prentice et al. 1990). For example, in a study between the tailraces of Lower Granite and McNary Dams (225 km), Hockersmith et al. (2000) concluded that the performance of yearling Chinook salmon was not adversely affected by gastrically-or surgically implanted sham radio tags or PIT-tags. Additional studies have shown that growth rates among PIT-tagged Snake River juvenile fall Chinook salmon in 1992 (Rondorf and Miller 1994) were similar to growth rates for salmon that were not tagged (Connor et al. 2001). Prentice and Park (1984) also found that PIT-tagging did not substantially affect survival in juvenile salmonids.

Coded wire tags (CWTs)

Coded wire tags (CWTs) are made of magnetized, stainless-steel wire. They bear distinctive notches that can be coded for such data as species, brood year, hatchery of origin, and so forth (Nielsen 1992). The tags are intended to remain within the animal indefinitely, consequently making them ideal for long-term, population-level assessments of Pacific Northwest salmon. The tag is injected into the nasal cartilage of a salmon and therefore causes little direct tissue damage (Bergman et al. 1968, Bordner et al. 1990). The conditions under which CWTs may be inserted are similar to those required for applying PIT-tags.

A major advantage to using CWTs is the fact that they have a negligible effect on the biological condition or response of tagged salmon. However, if the tag is placed too deeply in the snout of a fish, it may kill the fish, reduce its growth, or damage olfactory tissue (Fletcher et al. 1987; Peltz and Miller 1990). This latter effect can create problems for species like salmon because they use olfactory clues to guide their spawning migrations (Morrison and Zajac 1987).

In order for researchers to be able to determine later (after the initial tagging) which fish possess CWTs, it is necessary to mark the fish externally—usually by clipping the adipose fin—when the CWT is implanted (see text below for information on fin clipping). One major disadvantage to recovering data from CWTs is that the fish must be killed in order for the tag to be removed. However, this is not a significant problem because researchers generally recover CWTs from salmon that have been taken during the course of commercial and recreational harvest (and are therefore already dead).

Radio tagging

Radio tagging is another method for tagging fish. There are two main ways to accomplish this and they differ in both their characteristics and consequences. First, a tag can be inserted into a fish's stomach by pushing it past the esophagus with a plunger. Stomach insertion does not cause a wound and does not interfere with swimming. This technique is benign when salmon are in the portion of their spawning migrations during which they do not feed (Nielsen 1992). In addition, for short-term studies, stomach tags allow faster post-tagging recovery and interfere less with normal behavior than do tags attached in other ways.

The second method for implanting radio tags is to place them within the body cavities of (usually juvenile) salmonids. These tags do not interfere with feeding or movement. However, the tagging procedure is difficult, requiring considerable experience and care (Nielsen 1992). Because the tag is placed within the body cavity, it is possible to injure a fish's internal organs. Infections of the sutured incision and the body cavity itself are also possible, especially if the tag and incision are not treated with antibiotics (Chisholm and Hubert 1985; Mellas and Haynes 1985).

Fish with internal radio tags often die at higher rates than fish tagged by other means because radio tagging is a complicated and stressful process. Mortality is both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). Acute mortality is caused by trauma induced during capture, tagging, and release. It can be reduced by handling fish as gently as possible. Delayed mortality occurs if the tag or the tagging procedure harms the animal in direct or subtle ways. Tags may cause wounds that do not heal properly, may make swimming more difficult, or may make tagged animals more vulnerable to predation (Howe and Hoyt 1982; Matthews and Reavis 1990; Moring 1990). Tagging may also reduce fish growth by increasing the energetic costs of swimming and maintaining balance.

Fin clipping

Fin clipping is the process of removing part or all of one or more fins to alter a fish's appearance and thus make it identifiable. When entire fins are removed, it is expected that they will never grow back. Alternatively, a permanent mark can be made when only a part of the fin is removed or the end of a fin or a few fin rays are clipped. Although researchers have used all fins for marking at one time or another, the current preference is to clip the adipose, pelvic, or pectoral fins. Marks can also be made by punching holes or cutting notches in fins, or severing individual fin rays (Kohlhorst 1979; Welch and Mills 1981). Many studies have examined the effects of fin clips on fish growth, survival, and behavior. The results of these studies are somewhat varied; however, it can be said that fin clips do not generally alter fish growth. Studies comparing the growth of clipped and unclipped fish generally have shown no differences between them (Brynildson and Brynildson 1967). Moreover, wounds caused by fin clipping usually heal quickly—especially those caused by partial clips.

Mortality among fin-clipped fish is also variable. Some immediate mortality may occur during the marking process, especially if fish have been handled extensively for other purposes (e.g., stomach sampling). Delayed mortality depends, at least in part, on fish size; small fishes have often been found to be susceptible to it. Coble (1967) suggested that fish shorter than 90 mm are at particular risk. The degree of mortality among individual fishes also depends on which fin is clipped. Studies show that adipose- and pelvic-fin-clipped coho salmon fingerlings have a 100 % recovery rate (Stolte 1973). Recovery rates are generally recognized as being higher for adipose- and pelvic-fin-clipped fish in comparison to those that are clipped on the pectoral, dorsal, and anal fins (Nicola and Cordone 1973). Clipping the adipose and pelvic fins probably kills fewer fish because these fins are not as important as other fins for movement or balance (McNeil and Crossman 1979). Mortality is generally higher when the major median and pectoral fins are removed. Mears and Hatch (1976) showed that clipping more than one fin may increase delayed mortality but other studies have been less conclusive.

Regardless, any time researchers clip or remove fins, it is necessary that the fish be handled. Therefore, the same safe and sanitary conditions required for tagging operations also apply to clipping activities.

Stomach Flushing

Stomach flushing is a technique to induce fish to regurgitate the contents of their stomachs without killing the fish. Knowledge of the food and feeding habits of fish are important in the study of aquatic ecosystems. However, in the past, food habit studies required researchers to kill fish for stomach removal and examination. Consequently, several methods have been developed to remove stomach contents without injuring the fish. Most techniques use a rigid or semi-rigid tube to inject water into the stomach to flush out the contents.

Few assessments have been conducted regarding the mortality rates associated with nonlethal methods of examining fish stomach contents (Kamler and Pope 2001). However, Strange and Kennedy (1981) assessed the survival of salmonids subjected to stomach flushing and found no difference between stomach-flushed fish and control fish that were held for three to five days. In addition, when Light et al. (1983) flushed the stomachs of electrofished and anesthetized brook trout, survival was 100% for the entire observation period. In contrast, Meehan and Miller (1978) determined the survival rate of electrofished, anesthetized, and stomach flushed wild and hatchery coho salmon over a 30-day period to be 87% and 84% respectively.

Biological Sampling

Genetic Samples (fin clips)
Non-lethal sampling to develop population structure and assess parentage.

Sacrifice
In some instances, it is necessary to kill a captured fish in order to gather whatever data a study is designed to produce. In such cases, determining effect is a very straightforward process: the sacrificed fish, if juveniles are forever removed from the listed species' gene pool; if the fish are adults, the effect depends upon whether they are killed before or after they have a chance to spawn. If they are killed after they spawn, there is very little overall effect. Essentially, it amounts to removing the nutrients their bodies would have provided to the spawning grounds. If they are killed before they spawn, not only are they removed, but so are all their potential progeny. Thus, killing pre-spawning adults has the greatest potential to affect the listed species. Due to this, NOAA Fisheries rarely allows it to happen. And, in almost every instance where it is allowed, the adults are stripped of sperm and eggs so their progeny can be raised in a controlled environment such as a hatchery—thereby greatly decreasing the potential harm posed by sacrificing the adults. There is no way to mitigate the effects of outrightly sacrificing a fish.

Habitat surveys and installation of monitoring devices
The following potential effects to listed species and their habitats associated with the proposed actions for stream channel, floodplain, and upland surveys and installation of stream monitoring devices - erosion and sedimentation, compaction and disturbance of streambed sediments - are negligible and would have little impact on compaction or instream turbidity. The effect of stream channel, floodplain, and upland surveys and installation of stream monitoring devices activity is described in the HIP Biological Opinion (2.2.1.2.1 Stream Channel, Floodplain, and Uplands Surveys and Installation Stream Monitoring Devices such as Streamflow and Temperature Monitors**) (**NMFS 2003c) as applicable. These actions will incorporate the conservation measures for general construction identified in that Biological Opinion. Similarly, there is the potential for trampling a negligible amount of vegetation during upland and floodplain surveys, but the vegetation would be expected to recover.

Excavated material from cultural resource testing conducted near streams may contribute sediment to streams and increase turbidity. The amount of soil disturbed would be negligible and would have a minimal effect on instream turbidity.

Conservation Measures
The following conservation measures will avoid or minimize the adverse effects discussed above:

- The FCRPS Action Agencies must obtain NOAA Fisheries' review and approval of monitoring and evaluation plans prior to initiating any research-related activities anticipated in this RPA. The plans must identify annual anticipated take levels.

- Listed species must be taken only at the levels, by the means, in the areas, and for the purposes stated in each specific monitoring or evaluation proposal, approved by NOAA Fisheries.

- Workers must not intentionally kill or cause to be killed any listed species unless a specific monitoring or evaluation proposal, approved by NOAA Fisheries, specifically allows intentional lethal take.

- Workers must handle listed fish with extreme care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided (e.g., the holding units must contain adequate amounts of well-circulated water). When using gear that captures a mix of species, the permit holder must process listed fish first to minimize handling stress.

- Workers must stop handling listed juvenile fish if the water temperature exceeds 70 degrees F at the capture site. Under these conditions, listed fish may only be visually identified and counted.

- If workers anesthetize listed fish to avoid injuring or killing them during handling, the fish must be allowed to recover before being released. Fish that are only counted must remain in water and not be anesthetized.

- Workers must use a sterilized needle for each individual injection when PIT-tags are inserted into listed fish.

- If workers incidentally capture any listed adult fish while sampling for juveniles, the adult fish must be released without further handling and such take must be reported.

- If backpack electrofishing methods are used, workers must comply with NOAA Fisheries' Guidelines for Electrofishing (NMFS 2000d) available at http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/final4d/electro2000.pdf

- The FCRPS Action Agencies must obtain approval from NOAA Fisheries before changing sampling locations or research protocols.

- Except for escapement (redd) surveys, no in-water work will occur within 300 feet of spawning areas during anadromous fish spawning and incubation times.

- Persons conducting redd surveys will be trained in redd identification, likely redd locations, and methods to minimize the likelihood of stepping on redds or delivering fine sediment to redds.

- Workers will avoid redds and listed spawning fish while walking within or near stream channels to the extent possible. Avoidance will be accomplished by examining pool tail outs and low gradient riffles for clean gravel and characteristic shapes and flows prior to walking or snorkeling through these areas.

- If redds or listed spawning fish are observed at any time, workers will step out of the channel and walk around the habitat unit on the bank at a distance from the active channel.

- Snorkel surveys will follow a statistically valid sampling design or rely on a single pass approach.

- Surveyors will coordinate with other local agencies to prevent redundant surveys.

- Excavated material from cultural resource test pits will be placed away from stream channels. All material will be replaced back into test pits when testing is completed.

- Multiple stream sites will be used for field trips to minimize effects on any given stream or riparian buffer area.

- The FCRPS Action Agencies will prepare an annual report of activities, including stream mileage surveyed and inventoried, categorized by method and by WRIA, USGS 6th field HUC, and UTM or other appropriate spatial point information.

Benefits of Monitoring & Evaluation

NOAA Fisheries will not approve a monitoring plan if it operates to the disadvantage of the endangered and/or threatened species that is/are the subject of the plan. In addition, NOAA Fisheries does not approve monitoring plans unless the proposed activities are likely to result in a net benefit to the listed species; benefits accrue from the acquisition of scientific information.

For more than a decade, research and monitoring activities conducted with anadromous salmonids in the Pacific Northwest have provided resource managers with a wealth of important and useful information on anadromous fish populations. For example, juvenile fish trapping efforts have enabled the production of population inventories, PIT-tagging efforts have increased the knowledge of anadromous fish migration timing and survival, and fish passage studies have provided an enhanced understanding of fish behavior and survival when moving past dams and through reservoirs. By approving plans, NOAA Fisheries will enable information to be acquired that will enhance resource manager's ability to make more effective and responsible decisions to sustain anadromous salmonid populations that are at risk of extinction, to mitigate impacts to endangered and threatened salmon and steelhead, and to implement recovery efforts. The resulting data continue to improve the knowledge of the respective species' life history, specific biological requirements, genetic make-up, migration timing, responses to anthropogenic impacts, and survival in the river system.

8.1.5 Effect of Hatchery Programs

An overview of the effects of past and ongoing hatchery factors on the current status of ESA protected salmon and steelhead of the Columbia Basin is provided in NMFS 2004b; the Salmonid Hatchery Inventory and Effects Evaluation Report), in the Hatchery Effects Appendix, and in the Artificial Propagation for Pacific Salmon Appendix.

The hatchery Prospective Actions consist of continued funding of hatcheries as well as reforms to current federally funded programs that will be identified in future hatchery-specific ESA § 7(a)(2) consultations. Subject to these future hatchery consultations, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives; 2) preserve genetic resources; and 3) accelerate trends toward recovery as limiting factors and threats are fixed and natural productivity increases. These benefits, however, are not relied upon for this consultation and are pending completion of the future hatchery consultations.

Hatcheries have a wide variety of purposes and effects, but many hatchery programs are intended to compensate for the effects of hydropower projects, such as blockage of access to or inundation of spawning habitat, and reduced survivals during juvenile and adult migration limiting natural salmon and steelhead productivity (See Section 5.5 of the SCA). The nearly two hundred programs that operate in the Columbia Basin are compensation for Federal and public and private utilities projects and the Action Agencies, through RPA 39, will continue to fund hatchery programs associated with the FCRPS projects. NMFS 2004b provides an overview of hatchery effects at two levels: at the population level and at the ESU or DPS level. For programs in the Interior Columbia (upstream from Bonneville Dam), the Hatchery Effects Appendix, was developed with input provided by members of the Hatchery and Harvest Workgroup of the FCRPS collaboration. The report (1) summarized the major factors limiting salmon and steelhead recovery at the population scale, (2) provided an inventory of existing hatchery programs including their funding source(s) and the status of their regulatory compliance under the ESA and under the National Environmental Policy Act (NEPA), (3) summarized the effects on salmon and steelhead viability from current hatchery operations, and (4) identified new opportunities or changes in hatchery programs likely to benefit population viability. As a follow-up to this report, NOAA Fisheries developed a framework for determining hatchery effects, including a general assessment of Interior Columbia Basin hatchery program effects, and presented this paper and results to the Hatchery and Harvest Workgroup and to the Policy Workgroup in August of 2006. NOAA Fisheries received comments on the paper from members of each workgroup and made numerous revisions (see Artificial Propagation for Pacific Salmon Appendix).

In general, a summary of progress in hatchery reform for Interior Columbia programs is reported in Table 2 of Hatchery Effects Appendix. The overview provided in the Artificial Propagation for Pacific Salmon Appendix identifies six Interior Columbia hatchery programs that are leading factors limiting salmon and steelhead population viability. On the positive or beneficial side, nine hatchery programs were identified as improving viability and population status in the short-term and thirty programs were identified as slowing trends toward extinction or reducing short-term extinction risk. In this later case, genetic resources important to ESU or steelhead DPS survival and recovery would disappear at an accelerated rate or be lost altogether, but this beneficial effect should be considered transitory because increasing dependence on hatchery intervention results in decreasing benefits and increasing risk (ICTRT 2007a).

For many of the ESUs considered in this analysis, the past effects, and in some instances, continuing effects, of hatchery practices constitute significant factors which may increase risk to the recovery of the ESU (See SCA, Section 5.5). The hatchery Prospective Actions and other on-going hatchery improvement actions are important steps to reducing risk and assuring the long-term viability of these ESUs. These actions are necessary and valuable, and NOAA Fisheries anticipates that they will yield major progress over the next several years with benefits extending into the future. However, by necessity, major hatchery reform of this kind requires that a Hatchery and Genetic Management Plan (HGMP) be submitted to NOAA Fisheries for each hatchery program and detailed review and analysis of each HGMP. The results will be realized in reforms and improvements that are specific to the program involved. At this time, submittal of updated HGMPs to NOAA Fisheries is awaiting recommendations that are pending from science teams and it is not possible to anticipate exactly what those results might be for each of the programs. While we are confident that reforms will occur, in most instances we do not have updated information and analysis to quantify the benefits sufficiently for the quantitative analyses of this SCA.

Because integrated consideration of hatcheries is important to understanding these ESUs, the discussion for these ESUs includes a consideration of the effects of hatchery programs (i.e., overviews without the benefit of proposed hatchery actions and accompanying technical analysis), and where appropriate, a discussion of the effect of potential improvements to these programs. However, except where specifically indicated (such as the consideration of "safety net" hatchery programs to assure survival), the conclusions in this opinion regarding jeopardy and the potential effect of these hatchery improvements can rely only qualitatively on the FCRPS RPA requiring hatchery reform and improvement.

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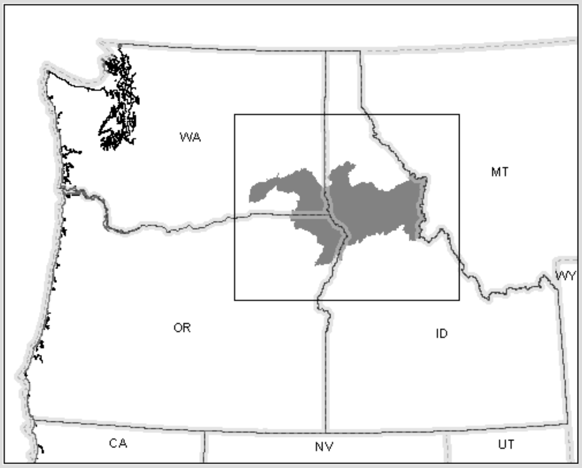
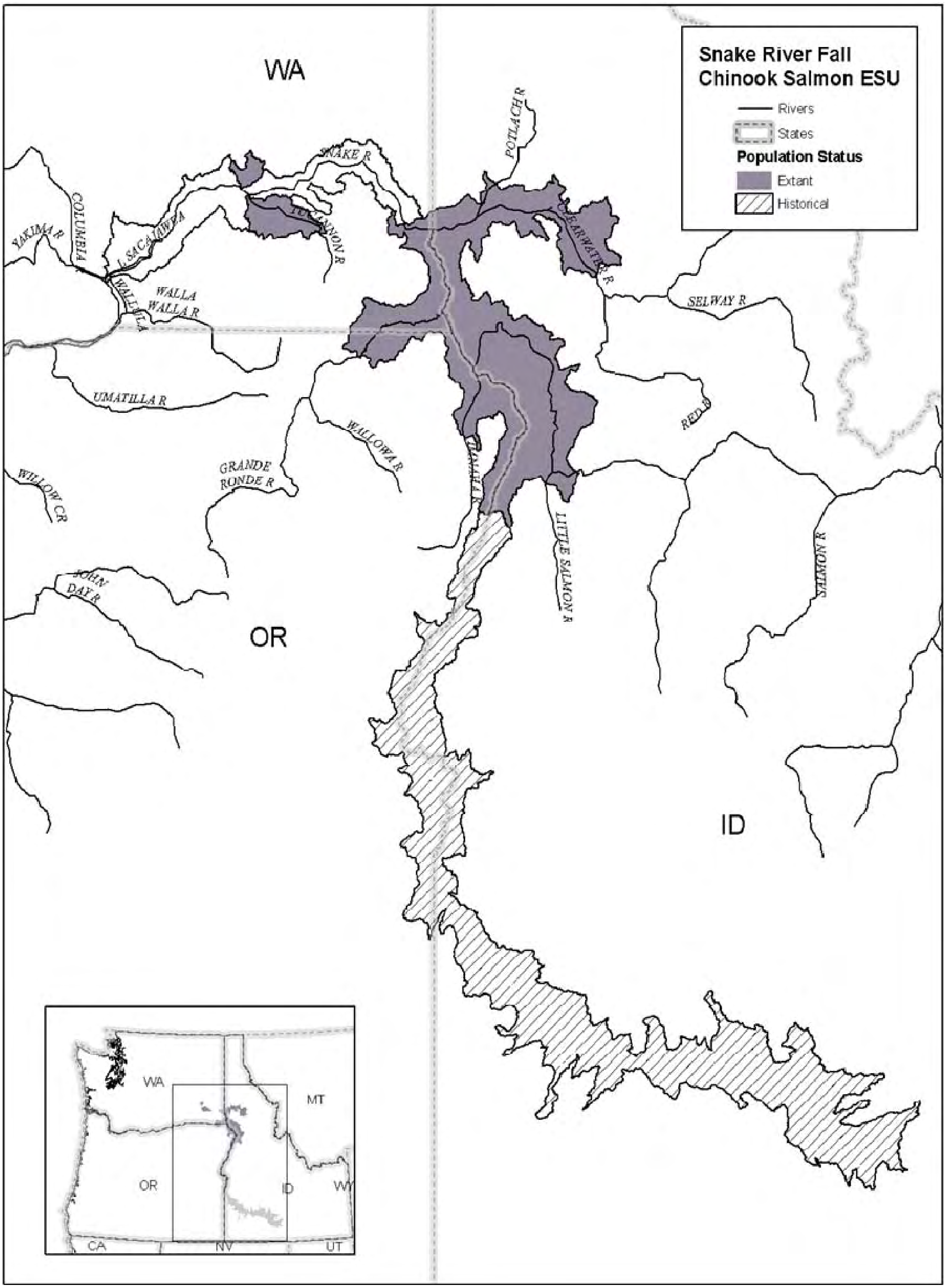
Section 8.2
Snake River Fall Chinook Salmon




Snake River Fall Chinook Salmon ESU
Rivers
States
Population Status
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SNAKE R
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SELWAY R
TUCANNON R
COLUMBIA
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UMATILLA R
WALLOWA R
GRANDE RONDE R
WILLOW CR
JOHN DAY R
IMNAHA R
LITTLE SALMON R
SALMON R
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MT
WY
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Section 8.2
Snake River Fall Chinook Salmon

Species Overview

Background

The Snake River (SR) fall Chinook salmon ESU is a single population in one major population group (MPG) that spawns and rears in the mainstem Snake River and its tributaries below Hells Canyon Dam. The decline of this ESU was due to heavy fishing pressure beginning in the 1890s and loss of habitat with the construction of Swan Falls Dam in 1901 and the Hells Canyon Complex from 1958 to 1967, which extirpated two of the historical populations. Only 10 to 15% of the historical range of this ESU remains. Hatcheries have played a major role in the production of Snake River fall Chinook since the 1980s. Snake River fall Chinook were listed under the ESA as threatened in 1992.

Designated critical habitat for Snake River fall Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; the Snake River, upstream to Hells Canyon Dam; the lower reaches of the Palouse; and the North Fork Clearwater River (upstream to Dworshak Dam).

Current Status & Recent Trends

The average abundance (1,273) of SR fall Chinook over the most recent 10-year period is below the 3,000 natural spawner average abundance thresholds that the ICTRT identified as a minimum for recovery. Total returns to Lower Granite Dam increased steadily from the mid-1990s to the present. Natural returns increased at roughly the same rate as hatchery origin returns (through run year 2000), but since then hatchery returns have increased disproportionately to natural-origin returns. On average over the last 23 full brood year returns (1977-1999, which includes adult returns through 2004), the natural origin component of the population has not replaced itself.

Limiting Factors and Threats

Limiting factors for SR fall Chinook include mainstem hydroelectric projects in the Columbia and Snake rivers, predation, harvest, hatcheries, the estuary, and tributary habitat. Ocean conditions have also affected the status of this ESU. Generally, ocean conditions have been poor for this ESU over the past 20 years, improving only recently.

Recent Ocean and Mainstem Harvest

SR fall Chinook are present throughout ocean fisheries from Alaska to California, and in fall season fisheries in the mainstem Columbia River. Incidental catch occurs in fisheries that target harvestable hatchery and natural-origin fish. The total ocean fishery exploitation rate averaged 46% from 1986 to 1991, and 31% from 1992 to 2006. Ocean fisheries have been required since 1996, through ESA consultation, to achieve a 30% reduction in the average exploitation rate observed during the 1988 to 1993 base period. In recent years, about 14% of the incidental take has occurred in the southeast Alaska fishery, about 23% in the Canadian fishery (primarily off the west coast of Vancouver Island), about 20% in the coastal fishery (primarily off Washington, and to a lesser degree off Oregon and Northern California), about 11% in the non-Treaty fishery in the Columbia River, and about 30% in the Columbia River tribal treaty-right fishery. The presence of large numbers of harvestable natural-origin fish in the fishing locations from other sources makes it infeasible to distinguish Snake River fall Chinook through means of mark-selective fishing techniques.

SR fall Chinook area also caught in fall season fisheries in the Columbia River with most impacts occurring in Non-Treaty and treaty Indian fisheries from the river mouth to McNary Dam. Fisheries affecting SR fall Chinook have been subject to ESA constraints since 1992. Since 1996, Columbia River fisheries have been subject to a total harvest rate limit of 31.29%. This represents a 30% reduction in the 1988 to 1993 base period harvest rate.

Total harvest mortality for the combined ocean and inriver fisheries can be expressed in terms of exploitation rates which provide a common currency for comparing ocean and inriver fishery impacts (Fisheries in the Columbia River are generally managed subject to harvest rate limits. Harvest rates are expressed as a proportion of the run returning to the river that is killed in river fisheries). The total exploitation rate has declined significantly since the ESA listing. Total exploitation rate averaged 75% from 1986 to 1991, and 45% from 1992 to 2006.

8.2.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.2.2.1 Current Rangewide Status of the Species

Snake River (SR) fall Chinook is a threatened species composed of one extant population in one major population group (MPG). Two historical populations have been extirpated. This population must be highly viable to achieve the ICTRT's suggested viability scenario (ICTRT 2007a, Attachment 2). Key statistics associated with the current status of SR fall Chinook salmon are summarized in Tables 8.2.2-1 through 8.2.2-4.

Limiting Factors and Threats

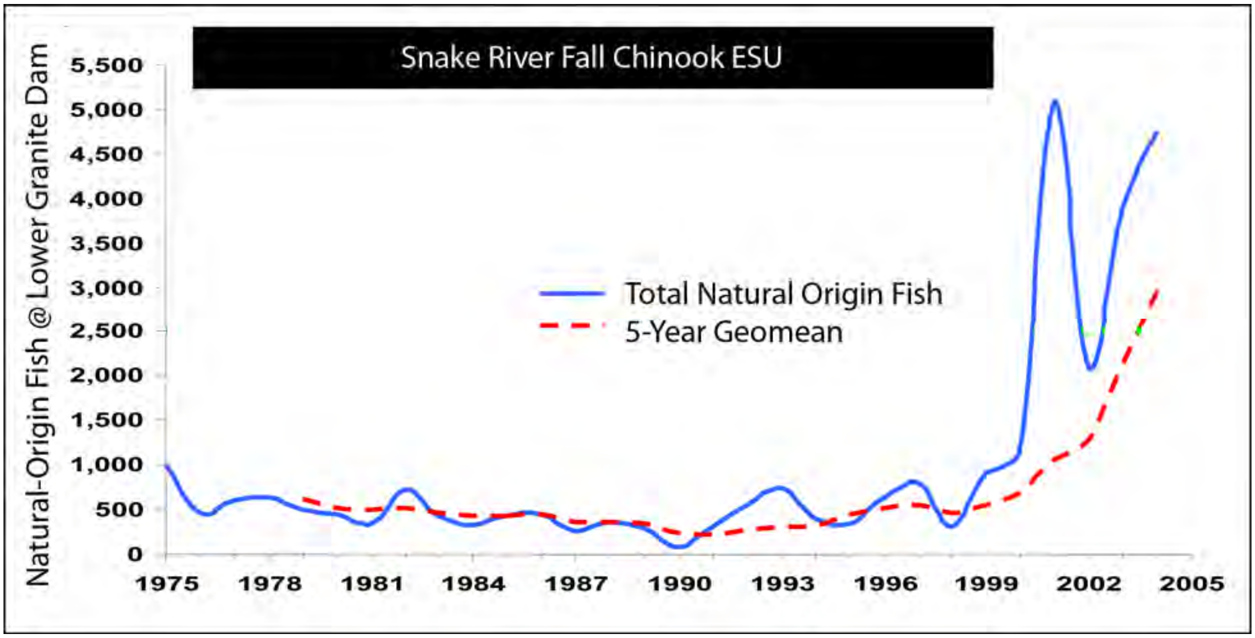
The key limiting factors and threats for the Snake River fall Chinook include hydropower projects, predation, harvest, degraded estuary habitat, and degraded mainstem and tributary habitat. Ocean conditions have also affected the status of this ESU. Ocean conditions affecting the survival of Snake River fall Chinook were generally poor during the early part of the last 20 years.

Abundance

Average abundance (1,273) of SR fall Chinook over the most recent 10-year period is below the 3,000 natural spawner average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.2.2-1).[4] The ICTRT recommends that no fewer than 2,500 of the 3,000 natural-origin fish be mainstem Snake River spawners. Total returns of fall Chinook over Lower Granite Dam increased steadily from the mid-1990s to the present. Natural returns increased at roughly the same rate as hatchery origin returns (through run year 2000), since then hatchery returns have increased disproportionately to natural-origin returns (Figure 8.2.2.1-1). The median proportion of natural-origin has been approximately 32% over the past two brood cycles (Cooney and Ford 2007).

[4] BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for "no jeopardy" determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Figure 8.2.2.1-1 Snake River Fall Chinook Salmon Abundance Trends (adopted from Fisher and Hinrichsen 2006)



The driving factors for the recent increase may include reduced harvest rates, improved in-river rearing and migration conditions, the development of life history adaptations to current conditions, improved ocean conditions benefiting the relatively northern migration patter, the supplementation program or other factors. As this time, there is insufficient information to estimate the relative contributions of these factors (Cooney and Ford 2007).

"Base Period" Productivity

On average over the last 23 full brood year returns (1977-1999 brood years [BY], including adult returns through 2004), when only natural production is considered, SR fall Chinook populations have not replaced themselves (i.e., average R/S has been less than 1.0; Table 8.2.2-1). R/S productivity was below 1.0 for all but three brood years prior to 1995, and it was above 1.0 between 1995 and 1999 (Cooney and Ford 2007). Additionally, Cooney and Ford (2007) make preliminary estimates for the 2000-2003 brood years, half of which also indicate R/S>1.0.

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at <5% extinction risk (ICTRT 2007c)

The BRT trend in abundance was >1.0 during the 1980-2004 period (Table 8.2.2-1). Median population growth rate (lambda), when calculated with an assumption that hatchery-origin natural spawners do not reproduce effectively (HF=0), also was greater than 1.0 (increasing) for SR fall Chinook (Table 8.2.2-1). When calculated with the HF=1 assumption, lambda has been less than 1.0.

Spatial Structure

The ICTRT does not yet characterize the spatial structure risk to SR fall Chinook, although generic spatial structure criteria have been described in ICTRT (2007d). However, the Biological Review Team (Good et al. 2005) characterizes the risk for the "distribution" VSP factor as "moderately high" (Table 8.2.2-2) because approximately 85% of historical habitat is inaccessible and the distribution of the extant population makes it relatively vulnerable to variable environmental conditions and large disturbances.

Diversity

The ICTRT has not yet characterized the diversity risk to SR fall Chinook, although generic diversity criteria and the presence of five major spawning areas within currently occupied habitat are described in ICTRT (2007d). However, the Biological Review Team (Good et al. 2005) characterizes the risk for the diversity VSP factor as "moderately high" (Table 8.2.2-2) because of the loss of diversity associated with extinct populations and the significant hatchery influence on the extant population. The median proportion of hatchery-origin has been approximately 68% over the past two brood cycles.

Based on NOAA Fisheries' SHIEER document (NMFS 2004b), the hatchery and harvest workgroup (under the Policy Work Group), "Hatchery Effects Report," and Cooney and Ford (2007), there are four primary reasons why the current supplementation program contributes to a diversity risk for Snake River fall Chinook: 1) In order to meet the ICTRT's (2007a) diversity viability goals, the proportion of hatchery fish spawning naturally must be significantly reduced from current levels; 2) In the current configuration of the program, all components of the ESU are supplemented, limiting the options for evaluating the programs; 3) In the mainstem Snake River major spawning areas, the ESU may be at or near carrying capacity, suggesting the further supplementation is unlikely to be beneficial to the ESU; and 4) The proportion of natural origin fish in the broodstock has been low. These issues are discussed in more detail in Cooney and Ford (2007).

"Base Period" Extinction Risk

A draft ICTRT Current Status Summary (ICTRT 2007d) characterizes the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of SR fall Chinook during the 1977-1999 Brood year "base period" described above for R/S productivity estimates, as "High" (>25% 100-year extinction risk). In these analyses, the ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years (QET=50). The ICTRT also calculated the extinction risk based on the 1990-1999 time period and determined that it was "moderate" (6-25% 100-year extinction risk). The ICTRT indicates that extinction risk is likely between these estimates ("moderate" to "high").

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk, as discussed in Section 7.1.1 of this Supplemental Comprehensive Analysis. Table 8.2.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for SR fall Chinook. This short-term extinction risk analysis is also based on the assumption that productivity observed during the “base period” will be unchanged in the future. At QET=50, as well as at lower QET levels, there is less than 5% risk of short-term extinction. Confidence limits on this estimate are extremely wide, ranging from 0 to 100% risk of extinction.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1 of the SCA, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. If hatchery supplementation is assumed to continue at current levels for SR fall Chinook, short-term extinction risk is 0% at all QETs (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival that is necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.2.2-4. Mean base period R/S survival gap for the 1977-1999 brood year base period is 34%, while the mean survival gap for lambda (HF=1) is 27%. No additional survival improvements are needed for the R/S gap calculated using the 1990-1999 period, for lambda (HF=0) or for BRT trend estimates. Because base short-term extinction risk is 0-1%, no additional improvements are needed to achieve less than 5% risk at QET=50.

8.2.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for SR fall Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. Critical habitat also includes river reaches presently or historically accessible (except those above impassable natural falls and Dworshak and Hells Canyon dams) in the following subbasins: Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower North Fork Clearwater, Lower Salmon, Lower Snake, Lower Snake-Asotin, Lower Snake-Tucannon, and Palouse. The lower Columbia River corridor is among the areas of high conservation value to the ESU 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 1993). The status of critical habitat is discussed further in Section 8.2.3.3.

8.2.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.2.3.1 "Current" Productivity & Extinction Risk

Because the action area, as defined in Chapter 5, encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk are based on performance of populations during a 20-year "base period," ending with the 1999 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity through bank stabilization, shading, etc.).

Quantitative Estimates

Because a number of ongoing human activities have changed in recent years, it is necessary to evaluate changes that have occurred and adjust the "base period" estimates to reflect what would be expected if current management practices continued into the future. For SR fall Chinook, two approaches are used to characterize the current status (Section 7.1.1 of this document).

Base-to-Current Adjustment Approach

The first approach is to adjust the 1977-1999 brood year estimates by estimating a "base-to-current" survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Section 4.3.1 of the CA. Results are presented in Table 8.2.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately a 9% survival change [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), estuary habitat projects (a less than 1% survival change, based on CA Appendix D), and a reduction in tern mortality (approximately 2%) result in a quantitative survival improvement for SR fall Chinook. The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 12% compared to the 1980-1999 BY average. This also means that the survival "gaps" described in Table 8.2.2-4 would be proportionately reduced by this amount (i.e., ["Gap" ÷ 1.12).

This approach is of limited utility for SR fall Chinook because some of the more important changes from the base period, discussed below, cannot be estimated quantitatively for this species. Therefore, it is only possible to estimate a portion of the survival change that has occurred and the base-to-current survival multiplier represents a very conservative (i.e., negative) estimate of the effect of continuing current hydro operations into the future.

The main change from the base period that cannot be quantified is improvements to hydro configuration and operation for fall Chinook due to uncertainties about the juvenile life history strategies this species employs (Section 8.2.5.1).

Qualitatively, several hydro-related actions have likely contributed to increased productivity of naturally produced SR fall Chinook salmon (base-to-current adjustment). First, Reclamation has provided some level of flow augmentation water (90,000 to 487,000 acre-feet), primarily during July and August, since 1991 (except 1992) to enhance flows (migratory conditions) through the lower Snake and Columbia Rivers (USBR 1998). Second, since 1991, Idaho Power Company has voluntarily provided generally stable outflows (ranging from 8,000 and13,000 cfs depending on prevailing flow conditions in a given year) at Hells Canyon Dam during the fall Chinook spawning season (primarily late October and November); and maintained these flows as minimums throughout the incubation period (primarily late November through April) to enhance the survival of incubating fall Chinook to emergence (IPC 1991 and FERC 2007). During rearing (March through June) peaking at Hells Canyon Complex is known to cause limited entrapment of fall Chinook fry this effect is currently under investigation by IPC and mitigative measures are being evaluated (Brink and Chandler 2006). Third, since 1993, the Corps of Engineers has drafted Dworshak reservoir (north fork, Clearwater River) to enhance juvenile migratory conditions (reduced summer temperatures and enhanced summer flows) in the lower Snake River (Corps et al. 2007b, Appendix 1). By providing suitable water temperatures for over-summer rearing within the Snake River reservoirs, this action apparently has allowed the expression of a productive “yearling” life-history strategy that was not available to this ESU in the past (Connor et al. 2007). Finally, actions required by the 1995 FCRPS Biological Opinion generally resulted in improved dam configurations, better summer flow conditions, and expanded summer spill programs in the lower Columbia River (BA, Appendix A) beginning in 1996 compared to previous years. This likely resulted in improved passage conditions and increased survival rates for in-river migrating juvenile fall Chinook salmon. Together, these factors likely have increased productivity of this species since the base period depicted in the base-to-current survival adjustments.

Hatchery effects are also considered qualitatively. The discussion of diversity under rangewide status (Section 8.2.2.1) also applies to the status of hatchery programs under the environmental baseline.

1990-Present Approach

An alternative approach to adjusting extinction risk is included here because alternative base periods were evaluated by the ICTRT (2007c). In addition to evaluating the 1977-1999 BY time series, the ICTRT evaluated a 1990-1999 BY series. The more recent time series is representative of recent harvest rates and hydro effects, as well as other human impacts. In this sense it is a better representation of current conditions under the environmental baseline than is the 1977-1999 time series. However, there are also two potential drawbacks to the shorter time series. First, because it is a shorter time series it captures less of the variability of the population performance and is generally less reliable for making estimates of productivity and extinction risk. As described in Chapter 7, this is the primary reason why the 20-year time series is emphasized in our quantitative analysis. A second factor is that the more recent time period may include a higher percentage of climatic conditions that appear to be favorable to Columbia basin salmon survival. The base-to-current survival adjustment is intended to represent changes in Columbia basin resource management rather than changes in climate.

The ICTRT (2007c) concluded that "at this time, it is reasonable to assume that the A/P [abundance and productivity] gap falls within the range defined by the two recent scenarios." Therefore, both approaches are used to characterize the current status of SR fall Chinook. The 1990-present productivity estimates are presented in Table 8.2.2-1 and the gaps necessary for productivity >1.0 are included in Table 8.2.2-4. It is not possible to estimate short-term extinction risk for the 1990-present time series (Section 7.1.1). Under this approach, there is no base-to-current adjustment for this metric.

8.2.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.2.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Salmon habitat has been altered through activities such as urban development, logging, grazing, power generation, and agriculture. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. The following are the major factors limiting the conservation value of critical habitat for SR fall Chinook:

- Mainstem lower Snake and Columbia River hydropower system mortality (juvenile migration corridors with safe passage)
- Altered seasonal temperature regimes
- Reduced spawning/rearing habitat due to mainstem lower Snake River hydropower system (spawning areas with gravel, water quality, cover/shelter, riparian vegetation, and space to support egg incubation and larval growth and development)

The FCRPS Action Agencies have taken a number of actions in recent years to improve the conservation value of PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at FCRPS dams has been improved by the structural improvements and operations described in Section 4.3.1.1 in Corps et al. (Corps et al. 2007a).

Spawning Areas

Dauble et al. (2003) described the sequence of mainstem hydro development that reduced the spawning range of SR fall Chinook salmon in the Snake River. Idaho Power Company (IPC 2003) has estimated that as many as 450,000 fish returned to the Snake River each year before hydropower development. About 270,000 spawned upstream of the current location of the Hells Canyon Complex, a series of three dams that IPC built between 1958 and 1967, blocking access to 210 miles (338 km) of mainstem riverine habitat. Construction of the four federal dams on the lower Snake River (1962 to 1975) converted almost 147 miles (236 km) of riverine to reservoir habitat. The reservoirs reduced average water velocities and habitat complexity and increased water surface elevations. Since then, the 101-mile Hells Canyon Reach (i.e., between the upper end of Lower Granite Reservoir and the tailrace of Hells Canyon Dam) has been the only continuous stretch of free-flowing mainstem habitat available to fall Chinook for spawning. Garcia et al. (2007) reported a peak count of 1,709 redds in this reach in 2004 (and more than 1,000 redds each year from 2002 through 2006; see Appendix 3 in Garcia et al. 2007). Assuming two fish per redd, the Hells Canyon Reach has recently supported at least 3,400 spawners.

SR fall Chinook also spawned historically in the lower mainstems of the Clearwater, Grande Ronde, Salmon, Imnaha, and Tucannon river systems. At least some of these areas probably supported significant production, but at much lower levels than in the mainstem Snake River. Smaller portions of habitat in the Imnaha and Salmon rivers have supported fall Chinook. Some limited spawning currently occurs in all these areas, although returns to the Tucannon are predominately releases and strays from the Lyons Ferry hatchery program. The Clearwater, Grande Ronde, Salmon, and Imnaha collectively supported a maximum of 852 redds in 2004 (averaging at least 500 each year since 2002; see Appendices 3-7 in Garcia et al. 2007). Thus, under current conditions, the available area below Hells Canyon Dam has demonstrated the capacity to support at least 5,000 spawners. The ICTRT has set a recovery abundance threshold of 3,000 spawners (i.e., to meet viability goals for abundance at <5% risk of extinction (ICTRT 2007c).

As discussed in Section 8.2.3.1 (Current Productivity and Extinction Risk), several recent hydro-related activities have improved the functioning of PCEs for spawning and rearing. Since 1991, IPC has voluntarily stabilized outflows from Hells Canyon Dam during late October and November and kept the redds established during that period "watered" through emergence in April. However, if rearing fry move to the shallow river margin, they can become entrapped in several pool complexes. Idaho Power Company is currently investigating this issue and evaluating mitigative measures (Brink and Chandler 2006).

Factors limiting the functioning and thus conservation value of PCEs in the available spawning areas (i.e., affecting water quality, water quantity, space, and/or spawning gravel) are:

- In the Hells Canyon Reach of the mainstem Snake River—changes in river flow *[reductions in flow entrap and strand fry]*, temperature regime *[warmer in fall when adults arrive for spawning and cooler during the spring incubation period due to the existence and operation of IPC's Brownlee reservoir (Hells Canyon complex), may delay the emergence of fry production by later* *spawning adults]* and dissolved oxygen *[episodic low dissolved oxygen conditions can persist into early fall when adult fish arrive and stage for spawning]*

- In the Clearwater River below the North Fork—changes in water temperature *[cooler during spring incubation period due to Dworshak operations, slowing development and growth rates in the Clearwater, although cooling the Snake for juvenile fall Chinook migrating from mainstem spawning areas]*

- In the lower Grande Ronde River—sediment in gravel, degraded water quality *[including high temperature and low concentration of dissolved oxygen]*

- In the lower Tucannon River—sediment in gravel *[limits survival in egg to fry stages]*

Rearing Areas & the Juvenile Migration Corridor

Fall Chinook salmon generally begin spawning in the Snake River during the third week of October (Groves and Chandler 1999). Fry emerge from redds during April through June and rear for two months or more in the sandy littoral zone along the river margins (Tiffin et al. 1999). Parr and presmolts move offshore and begin downstream migration and/or extended rearing in the deeper waters of the flowing river and reservoirs. Subyearling smolts are detected passing Lower Granite Dam as early as May and through the late fall when the juvenile fish passage facilities cease operation (Connor et al. 2007). Most of the in-river migrants pass Bonneville Dam by mid-July. Subyearlings that enter the estuary as smolts are thought to reside there for a few weeks before moving into the plume and offshore waters (Fresh et al. 2005). However, recent acoustic tag studies indicate that Snake River fall Chinook subyearling smolts travel from Bonneville Dam to the mouth of the Columbia River in about four days (median value). Survival estimates through this reach (2005-2007) ranged from about 70 to 90% in June, declining to only 20 to 60% in mid-July (McComas et al. 2008).

Several recent hydro-related actions have improved the functioning of PCEs in the juvenile migration corridor. Since 1993, the Corps of Engineers has drafted Dworshak Reservoir to enhance conditions in the juvenile migration corridor by adding cooler water to that in the lower Snake. Reclamation has provided flow augmentation (90,000 to 487,000 acre-feet) from the upper Snake basin to enhance flows in the lower Snake and Columbia rivers during July and August. Actions required by the 1995 FCRPS Biological Opinion have generally resulted in improved dam configurations, better flow conditions, and expanded summer spill programs.

The following are the major factors that limit the functioning and thus the conservation value of rearing areas and the juvenile migration corridor (i.e., affecting water quality, water quantity, cover/shelter, space, food and/or riparian vegetation):

- In the Hells Canyon Reach of the mainstem Snake River, cooler spring temperatures of water released form the Hells Canyon complex *[delays emergence of some fry]*

- In the juvenile migration corridor—scarcity of cover in the reservoirs (as refuge from fish predators – particularly non-native small mouth bass in the in the Snake River); passage mortality *[FCRPS dams and reservoirs];* and warm summer temperatures [*juveniles had typically completed their migration from the Snake River basin by the end of June prior to construction of the Hells Canyon complex and Snake River mainstem dams, excluding Ice Harbor dam.]*

- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat *[agriculture and other development in riparian areas; FCRPS and Upper Snake water management*].

In the mainstem FCRPS migration corridor, the Action Agencies have improved safe passage through the hydrosystem for subyearling Chinook with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements. For salmon that use an ocean-type life-history strategy, recent restoration projects in the estuary are improving the functioning of the juvenile migration corridor. Projects that are protecting or restoring riparian areas and breach or lower dikes and levees are providing access to the cover/shelter, food, and riparian vegetation required by this type of juvenile migrant. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality off-channel habitat (see Section 4.3.1.3 in Corps et al. 2007a).

Adult Migration Corridor

The Action Agencies have increased the likelihood of safe passage in the mainstem FCRPS for adult fall Chinook in recent years by improving the collection channel at The Dalles and the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams.

Areas for Growth & Development to Adulthood

Although Snake River fall Chinook probably spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas are not considered further in this consultation.

8.2.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the ESU and its designated critical habitat.

The Corps completed several consultations on its Clean Water Act section 404 permitting process (maintenance dredging of a barge slip at near the mouth of the Snake River, construction of a new floating dock at the Port of Clarkston, WA, and installing a new boat launch at Wawawai Landing, WA). NOAA Fisheries also completed a consultation with BPA on replacing wood pole transmission lines north of Lewiston, ID and with the US Army Corps of Engineers on operations of the fish sampling facility at Lower Granite Dam that will reduce risks to fall Chinook diversity by removing stray hatchery fish and increase the proportion of natural-origin fish in hatchery broodstock.

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies also completed consultation on a large number of projects affecting habitat in the lower Columbia River and estuary including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.3.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect the habitat of multiple populations within the ESU. The effects of some on population viability will be positive (habitat restoration; fish sampling at Lower Granite Dam; tar remediation). Other projects, including dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality (habitat restoration with stormwater facilities; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.2.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. However, neither the states nor NOAA Fisheries identified any habitat-related actions and programs by non-federal entities that were expected to benefit Snake River fall Chinook.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.2.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have some continuing adverse effects that are described in this section; however, these will be reduced from past levels. The Prospective Actions also require habitat improvement in the estuary and predator reductions, which are expected to be beneficial. Continuation of flow augmentation from the Upper Snake Projects will continue to provide benefits through 2034. These beneficial effects are described in Sections 8.2.5.2, 8.2.5.3, and 8.2.5.5. Some Prospective Actions, implementing habitat restoration and RM&E, may have short-term minor adverse effects, but these will be balanced by short-and long-term beneficial effects, as described in Section 8.2.5.6.

Continued funding of hatcheries by the FCRPS Action Agencies will have both adverse and beneficial effects, as described in the Hatchery Effects Report (SCA Hatchery Effects Appendix.). The Prospective Actions will ensure continuation of the beneficial effects and will reduce threats to the SR fall Chinook population posed by existing hatchery practices.

The effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit on this species are discussed in Chapter 11 of the FCRPS Biological Opinion. The expected use of transportation under the permit is included in the effects of the FCRPS Prospective Actions, which is described in Section 8.2.5.1.

8.2.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

NOAA Fisheries abandoned efforts to parameterize the COMPASS model to estimate the effect of alternative operations on the survival of SR fall Chinook salmon. This was due to critical uncertainties regarding subyearling juveniles' migration pattern in July and August, and their recently observed "yearling" life-history strategy (see Section 7.2.1). Thus, NOAA Fisheries must use qualitative analysis to assess the likely hydro effects of these Prospective Actions on this ESU.[5]

The Prospective Actions strategies for hydro that are most likely to benefit SR fall Chinook salmon include:

1. Further modification to Columbia and Snake river dams to facilitate safe passage (RPA Actions 4, 5, 14, 18-25, 27, 28, 52, 54);

2. Implement operational improvements at Columbia and Snake river dams (RPA Actions 18-25, 52, 54, 55);

3. Operate and maintain juvenile and adult fish passage facilities (RPA Actions 18-25, 28, 29, 30, 54); and

4. Continue to evaluate the best passage management strategy for fall Chinook salmon (i.e., transport vs. in-river) (RPA Actions 18-25, 31, 52, 53, 54, 55, 58, 59, 60, 61).

Of these Prospective Actions, modifying and implementing operations at the Columbia and Snake River dams to facilitate safe passage – which requires the construction and operation of surface

[5] NOAA Fisheries assumed – for the purpose of the quantitative analysis – that no benefits would accrue from Hydro related prospective actions (CA Table 4-7).

passage routes at Little Goose, Lower Monumental, McNary and John Day Dams,[6] in concert with training spill (amount and pattern) to provide safe egress conditions, are likely to have a large positive effect on juvenile migrants. These structures and operations are expected to reduce travel times within the forebays and tailraces of the individual projects. This is likely to result in survival improvements where predation rates are often the highest, because the juvenile fish will be guided out of the forebay and tailrace faster, reducing their exposure to predators such as the northern pikeminnow (see Section 8.1 of the Supplemental Comprehensive Analysis). Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants if faster migrating juveniles are less stressed than is currently the case. Finally, adaptive management of passage strategies should lead to even further improvements in post-Bonneville survival in the future. That is, the continuous evaluation of fish passage performance metrics (RPA Action 52, 53, 54) should ensure that benefits accrued to date or described above as prospective operations and maintenance of juvenile fish passage facilities do not diminish within the time period relevant to the Prospective Actions.

For adult SR fall Chinook salmon migrating from Bonneville Dam upstream to Lower Granite Dam, the Prospective Actions addressing hydro operation and the RM&E program generally should maintain the relatively high levels of survival currently observed in most years. The current average adult survival is 81.0% [7] (about 96.9% per project), taking account of reported harvest and "natural" stray rates within this reach, (BA Table 2.1). If currently, adults die outside of the Bonneville Dam to Lower Granite Dam migration corridor (i.e., after passage to the top-most dam but before spawning, known as delayed mortality), this "delayed mortality" is not expected to be affected by the Prospective Actions.

Effects on Critical Habitat

Although one of the effects of the Prospective Actions on critical habitat will be the continued loss of historical spawning areas due to the existence and operation of the lower Snake River dams, the available habitat will have the capacity (space) to support at least 5,000 spawners as described in Section 8.2.3.3. This will be adequate for meeting the ICTRT's recovery abundance threshold of 3,000 spawners (i.e., to meet viability goals for abundance at <5% risk of extinction). To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. However, this was not identified as a limiting factor for Snake River fall Chinook by the Remand Collaboration Habitat Technical Subgroup.

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[6] Surface bypass facilities are already in place at Lower Granite, Ice Harbor, and Bonneville dams. The RSW at Ice Harbor Dam was first operated in 2005. Therefore, benefits have not yet been reflected in R/S.

[7] NOTE: 81.0% is an average of the minimum survival estimates for the 2002 to 2007 adult migration years. In 2003 and 2004 adult survival (excluding 1-ocean jacks) was estimated to be 98.6 to 93.7% (average of 96.3%), respectively, falling to 71.2% in 2005, and only 58.8% in 2006, increasing to 83.9% in 2007. While NOAA Fisheries is unable to ascertain the cause of this decline at this time, it is highly unlikely that this effect is due solely, or even primarily, to passage through the FCRPS projects. See SCA Adult Survival Estimates Appendix for calculations and to view assumptions about harvest and stray rates. Future research (RPA 52, 55, 56) should provide additional information to identify the causative factors so that they can be addressed through adaptive management.

The survival of juvenile SR fall Chinook in the mainstem migration corridor will increase with the construction of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress. In-river migrants will experience reduced travel times past FCRPS dams, reducing predation rates and stress. Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address factors that limit the conservation value of safe passage in rearing areas and the migration corridor. The prospective actions also include passage improvements at The Dalles and John Day dams that will reduce adult delay, which will further improve the conservation value of safe passage in the adult migration corridor.

In addition to increasing flows and reducing travel time in the lower Snake River, releasing cold water from Dworshak Dam will enhance migration conditions by reducing the risk of disease for juvenile migrants. Adult fall Chinook will also continue to benefit from cold water released from Dworshak during summer (improved water quality).

Under the Prospective Actions, flows in the lower Snake River will continue to be reduced during spring compared to an unregulated system (Section 8.1.1.3). However, shifting the delivery of a portion of the Upper Snake flow augmentation water from summer to spring will benefit the subyearling life history type (i.e., ocean-type juveniles) migrating in late spring. This water will be slightly cooler than if delivered during summer, especially in average or dry years, thereby improving water quality in mainstem rearing areas and the migration corridor. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.2.3.3).

8.2.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

Under the RPA (34), the Action Agencies will obtain funding to continue, with the state's Soil and Water Conservation Districts, efforts to reduce soil erosion on the uplands and along the streams of Garfield County. These projects will address the problem of sediment inputs from agricultural lands to gravel in the lower Tucannon River (Section 8.2.3.3), which will support increased productivity of that portion of the population.

Effects on Critical Habitat

Reduced sediment inputs to the lower Tucannon will improve the functioning of spawning gravel.

8.2.5.3 Effects of Prospective Actions in the Estuary

Effects on Species Status

The estimated survival benefit for Snake River fall Chinook (ocean-type life history) associated with the Prospective Actions in the estuary (RPA Actions 36 and 37) is approximately 9.0% (CA Section 4.3.3.3). For ocean-type fish, restoration projects that are placed along the estuary corridor are likely to improve abundance, productivity, life history diversity, and spatial structure by providing off-channel rearing habitat and refugia (Fresh et al 2005).

Effects on Critical Habitat
Estuary habitat restoration projects will address the alteration of channel margin habitats, a factor limiting the functioning of PCEs used by subyearling Chinook migrants from the Snake River. Specifically, the Action Agencies will fund conservation protection and rehabilitation for approximately 380 acres of off-channel rearing habitat, or projects similar in nature, under its LCREP project during FY 2007–2009. Thirty acres of riparian areas, including two linear miles of fencing, will be restored during that period. In addition, the Action Agencies will:

- Install tide gates to increase tidal flushing and fish access to approximately 110 acres of wetlands on the Julia Butler Hanson National Wildlife Refuge near Cathlamet, Washington
- Retrofit a tide gate at Vancouver Lake
- Reestablish hydrologic connectivity between Columbia Slough and the Columbia River to improve floodplain wetland function for approximately 5 acres of currently isolated habitat and to increase the amount (by approximately 2.5 acres) and quality of off-channel rearing and refuge habitat (Ramsey Lake)
- Improve hydrologic flushing and fish access to approximately 3,200 acres of habitat in Sturgeon Lake on Sauvie Island, Oregon (Dairy Creek)
- Breach dike and reestablish flow to a portion of the Sandy River channel in the delta reach; plant native vegetation on over 200 acres and remove invasive wetland plants on 45 acres
- Protect and restore approximately five to 10 acres of emergent wetland and riparian forest (Vancouver Water Resources)

The Action Agencies have not identified the specific projects that they will implement during 2010 to 2017. However, the projects selected will address limiting factors, based on the recommendations of the LCREP Science Workgroup.

Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.2.5.4 Effects of Prospective Hatchery Actions

Effects on Species Status

NOAA Fisheries cannot consult on the operation of existing or new hatchery programs until Hatchery and Genetic Management Plans (HGMPs) are updated and consultation is initiated. For more than 30 hatchery programs in the Snake River basin, including fall Chinook hatcheries, proposed programs are to be submitted to NOAA Fisheries by February 2010 and ESA consultation is expected to be completed by August 2010. Site specific application of BMPs will be defined in ESA Section 7, Section 10, or Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS BA, page 2-44). Based on the scientific work to date by the ICTRT and Hatchery Science Review Group (HSRG), NOAA Fisheries expects that implementation of the criteria and practices described in the Prospective Actions (RPA 39) will have a positive effect on the productivity and, particularly, on the diversity of SR fall Chinook.

Subject to subsequent hatchery specific ESA § 7(a)(2) Consultation , implement of MPS in NOAA Fisheries approved HGMPS are expected to 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations

However, Federal agencies have obligations in addition to implementing the Endangered Species Act and NOAA Fisheries must consider the effects of Prospective Actions on the exercise of treaty fishing rights and the Federal government’s trust responsibilities to Tribes. Because Snake River fall Chinook provide a substantial contribution to tribal fisheries, the long-term recovery goals for this ESU will take into account tribal treaty rights and the federal trust responsibility. NOAA Fisheries will continue to work closely with the tribal and state fishery managers and evaluate all relevant scientific information, including the work of the Columbia Hatchery Science Review Group (HSRG), to find ways to reduce risk to this ESU, including modifications to hatchery programs, consistent with treaty rights and trust responsibilities.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on the primary constituent elements of critical habitat in subsequent consultations on site-specific actions.

8.2.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

Under the Prospective Action the harvest of SR fall Chinook will vary from year-to-year based on the following abundance-based harvest rate schedule (Table 8.2.5.5-1). Harvest will depend on the abundance of unlisted upriver fall Chinook and natural-origin SR fall Chinook. The allowable harvest rate will range from 21.5% to 45.0%.

Table 8.2.5.5-1. Abundance-based harvest rate schedule for SR fall Chinook (TAC 2008). State/Tribal Proposed Snake River Fall Chinook Harvest Rate Schedule

State/Tribal Proposed Snake River Fall Chinook Harvest Rate Schedule					
Expected URB River Mouth Run Size	Expected River Mouth Snake River Wild Run Size [1]	Treaty Total Harvest Rate	Non-Treaty Harvest Rate	Total Harvest Rate	Expected Escapement of Snake R. Wild Past Fisheries
60,000	1,000	20%	1.50%	21.50%	784
60,000	1,000	23%	4%	27.00%	730
120,000	2,000	23%	8.25%	31.25%	1,375
200,000	5,000	25%	8.25%	33.25%	3,338
	6,000	27%	11%	38.00%	3,720
	8,000	30%	15%	45.00%	4,400

1. If the Snake River natural fall Chinook forecast is less than level corresponding to an aggregate URB run size, the allowable mortality rate will be based on the Snake River natural fall Chinook run size.

Notes:

Treaty Fisheries include: Zone 6 Ceremonial, subsistence, and commercial fisheries from August 1-December 31.

Non-Treaty Fisheries include: Commercial and recreational fisheries in Zones 1-5 and mainstem recreational fisheries from Bonneville Dam upstream to the confluence of the Snake River and commercial and recreation SAFE (Selective Areas Fisheries Evaluation) fisheries from August 1-December 31.

The Treaty Tribes and the States of Oregon and Washington may agree to a fishery for the Treaty Tribes below Bonneville Dam not to exceed the harvest rates provided for in this Agreement.

Fishery impacts in Hanford sport fisheries count in calculations of the percent of harvestable surplus achieved.

When expected river-mouth run sizes of naturally produced Snake River Fall Chinook equal or exceed 6,000, the states reserve the option to allocate some proportion of the non-treaty harvest rate to supplement fall Chinook directed fisheries in the Snake River.

Since 1996, fall season fisheries in the mainstem Columbia River have been managed subject to an ESA harvest rate limit of 31.29%. This represented a 30% reduction in the 1988 to 1993 base period harvest rate. The status of Snake River fall Chinook has improved considerably over the last ten to fifteen years, and harvest reductions were among the actions taken to improve the overall status of this species.

The prospective harvest rate schedule modifies the past practice of managing fisheries subject to a fixed harvest rate, providing a management structure that is responsive to the status of the species. Under the new schedule, harvest may vary up or down depending on the overall abundance of unlisted upriver fall Chinook and listed natural-origin Snake River fall Chinook. The harvest rate schedule is generally calibrated to provide higher harvest rates when abundance is high enough to accommodate the increased harvest and still meet the TRT recovery abundance threshold of 3,000 natural-origin fish to Lower Granite Dam. Conversely, when numbers are low, harvest rates are reduced to provide greater protection.

The SCA Harvest Appendix describes an analysis that compares base, current, and future harvest rates and derives multipliers necessary for this analysis. The analysis was provided by a *U.S. v. Oregon* Work Group (*U.S. v Oregon* Workgroup 2008; Quantitative Analysis of Harvest Actions Appendix). As described above, a 1.09 base-to-current multiplier is estimated. The prospective harvest action will result in no change from the base harvest rate if only the authorized harvest rate is considered (i.e., harvest survival multiplier = 1.0). However, since 1996, based on a post season review, actual harvest rates have, with one exception, been less than the ESA-authorized limit. The difference between the allowed and observed harvest rate has ranged from -0.9% to 10.7% (Table 8.2.5.5-2). On average, the observed harvest rate has been 5.1% less than the 31.3% limit in absolute terms (i.e., 83.7% of the 31.3% limit). Assuming that this practice continues, the expected prospective harvest rate is therefore likely to be less than those in Table 8.2.5.5-1 and the survival multiplier associated with the expected prospective harvest rate will be 1.06. The range of prospective harvest multipliers recommended by the *U.S. v. Oregon* Work Group is therefore 1.00-1.06.

Table 8.2.5.5-2 Observed harvest rate on SR fall Chinook compared to the maximum allowable harvest rate limit (Observed HR from TAC 2008).

Year	Observed HR (%)	Allowed HR (%)	Difference
1996	26.4	31.3	4.9
1997	32.2	31.3	-0.9
1998	26.6	31.3	4.7
1999	30.3	31.3	1.0
2000	28.8	31.3	2.5
2001	21.0	31.3	10.3
2002	28.3	31.3	3.0
2003	21.5	31.3	9.8
2004	20.6	31.3	10.7
2005	25.6	31.3	5.7
2006	27.1	31.3	4.2
Average	26.2	31.3	5.1

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for Snake River fall Chinook.

8.2.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Snake River fall Chinook from reduction in Caspian tern nesting habitat on East Sand Island, and subsequent relocation of most of the terns to sites outside the Columbia River Basin (RPA 45) is 0.7% (CA Chapter 4, Table 4-7). Compensatory mortality may occur but based on the discussion in Section 8.2.5.7 is unlikely to significantly affect the results of the action.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA 43) should further reduce consumption rates of juvenile salmon and steelhead by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Snake and Columbia dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA 48).

Effects on Critical Habitat

Reduction of Caspian tern nesting habitat on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport fishery, and continued implementation and improvement of avian deterrence at mainstem dam will improve the functioning of the PCE safe passage in the migration corridor for juvenile fall Chinook. These actions will enhance the conservation value of critical habitat over both the short- and long-term.

8.2.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the Supplemental Comprehensive Analysis.

8.2.5.8 Summary: Quantitative Survival Changes Expected from All Prospective Actions

Expected changes in productivity and quantitative extinction risk for those Prospective Actions that can be quantified (estuary habitat restoration, tern relocation, and Northern Pikeminnow reduction) are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.2.5.1 through 8.2.5.7 and quantitative estimates are summarized in Table 8.2.5-1. The net effect is 11-18% increased survival, compared to the “current” condition, and 24-32% increased survival, compared to the “base” condition (applied only to the

1977-present time series). These represent a subset of the effects of the Prospective Actions because hydro and hatchery effects are only considered qualitatively. These future survival changes expected from implementation of the Prospective Actions are applied to both the 1977-present and 1990-present time series.

8.2.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Table 8.2.6-1. In addition to this summary table, the SCA Aggregate Analysis Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to this ESU are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions.

8.2.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and ESU viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

The Snake River Mainstem MPG is the only MPG within the Snake River fall Chinook ESU. Because there is only one MPG, Section 8.2.7 applies to both the Snake River Mainstem MPG and the Snake River fall Chinook ESU. The single population in this MPG must be highly viable to achieve the ICTRT's suggested viability scenario (ICTRT 2007a, Attachment 2).

8.2.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Fall Chinook ESU

This section summarized the basis for conclusions at the ESU level.

8.2.7.1 Potential for Recovery

It is likely that the Snake River fall Chinook salmon ESU will trend toward recovery.

The future status of the single extant population and single MPG of Snake River fall Chinook salmon will be improved compared to its current status through the reduction of current adverse FCRPS and Upper Snake project effects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.2.5, 8.2.6, and 8.2.7.2. Therefore, the status of the ESU as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to estuary habitat improvements (Section 5.2.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this ESU.

The Prospective Actions include hydropower, predation, and estuary habitat actions that address limiting factors and threats and will reduce their negative effects. ICTRT concerns regarding high spatial structure risk and the need to begin assessing the feasibility of reintroducing historical populations above Hells Canyon are being addressed through other processes outside of the FCRPS, Upper Snake, and *U.S. v. Oregon* consultations. ICTRT concerns about high diversity risk are being addressed through hatchery Prospective Actions, which ensure that the Action Agencies will implement programmatic funding criteria, including those that will reform FCRPS hatchery operations to reduce genetic and ecological effects on ESA-listed salmon. This will have a positive effect on the diversity of Snake River fall Chinook. The harvest prospective action is to implement a *U.S. v. Oregon* process harvest rate schedule that is expected to either result in no change (authorized harvest) or a reduction (expected harvest) from the current harvest rates in the environmental baseline.

In addition, the harvest Prospective Action is to implement a *U.S. v. Oregon* process harvest rate schedule that is expected to either result in no change (authorized) or a reduction (expected) from the harvest rates in the environmental baseline.

Some threats to the recovery of Snake River fall Chinook salmon, such as diversity risk from ongoing hatchery actions, will probably take longer than 10 years to correct. The adaptive management Prospective Actions will quantify hatchery fish effectiveness and provide the first information on threats from the hatchery program. The Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years.

The Prospective Actions include a strong monitoring program to assess if implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of RSWs and other passage improvements to reduce delay and exposure to warm temperatures in project forebays and regulation of late summer water temperatures at Lower Granite by regulating outflow temperatures at Dworshak Dam. Estuary habitat projects include dike removal and opening off-channel habitat, which in some cases is likely to encourage hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

In sum, these qualitative considerations suggest that the Snake River fall Chinook ESU will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion.

Productivity based on R/S, lambda, and BRT trend is expected to be greater than 1.0 for SR fall Chinook, using both the base-to-current method with the 1977-present time series and the unadjusted 1990-present method, except for estimated lambda of 0.99 with HF=1 for the 1977-present series (Table 8.2.6-1 for results; description in Section 8.2.3.1). Note that hydro improvements have not been quantified for this species, so all estimates would be greater than 1.0 if these improvements had been included in the calculations. This means that survival will be sufficient for the population to grow and that the abundance of spawners will have a positive trend.

Some important caveats that apply to all three quantitative estimates are as follows:

- In addition to unquantifiable hydro improvements, other beneficial effects of the Prospective Actions could not be quantified (e.g., habitat improvements that accrue over longer than a 10-year period), so these quantitative estimates of prospective productivity are low.

- This summary of productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. The ICTRT was not able to estimate ocean climate factors for this species. However, because productivity estimates were all greater than 1.0 based on the recent climate period, it is likely that under a longer historical ocean climate assumption all three metrics would also be greater than 1.0, and the positive trends would likely be greater. Under a “Warm PDO” ocean climate assumption, it is possible that productivity would be less than 1.0 for one or more metrics.

- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, the three metrics are generally less than 1.0 for the lower 95% confidence limits and are consistently higher than 1.0 at the upper 95% confidence limits (SCA Aggregate Analysis Appendix). This uncertainty is an important reason that NOAA Fisheries also considers qualitative factors in reaching its conclusions.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

Taken together, the combination of all the qualitative and quantitative factors indicates that the ESU as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. Quantitative estimates indicate that survival will be sufficient for the population to grow and that the abundance of spawners will have a positive trend. Prospective Actions, which will implement programmatic funding criteria including those that will reform FCRPS hatchery operations to reduce genetic and ecological effects on ESA-listed salmon, will reduce the current diversity risk of SR fall Chinook.

This does not mean, however, that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes resulting from the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the ESU being on a trend toward recovery.

8.2.7.2 Short-term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Actions and a continuation of other current management actions in the environmental baseline, as described in Sections 8.2.3 and 8.2.5.

As described above and in Section 8.2.6, Snake River fall Chinook abundance is expected to increase and natural productivity (R/S) is expected to be sufficient for population growth. The recent 10-year geometric mean abundance has been 1,273 natural spawning fish, which is well above the 50 fish QET (Table 8.2.2-1). Snake River fall Chinook have not dropped below 50 fish in any single year (Cooney and Ford 2007). These factors also indicate a decreasing risk of extinction.

Snake River fall Chinook are heavily supplemented and the hatchery fish are part of the ESU, contributing to total abundance and thereby reducing short-term extinction risk. Over time, this level of supplementation may result in a higher level of long-term risk to diversity and natural productivity than would occur in an un-supplemented population and there is uncertainty over whether the apparent increases in productivity and abundance reflect temporary or more sustained improvements in survival. However, it appears possible to further improve hatchery practices and reduce supplementation impacts on some portions of this ESU without reducing the overall level of hatchery production. The risks associated with supplementation will be reduced through on-going hatchery reviews and consultations as indicated in Section 8.2.5.4.

The Prospective Actions include a strong monitoring program (RPA Actions 50-73) to assess if implementation is on track and to signal potential problems early. The Prospective Actions include the monitoring of hatchery fish effectiveness and risk to the population. Other Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations (RPA Actions 1-3) to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

The base period 24-year extinction risk is estimated to be 0-1%, depending on QET level (Table 8.2.2-3). Therefore, no survival improvement would be needed to reduce risk to <5%, so no additional survival gap was identified. Improvements associated with the Prospective Actions would further support the conclusion of low short-term extinction risk.

The base period extinction risk analysis described above assumes that all supplementation ceases. There is an ongoing hatchery program, which is included in both the environmental baseline and the Prospective Actions, to further reduce short-term extinction risk. A quantitative analysis of extinction risk with a continuing supplementation program indicates 0% risk over either 24- or 100-year periods (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix).

In addition to unquantifiable hydro improvements, other beneficial effects of the Prospective Actions could not be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of improvements in Table 8.2.5-1 may be low.

This summary of extinction risk estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described above for recovery metrics and in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. The ICTRT was not able to estimate ocean climate factors for this species. However, because productivity estimates were all greater than 1.0 based on the recent climate period, it is likely that under a longer historical ocean climate assumption all three metrics would also be greater than 1.0, and the positive trends would likely be greater. Under a “Warm PDO” ocean climate assumption, it is possible that productivity would be less than 1.0 for one or more metrics.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an under-estimate of the short-term extinction risk, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from 0 to near 100% for SR fall Chinook (Table 8.2.2-3). This uncertainty is an important reason that NOAA Fisheries also considers qualitative factors in reaching its conclusions.

Taken together, the combination of all the factors above indicates that the SR fall Chinook ESU is likely to have a low short-term extinction risk when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements will result in lower short-term extinction risk than in recent years. Current abundance is well above the quasi-extinction threshold considered by the ICTRT. Quantitative analyses also support this conclusion. In addition, there are hydrosystem improvements with benefits that cannot be quantified, which will further reduce this risk compared to quantitative estimates. SR fall Chinook are heavily supplemented and the hatchery fish are part of the ESU, contributing to abundance and thereby reducing short-term extinction risk. However, over time this level of supplementation poses long-term risks to diversity and natural productivity as described in Section 8.2.5. Implementation of the Prospective Actions will help to reduce this long-term diversity risk and will confirm the benefits and risks of the hatchery mitigation program. In summary, it is likely that the SR fall Chinook ESU will have a low short-term extinction risk.

8.2.7.3. Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for SR fall Chinook salmon including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. The environmental baseline within the action area, which encompasses all of these areas, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR fall Chinook. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Snake and Columbia rivers; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns and northern pikeminnows will further improve safe passage for juveniles. Habitat work in estuarine areas used for rearing and migration will improve the functioning of water quality, natural cover/shelter, forage,` riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of Columbia River fisheries managed pursuant to the 2008 *U.S. v Oregon* Agreement, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River fall Chinook ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Snake River fall Chinook ESU nor result in the destruction or adverse modification of its designated critical habitat.

Table 8.2.2-1. Status of SR fall Chinook salmon with respect to abundance and productivity VSP factors. Productivity is estimated using two base time periods, as described in Section 8.2.3.

			Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
ESU	**MPG**	**Population**	Most Recent 10-yr Geomean Abundance[1]	Years Included In Geomean	ICTRT Recovery Abundance Threshold[1]	Average R/S: non-SAR adj.; non-delimited[2]	Lower 95% CI	Upper 95% CI	Median Population Growth Rate (lambda; HF=0)[3]	Lower 95% CI	Upper 95% CI	Median Population Growth Rate (lambda; HF=1)[3]	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope[4]	Lower 95% CI	Upper 95% CI
Snake River Fall Chinook Salmon	**Main Stem and Lower Tributaries**	Lower Mainstem Fall Chinook 1977-	1273	1995-2004	3000	0.81	0.46	1.21	1.09	0.91	1.30	0.95	0.80	1.12	1.09	1.06	1.13
		Lower Mainstem Fall Chinook 1990-	1273	1995-2004	3000	1.24	0.93	1.66	1.18	0.89	1.56	1.01	0.79	1.27	1.23	1.16	1.31

1 Most recent year for 10-year geometric mean abundance is 2004. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from draft ICTRT (2007c).
2 Mean returns-per-spawner are estimated from the most recent periods of 1977-2004 (1977 through 1999 brood years) and 1990-2004 (1990 through 1999 brood years). Averages are calculated from information in Cooney and Ford (2007), updated with information in Cooney (2007).
3 Median population growth rate (lambda) are estimated from the most recent periods of 1977-2004 (1977 through 1999 brood years) and 1990-2004 (1990 through 1999 brood years) using estimates from Cooney (2008d).
4 Biological Review Team (Good et al. 2005) trend estimates updated for recent years in Cooney (2008d).

Table 8.2.2-2. Status of SR fall Chinook salmon with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	BRT Current Risk For Distribution[1]	BRT Current Risk For Diversity[1]	10-yr Average % Natural-Origin Spawners[2]
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook	"Moderately High" (Large portion of historical habitat is inaccessible and the distribution of the extant population makes it vulnerable to variable environmental conditions and large disturbances)	"Moderately High" (Loss of diversity associated with extinct populations and significant hatchery influence for the extant population)	0.46

1 The ICTRT has not assigned specific risk levels to this population at this time. Biological Review Team (BRT) assessments are from Good et al. (2005).
2 Average fraction of natural-origin natural spawners from ICTRT (2007c).

Table 8.2.2-3. Status of SR fall Chinook salmon with respect to extinction risk. Short-term (24-year) extinction risk is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY). It was not possible to estimate short-term extinction risk from the more recent 1990-1999 BY data set.

			24-Year Extinction Risk											
ESU	MPG	Population	Risk (QET=1)[1]	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10)[1]	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30)[1]	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50)[1]	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.01	0.00	1.00
		Lower Mainstem Fall Chinook 1990-												

1 Short-term (24-year) extinction risk from Hinrichsen (2008), in the Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

Table 8.2.2-4. Changes in density-independent survival ("gaps") necessary for indices of productivity to equal 1.0 and estimates of extinction risk no higher than 5% for SR fall Chinook salmon. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated "gaps" are based on population performance during the "base period" of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0[1]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0@ HF=1[2]	Upper 95% CI	Lower 95% CI	Survival Gap For BRT trend = 1.0[3]	Upper 95% CI	Lower 95% CI	Survival Gap for 24-Yr Ext. Risk <5% (QET=1)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=10)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=30)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=50)[4]
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-	1.34	2.17	0.83	0.68	1.52	0.31	1.27	2.73	0.59	0.67	0.78	0.58	<1.0	<1.0	<1.0	<1.0
		Lower Mainstem Fall Chinook 1990-	0.80	1.07	0.60	0.48	1.66	0.14	0.98	2.86	0.34	0.39	0.51	0.30				

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.2.2-1.
2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.2.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.
3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.2.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.
4 Extinction risk survival gap is calculated as the exponent of a Beverton-Holt "a" value from a production function that would result in 5% risk, divided by the exponent of the base period Beverton-Holt "a" value. Estimates are from Hinrichsen (2008), in the Aggregate Analysis Appendix.

Table 8.2.3-1. Proportional changes in average base period survival expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average). The 1990-present estimate, which likely includes recent harvest and hydro survival, is not adjusted.

			Base-to-Current Adjustment (Survival Multiplier)						
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2]	Estuary Habitat[3]	Bird Predation[4]	Harvest[5]	Hatcheries[6]	Total Base-to-Current Survival Multiplier[7]
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-	N/A	1.00	1.01	1.02	1.09	N/A	1.12
		Lower Mainstem Fall Chinook 1990-							1.00

1 Hydro survival cannot be quantified or compared between the base and current periods for this species.
2 No tributary habitat actions are relevant per CA Section 4.3.1.2.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Current 2 S/Baseline 2 S" approach, as described in Attachment F-2.
5 From SCA Quantitative Analysis of Harvest Actions Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
6 Hatchery survival is not quantified for comparison between the base and current period
7 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

Table 8.2.5-1. Proportional changes in survival expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

			Current-to-Future Adjustment (Survival Multiplier)											
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2] (2007-2017)	Estuary Habitat[3]	Bird Predation[4]	Pike-minnow Predation[5]	Hatcheries[6]	Low Harvest[7]	High Harvest[7]	Non-Hydro Current-to-Future Survival Multiplier[8]	Total Current-to-Future Survival Multiplier[9]		Total Base-to-Future Survival Multiplier[10]
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-1999 with Allowable Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00	1.00		1.11	1.11		1.24
		Lower Mainstem Fall Chinook 1977-1999 with Expected Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00		1.06	1.18	1.18		1.32
		Lower Mainstem Fall Chinook 1990-1999 with Allowable Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00	1.00		1.11	1.11		1.11
		Lower Mainstem Fall Chinook 1990-1999 with Expected Future Harvest	1.00	1.00	1.09	1.01	1.01	1.00		1.06	1.18	1.18		1.18

1 Hydro survival cannot be quantified or compared between the base and current periods for this species.
2 No tributary habitat actions are relevant per CA Section 4.3.3.2.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Prospective 2 S/Current 2 S” approach, as described in Attachment F-2.
5 From CA Appendix F, Attachment F-1.
6 Hatchery survival is not quantified for comparison between the current and future period
7 Harvest estimates from SCA Quantitative Analysis of Hatchery Actions Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
8 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.
9 Same as Footnote 7, except it is calculated from all Prospective Actions. For SR fall Chinook, hydro survival changes cannot be quantified, so this number represents a minimum survival change.
10 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.2.3-1. For SR fall Chinook, hydro survival changes cannot be quantified, so this number represents a minimum survival change.

Table 8.2.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for SR fall Chinook. The 1977-present time series was adjusted for base-to-current survival changes other than hydro, which could not be estimated quantitatively. The 1990-present time series was not adjusted for base-to-current changes. Estimates of productivity expected under the Prospective Actions do not include future hydro survival improvements, which could not be quantified for this species.

ESU	MPG	Population	R/S Recent Climate[1]	Lambda Recent Climate @ HF=0[2]	Lambda Recent Climate @ HF=1[3]	BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
Snake River Fall Chinook Salmon	Main Stem and Lower Tributaries	Lower Mainstem Fall Chinook 1977-1999 with Allowable Future Harvest	1.01	1.14	0.99	1.15	Must be HV	All three metrics >1, with both a base-to-current adjusted 1977-present time series or a 1990-present time series with no base-to-current adjustment, except for lambda = 0.99 with HF=1 for the 1977-1999 series. Note that hydro improvements have not been quantified for this species.	"Moderately High" (Large portion of historical habitat is inaccessible and the distribution of the extant population makes it vulnerable to variable environmental conditions and large disturbances)	"Moderately High" (Loss of diversity associated with extinct populations and significant hatchery influence for the extant population)
		Lower Mainstem Fall Chinook 1977-1999 with Expected Future Harvest	1.07	1.16	1.01	1.16				
		Lower Mainstem Fall Chinook 1990-1999 with Allowable Future Harvest	1.38	1.21	1.03	1.26				
		Lower Mainstem Fall Chinook 1990-1999 with Expected Future Harvest	1.47	1.22	1.04	1.28				

1 Calculated as the base period R/S productivity from Table 8.2.2-1, multiplied by the total base-to-future survival multiplier in Table 8.2.5-1.
2 Calculated as the base period mean population growth rate (lambda) from Table 8.2.2-1, multiplied by the total base-to-future survival multiplier in Table 8.2.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
3 Calculated as the base mean BRT abundance trend from Table 8.2.2-1, multiplied by the total base-to-future survival multiplier in Table 8.2.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
4 From ICTRT (2007a), Attachment 2
5 From Table 8.2.2-2

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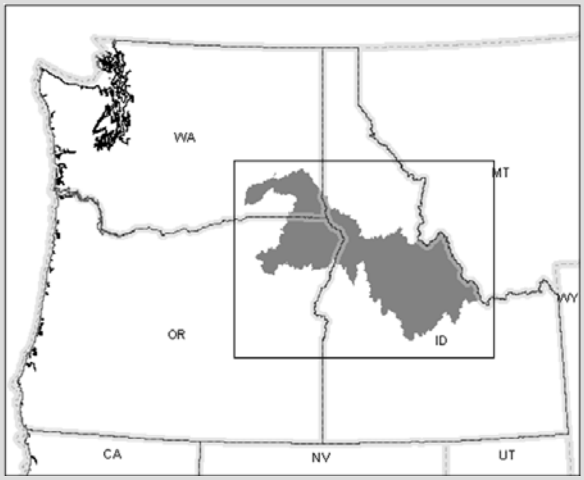

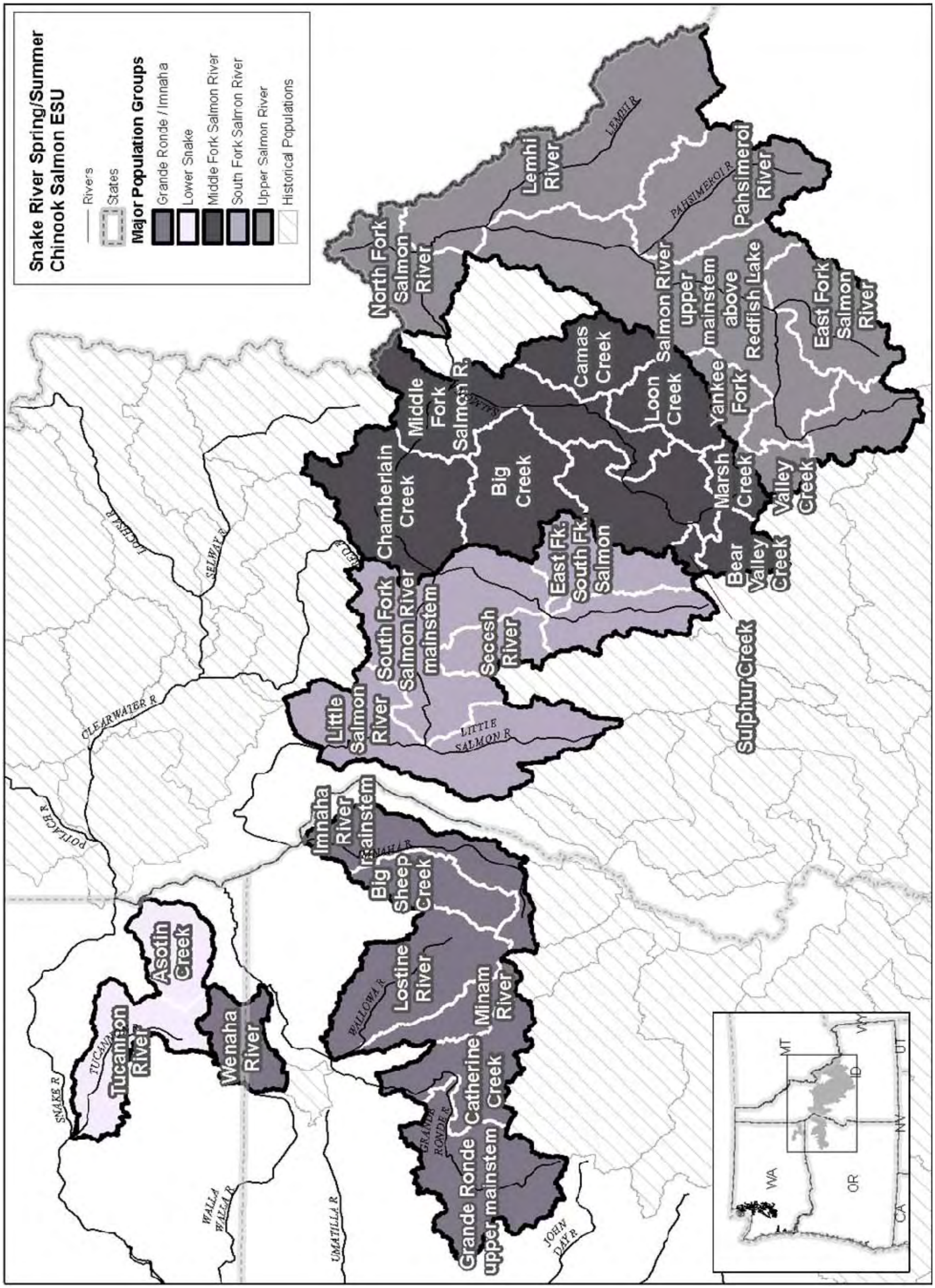
Snake River Spring/Summer Chinook Salmon ESU
Rivers
States
Major Population Groups
Grande Ronde / Imnaha
Lower Snake
Middle Fork Salmon River
South Fork Salmon River
Upper Salmon River
Historical Populations
North Fork Salmon River
Lemhi River
Pahsimeroi River
Salmon River upper mainstem above Redfish Lake
East Fork Salmon River
Yankee Fork
Valley Creek
Camas Creek
Loon Creek
Middle Fork Salmon R.
Marsh Creek
Bear Valley Creek
Chamberlain Creek
Big Creek
East Fk. South Fk. Salmon
Sulphur Creek
South Fork Salmon River mainstem
Secesh River
Little Salmon River
LITTLE SALMON R
Imnaha River mainstem
IMNAHA R
Big Sheep Creek
Lostine River
Minam River
WALLOWA R
Catherine Creek
GRANDE RONDE R
Grande Ronde upper mainstem
Asotin Creek
Wenaha River
Tucannon River
TUCANNON R
SNAKE R
WALLA WALLA R
UMATILLA R
JOHN DAY R
CLEARWATER R
POTLATCH R
LOCHSA R
SELWAY R
LEMHI R
PAHSIMEROI R
MT
WY
ID
UT
WA
OR
NV
CA

Section 8.3
Snake River Spring/Summer Chinook Salmon

Species Overview

Background

The Snake River (SR) spring/summer Chinook consists of five major population groups that spawn and rear in the tributaries of the Snake River between the confluence of the Snake and Columbia rivers and the Hells Canyon Dam. The factors that contributed to their decline include intensive harvest and habitat degradation in the early and mid 1900s, high harvest in the 1960s and early 1970s, and Federal and private hydropower development, as well as poor ocean productivity in the late 1970s through the late 1990s. Snake River spring/summer Chinook were listed under the ESA as threatened in 1992.

Designated critical habitat for SR spring/summer Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers and a number of tributary subbasins.

Current Status & Recent Trends

The SR spring/summer Chinook's five major population groups (MPGs) are further composed of 28 extant populations. Abundance has been stable or increasing on average over the last 20 years. In 2007, jack counts (a qualitative indicator of future adult returns) were the second highest on record. However, on average, the natural-origin components of SR spring/summer Chinook populations have not replaced themselves.

Limiting Factors and Threats

Limiting factors for the Snake River spring/summer Chinook include the Federal and private hydropower projects, predation, harvest, the estuary, and tributary habitat. Ocean conditions have also affected the status of this ESU. These conditions have been generally poor for this ESU over the at least the last four brood cycles, improving only in the last few years. Although hatchery management is not identified as a limiting factor for the ESU as a whole, the ICTRT has indicated potential hatchery impacts for a few individual populations.

Recent Ocean and Mainstem Harvest

The ocean fishery mortality on Snake River spring/summer Chinook is very low and, for practical purposes, assumed to be zero. Incidental take of Snake River spring/summer Chinook occurs in spring and summer season fisheries in the mainstem

Columbia River that target harvestable hatchery and natural-origin stocks. The fisheries on harvestable runs were limited to ensure that incidental take of ESA-listed Snake River Spring/Summer Chinook does not exceed a rate of from 5.5 to 17%. The incidental take of natural-origin upriver spring/summer Chinook averaged 10.2% since 2001.

8.3.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.3.2.1 Current Rangewide Status of the Species

Snake River (SR) spring/summer Chinook is a threatened species composed of 28 extant populations in five major population groups (MPGs). Key statistics associated with the current status of SR spring/summer Chinook salmon are summarized in Tables 8.3.2-1 through 8.3.2-4 and are discussed below.

Limiting Factors and Threats

The key limiting factors and threats for the Snake River spring/summer Chinook include hydropower projects, predation, harvest, degraded estuary habitat, and degraded tributary habitat. Ocean conditions generally have been poor for this ESU over the last 20 years, improving only in the last few years. Eleven populations spawn in wilderness areas, where the habitat is considered functional. Limiting factors are discussed in detail in the context of the conservation value of critical habitat in Section 8.3.3.3.

Abundance

For all populations, average abundance over the most recent 10-year period is below the average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.3.2-1).[1] Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels near the recovery abundance thresholds in a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Corps et al. 2007a Chapter 5, Figure 5-2 showing annual abundance of combined populations). The 2007 Snake River jack counts at Lower Monumental Dam are the second highest on record. Qualitatively, Chinook jacks are an indicator of future adult returns. While jack returns include both hatchery and wild fish, these numbers suggest a larger than average return of adults from the 2005 brood year. The majority of these fish will return in 2008 and 2009.

Although recovery criteria rely on the abundance of individual spawning populations, evaluated at the MPG and ESU level, the quality of information varies among populations. The aggregate abundance of all populations of natural-origin SR spring/summer Chinook has been measured since 1962 by counts at the four dams on the lower Snake River. Since 1975 counts have been made at Lower

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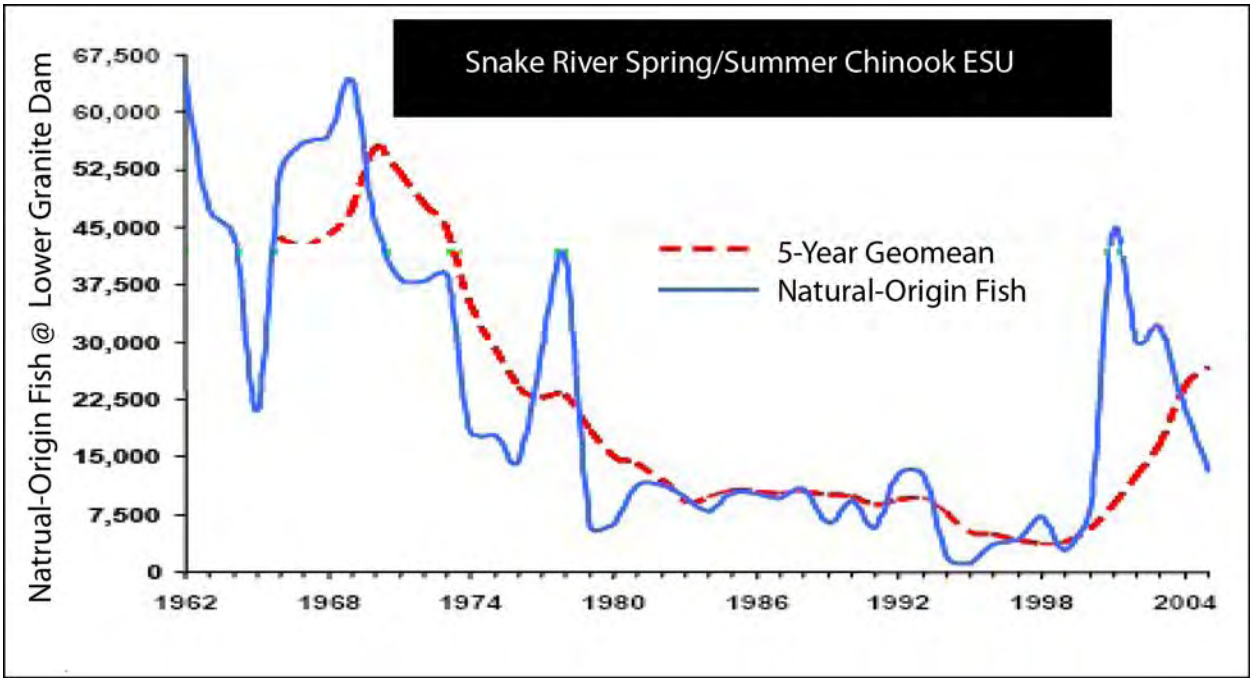
[1] BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for "no jeopardy" determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Granite Dam, which encompass most populations within the ESU. Abundance and a rolling 5-year geometric mean of abundance for the aggregate of most populations in the ESU are shown in Figure 8.3.2-1. Geometric mean abundance peaked in the late 1960s and continued to decrease until the late 1990s. Geometric mean abundance since the late 1990s has increased substantially for the Lower Granite aggregate count. Geomean abundance of natural-origin fish for the 2001 to 2005 period was 25,957 compared to 4,840 for abundance of natural-origin fish for the 1996 to 2000 period, a 436 percent improvement (Fisher and Hinrichsen 2006). As a point of reference, the sum of the TRT's minimum abundance thresholds for all populations in this ESU is 26,500 (ICTRT 2007c).

Figure 8.3.2-1. Snake River Spring Summer Chinook Abundance Trends (adopted from Fisher and Hinrichsen 2006)



"Base Period" Productivity

On average over the last 20 full brood year returns (~1980-1999 brood years [BY], including adult returns through ~2004), approximately two-thirds of SR spring/summer Chinook populations have not replaced themselves (Table 8.3.2-1) when only natural production is considered (i.e., average R/S has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries, ICTRT 2007d, updated with Cooney 2007b.

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at ≤5% extinction risk (ICTRT 2007c).

While natural productivity has been, for most populations, low during this period, the BRT trend in abundance of natural fish has been stable or increasing for nearly all populations (Table 8.3.2-1).

Median population growth rate (lambda) results are intermediate to those of R/S and the BRT trend. When calculated with an assumption that hatchery-origin natural spawners do not reproduce successfully (HF=0), results are similar to the BRT trend, and when calculated with an assumption that hatchery-origin natural spawners' fitness and effectiveness are as successful as natural-origin natural spawners (HF=1), results are similar to the average R/S (Table 8.3.2-1). The ICTRT is incorporating this range of hatchery effectiveness assumptions into updated lambda estimates in the ICTRT Current Status Summaries, so NOAA Fisheries considers the full range.

In summary, abundance of natural-origin and total spawners has been stable or increasing for most SR spring/summer Chinook populations over the last 20 full brood years, based on lambda (HF=0) and BRT trend estimates, generally >1.0. For many populations, this stability or increase has been at least partially dependent on production from naturally spawning hatchery fish, the progeny of which (F2 generation) are considered natural-origin fish in these calculations. For most populations, natural survival rates have not been sufficient for spawners to replace themselves, as indicated by average R/S and lambda (HF=1) estimates <1.0. The presence of hatchery-origin natural spawners does not explain, in its entirety, the differences among the three metrics, as evidenced by populations in the Middle Fork Salmon MPG which are not affected by hatcheries. As described in Chapter 7, each metric requires different types of information and assumptions, and each encompasses a somewhat different time period.

Spatial Structure

The ICTRT characterizes the spatial structure risk to nearly all SR spring/summer Chinook populations as "low" or "moderate" (Table 8.3.2-2). "High" risk exceptions are the Upper Grande Ronde and Lemhi populations, which are a result of accessible but currently unoccupied historically significant spawning areas.

Diversity

The ICTRT characterizes the diversity risk to nearly all SR spring/summer Chinook populations as "low" or "moderate" (Table 8.3.2-2). "High" risk exceptions are found in the Upper Salmon MPG. Factors indicating high risk include loss of the summer-run life history characteristic for the Lemhi population. Ten of the fourteen hatchery programs use fish included in the ESU and are thought to have preserved some of the remaining diversity in this ESU, particularly when individual populations declined to very low numbers in 1994 and 1995 (See NMFS' May 2004 SHIEER NMFS 2004b).

"Base Period" Extinction Risk

The ICTRT Current Status Summaries (ICTRT 2007d) have characterized the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the "base period" described above for R/S productivity estimates, as "Moderate" (5-25% 100-year extinction risk) for most SR spring/summer Chinook populations. The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50). Those populations classified at "high" long-term risk of extinction (>25% risk) are the Tucannon, Upper Grande Ronde, Lemhi, Yankee Fork Salmon R., East Fork Salmon R., and Pahsimeroi populations. Six populations are characterized as having a "low" risk of long-term extinction (<5% risk).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk, as discussed in Section 7.1.1.1 of this Supplemental Comprehensive Analysis. Table 8.3.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish). This "base" short-term extinction risk analysis assumes that productivity observed during the "base period" will be unchanged in the future. At QET=50, nearly all populations have greater than a 5% risk of extinction. The exceptions are the three South Fork Salmon MPG populations and the Upper Salmon River population. Confidence limits on these estimates are extremely high, with many estimates ranging from 0% to close to 100% risk of extinction.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. At QET levels below 50 spawners, more populations have <5% short-term extinction risk.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately, which is not consistent with the Prospective Actions. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. When hatchery supplementation is assumed to continue at current levels for those populations affected by hatchery programs, the estimated extinction risk is lower for the affected populations, even at QET=50 (Hinrichsen 2008 in the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival (see Table 7.4.1) that would be necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.3.2-4. Mean base period R/S survival gaps range from no needed change to approximately 3-fold needed survival improvements, depending on population. Many populations have no lambda or BRT gaps, but some populations require nearly 2-fold survival improvements. While a few populations have no extinction risk gap at QET=50, most populations have gaps between approximately 1.2 and 5.4. Gaps are much smaller at QET levels less than 50 spawners.

8.3.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for SR spring/summer Chinook salmon 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 1999a). Critical habitat also includes river reaches presently or historically accessible (except those above impassable natural falls, including Napias Creek Falls, and Dworshak and Hells Canyon dams) in the following subbasins: Hells Canyon, Imnaha, Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon-Panther, Pahsimeroi, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, and Wallowa. The lower Columbia River corridor is among the areas of high conservation value to the ESU 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 1999a). Designation did not involve rating the conservation value of specific watersheds as was done in subsequent designations (NMFS 2005b). The status of critical habitat is discussed further in Section 8.3.3.3.

8.3.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.3.3.1 “Current” Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk were based on performance of populations during a 20-year “base period,” ending in most cases with the 1999 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity through bank stabilization, shading, etc).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, Table 8.3.3-1 includes estimates of a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7.2 and the Aggregate Analysis Appendix of this document). Results are presented in Table 8.3.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately a 4% survival change [see Quantitative Analysis of Harvest Actions Appendix in the SCA, based on *U.S. v .Oregon* estimates]), improvements in FCRPS configuration and operation (approximately a 20% survival change, based on ICTRT base survival and COMPASS analysis of current survival in the SCA Hydro Modeling Appendix), and estuary habitat projects (a less than 1% survival change, based on Corps et al. 2007a Appendix D) result in a survival improvement for all SR spring/summer Chinook populations. Tributary habitat projects and changes in hatchery operations result in survival improvements for some specific populations within the ESU. Populations affected by tributary improvements experience survival changes ranging from 1-4% (CA Chapter 5, Table 5-7). In contrast, development of tern colonies in the estuary results in less than a 1% reduction in survival for all populations. Additionally, increased adult Chinook predation by marine mammals (primarily California sea lions) in the Columbia River immediately downstream of Bonneville Dam has likely resulted in approximately a 8.5% reduction in survival for SR spring Chinook salmon populations (SCA Marine Mammal Appendix).

Base-to-current adjustments in survival resulting from changing hatchery practices are described in the SCA Quantitative Analysis of Hatchery Actions Appendix. Hatchery reforms in the Grande Ronde have eliminated the use of broodstock originating from outside the area and ESU and have reduced straying, likely resulting in increased hatchery fish effectiveness or fitness in the wild and reduced impacts on genetic diversity. Some populations affected by hatchery operational changes experience improvements estimated at up to 39%. Adjustments in survival are described in the SCA Hatchery Effects Appendix, as estimated survival improvements in Table 5-7 of the CA use hatchery fish effectiveness values that are too high. Effectiveness values reported by Berejikian and Ford 2004 and Araki et al. 2007b were used to generate survival changes in this analysis.

The net result is that, if these recent human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 21-68%, depending on the particular population (Table 8.3.3-1). This also means that the survival “gaps” described in Table 8.3.2-4 would be proportionately reduced by this amount (i.e., [“Gap” ÷ 1.21] to [“Gap” ÷ 1.68], depending on the population).

8.3.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.3.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by SR spring/summer Chinook salmon. Factors affecting the conservation value of critical habitat vary from mortality in the mainstem hydrosystem to lack of adequate pool/riffle channel structure in tributaries, high summer water temperatures, low flows, poor overwintering conditions due to loss of connection to the floodplain, and high sediment loads.

Spawning & Rearing Areas

SR spring/summer Chinook salmon spawn at high elevations in the headwater tributaries of the Clearwater, Grande Ronde, Salmon, and Imnaha rivers. Spawning is complete by the second week of September. Natural-origin juveniles start moving downstream the following autumn, but typically overwinter in streams, becoming active seaward migrants during the following spring as yearlings (stream-type juvenile life history) (Connor et al. 2005).

The following are the major factors that have limited the functioning and thus the conservation value of tributary habitat used by SR spring-summer Chinook salmon for these purposes (i.e., spawning and juvenile rearing areas with spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Physical passage barriers *[culverts; push-up dams; low flows]*
- Reduced tributary stream flow, which limits usable stream area and alters channel morphology by reducing the likelihood of scouring flows *[water withdrawals]*
- Altered tributary channel morphology *[bank hardening for roads or other development and livestock on soft riparian soils and streambanks]*
- Excess sediment in gravel *[roads; mining; agricultural practices; livestock on soft riparian soils and streambanks, and recreation]* [2]
- Degraded tributary water quality including high summer temperatures and in some cases, chemical pollution from mining *[water withdrawals; degraded riparian condition]*

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors for this ESU in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with improvements in PCE function accruing into the future.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]

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[2] In some subbasins (e.g., Upper Middle Fork and Upper Salmon), high levels of sediment in gravel are due, at least in part, to the geologically unstable nature of the watershed.

- Juvenile and adult passage mortality [*hydropower projects in the mainstem lower Snake and Columbia rivers*]
- Pinniped predation on adults due to habitat changes in the lower river [*existence and operation of Bonneville Dam and an increased sea lion population*]
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS migration corridor, the Action Agencies have improved safe passage through the hydrosystem for yearling Chinook with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements listed in section 5.3.1.1 in Corps et al. (2007a). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the absolute survival of spring-run Chinook by 5.5%. Thus, the continuing negative impact of sea lions will likely be approximately 3% for spring Chinook populations.

The safe passage of yearling Chinook through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For juvenile Chinook with a stream-type life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although SR spring/summer Chinook spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.3.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that could be used to adjust the status of the populations between the base and current periods. No such actions were found for the extant population within the Lower Snake MPG (Tucannon River population). Results for the other MPGs/populations are described below.[3]

Grande Ronde/Imnaha MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the Wenaha or Lostine river populations.

Catherine Creek

The USFS consulted on a single forestry thinning project to reduce fire danger.

Upper Mainstem Grande Ronde

The USFS consulted on two grazing allotments and a rangeland analysis and the Federal Highways Administration consulted on a bridge repair project.

Imnaha River

The USFS consulted on a timber harvest/vegetation management project in the Upper Imnaha and a bridge replacement project in the Middle Imnaha River watershed. The USFS also consulted on granting a special use permit to private energy companies for operating and maintaining transmission lines in the Upper Imnaha River watershed. The USFS also consulted on a culvert replacement project in the upper Imnaha watershed that was designed to restore access to 3.5 miles of rearing habitat.

South Fork Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the South Fork Salmon River mainstem, Secesh River, or East Fork South Fork Salmon River populations. Under the 2000 RPA and 2004 Biological Opinion, Reclamation decommissioned a water diversion structure—restoring fish passage to three miles of Squaw Creek—and consolidated water rights from Squaw Creek with those in the Little Salmon River, increasing flows in Squaw Creek 4 cfs (enough to support a low temperature thermal refuge at the confluence with the Little Salmon River). Reclamation also consulted on a culvert replacement that will improve access to four miles of habitat in Squaw Creek and will improve habitat complexity in Squaw and Papoose creeks. The USFS consulted on a project to treat weeds within a wilderness area at a rate of approximately 6,250 acres per year.

During the summer of 2007, wildfires burned approximately 310,000 acres of forested habitat within the range of South Fork and Middle Fork Salmon River (see below) MPGs. NOAA Fisheries expects that instream habitats will experience increased temperatures, sediment, and large woody debris delivery in the near term. Recovery times for pre-existing conditions will depend on the effects of the fire at each location, which are unknown at this time.

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[3] This information does not include any habitat conservation or restoration projects funded by BPA under NOAA Fisheries' programmatic Biological Opinion for the Habitat Improvement Program (HIP). The effects of those projects are already taken into account in the base-to-current adjustment for species/population status.

Middle Fork Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the Middle Fork Salmon River populations above or below Indian Creek or the Big, Camas, Loon, Sulphur, Bear Valley, or Marsh Creek populations. The USFS consulted on a timber sale/salvage project in the lower South Fork Salmon River.

Upper Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that would affect the Yankee Fork or Valley Creek populations.

North Fork Salmon River

The USFS consulted on a culvert replacement project in the North Fork Salmon River, designed to restore both access and the hydraulic processes that transport sediment and large wood.

Lemhi River

The FHWA/IDT consulted on the construction of a pedestrian bridge over the Salmon River (Middle Salmon River—Williams Creek watershed).

The USFS consulted on a bank stabilization project at Bog Creek Crossing (Upper Lemhi watershed) and two projects to rehabilitate stream channels and their respective riparian zones in the Middle Salmon River—Carmen Creek and Hayden Creek watersheds. The USFS also consulted on a riparian restoration project in Big Creek.

NOAA Fisheries consulted with itself on funding to screen a water diversion on Kenney Creek and to remove a barrier that will restore passage to 144 miles of rearing habitat and will increase flows 7 to 12 cfs over at least three miles in the Upper Lemhi River (Whitefish Ditch Project). Both projects are in the Eighteenmile Creek watershed.

Lower Mainstem Salmon River—below Redfish Lake

The USFS consulted on a whitebark pine treatment project and FHWA/IDT consulted on two bridge construction/repair projects. The USFS consulted on habitat improvement projects in Slate Creek (Salmon River—Slate Creek watershed), which are expected to add LWD and pool structure while preventing the introduction of excess sediment from forest roads.

Pahsimeroi

The Corps consulted on a project to prevent a hatchery facility from contaminating the naturally spawning population in the upper Pahsimeroi River watershed with disease. The BLM proposed to rehabilitate Fall Creek and its associated riparian zone (Middle Pahsimeroi River watershed). NOAA Fisheries and USFWS each consulted on projects intended to remove passage barriers and improve stream flows by modifying water diversions and irrigation practices in the Lower Pahsimeroi River watershed. The Natural Resources Conservation Service consulted on instream flow work (conversion from flood irrigation to sprinklers) along Iron Creek.

East Fork Salmon River

The USFS consulted on a road reconstruction and maintenance project in the Lower East Fork Salmon River watershed.

Upper Mainstem Salmon River—above Redfish Lake

The USFS consulted on an emergency fire project and whitebark pine treatment in the Salmon River—Pole Creek and Salmon River—Redfish Lake watersheds. The USFS also consulted on the Alturas Spur Road Obliteration and Cabin Creek Reconnect projects. These projects removed fish passage barrier in Cabin Creek and may reduce road generated sediment from entering Alturas Lake Creek (Alturas Lake Creek watershed).

Panther Creek

The Corps consulted on a culvert and wetlands fill project in Upper Panther Creek, which will result in the conversion of irrigated agricultural land to low density residential housing. The project is expected to increase safe passage for fish in upper Panther Creek and in the mainstem Salmon River by eliminating rapid drawdowns when water was withdrawn from irrigation ditches. The BLM consulted on watershed rehabilitation activities associated with while managing waste from the abandoned Twin Peaks Mine (Lower Panther Creek).

Projects Affecting Multiple MPGs/Populations

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.3.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of SR spring/summer Chinook salmon that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and create thermal refuges. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including forest thinning, grazing, bridge repairs, whitebark pine treatment, bank stabilization, and road construction/maintenance, will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PCEs. However, all of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.3.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment (Corps et al. 2007a). They include tributary habitat actions that will benefit the Lemhi and Asotin populations as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.[4] Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly

[4] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects submitted.

improve conditions for Snake River spring/summer Chinook. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.3.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.3.5.1 and 8.3.5.2. However, the Prospective Actions will ensure that these adverse effects will be reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Flow augmentation from the Upper Snake Project (NMFS 2008b) will also provide some benefits. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be more than balanced by short -and long- term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

The effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit on this species are discussed in Chapter 10 of the FCRPS Biological Opinion. The expected use of transportation under the permit is discussed in the effects of the FCRPS Prospective Action, which is described in Section 8.3.5.1.

8.3.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the Prospective Actions in the productivity and extinction risk analysis (See SCA Sections 7.2.1 and 8.1.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions is expected to increase the in-river survival (from Lower Granite to the Bonneville tailrace) of SR spring/summer Chinook salmon from 48.5% (Current) to 55.0% (Prospective), a relative change of 13.3%. The average proportion of juveniles destined for transportation is expected to drop from 78.1 to 73.5%. The altered timing of spill and transportation operations (see FCRPS RPA Table 3) will, in most years (about 80%) result in (1) no fish being collected and transported prior to April 21 (when SARs generally favor in-river migrants), (2) > 90% of juveniles being transported after May 15 (when SARs generally favor transported juveniles), and (3) an intermediate number of juveniles being transported between April 21 and May 14 (when SARs do not clearly favor in-river or transported migrants on a consistent basis). During the lowest flow years (about 20% of years when spring flows are predicted to be < 65 kcfs at Lower Granite Dam), over 95% of juveniles are likely to be transported to below Bonneville Dam.

Implementation of the Prospective Actions is not expected to substantially affect total system survival. The total percentage of fish arriving at Lower Granite Dam expected to survive to below Bonneville Dam via in-river migration and transportation should increase slightly from about 85% to nearly 87%. However, the COMPASS model estimates that Lower Granite Dam to Lower Granite Dam smolt-to-adult returns (LGR to LGR SARs) are expected to increase from about 0.87 to 0.91% (a relative improvement of 5.2%) as a result of the hydro Prospective Actions governing spill and transport operations and their effect on migration timing to below Bonneville Dam (see discussion above).[5]

The hydro Prospective Actions, including the RM&E program are likely to maintain the high levels of survival currently observed for adult SR spring/summer Chinook salmon migrating from Bonneville Dam upstream to Lower Granite Dam. The current PIT tag based average survival estimate, taking

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[5] NOTE: The COMPASS model estimates SARs for in-river and transported migrants separately before combining them (with the estimated percentage of in-river and transported juveniles surviving to below Bonneville Dam) to provide an overall LGR to LGR SAR. Thus, the COMPASS model SAR estimates include (through the transport SAR estimate) the increased stray rates that are often observed for adult fish transported as juveniles (compared to stray rates of those that migrated in-river as juveniles) – a negative effect of transportation.

account of harvest and "natural" stray rates within this reach, is 91.0% (about 98.6% per project) for spring and summer Chinook populations (SCA, Adult Survival Estimates Appendix). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to Lower Granite Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The Prospective Actions are also likely to positively affect the survival of SR spring/summer Chinook salmon in ways that are not included in the quantitative analysis. To be clear, NOAA Fisheries considers these expected benefits qualitatively below, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at Little Goose, Lower Monumental, McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects where predation rates are currently often the highest (see Section 8.1.1.1.) Taken together, surface passage routes should increase migration rates (decrease travel time) of in-river migrants through the migration corridor, which is likely to improve the post-Bonneville survival (i.e., SARs) of in-river migrants to a greater degree than has been estimated in the quantitative analysis. Additional benefits are likely to the extent that faster migrating juveniles would be in better condition (i.e., are less stressed, have more energy reserves, etc.) upon reaching the Bonneville tailrace than is currently the case.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from Lower Granite Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem's effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to nearly 68%. A portion of the 39% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling Chinook would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of yearling SR spring/summer Chinook in a hypothetical unimpounded Columbia River would be 78%. Therefore, approximately 56% (22%/39%) of the expected mortality experienced by in-river migrating juvenile spring/summer Chinook is probably due to natural factors.

In recent years, scientists in the U.S. and Canada have started to investigate survival in unimpounded rivers (West Coast River Survival Appendix). Results for the Thompson-Frasier basin are preliminary, but the 78% natural survival rate assumed for the Snake-Columbia migration corridor in the 2004 FCRPS Biological Opinion may have been high.[6] That is, yearling survival through the Prospective operations and configuration of the hydrosystem may be closer to "natural" than previously thought.

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[6] The West Coast River Survival Appendix describes a presentation by Dr. David Welch (Kintama Research, Nanaimo, BC) in July 2007. Dr. Welch presented survival data from acoustic tag studies with yearling Chinook in 2006. Additional studies will be needed before NOAA Fisheries considers these data reliable indicators of juvenile survival through a free flowing reach.

The direct survival rate of adults through the FCRPS is already quite high. The Prospective Actions include additional passage improvements (to the collection channel at The Dalles and to the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams and other improvements in section 5.3.3.1 in Corps et al. 2007a). Adult spring/summer Chinook survival from Bonneville to Lower Granite Dam will be approximately 91.0%.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will benefit the yearling migrants by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.3.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the functioning of safe passage in the juvenile and adult migration corridors by addressing water quality, water velocity, project mortality, and exposure to predators. To the extent that these improvements result in more adults returning to spawning areas, the hydro Prospective Actions will improve water quality and forage for juveniles by increasing the return of marine derived nutrients. However, the Remand Collaboration Habitat Technical Subgroup did not identify nutrients as a limiting factor for this species.

8.3.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Table 5-9, p. 5-20. For targeted populations in this ESU the effect is a <1 - 41% expected increase in low density egg-smolt survival, depending on population, as a result of implementing tributary habitat Prospective Actions that improve habitat function by addressing significant limiting factors and threats.[7] For example, water withdrawals in the Lemhi watershed (upper Salmon River subbasin) currently reduce streamflow enough to block access to spawning and rearing habitat and unscreened water diversions entrain yearling Chinook. As part of their implementation of the RPA (Action 34), the Action Agencies will address this limiting factor by securing water to improve baseflow in the Lemhi River and move points of diversion downstream (to provide more flow in the upstream reach). The Action Agencies will also complete riparian improvement projects and take actions to reduce entrainment. The Action Agencies will assess stream crossings and determine actions needed to provide passage where culverts create barriers the upper mainstem Salmon River.

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[7] The Action Agencies identified the projects that will improve these PCEs and that they will fund by 2009 in Tables 3b; 4a; and 5a,b in Attachment B.2.2-2 to Corps et al. (Corps et al. 2007b).

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access.

Restoration actions will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.3.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Snake River Spring/Summer Chinook (stream-type life history) associated with the specific Prospective Actions to be implemented from 2007-2010 is 1.4 %. The survival benefit for Snake River Spring/Summer Chinook (stream-type life history) associated with actions to be implemented from 2010 through 2017 is 4.3 %. The total survival benefit for Snake River Spring/Summer Chinook, as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats, is approximately 5.7% (Corps et al. 2007a Section 5.3.3.3). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will provide habitats needed by yearling Chinook migrants from the Snake River to increase life history diversity, and spatial structure. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as habitat for this species (section 5.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by yearling Chinook from the Snake River (safe passage). Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction (Section 8.5.5.2) are expected to be minor, occur only at the project scale, and persist for a short time.

8.3.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Hatchery actions are summarized in Section 5.3.3.5 of the CA. The actions fall into two general categories, reforms of existing hatchery programs and new programs that are part of a specific initiative to recover any ESA-listed anadromous salmonid. The reforms and new programs will be determined after site specific consultations guided by available scientific information and Best Management Practices (BMPs) (Framework Work Group 2006).

The hatchery Prospective Actions include the continued funding of hatcheries and the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs. The criteria for making future funding decisions on hatchery programs for the FCRPS that incorporate BMPs is described in NOAA Fisheries' guidance (See Artificial Propagation for Pacific Salmon Appendix) and Appendix F of the CA. Site specific application of BMPs will be defined in subsequent discussions regarding ESA Section 7, Section 10, or Section 4(d) limits with NOAA Fisheries, to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS Biological Assessment, page 2-44).

NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated. The Prospective Actions (RPA Action 39) require the submittal of updated HGMPs for the more than 30 hatchery programs in the Snake River basin and initiation of ESA consultation with NOAA Fisheries by February 2010. Hatchery reforms will be implemented upon NOAA Fisheries' completion of these ESA consultations in August 2010. Available information, principles, and guidance for operating hatchery programs are described in the SCA Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPS are expected to: 1) preserve mitigation obligations and integrate hatchery mitigation and conservation objectives; 2) preserve genetic resources; and 3) accelerate trends toward recovery as limiting factors and threats are fixed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations

Future actions described in Section 5.3.3.5 of the CA are important because they will effectively integrate hatchery mitigation and conservation objectives, which additionally will support ESU recovery. The Prospective Actions call for implementing new scientific information at existing federally funded spring/summer Chinook hatchery programs. The hatchery programs are mitigation for construction and operation of Federal hydro projects and are interrelated and interdependent to the continued operation of the FCRPS itself. Continued reform of these facilities will preserve genetic resources, and accelerate the trend toward recovery as limiting factors and threats are addressed and natural productivity increases.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.3.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

Under the Prospective Action the harvest of SR spring/summer Chinook will vary from year-to-year based on an abundance-based harvest rate schedule (Table 8.3.5.5-1). Harvest will depend on the total abundance of upriver spring, natural-origin SR spring/summer Chinook, and may be further limited by natural-origin Upper Columbia River spring Chinook (see footnote 4 of table 8.3.5.5-1). The allowable harvest rate will range from 5.5% to 17%. As indicated in Table 8.3.5.5-1, most of the prospective harvest would occur in treaty Indian fisheries.

Table 8.3.5.5-1. Abundance-based harvest rate schedule for upriver spring Chinook and Snake River spring/summer Chinook in spring management period fisheries (TAC 2008).

Harvest Rate Schedule for Chinook in Spring Management Period					
Total Upriver Spring and Snake River Summer Chinook Run Size	**Snake River Natural Spring/Summer Chinook Run Size[1]**	**Treaty Zone 6 Total Harvest Rate [2,5]**	**Non-Treaty Natural Harvest Rate [3]**	**Total Natural Harvest Rate[4]**	**Non-Treaty Natural Limited Harvest Rate[4]**
<27,000	<2,700	5.0%	<0.5%	<5.5%	0.5%
27,000	2,700	5.0%	0.5%	5.5%	0.5%
33,000	3,300	5.0%	1.0%	6.0%	0.5%
44,000	4,400	6.0%	1.0%	7.0%	0.5%
55,000	5,500	7.0%	1.5%	8.5%	1.0%
82,000	8,200	7.4%	1.6%	9.0%	1.5%
109,000	10,900	8.3%	1.7%	10.0%	
141,000	14,100	9.1%	1.9%	11.0%	
217,000	21,700	10.0%	2.0%	12.0%	
271,000	27,100	10.8%	2.2%	13.0%	
326,000	32,600	11.7%	2.3%	14.0%	
380,000	38,000	12.5%	2.5%	15.0%	
434,000	43,400	13.4%	2.6%	16.0%	
488,000	48,800	14.3%	2.7%	17.0%	

1. If the Snake River natural spring/summer forecast is less than 10% of the total upriver run size, the allowable mortality rate will be based on the Snake River natural spring/summer Chinook run size. In the event the total forecast is less than 27,000 or the Snake River natural spring/summer forecast is less than 2,700, Oregon and Washington would keep their mortality rate below 0.5% and attempt to keep actual mortalities as close to zero as possible while maintaining minimal fisheries targeting other harvestable runs.
2. Treaty Fisheries include: Zone 6 Ceremonial, subsistence, and commercial fisheries from January 1-June 15. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.
3. Non-Treaty Fisheries include: Commercial and recreational fisheries in Zones 1-5 and mainstem recreational fisheries from Bonneville Dam upstream to the Hwy 395 Bridge in the Tri-Cities and commercial and recreation SAFE (Selective Areas Fisheries Evaluation) fisheries from January 1-June 15; Wanapum tribal fisheries, and Snake River mainstem recreational fisheries upstream to the Washington-Idaho border from April through June. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.
4. If the Upper Columbia River natural spring Chinook forecast is less than 1,000, then the total allowable mortality for treaty and non-treaty fisheries combined would be restricted to 9% or less. Whenever Upper Columbia River natural fish restrict the total allowable mortality rate to 9% or less, then non-treaty fisheries

would transfer 0.5% harvest rate to treaty fisheries. In no event would non-treaty fisheries go below 0.5% harvest rate.

5. The Treaty Tribes and the States of Oregon and Washington may agree to a fishery for the Treaty Tribes below Bonneville Dam not to exceed the harvest rates provided for in this Agreement.

The prospective harvest schedule is similar to that first used in 2001, as well as in the most recent 2005 to 2007 Agreement. Since 2001, the allowable harvest rates ranged from 5.5 to 17%. The 2001 schedule did not include SR summer Chinook as part of the abundance indicator. The 2005 schedule was modified to included SR summer Chinook, but the abundance levels were adjusted accordingly to provide a comparable level of harvest for the adjusted run size. The harvest rate schedule proposed for use in 2008 and beyond differs from the 2005 schedule only in that it adjusts the allocations between the treaty Indian and non-treaty fisheries, but the total allowable harvest for all abundance levels is otherwise unchanged from the 2005 Agreement.

Harvest rates under the Prospective Actions will be the same as they have been in recent years. Therefore, no additional current-to-future survival adjustment is necessary for the prospective harvest action for this species.

It is also pertinent to consider the potential effects of conservative management. Fisheries directed at upriver spring Chinook can be managed with relative precision. Catch is tracked on a daily basis, and runsize estimates can be adjusted in-season using counts at Bonneville dam. Since 2001, actual harvest rates have ranged between 1.1 and 2.6% less than those allowed (Table 8.3.5.5-2). Any analysis that assumes that the allowed harvest rates will always be fully used would therefore be conservative.

Table 8.3.5.5-2. Actual harvest rate on SR spring/summer Chinook, & those allowed under the applicable abundance based harvest rate schedule (Observed HR from TAC 2008).

Year	Actual HR (%)	Allowed HR (%)	Difference (%)
2001	14.6	16.0	1.4
2002	12.7	14.0	1.3
2003	9.4	12.0	2.6
2004	10.8	12.0	1.2
2005	7.9	9.0	1.1
2006	8.0	10.0	2.0

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for SR spring/summer Chinook salmon.

8.3.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Snake River spring/summer Chinook from the reduction in Caspian tern nesting habitat and subsequent relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45), is 2.1 % (CA Attachment F-2, Table 4).

The projected benefit of reduced tern predation is sensitive to assumptions about the additive or compensatory nature of mortality from tern predation. The projected benefits identified in the CA (Appendix F) assume complete additivity (no compensatory mortality (i.e., every salmonid not consumed by terns survives all other sources of mortality)). However, if some portion of the tern's prey consists of salmonids predestined to die as a result of illness or poor condition or to be caught by other predators, the survival improvements modeled above would need to be reduced. Although tern predation likely falls in a class between completely additive and completely compensatory (Roby et al. 2003), current literature and empirical data do not identify more specific estimates or ranges. However, assuming a hypothetical compensatory mortality of 50% (Roby et al. 2003), the range of survival benefits from reducing tern predation across the affected ESUs would decline from 0.7 - 3.4% to 0.3 - 1.7%, approximately. As a result of the small incremental reduction in survival that results from reducing predation by terns nesting on East Sand Island, consideration of compensatory mortality does not significantly alter the estimated benefits of this action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 34) should further reduce consumption rates of juvenile salmon by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Snake and Columbia dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport-reward fishery, and continued implementation and improvement of avian deterrence at mainstem dams are expected to improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.3.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the Supplemental Comprehensive Analysis.

8.3.5.8 Summary: Quantitative Survival Changes Expected from All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of "prospective" expected survival changes resulting from the Prospective Actions are described in Sections 8.3.5.1 through 8.3.5.8 and are summarized in Table 8.3.5-1. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the ESU. Tributary habitat Prospective Actions are expected to increase survival for selected populations. The net effect, which varies by population, is 15-62% increased survival, compared to the "current" condition, and 39-115% increased survival, compared to the "base" condition.

8.3.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.3.6-1 and 8.3.6-2 and in Figures 8.3.6-1 through 8.3.6-4. In addition to these summary tables and figures, the SCA Life Cycle Modeling Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and ESU level.

8.3.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and ESU viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Lower Snake River MPG

This MPG consists of only one extant population (Tucannon), which must be highly viable to achieve the ICTRT's suggested MPG viability scenario. The ICTRT also recommends conducting scoping efforts for re-introduction of the functionally extirpated Asotin population.

The estimated prospective trend in abundance for the Tucannon population (based on R/S, lambda with the HF=0 assumption, and BRT trend) is greater than 1.0, meaning that with implementation of the Prospective Actions the population is expected to replace itself and grow (Table 8.3.6.1-1). When hatchery-origin spawners are considered as effective as natural-origin spawners (HF=1), lambda is estimated to be less than 1.0 (0.98). However, there is considerable uncertainty regarding the reliability of quantitative estimates of productivity. The broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) suggests that other qualitative information should also be considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in tributary habitat as a result of the Prospective Actions, as described in Section 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal (i.e., as long as survival in some other life stage does not decrease), survival over the life cycle should also increase. It also indicates that estimates of productivity greater than 1.0 for this population are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is "moderate," as defined by the ICTRT (Table 8.3.2-2). The MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds. The Prospective Actions are unlikely to negatively affect spatial structure and diversity, so spatial structure and diversity risks are not expected to increase under the Prospective Actions. In the near term, the Tucannon hatchery supplementation program provides a reserve for maintaining diversity, potentially accelerating recovery pending increases in natural productivity. In the longer term, proportional contributions of hatchery fish to natural spawning would have to be reduced to achieve the ICTRT diversity criteria associated with low risk.

- Prospective Actions include tributary habitat improvements in the Asotin River. These actions are a necessary step toward potentially re-establishing the Asotin population. The problems facing this ESU, such as the need to re-establish the functionally extirpated Asotin population, will take longer than 10 years to resolve; however, the Prospective Actions take the necessary steps within the next ten years.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario the Tucannon population is expected to have R/S considerably greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT "Warm PDO" climate scenario, in which all years are anomalously warm, the estimate is lower but still greater than 1.0.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Short-term extinction risk is estimated to be <5% at QET=50, whether Prospective Actions occur immediately or not (Table 8.3.6.1-2).

As discussed in Section 7.1.1.1 of the Supplemental Comprehensive Analysis, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses to QET levels of 30 fish or less also indicate <5% extinction risk, even if no Prospective Actions were to be implemented immediately (Table 8.3.6.1-2).

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (see 95% confidence limits in Table 8.3.2-3). For this reason, other qualitative information is also considered:

- There is a safety-net hatchery program for this population, which is required to continue under the Prospective Actions, to further reduce short-term extinction risk.

- The recent 10-year geometric mean abundance has been 88 fish, which is above the 50 fish QET (Table 8.3.2-1). Only 2 of the last 25 years of returns have been below 50 fish (Cooney 2007).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Grande Ronde/Imnaha MPG

This MPG consists of six extant populations. The ICTRT recommends that four of these populations be viable or highly viable for MPG viability. Key populations within this MPG include the Imnaha because of its unique life history strategy (summer spawning timing and associated juvenile rearing patterns) and the Lostine/Wallowa, which is one of only three “large” populations. The ICTRT also suggests choices among two pairs of populations: Catherine Creek or Upper Grande Ronde (both representing “large” populations) and Minam or Wenaha (populations least affected by hatchery fish and with little spatial structure or diversity impairment). The ICTRT considers two additional populations (Big Sheep Creek and Lookingglass Creek) functionally extirpated. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

All of the populations are likely to increase in abundance, based on estimated lambda (HF=0) and BRT trends greater than 1.0 with the implementation of the Prospective Actions (Table 8.3.6.1-1). Additionally, three of the six populations are likely to have R/S and lambda (HF=1) greater than 1.0, indicating natural survival sufficient for the population to grow, and three of the populations are not likely to have R/S and lambda (HF=1) greater than 1.0. Furthermore, two of three populations with R/S<1 (Imnaha and either Catherine Creek or the Upper Grande Ronde) would need to be viable or highly viable under the ICTRT’s recommended MPG viability scenario. Additional survival improvements of 8% for Catherine Creek and 20% for the Imnaha would be necessary for two of these populations to exceed 1.0 for R/S (Aggregate Analysis Appendix).

There is considerable uncertainty regarding the reliability of quantitative productivity estimates because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix). For this reason, other qualitative information is also considered:

- As a result of the Prospective Actions, life-stage-specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in selected tributaries, as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not solely determined by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is “low” to “moderate” for all populations except the Upper Grande Ronde, which is at a “high” spatial structure risk because of unoccupied major and minor spawning areas (Table 8.3.2-2). The Upper Grande Ronde hatchery program has transitioned into a supplementation program that will build genetic resources and diversity. The MPG can achieve the ICTRT-suggested MPG viability scenario with the remaining populations having “low” to “moderate” risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- For these populations, the problems that must be addressed, in order to have higher R/S, will take longer than 10 years to resolve. In particular, the water quality and quantity problems in the lower reaches of the Upper Grande Ronde and Catherine Creek will require a long-term program working with private landowners.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario all populations in the Grande Ronde MPG are expected to have R/S greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT "Warm PDO" climate scenario, in which all years are anomalously warm, four of six populations are expected to have R/S less than 1.0.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of short-term extinction risk indicate <5% risk at QET=50 or less for two populations (Minam and Imnaha), but >5% risk at QET=50 for the remaining four populations (Catherine Creek, Upper Grande Ronde, Wenaha, and Lostine/Wallowa; Table 8.3.6.1-2). For the Wenaha population, nearly all of the Prospective Actions survival improvements would have to occur immediately to reduce risk below 5% at QET=50. This is not expected to occur. For Catherine Creek, Lostine/Wallowa, and Upper Grande Ronde, extinction risk would be >5%, even if all Prospective Actions were implemented immediately.

As discussed in Section 7.1.1.1, CA Chapter 3, and the Aggregate Analysis Appendix, QET levels less than 50 fish are also relevant to short-term extinction risk. Sensitivity analyses to QET levels of 30 fish or less indicate approximately 5% extinction risk for the Lostine/Wallowa population (Table 8.3.6.1-2). QET levels of 10-30 (depending on speed of Prospective Actions implementation) or less would result in <5% risk for the Upper Grande Ronde population.

There is considerable uncertainty regarding the reliability of quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base extinction risk range from 0 to nearly 100% for these populations; Table 8.3.2-3). For this reason, other qualitative information is also considered:

- The recent 10-year geometric mean abundance is above 50 fish for all populations except the Upper Grande Ronde (Table 8.3.2-1).
- The Upper Grande Ronde, Catherine Creek, and Lostine/Wallowa populations have dropped below 50 fish in some individual years since 1980 (Cooney 2007). No other populations have fallen below 50 fish.
- There is a hatchery program, which is required to continue under the Prospective Actions, acting as a safety net for most of the affected populations to reduce short-term extinction risk.
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

South Fork Salmon MPG

This MPG consists of four extant populations. The two largest of the four populations (South Fork Mainstem and East Fork South Fork) must be viable or highly viable to achieve the ICTRT suggested MPG viability scenario**.** Please see Section 7.3 of the SCA for a discussion of these MPG viability scenarios.

The productivity (based on all three metrics: R/S, lambda, and BRT trend) is expected to be greater than 1.0 with implementation of the Prospective Actions (Table 8.3.6.1-1). This means that these populations are expected to have survival sufficient to grow and that the abundance of spawners will increase.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) for two of the three populations. For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in selected tributaries as a result of the Prospective Actions, as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. These improvements also indicate that estimates of productivity >1 for this population are not driven solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is "low" to "moderate" (Table 8.3.2-2). The MPG can achieve the ICTRT-suggested recovery scenario with moderate risk for these factors and sufficient productivity, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario all South Fork Salmon MPG populations are expected to have R/S greater than 1.0 and to be farther above 1.0 than under the recent climate scenario (SCA Aggregate Analysis Appendix). Under the ICTRT "Warm PDO" climate scenario, in which all years are anomalously warm, all populations are expected to have R/S greater than 1.0.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of extinction risk indicate <5% risk at QET=50 or less for all three populations for which estimates can be made, even if no Prospective Actions are implemented immediately (Table 8.3.6.1-2).

There is some uncertainty regarding the reliability of quantitative estimates of extinction risk because of the range of statistical results (95% confidence limits in Table 8.3.2-3). For this reason, other qualitative information is also considered:

- There is a safety-net hatchery program for the East Fork South Fork (including Johnson Creek) population in this MPG to further reduce short-term extinction risk.

- The recent 10-year geometric mean abundance is above 50 fish for all three populations (Table 8.3.2-1). Returns have not dropped below 50 fish in individual years (Cooney 2007). Population abundance is expected to increase in the future as a result of actions already completed and additional Prospective Actions.

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Middle Fork Salmon MPG

There are nine populations in this MPG and five must be viable or highly viable to achieve the ICTRT suggested MPG viability scenario. Important populations include: Big Creek (the only large population), Chamberlain Creek (unique geographical position between MPGs and one of two needed "intermediate" sized populations), Bear Valley/Elk Creek (a second "intermediate" sized population, after Chamberlain Creek), Marsh Creek (one of two needed "basic" sized populations, with a larger production area and somewhat less isolation than others), and either Camas Creek or Loon Creek (one of which is needed for second "basic" sized population). Please see Section 7.3 for a discussion of these MPG viability scenarios.

Quantitative information is sufficient to estimate productivity for six of the nine populations (R/S, lambda, and BRT trend). Productivity (based on all three metrics: R/S, lambda, and BRT trend) is estimated to be greater than 1.0 for all 6 populations under the Prospective Actions (Table 8.3.6.1-1). This means that the populations will have survival sufficient to grow and that the abundance of spawners will achieve a positive trend.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1 for most of the R/S estimates; Aggregate Analysis Appendix). For this reason, other qualitative information is also considered:

- As a result of the Prospective Actions, life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and tributary habitat survival (in Big Creek only), as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of expected productivity >1 for these populations are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is "very low" to "moderate" (Table 8.2.2-2). The MPG can achieve the ICTRT-suggested recovery scenario with moderate risk for these factors and sufficient productivity, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT "historical" ocean scenario, all populations in the Middle Fork MPG are expected to have productivity (all three metrics) greater than 1.0 (SCA Aggregate Analysis Appendix). Under the "Warm PDO" ocean scenario, in which all years are anomalously warm, 5 of 6 populations in the Middle Fork MPG are expected to have productivity (all three metrics) greater than 1.0.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Although quantitative estimates of extinction risk are not available for five of the nine populations in this MPG, quantitative estimates of extinction risk indicate that each of the four populations with sufficient data to make an estimate have >5% risk at QET=50 under current conditions (Table 8.3.6.1-2). If the Prospective Actions result in at least a 4% immediate improvement, then the Bear Valley/Elk Creek population will have <5% risk.

As discussed in Section 7.1.1.1, QET levels of less than 50 fish may be relevant to short-term extinction risk. This may be especially relevant for the small populations in the Middle Fork MPG, which have fallen below 50 spawners frequently during the last 20 years and yet survived (Cooney 2007; Figure 7.1-3). Within the last 20 years, seven populations in this MPG have fallen below 50 spawners four years in a row, yet have survived and rebounded to much higher levels (although not as high as historical abundance). This lends some empirical support to the view that QET=50 spawners may overstate the risk of actual biological extinction for some of these populations. A QET level of 30 spawners would result in <5% extinction risk for one of the four populations in this MPG for which quantitative estimates are possible, while a QET of 10 spawners would result in <5% risk for three of the four populations.

There is considerable uncertainty regarding the quantitative estimates of extinction risk, both because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to nearly 100% for these populations; Table 8.3.2-3) and because of uncertainty regarding the appropriate QET for short-term risk. For this reason, other qualitative information is also considered:

- There is not a safety-net hatchery program operating in the Middle Fork Salmon MPG to further reduce extinction risk but the hatchery Prospective Actions require the FCRPS Action Agencies to "identify and plan for additional safety-net programs. This MPG is primarily located in National Forest and wilderness areas and has been managed for wild fish production.

- The recent 10-year geometric mean abundance is above 50 fish for Big Creek, Bear Valley/Elk, and Loon Creeks, but is below 50 fish for Marsh, Sulphur, and Camas Creeks (Table 8.3.2.1-1). No estimates are available for the Upper Middle Fork, Lower Middle Fork, or Chamberlain populations. Since 1980, returns have dropped below 50 fish in individual years for all six populations for which abundance estimates are available (Cooney 2007). Population abundance is expected to increase in the future as a result of actions already completed and additional Prospective Actions.

- Fish management agreements do not currently support hatchery supplementation for these populations. However, if these populations fall to critically low levels, a hatchery safety net program could be implemented.

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Upper Salmon MPG

There are eight populations in the Upper Salmon MPG, five of which have to be viable or highly viable to achieve the ICTRT suggested recovery scenario. Important populations include: Lemhi River (one of two very large populations, connectivity to other MPGs), Pahsimeroi River (unique life history pattern), East Fork Salmon River (one of two needed large populations), Upper Salmon River (second needed large population), and Valley Creek (historically larger production than most basic-sized populations). Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Quantitative information is sufficient to estimate 20-year productivity for six of the eight populations (lambda, R/S, and BRT trend). Only 15 brood years are available for the Pahsimeroi population, but

R/S based on these 15 years is also displayed for this population. Productivity (based on all three metrics: R/S, lambda, and BRT trend) is estimated to be 1.0 or greater than 1.0 for all 6-7 populations under the Prospective Actions (Table 8.3.6.1-1). This means that the population will have survival sufficient to grow and that the abundance of spawners will achieve a positive trend.

For most of the populations with sufficient information for productivity estimates, there is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1, while lower 95% confidence intervals indicate productivity <1; Aggregate Analysis Appendix). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.3.5.1 through 8.3.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not driven solely by favorable environmental conditions.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario all Upper Salmon MPG populations are expected to have R/S greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT "Warm PDO" (poor) climate scenario, five of seven populations are expected to have R/S greater than 1.0.
- Current risk associated with spatial structure and diversity is "high" for the Lemhi population and risk associated with diversity is "high" for the East Fork Salmon and Pahsimeroi populations, which also must be viable to achieve the long-term viability scenario suggested by the ICTRT (Table 8.3.2-2). Problems for these populations include unoccupied major and minor spawning areas and loss of the summer life history strategy for the Lemhi population.
- The problems associated with these populations that need to be addressed in order to have lower short-term extinction risk will take longer than 10 years to resolve. In particular, the occupation of sufficient major and minor spawning areas and loss of the Lemhi summer life history strategy involve long-term improvements.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.
- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to

reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Short-term extinction risk could be estimated quantitatively for only three populations (Valley Creek, Upper Salmon, and Lower Salmon). Quantitative estimates of extinction risk indicate that the Upper Salmon River population has <5% risk at QET=50 (Table 8.3.6.1-2). The other two populations have >5 risk at QET=50.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses indicate that QET would need to be between 10-30 spawners (depending on the degree to which Prospective Actions are implemented immediately) to conclude that two of the three available populations have <5% extinction risk (Table 8.3.6.1-2).

There is considerable uncertainty regarding the quantitative estimates of extinction risk, both because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to nearly 100% for these populations; Table 8.3.2-3) and because of uncertainty regarding the appropriate QET for short-term risk. For this reason, other qualitative information is also considered:

- There is a captive rearing program to reduce short-term extinction risk for the Yankee Fork population. A captive broodstock program for the Lemhi has existed since 1995. There are no other safety-net hatchery programs for other populations in the Upper Salmon MPG.

- The recent 10-year geometric mean abundance is above 50 fish for the Lemhi, Upper Salmon, Lower Salmon, East Fork Salmon, and Pahsimeroi populations, but mean abundance is below 50 fish for the Valley Creek and Yankee Fork populations (Table 8.3.2-1). No estimates are available for the North Fork Salmon population. Returns have dropped below 50 fish in individual years since 1980 for all seven populations for which abundance estimates are available (Cooney 2007).

- While NOAA Fisheries would have greater confidence that populations in this MPG will not go extinct while recovery actions are being implemented if results showed a low likelihood of dropping below QET=50 fish, these populations have dropped below 50 spawners in the past and then increased dramatically when survival conditions were more favorable. For example, the abundance of Yankee Fork spawners ranged from 0-21 in the eight years between1993-2000. However, from 2001-2003 (the last available year in the ICTRT data set) abundance has ranged from 92-161 (Cooney 2007).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

8.3.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Spring/Summer Chinook Salmon ESU

This section summarizes the basis for conclusions at the ESU level.

8.3.7.1 Potential for Recovery

It is likely that the Snake River spring/summer Chinook salmon ESU will trend toward recovery.

The future status of all populations and MPGs of SR spring/summer Chinook salmon will be improved from their current status through the reduction of current adverse effects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.3.5, 8.3.6, and 8.3.7.2. Therefore, the status of the ESU as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.3.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this ESU.

The Prospective Actions include hydropower, predation, and estuary and tributary habitat actions that address limiting factors and threats and will reduce their negative effects. As described in Section 8.3.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, and degradation of tributary and estuary habitat. Prospective habitat improvements will initiate and at least partially address concerns regarding high spatial structure risk for the Lemhi and Lostine/Wallowa populations. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions appropriately considered cumulative effects also address limiting factors and threats. The harvest Prospective Action is to implement a *U.S. v. Oregon* harvest rate schedule that is expected to be no change from the current harvest rates in the environmental baseline. Although hatchery management is not identified as a current limiting factor for the ESU as a whole, the ICTRT has identified concerns for a few individual populations with high diversity risk. Additionally, the longer hatchery programs continue the more likely their effects will limit recovery potential. The Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce the likelihood of longer-term problems associated with continuing hatchery programs although subject to future hatchery-specific consultations after which these benefits may be realized.

Some of the problems limiting recovery of SR spring/summer Chinook salmon, such as tributary habitat problems affecting some Grande Ronde MPG populations, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years. Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of RSWs and other passage improvements to reduce delay and exposure to warm temperatures in project forebays and regulation of late summer water temperatures at Lower Granite by regulating outflow temperatures at Dworshak Dam. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

In sum, these qualitative considerations suggest that the SR spring/summer Chinook ESU will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of hatchery supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S estimates incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

As described in Section 8.3.6, R/S is expected to be >1.0 for 19 of 23 populations in this ESU for which estimates are available in this ESU and stable (1.0) for one additional population (Figure 8.3.6-1). R/S is expected to be >1.0 for most of the important populations identified by ICTRT in four of the five MPGs in this ESU (Table 8.3.6.1-1). The Grande Ronde is the MPG with key populations that are expected to have R/S<1.0 after implementation of the Prospective Actions.

Populations for which R/S is expected to be greater than 1.0 generally have estimates that are considerably greater than 1.0 (range 1.1-2.4; mean 1.5). By providing additional benefits to stronger populations, the Prospective Actions help offset problems with more poorly performing populations, supporting the viability of the ESU as a whole.

Population growth rate (lambda) and BRT trend estimates are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. The method of calculating lambda leads to a range of results for populations influenced by hatchery production, depending upon assumed effectiveness of hatchery-origin spawners. These estimates require fewer assumptions and less data than R/S estimates, but still depend on data quality. Because of the hatchery assumptions these metrics may be less indicative of a trend toward recovery than R/S for populations significantly influenced by or dependent on hatchery programs, since recovery implies self-sustaining populations.

With implementation of the Prospective Actions, all populations in this ESU have lambda (with the HF=0 assumption that hatchery-origin spawners are completely ineffective) and BRT trends that are expected to be greater than 1.0, as described in Section 8.3.6. For lambda under the HF=1 assumption that hatchery-origin spawners are as effective as natural-origin spawners, estimates are less than 1.0 for four populations in two MPGs (Lower Snake and Grande Ronde). As with R/S, the estimates that are greater than 1.0 are considerably higher. Therefore, all important populations identified by the ICTRT are expected to have lambda (HF=0) and BRT trend greater than 1.0 for all five MPGs, but key populations in two of the five MPGs have expected lambda (HF=1) less than 1.0.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S may be low.
- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate and effects on early ocean survival will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the “historical” ocean scenario, all but one population are expected to have R/S greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.3.6-2). Under the ICTRT “Warm PDO” climate scenario, in which all years are anomalously warm, the number of populations with R/S less than 1.0 increases to seven (out of 22), compared to three under the “recent” climate scenario.
- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

- The mean results represent the most likely future condition, but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S, lambda, and the BRT trend are expected to be greater than 1.0 at the upper 95% confidence limits for all populations. R/S is expected to be less than 1.0 for most populations at the lower 95% confidence limits (SCA Aggregate Analysis Appendix; Figure 8.3.6-1). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors indicates that the ESU as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. NOAA Fisheries cannot demonstrate quantitatively that all populations (including important populations in the Upper Grande Ronde MPG) will be increasing as a result of the actions considered in the aggregate analysis and as indicated by expected R/S>1. However, the majority of populations are likely to increase in abundance and enough populations are likely to be increasing to conclude that the ESU as a whole will be trending toward recovery. Those populations that do have R/S greater than 1.0 have considerably higher R/S, in part due to the Prospective Actions. These populations with high productivity help offset problems with more poorly performing populations, making the ESU as a whole more viable.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes resulting from the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the ESU being on a trend toward recovery.

8.3.7.2 Short-term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Actions and a continuation of other current management actions in the environmental baseline, as described above and in Sections 8.3.3 and 8.3.5. Additionally, implementation of Prospective Actions in other life stages is expected to further improve survival and reduce extinction risk.

As described in Section 8.3.6, abundance is expected to be stable or increasing for most populations and natural productivity (R/S) is expected to be sufficient for most populations to grow. These factors also indicate a decreasing risk of extinction.

A number of critical populations are supported in part by safety-net hatchery supplementation programs. These programs ensure that the affected populations will not go extinct in the short term, although, as described above, they increase diversity risk to the ESU if continued over a long time period. Safety-net hatchery supplementation programs protect the single extant population in the Lower Snake MPG, all high-risk populations in the Grande Ronde MPG, the East Fork South Fork Salmon population in the South Fork Salmon MPG, and the Yankee Fork population in the Upper Salmon MPG. There are no hatchery programs affecting the Middle Fork Salmon MPG.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 and above, some important improvements include installation of RSWs and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

As described in Section 8.3.6, short-term extinction risk is expected to be $\leq$ 5% at QET=50 for seven to nine of 17 populations in this ESU for which estimates were available (Figure 8.3.6-3). Critical populations have $\leq$ 5% risk at QET=50 for three of the five MPGs. The range reflects whether the estimate is based on a continuation of current baseline management practices (low estimate) or if the Prospective Actions are considered (higher estimate). These estimates assume no continued hatchery supplementation and assume that the population will be extinct if it falls below 50 fish for four years in a row.

Quantitative estimates of short-term extinction risk, assuming base period conditions and that supplementation continues (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix), indicate that the Lostine and Imnaha populations in the Grande Ronde MPG have $\leq$ 5% risk at QET=50 and the Upper Grande Ronde and Catherine Creek populations have greatly reduced extinction risk, although it is still >5% at QET=50. These estimates do not consider base-to-current improvements and improvements expected from Prospective Actions. If an analysis, assuming continued supplementation, were applied to all populations with safety-net hatchery programs, it is likely that only a few populations would remain with a high extinction risk at QET=50. Most of these populations are in the Middle Fork Salmon MPG, which has no supplementation program.

For the Middle Fork Salmon MPG, it was only possible to quantitatively estimate short-term extinction risk for four of the nine populations. One of these populations has ≤ 5% at QET=50 if some of the Prospective Actions achieve immediate benefits and the other three populations have higher risk. While these results are a cause for concern, two factors indicate that the short-term extinction risk for the Middle Fork Salmon MPG populations may not be as high as indicated by these quantitative results.

- First, as discussed in Section 7.1, the ICTRT selected a QET of 50 fish to represent a point at which long-term (100-year) extinction risk is qualitatively high, based on a combination of demographic considerations that would also apply in the short term and genetic considerations that may have less relevance to short-term survival. It is likely that a lower QET could be equally relevant to an assessment of short-term risk.
- Second, as described in Section 7.1, a QET of 50 overstates the true extinction risk of populations that have averaged less than 50 fish during the extinction model's base period. These populations must by definition have a very high extinction risk when the projection model compares to a 50 fish quasi-extinction threshold, yet the empirical evidence indicates that the populations in question clearly have not gone extinct during this period. Within the last 20 years, seven populations in the Middle Fork MPG have fallen below 50 spawners four years in a row, yet have survived and rebounded to much higher levels (although not as high as historical abundance).

At a QET of 10 fish, three out of four populations for which extinction risk could be estimated have low risk.

This summary of quantitative extinction risk estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario 10-11 of 17 populations are expected to have ≤ 5% risk at QET=50 (Aggregate Analysis Appendix; Figure 8.3.6-4). Under the ICTRT "Warm PDO" climate scenario, in which all years are anomalously warm, the number of populations with ≤ 5% risk at QET=50 decreases to 5-7, compared to 7-9 under the "recent" climate scenario.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0% to near 100% for many populations. This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the factors above indicates that the ESU as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. NOAA Fisheries cannot demonstrate quantitatively that all populations or all MPGs will have a low short-term extinction risk, as indicated by quantitative estimates and a quasi extinction threshold of 50 fish, which the ICTRT associated with long-term viability. These extinction risk estimates assume that all hatchery supplementation ceases. However, most of the populations with high short-term extinction risk are protected from extinction by safety-net hatchery programs. Quantitative estimates, with an assumption of continuing supplementation, indicate that supplemented populations have low short-term extinction risk. The exceptions are populations in the Middle Fork Salmon MPG, which are not influenced by hatchery programs. The Middle Fork MPG is a concern and these populations will be closely monitored under the Prospective Actions to ensure that any changes in status are detected and appropriate actions taken. However, although these populations appear to have high risk at QET=50, it is likely that a lower QET level is appropriate for some of the smaller populations. Most of these populations have dropped to levels below 50 fish, and in some cases for four years in a row, yet have not gone extinct and have increased to higher numbers in recent years. In summary, enough populations are likely to have a low enough risk of extinction to conclude that the ESU as a whole will have a low risk of short-term extinction.

8.3.7.3 Effect of Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for SR spring/summer Chinook salmon including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam; and river reaches presently or historically accessible in the Hells Canyon, Imnaha, Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon-Panther, Pahsimeroi, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, and Wallowa subbasins. The environmental baseline within the action area, which encompasses these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR spring/summer Chinook. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Snake and Columbia rivers; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, double-crested cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat spring Chinook in the tailrace of Bonneville Dam will do the same for adults. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River Spring Summer Chinook ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that the *U.S. v. Oregon* fisheries in 2008-2017 are not likely to jeopardize the continued existence of the Snake River Spring Summer Chinook ESU nor result in the destruction or adverse modification of its designated critical habitat.

Table 8.3.2-1. Status of SR spring/summer Chinook salmon with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

			Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
ESU	MPG	Population	Most Recent 10-yr Geomean Abundance[1]	Years Included In Geomean	ICTRT Recovery Abundance Threshold[1]	Average R/S: 20-yr non-SAR adj.; non-delimited[2]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0)[3]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1)[3]	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current[4]	Lower 95% CI	Upper 95% CI
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	82	1997-2006	750	0.72	0.48	1.10	0.96	0.67	1.38	0.87	0.63	1.21	0.92	0.85	0.99
		Asotin - Functionally Extirpated															
	Grande Ronde / Imnaha	Catherine Creek	107	1996-2005	1000	0.44	0.22	0.84	0.93	0.66	1.30	0.81	0.53	1.26	0.92	0.87	0.98
		Lostine/Wallowa Rivers	276	1996-2005	1000	0.72	0.41	1.26	0.95	0.77	1.17	0.82	0.59	1.13	1.01	0.96	1.06
		Minam River	337	1996-2005	750	0.80	0.47	1.37	1.05	0.82	1.35	0.98	0.71	1.36	1.02	0.97	1.07
		Imnaha River	380	1996-2005	750	0.59	0.40	0.86	1.04	0.80	1.37	0.93	0.65	1.33	0.98	0.94	1.02
		Wenaha River	376	1996-2005	750	0.66	0.41	1.08	1.03	0.78	1.36	0.94	0.68	1.32	1.04	0.99	1.10
		Upper Grande Ronde	38	1996-2005	1000	0.32	0.18	0.57	1.00	0.74	1.36	0.85	0.67	1.09	0.92	0.87	0.97
		Big Sheep Creek - Functionally Extirpated															
		Lookingglass- Functionally Extirpated															
	South Fork Salmon	South Fork Salmon Mainstem	601	1994-2003	1000	0.86	0.59	1.28	1.09	0.83	1.43	0.99	0.74	1.33	1.05	1.01	1.10
		Secesh River	403	1996-2005	750	1.19	0.81	1.76	1.06	0.86	1.32	1.06	0.85	1.31	1.05	1.01	1.09
		East Fork S. Fork Salmon (including Johns	105	1994-2003	1000	0.97	0.67	1.41	1.06	0.88	1.28	1.05	0.87	1.26	1.02	0.97	1.08
		Little Salmon River (including Rapid R.)			500												
	Middle Fork Salmon	Big Creek	90	1995-2004	1000	1.20	0.66	2.19	1.09	0.78	1.53	1.09	0.78	1.53	1.02	0.94	1.10
		Bear Valley/Elk Creek	182	1994-2003	750	1.35	0.82	2.22	1.11	0.79	1.55	1.11	0.79	1.55	1.05	0.98	1.13
		Marsh Creek	42	1994-2003	500	0.95	0.52	1.75	1.09	0.78	1.52	1.09	0.78	1.52	1.01	0.92	1.10
		Sulphur Creek	21	1994-2003	500	0.97	0.45	2.09	1.07	0.68	1.68	1.07	0.68	1.68	1.02	0.94	1.11
		Camas Creek	28	1995-2004	500	0.79	0.39	1.62	1.04	0.69	1.57	1.04	0.69	1.57	1.00	0.93	1.07
		Loon Creek	51	1995-2004	500	1.11	0.54	2.31	1.12	0.79	1.58	1.12	0.79	1.58	1.07	0.98	1.16
		Chamberlain Creek			500												
		Lower Middle Fork Salmon (below Ind. Cr.)			500												
		Upper Middle Fork Salmon (above Ind. Cr.)			750												
	Upper Salmon	Lemhi River	79	1994-2003	2000	1.08	0.63	1.84	1.03	0.66	1.59	1.03	0.66	1.59	0.98	0.92	1.05
		Valley Creek	34	1994-2003	500	1.07	0.61	1.87	1.07	0.72	1.59	1.07	0.72	1.59	1.03	0.96	1.11
		Yankee Fork	13	1994-2003	500	0.61	0.28	1.29	1.06	0.67	1.68	1.06	0.67	1.68	1.05	0.96	1.15
		Upper Salmon River (above Redfish L.)	246	1996-2005	1000	1.51	0.84	2.72	1.04	0.74	1.46	0.98	0.69	1.38	1.01	0.95	1.06
		North Fork Salmon River			500												
		Lower Salmon River (below Redfish L.)	103	1996-2005	2000	1.20	0.75	1.92	1.03	0.76	1.40	1.03	0.76	1.40	1.00	0.95	1.05
		East Fork Salmon River	148	1996-2005	1000	1.06	0.54	2.08	1.05	0.70	1.57	1.02	0.66	1.56	1.01	0.94	1.09
		Pahsimeroi River	127	1996-2005	1000	0.51	0.22	1.18									
		Panther - Extirpated															

1 ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from the ICTRT (2007c).
2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 brood years in Cooney (2007). Actual years in average vary by population.
3 Median population growth rate (lambda) during the most recent period of approximately 20 years. Actual years in estimate vary by population. Lambda estimates are from Cooney (2008c).
4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008c).

Table 8.3.2-2. Status of SR spring/summer Chinook salmon with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure[1]	ICTRT Current Risk For Diversity[1]	10-yr Average % Natural-Origin Spawners[2]
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	Currently Moderate Risk	Currently Moderate Risk	0.47
		Asotin - Functionally Extirpated			
	Grande Ronde / Imnaha	Catherine Creek	Currently Moderate Risk	Currently Moderate Risk	0.71
		Lostine/Wallowa Rivers	Currently High Risk (Loss of occupancy in 1.5 MaSA and 2 MiSA)	Currently Moderate Risk	0.72
		Minam River	Currently Low Risk	Currently Moderate Risk	0.96
		Imnaha River	Currently Low Risk	Currently Moderate Risk	0.35
		Wenaha River	Currently Low Risk	Currently Moderate Risk	0.95
		Upper Grande Ronde	Currently Low Risk	Currently Moderate Risk	0.77
		Big Sheep Creek - Functionally Extirpated			
		Lookingglass- Functionally Extirpated			
	South Fork Salmon	South Fork Salmon Mainstem	Currently Low Risk	Currently Moderate Risk	0.62
		Secesh River	Currently Low Risk	Currently Low Risk	0.96
		East Fork S. Fork Salmon (including Johns	Currently Low Risk	Currently Low Risk	0.90
		Little Salmon River (including Rapid R.)			
	Middle Fork Salmon	Big Creek	Currently Low Risk	Currently Low Risk	1.00
		Bear Valley/Elk Creek	Currently Very Low Risk	Currently Moderate Risk	1.00
		Marsh Creek	Currently Low Risk	Currently Low Risk	1.00
		Sulphur Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Camas Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Loon Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Chamberlain Creek	Currently Low Risk	Currently Low Risk	
		Lower Middle Fork Salmon (below Ind. Cr.)	Currently Moderate Risk	Currently Moderate Risk	
		Upper Middle Fork Salmon (above Ind. Cr.)			
	Upper Salmon	Lemhi River	Currently High Risk (Loss of occupancy of 2 upstream MaSA and 1 downstream MiSA)	Currently High Risk (Loss of summer-run life history)	1.00
		Valley Creek	Currently Low Risk	Currently Moderate Risk	1.00
		Yankee Fork	Currently Moderate Risk	Currently High Risk (Out of population and out of MPG hatchery straying)	1.00
		Upper Salmon River (above Redfish L.)	Currently Very Low Risk	Currently Moderate Risk	0.75
		North Fork Salmon River	Currently Low Risk	Currently Low Risk	
		Lower Salmon River (below Redfish L.)	Currently Low Risk	Currently Low Risk	1.00
		East Fork Salmon River	Currently Low Risk	Currently High Risk (Genetic diversity and legacy effects of hatchery fish)	0.92
		Pahsimeroi River	Currently Moderate Risk	Currently High Risk (High proportion of hatchery fish in multi-year program)	0.58
		Panther - Extirpated			

1 ICTRT conclusions for Snake River spring/summer Chinook are from ICTRT Current Status Summaries (ICTRT 2007d).
2 Average fractions of natural-origin natural spawners are from the ICTRT (Cooney 2007).

Table 8.3.2-3. Status of SR spring/summer Chinook salmon with respect to extinction risk. Extinction risk is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

			24-Year Extinction Risk											
ESU	MPG	Population	Risk (QET=1)[1]	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10)[1]	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30)[1]	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50)[1]	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	0.00	0.00	0.13	0.00	0.00	0.30	0.02	0.00	0.55	0.07	0.00	0.71
		Asotin - Functionally Extirpated												
	Grande Ronde / Imnaha	Catherine Creek	0.09	0.00	0.77	0.23	0.00	0.90	0.37	0.00	0.96	0.45	0.01	0.98
		Lostine/Wallowa Rivers	0.00	0.00	0.46	0.03	0.00	0.62	0.10	0.00	0.74	0.18	0.00	0.81
		Minam River	0.00	0.00	0.31	0.00	0.00	0.42	0.02	0.00	0.57	0.06	0.00	0.68
		Imnaha River	0.00	0.00	0.22	0.01	0.00	0.45	0.04	0.00	0.66	0.09	0.00	0.73
		Wenaha River	0.00	0.00	0.35	0.04	0.00	0.57	0.15	0.00	0.74	0.26	0.00	0.83
		Upper Grande Ronde	0.00	0.00	0.11	0.09	0.00	0.57	0.41	0.01	0.89	0.70	0.07	0.97
		Big Sheep Creek - Functionally Extirpated												
		Lookingglass- Functionally Extirpated												
	South Fork Salmon	South Fork Salmon Mainstem	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.07	0.00	0.00	0.13
		Secesh River	0.00	0.00	0.17	0.00	0.00	0.26	0.01	0.00	0.35	0.02	0.00	0.42
		East Fork S. Fork Salmon (including Johns	0.00	0.00	0.02	0.00	0.00	0.14	0.01	0.00	0.33	0.04	0.00	0.48
		Little Salmon River (including Rapid R.)												
	Middle Fork Salmon	Big Creek	0.00	0.00	0.60	0.04	0.00	0.80	0.20	0.00	0.89	0.37	0.00	0.93
		Bear Valley/Elk Creek	0.00	0.00	0.40	0.00	0.00	0.53	0.03	0.00	0.63	0.09	0.00	0.71
		Marsh Creek	0.03	0.00	0.64	0.21	0.00	0.82	0.43	0.00	0.92	0.56	0.00	0.95
		Sulphur Creek	0.00	0.00	0.65	0.06	0.00	0.79	0.33	0.00	0.88	0.55	0.00	0.92
		Camas Creek												
		Loon Creek												
		Chamberlain Creek												
		Lower Middle Fork Salmon (below Ind. Cr.)												
		Upper Middle Fork Salmon (above Ind. Cr.)												
	Upper Salmon	Lemhi River												
		Valley Creek	0.00	0.00	0.32	0.13	0.00	0.76	0.50	0.01	0.96	0.75	0.07	0.99
		Yankee Fork												
		Upper Salmon River (above Redfish L.)	0.00	0.00	0.37	0.00	0.00	0.53	0.00	0.00	0.64	0.00	0.00	0.71
		North Fork Salmon River												
		Lower Salmon River (below Redfish L.)	0.00	0.00	0.41	0.00	0.00	0.80	0.13	0.00	0.97	0.37	0.00	0.99
		East Fork Salmon River												
		Pahsimeroi River												
		Panther - Extirpated												

1 Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

Table 8.3.2-4. Changes in density-independent survival ("gaps") necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for SR spring/summer Chinook salmon. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated "gaps" are based on population performance during the "base period" of approximately the last 20 brood years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0[1]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0@ HF=1[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0[3]	Upper 95% CI	Lower 95% CI	Survival Gap for 24-Yr Ext. Risk <5% (QET=1)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=10)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=30)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=50)[4]
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	1.38	2.09	0.91	1.18	5.90	0.24	1.85	8.06	0.90	1.48	2.10	1.04	0.33	0.57	0.86	1.13
		Asotin - Functionally Extirpated																
	Grande Ronde / Imnaha	Catherine Creek	2.30	4.45	1.19	1.40	6.40	0.31	2.55	18.17	0.54	1.42	1.85	1.09	1.28	2.18	3.07	3.88
		Lostine/Wallowa Rivers	1.39	2.44	0.79	0.88	3.09	0.25	1.30	5.82	0.76	0.96	1.20	0.76	0.49	0.87	1.27	1.60
		Minam River	1.25	2.13	0.73	0.80	2.50	0.26	1.09	4.67	0.86	0.92	1.12	0.75	0.27	0.50	0.79	1.06
		Imnaha River	1.70	2.50	1.16	1.00	3.97	0.25	2.06	6.14	0.93	1.10	1.34	0.90	0.41	0.69	0.97	1.18
		Wenaha River	1.51	2.45	0.93	0.83	2.79	0.24	1.39	7.00	0.73	0.83	1.04	0.66	0.55	0.95	1.38	1.71
		Upper Grande Ronde	3.09	5.47	1.75							1.46	1.84	1.16	0.55	1.11	1.87	2.65
		Big Sheep Creek - Functionally Extirpated																
		Lookingglass- Functionally Extirpated																
	South Fork Salmon	South Fork Salmon Mainstem	1.16	1.71	0.78	0.69	2.33	0.20	1.04	3.83	0.91	0.79	0.94	0.66	0.16	0.27	0.37	0.45
		Secesh River	0.84	1.23	0.57	0.76	2.01	0.28	0.78	2.06	0.84	0.81	0.97	0.68	0.32	0.52	0.69	0.84
		East Fork S. Fork Salmon (including Johnson	1.03	1.49	0.71	0.78	1.80	0.34	0.81	1.86	0.82	0.90	1.12	0.72	0.39	0.63	0.81	0.94
		Little Salmon River (including Rapid R.)																
	Middle Fork Salmon	Big Creek	0.83	1.51	0.46	0.67	3.09	0.15	0.67	3.09	0.71	0.93	1.29	0.66	0.42	0.96	1.84	2.70
		Bear Valley/Elk Creek	0.74	1.21	0.45	0.63	2.84	0.14	0.63	2.84	0.80	0.79	1.08	0.59	0.27	0.53	0.90	1.26
		Marsh Creek	1.05	1.93	0.57	0.69	3.11	0.15	0.69	3.11	0.46	0.97	1.45	0.65	0.89	1.82	3.11	4.28
		Sulphur Creek	1.03	2.23	0.48	0.73	5.56	0.10	0.73	5.56	0.76	0.90	1.33	0.62	0.29	1.06	2.66	4.25
		Camas Creek	1.26	2.58	0.62	0.84	5.38	0.13	0.84	5.38	1.00	1.02	1.41	0.73				
		Loon Creek	0.90	1.86	0.43	0.61	2.87	0.13	1.11	0.79	1.58	0.75	1.09	0.52				
		Chamberlain Creek																
		Lower Middle Fork Salmon (below Ind. Cr.)																
		Upper Middle Fork Salmon (above Ind. Cr.)																
	Upper Salmon	Lemhi River	0.93	1.59	0.54	0.89	6.31	0.13	0.89	6.31	1.00	1.08	1.43	0.82	0.00	0.00	0.00	0.00
		Valley Creek	0.94	1.64	0.53							0.88	1.21	0.64	0.32	1.28	3.28	5.37
		Yankee Fork	1.65	3.52	0.77							0.82	1.23	0.54				
		Upper Salmon River (above Redfish L.)	0.66	1.19	0.37	0.85	3.97	0.18	1.11	5.17	0.97	0.98	1.24	0.77	0.07	0.21	0.47	0.74
		North Fork Salmon River																
		Lower Salmon River (below Redfish L.)	0.83	1.33	0.52	0.87	3.40	0.22	0.87	3.40	0.90	0.99	1.24	0.79	0.19	0.57	1.37	2.18
		East Fork Salmon River	0.94	1.84	0.48	0.82	5.08	0.13	0.93	6.40	1.00	0.96	1.35	0.69	0.00	0.00	0.00	0.00
		Pahsimeroi River	1.97	4.59	0.85							0.00	0.00	0.00				
		Panther - Extirpated																

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.3.2-1.
2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.3.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.
3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.3.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap is calculated as the exponent of a Beverton-Holt “a” value from a production function that would result in 5% risk, divided by the exponent of the base period Beverton-Holt “a” value. Estimates are from Hinrichsen (2008), in the Aggregate Analysis Appendix.

Table 8.3.3-1. Proportional changes in average base period survival of SR spring/summer Chinook salmon expected from completed actions and current human activities that are likely to continue into the future. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

			Base-to-Current Adjustment (Survival Multiplier)							
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2]	Estuary Habitat[3]	Bird Predation[4]	Marine Mammal Predation[5]	Harvest[6]	Hatcheries[7]	Total Base-to-Current Survival Multiplier[8]
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	1.20	1.04	1.00	1.00	0.97	1.04	1.00	1.25
		Asotin - Functionally Extirpated								
	Grande Ronde / Imnaha	Catherine Creek	1.20	1.04	1.00	1.00	0.97	1.04	1.20	1.51
		Lostine/Wallowa Rivers	1.20	1.01	1.00	1.00	0.97	1.04	1.03	1.26
		Minam River	1.20	1.00	1.00	1.00	0.97	1.04	1.22	1.47
		Imnaha River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.22
		Wenaha River	1.20	1.00	1.00	1.00	0.97	1.04	1.39	1.68
		Upper Grande Ronde	1.20	1.04	1.00	1.00	0.97	1.04	1.21	1.52
		Big Sheep Creek - Functionally Extirpated								
		Lookingglass- Functionally Extirpated								
	South Fork Salmon	South Fork Salmon Mainstem	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Secesh River	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		East Fork S. Fork Salmon (including Johnson	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Little Salmon River (including Rapid R.)	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
	Middle Fork Salmon	Big Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Bear Valley/Elk Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Marsh Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Sulphur Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Camas Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Loon Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Chamberlain Creek	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Lower Middle Fork Salmon (below Ind. Cr.)	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Upper Middle Fork Salmon (above Ind. Cr.)	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
	Upper Salmon	Lemhi River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		Valley Creek	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		Yankee Fork	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Upper Salmon River (above Redfish L.)	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		North Fork Salmon River	1.20	1.00	1.00	1.00	0.97	1.04	1.00	1.21
		Lower Salmon River (below Redfish L.)	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		East Fork Salmon River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		Pahsimeroi River	1.20	1.01	1.00	1.00	0.97	1.04	1.00	1.21
		Panther - Extirpated								

1 From SCA Hydro Modeling Appendix Based on differences in average base and current smolt-to-adult survival estimates.
2 From CA Chapter 5, Table 5-7.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the

"Current 2 S/Baseline 2 S" approach, as described in Attachment F-2.
5 From SCA Marine Mammal Appendix
6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
7 From SCA Quantitative Analysis of Hatchery Actions Appendix. Additional basis is in Section 8.3.3.1. Relevant calculation methods are described in the Aggregate Analysis Appendix.
8 Total base-to-current survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

Table 8.3.5-1. Proportional changes in survival of SR spring/summer Chinook salmon expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

			Current-to-Future Adjustment (Survival Multiplier)								
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2] (2007-2017)	Estuary Habitat[3]	Bird Predation[4]	Pike-minnow Predation[5]	Hatcheries[6]	Non-Hydro Current-to-Future Survival Multiplier[7]	Total Current-to-Future Survival Multiplier[8]	Total Base-to-Future Survival Multiplier[9]
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	1.05	1.17	1.06	1.02	1.01	1.00	1.28	1.35	1.68
		Asotin - Functionally Extirpated									
	Grande Ronde / Imnaha	Catherine Creek	1.05	1.23	1.06	1.02	1.01	1.00	1.34	1.41	2.13
		Lostine/Wallowa Rivers	1.05	1.02	1.06	1.02	1.01	1.00	1.11	1.17	1.47
		Minam River	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.70
		Imnaha River	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.42
		Wenaha River	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.93
		Upper Grande Ronde	1.05	1.23	1.06	1.02	1.01	1.00	1.34	1.41	2.15
		Big Sheep Creek - Functionally Extirpated									
		Lookingglass- Functionally Extirpated									
	South Fork Salmon	South Fork Salmon Mainstem	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.40
		Secesh River	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.40
		East Fork S. Fork Salmon (including Johnson)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Little Salmon River (including Rapid R.)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.40
	Middle Fork Salmon	Big Creek	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.40
		Bear Valley/Elk Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Marsh Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Sulphur Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Camas Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Loon Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Chamberlain Creek	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Lower Middle Fork Salmon (below Ind. Cr.)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Upper Middle Fork Salmon (above Ind. Cr.)	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
	Upper Salmon	Lemhi River	1.05	1.07	1.06	1.02	1.01	1.00	1.17	1.23	1.49
		Valley Creek	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.41
		Yankee Fork	1.05	1.30	1.06	1.02	1.01	1.00	1.42	1.49	1.81
		Upper Salmon River (above Redfish L.)	1.05	1.14	1.06	1.02	1.01	1.00	1.25	1.31	1.59
		North Fork Salmon River	1.05	1.00	1.06	1.02	1.01	1.00	1.09	1.15	1.39
		Lower Salmon River (below Redfish L.)	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.41
		East Fork Salmon River	1.05	1.01	1.06	1.02	1.01	1.00	1.10	1.16	1.41
		Pahsimeroi River	1.05	1.41	1.06	1.02	1.01	1.00	1.54	1.62	1.97
		Panther - Extirpated									

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates.
2 From CA Chapter 5, Table 5-9.
3 From CA Appendix D, Attachment D-1, Table 6.

4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the “Prospective 2 S/Current 2 S” approach, as described in Attachment F-2.
5 From CA Appendix F, Attachment F-1.
6 No survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.
7 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.
8 Same as Footnote 7, except it is calculated from all Prospective Actions, including hydro actions.
9 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.3.3-1.

Table 8.3.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for SR spring/summer Chinook salmon.

ESU	MPG	Population	20-Yr R/S Recent Climate[1]	20-yr lambda Recent Climate @ HF=0[2]	20-yr lambda Recent Climate @ HF=1[3]	1980-Current BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	1.22	1.08	0.98	1.03	Must be HV	All metrics >1, except lambda with HF=1	Currently Moderate Risk	Currently Moderate Risk
		Asotin - Functionally Extirpated								
							Need 1 HV and 3 V:			
	Grande Ronde / Imnaha	Catherine Creek	0.93	1.10	0.96	1.09	1 of these 2 populations must be HV or V	Lambda with HF=0 and BRT trend >1, but lambda with HF=1 and R/S <1, for both populations in this pair	Currently Moderate Risk	Currently Moderate Risk
		Upper Grande Ronde	0.70	1.13	0.97	1.09			Currently High Risk (Loss of occupancy in 1.5 MaSA and 2 MiSA)	Currently Moderate Risk
		Minam River	1.36	1.18	1.10	1.15	1 of these 2 populations must be HV or V	All three metrics >1 for both populations in this pair	Currently Low Risk	Currently Moderate Risk
		Wenaha River	1.28	1.21	1.08	1.21			Currently Low Risk	Currently Moderate Risk
		Lostine/Wallowa Rivers	1.06	1.12	1.03	1.10	HV or V if needed to make 4 total for MPG	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Imnaha River	0.83	1.08	0.92	1.06	HV or V if needed to make 4 total for MPG	Lambda with HF=0 and BRT trend >1, but lambda with HF=1 and R/S <1	Currently Low Risk	Currently Moderate Risk
		Big Sheep Creek - Functionally Extirpated								
		Lookingglass- Functionally Extirpated								
							Need 1 HV and 1 V:			
	South Fork Salmon	South Fork Salmon Mainstem	1.21	1.17	1.07	1.14	HV or V (need 2 of these 3 populations)	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Secesh River	1.68	1.15	1.14	1.13	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Low Risk
		East Fork S. Fork Salmon (including Johnson)	1.35	1.14	1.13	1.10	HV or V (need 2 of these 3 populations)	All three metrics >1	Currently Low Risk	Currently Low Risk
		Little Salmon River (including Rapid R.)					HV or V (need 2 of these 3 populations)	No Data		
							Need 1 HV and 4 V:			
	Middle Fork Salmon	Big Creek	1.69	1.18	1.18	1.10	Must be HV or V	All three metrics >1	Currently Low Risk	Currently Low Risk
		Bear Valley/Elk Creek	1.88	1.19	1.19	1.13	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
		Marsh Creek	1.32	1.17	1.17	1.08	Must be HV or V	All three metrics >1	Currently Low Risk	Currently Low Risk
		Sulphur Creek	1.35	1.15	1.15	1.10	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Camas Creek	1.10	1.12	1.12	1.07	1 of these 2 populations must be HV or V	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Loon Creek	1.55	1.20	1.20	1.15		All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Chamberlain Creek					Must be HV or V	No Data	Currently Low Risk	Currently Low Risk
		Lower Middle Fork Salmon (below Ind. Cr.)					"Maintained" Population	No Data	Currently Moderate Risk	Currently Moderate Risk
		Upper Middle Fork Salmon (above Ind. Cr.)					"Maintained" Population	No Data		
							Need 1 HV and 4 V:			
	Upper Salmon	Lemhi River	1.61	1.12	1.12	1.07	Must be HV or V	All three metrics >1	Currently High Risk (Loss of occupancy of 2 upstream MaSA and 1 downstream MiSA)	Currently High Risk (Loss of summer-run life history)
		Valley Creek	1.51	1.15	1.15	1.11	Must be HV or V	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Yankee Fork	1.09	1.21	1.21	1.19	"Maintained" Population	All three metrics >1	Currently Moderate Risk	Currently High Risk (Out of population and out of MPG hatchery straying)
		Upper Salmon River (above Redfish L.)	2.40	1.15	1.08	1.11	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
		North Fork Salmon River					"Maintained" Population	No Data	Currently Low Risk	Currently Low Risk
		Lower Salmon River (below Redfish L.)	1.70	1.11	1.11	1.08	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Low Risk
		East Fork Salmon River	1.50	1.13	1.10	1.09	Must be HV or V	All three metrics >1	Currently Low Risk	Currently High Risk (Genetic diversity and legacy effects of hatchery fish)
		Pahsimeroi River	1.00				Must be HV or V	R/S>1	Currently Moderate Risk	Currently High Risk (High proportion of hatchery fish in multi-year program)
		Panther - Extirpated								

1 Calculated as the base period 20-year R/S productivity from Table 8.3.2-1, multiplied by the total base-to-future survival multiplier in Table 8.3.5-1.

2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.3.2-1, multiplied by the total base-to-future survival multiplier in Table 8.3.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.

3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.3.2-1, multiplied by the total base-to-future survival multiplier in Table 8.3.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
4 From ICTRT (2007a), Attachment 2
5 From Table 8.3.2-2

Table 8.3.6.1-2. Summary of prospective estimates relevant to the survival prong of the jeopardy standard for SR spring/summer Chinook salmon. Numbers represent additional survival improvements (remaining "gaps") to reduce 24-year extinction risk to 5% or less. Numbers less than 1.0 indicate that no additional survival changes are necessary.

			Extinction - Based Only On Current Adjustment - Not Influenced By RPA[1]				Extinction - Based On Current Adjustment and RPA Prospective Actions[2]					
ESU	MPG	Population	24-yr Extinction Risk Gap for ≤5% at QET=1	24-yr Extinction Risk Gap for ≤5% at QET=10	24-yr Extinction Risk Gap for ≤5% at QET=30	24-yr Extinction Risk Gap for ≤5% at QET=50	24-yr Extinction Risk Gap for ≤5% at QET=1	24-yr Extinction Risk Gap for ≤5% at QET=10	24-yr Extinction Risk Gap for ≤5% at QET=30	24-yr Extinction Risk Gap for ≤5% at QET=50	ICTRT MPG Viability Scenario[3]	Survival Prong Notes for Extinction Risk
Snake River Spring/ Summer Chinook Salmon	Lower Snake	Tucannon	0.26	0.46	0.69	0.90	0.20	0.34	0.51	0.67	Must be HV	<5% risk at QET=50.
		Asotin - Functionally Extirpated										
											Need 1 HV and 3 V:	
	Grande Ronde / Imnaha	Catherine Creek	0.85	1.45	2.04	2.57	0.60	1.02	1.44	1.82	1 of these 2 populations must be HV or V	<5% risk only expected at low QET, but safety net programs in RPA reduce extinction risk.
		Upper Grande Ronde	0.36	0.73	1.23	1.74	0.26	0.52	0.87	1.23		<5% risk only expected at low QET, but safety net programs in RPA reduce extinction risk.
		Minam River	0.18	0.34	0.54	0.72	0.16	0.29	0.47	0.63	1 of these 2 populations must be HV or V	<5% risk at QET=50 without reliance on immediate RPA actions
		Wenaha River	0.33	0.57	0.82	1.02	0.28	0.49	0.71	0.89		≤5% risk at QET=50 if some prospective actions implemented immediately; otherwise >5% risk
		Lostine/Wallowa Rivers	0.39	0.69	1.01	1.27	0.33	0.59	0.86	1.09	HV or V if needed to make 4 total for MPG	<5% risk only expected at low QET, but safety net programs in RPA reduce extinction risk.
		Imnaha River	0.34	0.57	0.79	0.97	0.29	0.49	0.68	0.83	HV or V if needed to make 4 total for MPG	<5% risk at QET=50 without reliance on immediate RPA actions
		Big Sheep Creek - Functionally Extirpated										
		Lookingglass- Functionally Extirpated										
											Need 1 HV and 1 V:	
	South Fork Salmon	South Fork Salmon Mainstem	0.13	0.22	0.31	0.37	0.11	0.19	0.26	0.32	HV or V (need 2 of these 3 populations)	<5% risk at QET=50 without reliance on immediate RPA actions
		Secesh River	0.26	0.43	0.57	0.70	0.23	0.37	0.49	0.60	"Maintained" Population	<5% risk at QET=50 without reliance on immediate RPA actions
		East Fork S. Fork Salmon (including Johnson)	0.32	0.52	0.67	0.78	0.28	0.45	0.58	0.68	HV or V (need 2 of these 3 populations)	<5% risk at QET=50 without reliance on immediate RPA actions. Safety-net program also reduces short-term extinction risk.
		Little Salmon River (including Rapid R.)									HV or V (need 2 of these 3 populations)	No short-term extinction risk estimates
											Need 1 HV and 4 V:	
	Middle Fork Salmon	Big Creek	0.35	0.79	1.52	2.23	0.30	0.68	1.31	1.92	Must be HV or V	<5% risk only expected at low QET.
		Bear Valley/Elk Creek	0.22	0.44	0.74	1.04	0.19	0.38	0.65	0.91	Must be HV or V	<5% risk at QET=50 with some immediate RPA actions; otherwise, >5% risk
		Marsh Creek	0.74	1.51	2.57	3.54	0.64	1.31	2.24	3.08	Must be HV or V	<5% risk only expected at low QET.
		Sulphur Creek	0.24	0.88	2.20	3.52	0.21	0.76	1.91	3.06	"Maintained" Population	<5% risk only expected at low QET.
		Camas Creek									1 of these 2 populations must be HV or V	No short-term extinction risk estimates
		Loon Creek										No short-term extinction risk estimates
		Chamberlain Creek									Must be HV or V	No short-term extinction risk estimates
		Lower Middle Fork Salmon (below Ind. Cr.)									"Maintained" Population	No short-term extinction risk estimates
		Upper Middle Fork Salmon (above Ind. Cr.)									"Maintained" Population	No short-term extinction risk estimates
											Need 1 HV and 4 V:	
	Upper Salmon	Lemhi River									Must be HV or V	No short-term extinction risk estimates
		Valley Creek	0.26	1.05	2.70	4.42	0.23	0.91	2.33	3.81	Must be HV or V	<5% risk only expected at low QET.
		Yankee Fork									"Maintained" Population	No short-term extinction risk estimates. Captive rearing program in RPA reduces extinction risk.
		Upper Salmon River (above Redfish L.)	0.06	0.17	0.39	0.61	0.04	0.13	0.30	0.46	Must be HV or V	<5% risk at QET=50 without reliance on immediate RPA actions
		North Fork Salmon River									"Maintained" Population	No short-term extinction risk estimates
		Lower Salmon River (below Redfish L.)	0.16	0.47	1.13	1.80	0.13	0.40	0.97	1.55	"Maintained" Population	<5% risk only expected at low QET.
		East Fork Salmon River									Must be HV or V	Safety net programs in RPA reduce extinction risk.
		Pahsimeroi River									Must be HV or V	No short-term extinction risk estimates
		Panther - Extirpated										

1 These estimates assume that only actions that have already occurred can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.3.2-4, divided by the total base-to-current survival multiplier in Table 8.3.3-1.
2 These estimates assume that Prospective Actions to be implemented in the next 10 years can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.3.2-4, divided by the total base-to-future survival multiplier in Table 8.3.5-1.
3 From ICTRT (2007a), Attachment 2

Figure 8.3.6-1. Summary of prospective mean R/S estimates for SR spring/summer Chinook salmon under the "recent" climate assumption, including 95% confidence limits.

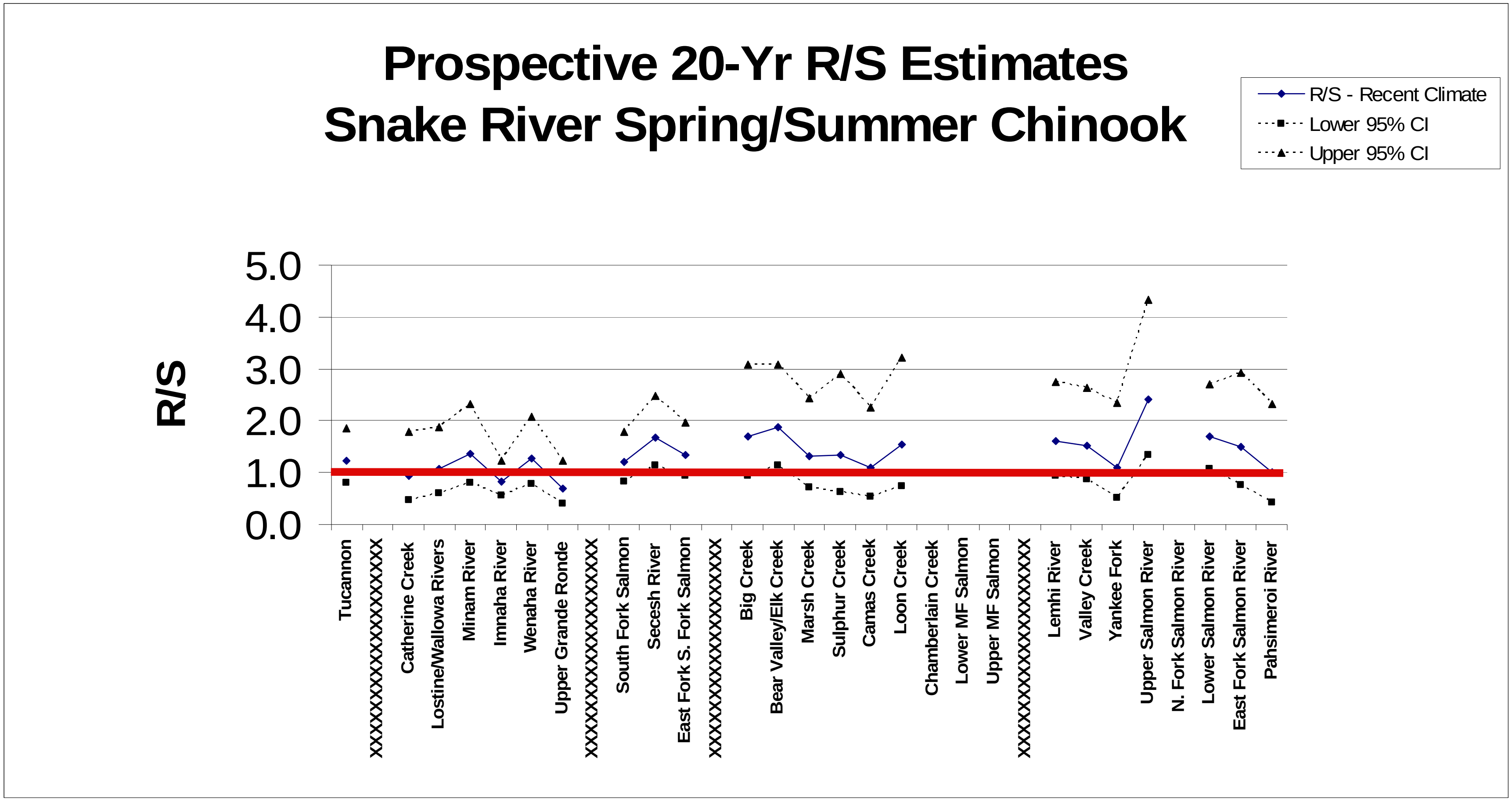


Figure 8.3.6-2. Summary of prospective mean R/S estimates for SR spring/summer Chinook salmon under three climate assumptions.

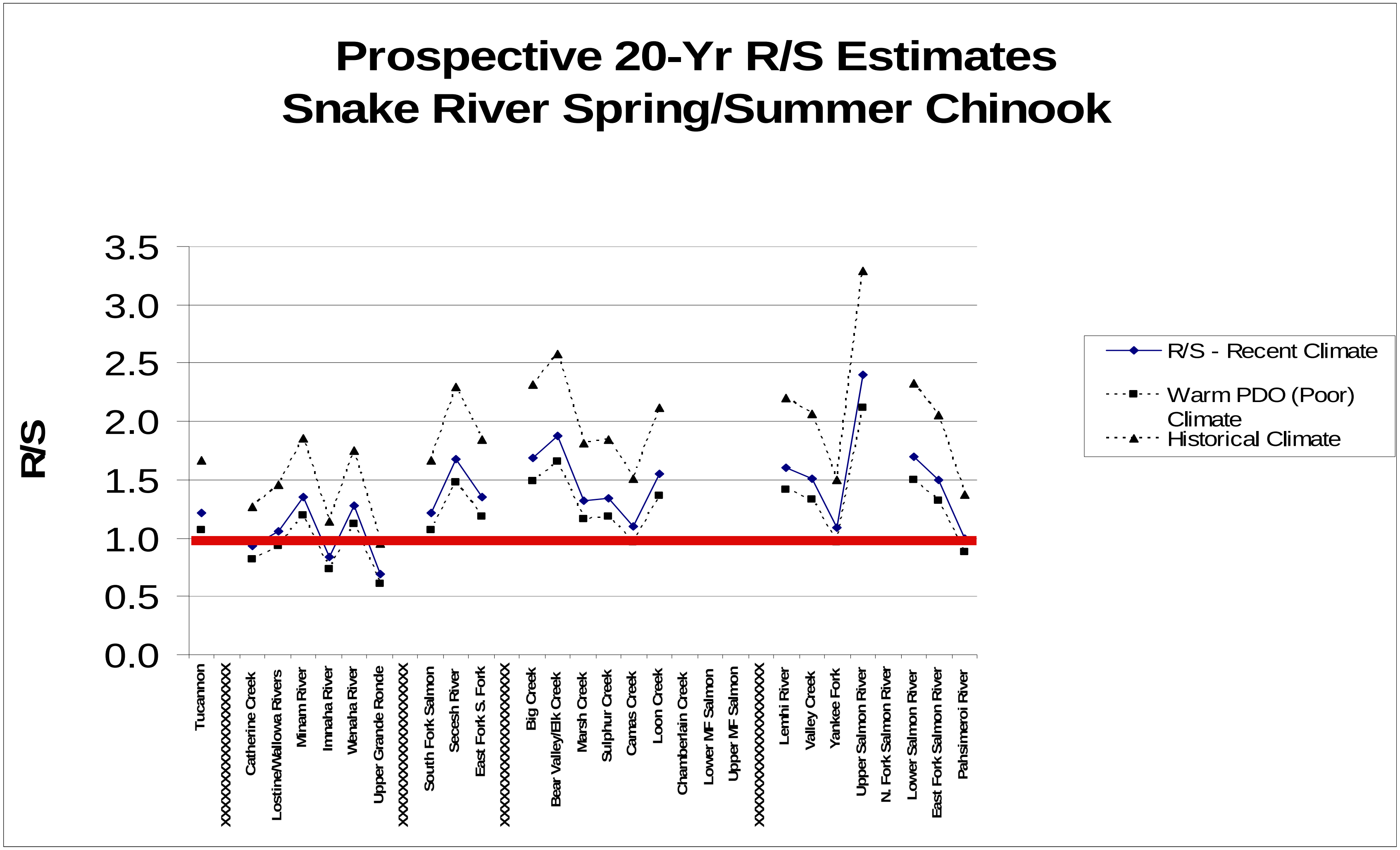


Figure 8.3.6-3. Summary of prospective 5% 24-year extinction risk gap estimates for SR spring/summer Chinook salmon under the "recent" climate assumption, showing effects of three alternative quasi-extinction thresholds (QET).

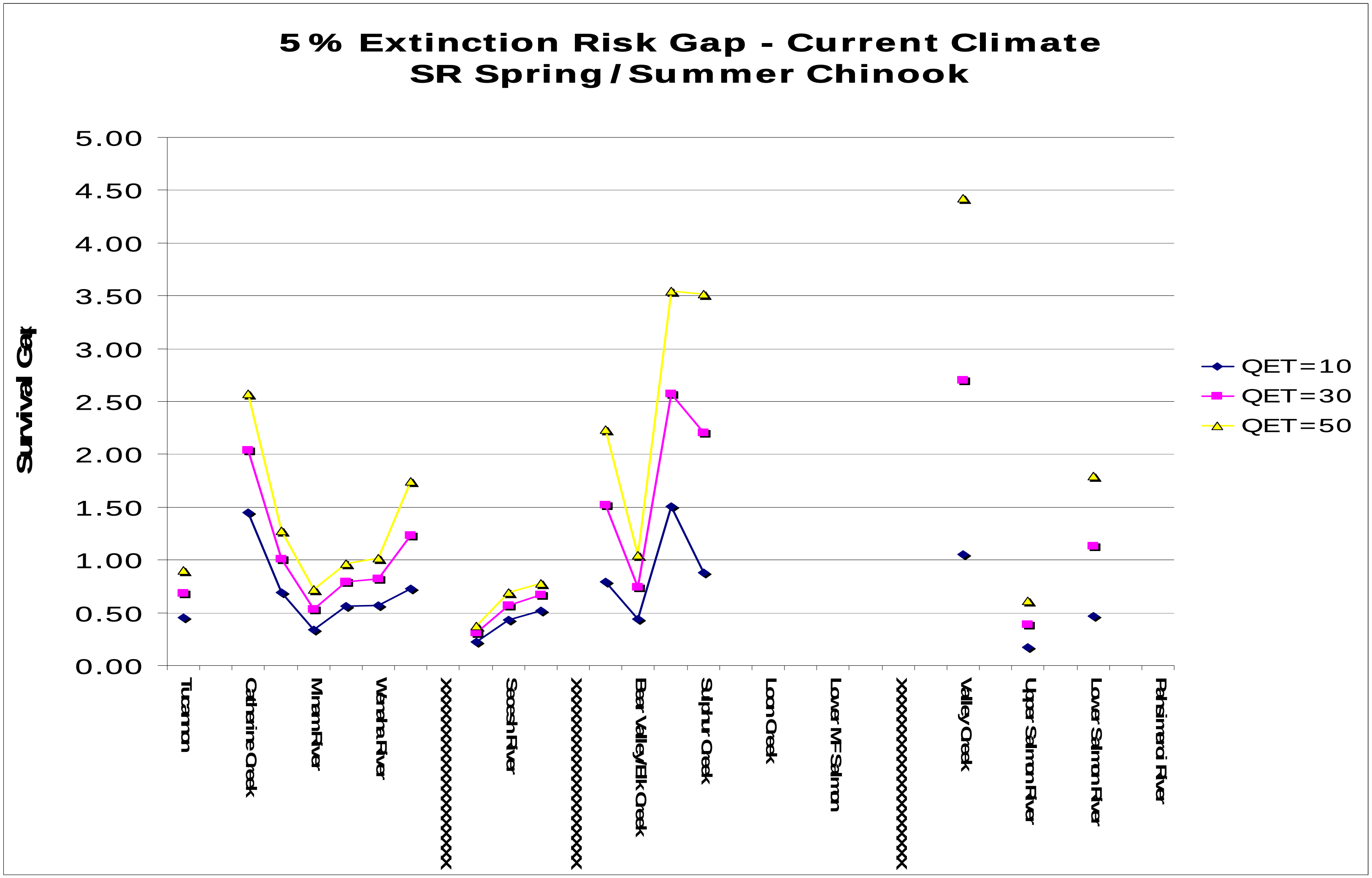
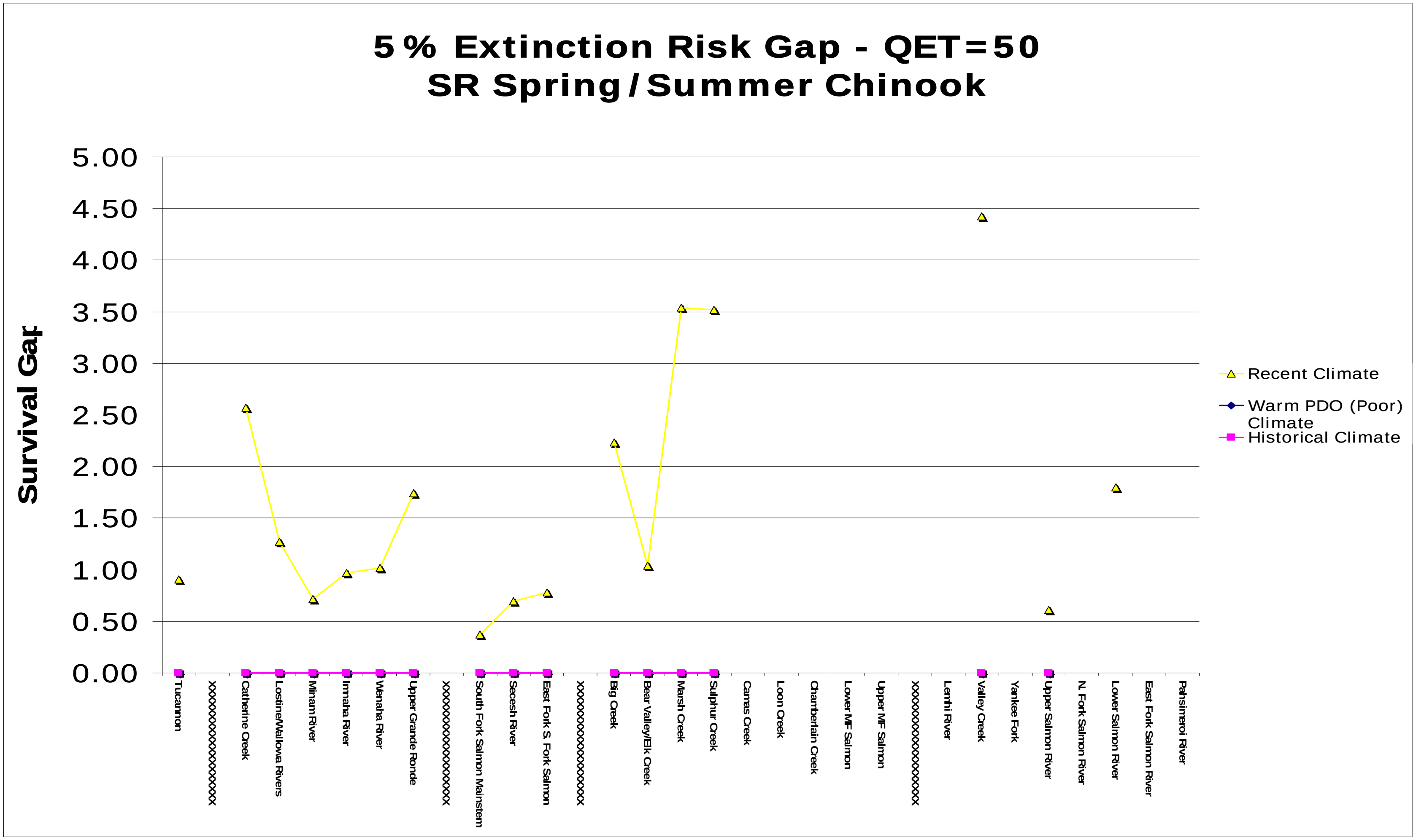
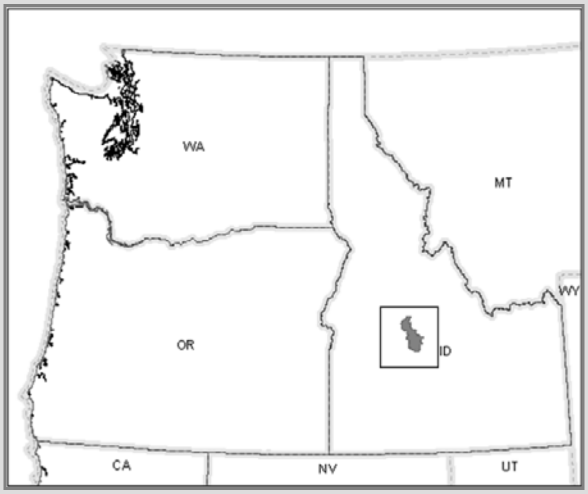
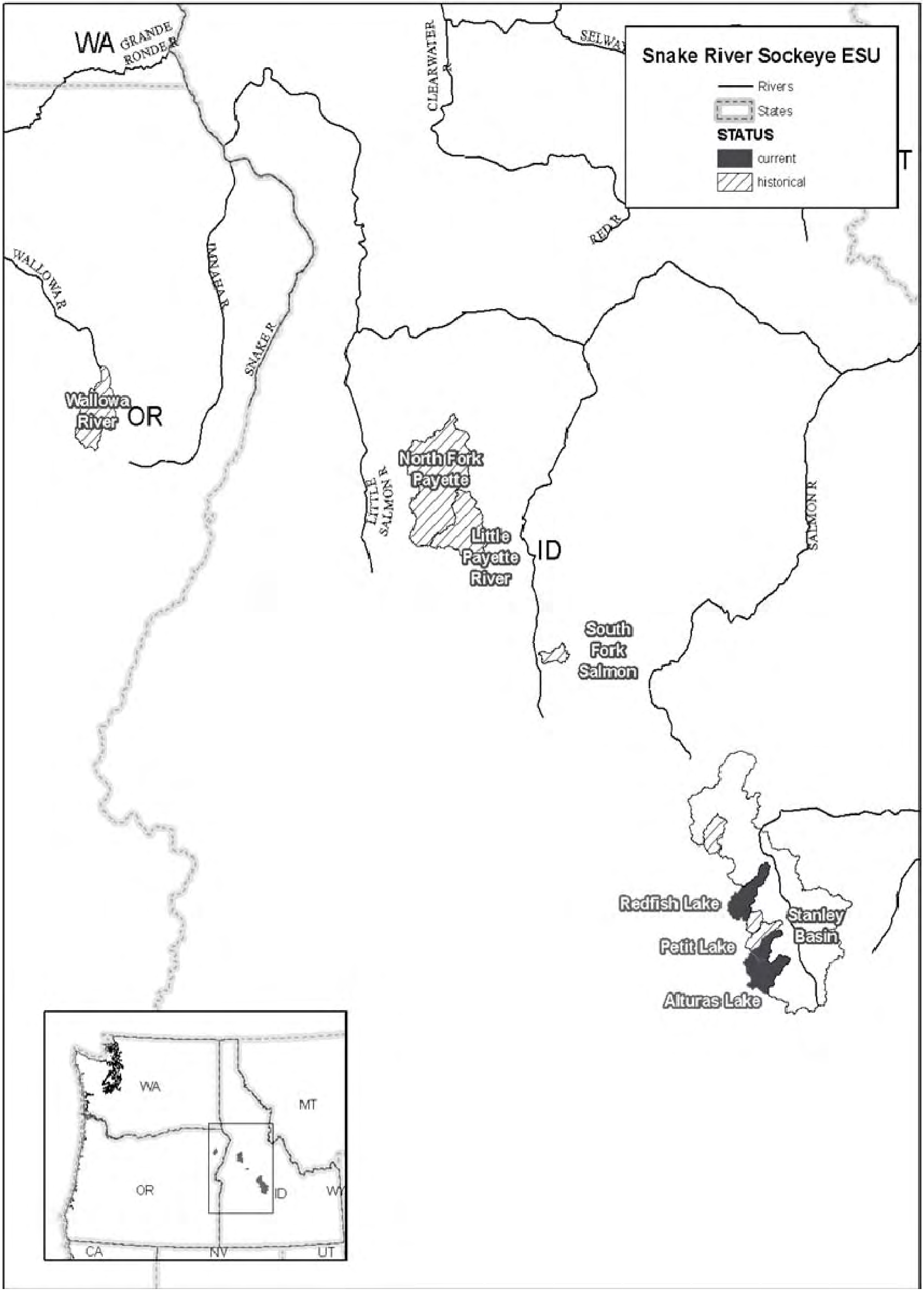


Figure 8.3.6-4. Summary of prospective 5% 24-year extinction risk gap estimates for SR spring/summer Chinook salmon under three climate assumptions.



Section 8.4
Snake River Sockeye Salmon




Snake River Sockeye ESU
Rivers
States
STATUS
current
historical
WA
GRANDE RONDE R
CLEARWATER R
SELWAY
RED R
WALLOWA R
IMNAHA R
SNAKE R
Wallowa River
OR
North Fork Payette
LITTLE SALMON R
Little Payette River
ID
SALMON R
South Fork Salmon
Redfish Lake
Stanley Basin
Petit Lake
Alturas Lake
WA
MT
OR
ID
CA
NV
UT

Section 8.4
Snake River Sockeye Salmon

Species Overview

Background

The Snake River (SR) sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. Sockeye salmon were historically numerous in many areas of the Snake River basin prior to the European westward expansion. However, intense commercial harvest of sockeye along with other salmon species beginning in the mid-1880s; the existence of Sunbeam Dam as a migration barrier between 1910 and the early 1930s; the eradication of sockeye from Sawtooth Valley lakes in the 1950s and 1960s; the development of mainstem hydropower projects on the lower Snake and Columbia Rivers in the 1970s and 1980s; and poor ocean conditions in 1977 through the late 1990s probably combined to reduce the stock to a very small remnant population. Snake River sockeye salmon are now found predominantly in a captive broodstock program associated with Redfish and the other Sawtooth Valley lakes. At the time of listing, one, one, and zero fish had returned to Redfish Lake in the three preceding years, respectively. The Snake River sockeye ESU was listed as endangered in 1991, reaffirmed in 2005.

The designated critical habitat for SR sockeye salmon includes all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks); Alturas Lake Creek; and that portion of Valley Creek between Stanley and Lake Creek and the Salmon River.

Current Status & Recent Trends

This species has a very high risk of extinction. Between 1991 and 1998, all 16 of the natural-origin adult sockeye salmon that returned to the weir at Redfish Lake were incorporated into the captive broodstock program. The program has used multiple rearing sites to minimize chances of catastrophic loss of broodstock and has produced several hundred thousand eggs and juveniles, as well as several hundred adults, for release into the wild. Between 1999 and 2007, more that 355 adults returned from the ocean from captive broodstock releases—almost 20 times the number of wild fish that returned in the 1990s. The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near-term. The Stanley Basin Sockeye Technical

Oversight Committee has determined that the next step toward meeting the goal of amplifying the wild population is to increase the number of smolts released.

Limiting Factors and Threats

By the time Snake River Sockeye were listed in 1991, the species had declined to the point that there was no longer a self-sustaining, naturally-spawning anadromous sockeye population. This has been the largest factor limiting the recovery of this ESU, important in terms of both risks due to catastrophic loss and potentially to genetic diversity. It is not yet clear whether the existing population retains sufficient genetic diversity to successfully adapt to the range of variable conditions that occur within its natural habitat. However, unpublished data from geneticists for the Stanley Basin Sockeye Technical Oversight Committee indicate that the captive broodstock has similar levels of haplotype diversity as other sockeye populations in the Pacific Northwest and that the program has been able to maintain rare alleles in the population over time. The broodstock program reduces the risk of domestication by using a spread-the-risk strategy, outplanting prespawning adults and fertilized eyed eggs as well as juveniles raised in the hatchery. The progeny of adults that spawn in the lakes and juveniles that hatch successfully from the eyed eggs are likely to have adapted to the lake environment rather than become “domesticated” to hatchery rearing conditions.

Recent Ocean and Mainstem Harvest

Few sockeye are caught in ocean fisheries. Ocean fishing mortality on Snake River Sockeye is assumed to be zero. Fisheries in the mainstem Columbia River that affect SR sockeye were managed subject to the terms of the *U.S. v. Oregon* Interim Management Agreement for 2005-2007. These fisheries were limited to ensure that the incidental take of ESA-listed SR sockeye does not exceed specified rates. Non-Treaty fisheries in the lower Columbia River were limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the run size of upriver sockeye stocks. Harvest rates have ranged from 0 to 0.95%, and 2.8 to 6.1% since 2001, respectively.

8.4.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.4.2.1 Current Rangewide Status of the Species

The Snake River (SR) sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program (Table 8.4.2.1-1). Sockeye salmon were historically numerous in many areas of the Snake River basin prior to the European westward expansion. However, intense commercial harvest of sockeye along with other salmon species beginning in the mid-1880s; the existence of Sunbeam Dam as a migration barrier between 1910 and the early 1930s; the eradication of sockeye from Sawtooth Valley lakes in the 1950s and 1960s; the development of mainstem hydropower projects on the lower Snake and Columbia Rivers in the 1970s and 1980s; and poor ocean conditions in 1977 through the late 1990s probably combined to reduce the stock to a very small remnant population. Snake River sockeye salmon are now found predominantly in a captive broodstock program associated with Redfish and the other Sawtooth Valley lakes (NMFS 1991a). At the time of listing, one, one, and zero fish had returned to Redfish Lake in the three preceding years, respectively.

Waples et al. (1997) examined the genetics of *0. nerka* from Sawtooth Valley lakes to determine whether the remnant population represented a distinct species or had been diluted by nonnative stocking during the 20th century. Sockeye salmon that returned to Redfish Lake during 1991 to 1993 were genetically distinct from Fishhook Creek kokanee, but were similar to juvenile sockeye outmigrants and a small group of "residual" sockeye salmon discovered in the lake in 1992.[1] This result supports the hypothesis that the original sockeye salmon population had not been extirpated. Populations of *0. nerka* that appear to be native have also been found in Alturas and Stanley lakes. Collectively, the native *0. nerka* from the Stanley Basin form a coherent group that is well separated genetically from all other populations of *0. nerka* in the Pacific Northwest. Therefore, although recent returns had been minimal, NOAA Fisheries' Biological Review Team recommended that the species be listed as Endangered under the ESA "to make a conservative decision in this circumstance" (Waples et al. 1991) and because the ESU might be restored using experimental hatchery programs.

Historically, adult SR sockeye salmon entered the Columbia River in June and July, migrated upstream through the Snake and Salmon rivers, and arrived at the Sawtooth Valley Lakes in August and September (Bjornn et al. 1968). Spawning in lakeshore gravels peaked in October. Fry emerged in late April and May and moved immediately to the open waters of the lake where they fed on plankton for one to three years before migrating to the ocean. Juvenile sockeye generally left the Sawtooth

[1] Residual sockeye salmon are progeny of anadromous or residual fish that remain in freshwater to mature and reproduce. The produce some anadromous offspring (Kline 1994). Residuals are genetically very similar to the anadromous for (Waples et al. 1997) and are ESA-listed along with the anadromous portion of the ESU.

Valley Lakes from late April through May and migrated nearly 900 miles to the Pacific Ocean. While pre-dam reports indicate that sockeye salmon smolts migrated through the lower Snake River in May and June, PIT-tagged smolts from Redfish Lake recently passed Lower Granite Dam during mid-May to mid-July. Snake River sockeye spend two to three years in the ocean before returning to their natal lake to spawn.

Table 8.4.2.1-1. Snake River sockeye ESU description. (Sources: NMFS 2005a ; ICTRT 2003; McClure et al. 2005; and Flagg 2007)

ESU Description	
Endangered	Listed under ESA in 1991, reaffirmed in 2005
	Population
	Anadromous sockeye salmon in the Snake River basin and residual sockeye in Redfish Lake [2]
Hatchery programs included in ESU	Captive Broodstock Program – at this time is divided between facilities at Sawtooth and Eagle ID, Burley Creek and Manchester WA, and Oxbow OR

Limiting Factors

By the time Snake River Sockeye were listed in 1991, the species had declined to the point that there was no longer a self-sustaining, naturally-spawning sockeye population. The absence of a functional natural population is the largest factor limiting the recovery of this ESU, important in terms of both risks due to catastrophic loss and potentially to genetic diversity. The population size issue will be directly addressed by the proposed action, which will result in roughly a 10-fold increase in the smolt releases from the current captive broodstock hatchery program. The captive broodstock program has succeeded in maintaining generations of sockeye that are derived from the remnants of the Redfish Lake population. It is now capable of expanding the number of fish produced in subsequent generations and the proposed action will result in the release of up to 1 million smolts per year, a level sufficient to seed Redfish Lake with natural spawners. However, even if the number of natural spawners is much larger, genetic diversity could remain as a significant limiting factor. Before intervention, Snake River Sockeye reached such low numbers that there has been concern that genetic bottlenecks have resulted. It is not yet clear whether the existing population retains sufficient genetic diversity to successfully adapt to the range of variable conditions that occur within its natural habitat. However, unpublished data from geneticists for the Stanley Basin Sockeye Technical Oversight Committee indicate that the captive broodstock has similar levels of haplotype diversity as other sockeye populations in the Pacific Northwest and that the program has been able to maintain rare alleles in the population over time (Flagg 2008). The broodstock program reduces the risk of domestication by using a spread-the-risk strategy, outplanting prespawning adults and fertilized eyed eggs as well as juveniles raised in the hatchery. The progeny of adults that spawn in the lakes and

[2] Progeny of Redfish Lake sockeye have been outplanted to Pettit and Alturas lakes. These fish and their descendants, including residual sockeye salmon in Pettit Lake, are also considered part of the ESU.

juveniles that hatch successfully from the eyed eggs are likely to have adapted to the lake environment rather than become "domesticated" to hatchery rearing conditions.

Mainstem Hydro

Compared to Snake River spring/summer Chinook salmon, there is relatively little route-specific information on the survival of SR sockeye salmon through the FCRPS. Reach survival estimates are imprecise because sample sizes of migrants from the Snake River are small. Williams et al. (2005) used detections of all PIT-tagged sockeye smolts (2000-2003) to the tailrace at Lower Granite Dam for annual estimates of survival between Lower Granite and McNary dams. In 2003, the estimated survival of sockeye smolts was 72.5%, similar to that of yearling Chinook salmon, but in 2000 through 2002, sockeye survival was considerably lower (23.9% to 56.0%). The reason is unclear, but sockeye salmon juveniles appear to be prone to descaling. Williams et al. 2005 reported that between 1990 and 2001, two adults returned from 478 juveniles transported and only one adult returned from 3,925 PIT-tagged fish that migrated in-river (SARs of 0.4% vs. 0.03%, respectively). As with Chinook salmon, most untagged sockeye salmon smolts were transported to below Bonneville Dam. Nonetheless, few adult sockeye salmon returned to Lower Granite Dam in the last decade. The Prospective Action of using the hatchery to increase smolt releases will also increase sample sizes and allow better estimates of juvenile survival through the FCRPS.

Habitat

Chapman and Witty (1993) reviewed the human influences that have resulted in the low numbers of sockeye salmon. Irrigation dams extirpated the anadromous sockeye runs to Wallowa and Payette lakes. Although the residual form of sockeye remains, irrigation withdrawals from Alturas Lake Creek severely reduced the anadromous sockeye salmon population in the watershed in the early 1900s. Sunbeam Dam blocked fish passage on the upper mainstem Salmon River beginning in 1910. Though a fish ladder was built at the dam in 1919, passage remained unlikely until the early 1930s. The IDFG eliminated sockeye from Pettit, Yellow Belly, and Stanley lakes during 1955 to 1965 to manage recreational fisheries for trout. At the time of the initial listing (NMFS 1991a), the greatest habitat problem faced by the ESU was probably the lack of access to any of the lakes but Redfish. The fish barriers on Alturas and Pettit Lake creeks (an irrigation intake and a concrete rough fish barrier, respectively) were modified to facilitate passage of anadromous sockeye into these historical habitats in the early 1990s (Teuscher and Taki 1996, cited in Flagg et al. 2004).

Although access to the spawning and rearing lakes is now considered functional, large portions of the migration corridor in the Salmon River (i.e., between Redfish Lake Creek and Yankee Fork Creek and between Thompson Creek and Squaw Creek) are water quality limited for temperature (IDEQ 2005), which is likely to reduce the survival of adult sockeye returning to the Stanley Basin in late July and August.

The USFS (USDA 2003) recommended the following site-specific measures to improve habitat conditions:

- Reduce lakeshore recreation pressure, particularly in shallow areas where sockeye spawn currently or historically

- Restore or maintain native vegetation that provides naturally resilient and productive shoreline habitats, through management of lakeside recreation and other human development

- Correct causes of listing Salmon River as water-quality limited (sediment and temperature) between the confluence of Redfish Lake Creek and that of Squaw Creek with the upper Salmon River.

The natural hydrological regime in the upper mainstem Salmon has been altered by water withdrawals. The Northwest Power and Conservation Council (NPCC 2004) made the following recommendation in its Salmon Subbasin Management Plan:

- Mimic the shape and timing of the natural hydrograph in the mainstem Salmon River between the East Fork confluence and the headwaters

The NPCC emphasized that the sustainability of base flows will require, in addition to improved water delivery, adequate water storage functions such as wetlands, functional riparian areas, side channels, groundwater recharge, etc. Otherwise, attempts to restore a normative hydrograph will result in more water leaving the system during peak flows and less water available during periods that are critical to sockeye salmon.

Harvest

Few sockeye are caught in ocean fisheries. Ocean fishing mortality on SR sockeye is assumed to be zero. Fisheries in the mainstem Columbia River that affect SR sockeye are currently managed subject to the terms of the *U.S. v. Oregon* Interim Management Agreement for 2005-2007. These fisheries are limited to ensure that the incidental take of ESA-listed SR sockeye does not exceed specified rates. Non-Indian fisheries in the lower Columbia River are limited to a harvest rate of 2%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7%, depending on the run size of upriver sockeye stocks. Actual harvest rates have ranged from 0 to 1.8%, and 2.8 to 7.0%, respectively.

Current Status of the ESU

Between 1991 and 1998, all 16 of the natural-origin adult sockeye salmon that returned to the weir at Redfish Lake were incorporated into the captive broodstock program. The program has used multiple rearing sites to minimize chances of catastrophic loss of broodstock and has produced several hundred thousand eggs and juveniles, as well as several hundred adults, for release into the wild. Between 1999 and 2007, more than 355 adults returned from the ocean from captive broodstock releases – almost 20 times the number of wild fish that returned in the 1990s (Flagg et al. 2004).[3] The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near-term. The Stanley Basin Sockeye Technical

[3] Some of these returning adults may have been anadromous progeny of residual sockeye.

Oversight Committee has determined that the next step toward meeting the goal of re-establishing and amplifying the wild population is to increase the number of smolts released.

8.4.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for SR sockeye salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks); Alturas Lake Creek; and that portion of Valley Creek between Stanley Lake Creek and the Salmon River (NMFS 1993). The lower Columbia River corridor is among the areas of high conservation value to the ESU 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 1993). Designation did not involve rating the conservation value of specific watersheds as was done in subsequent designations (NMFS 2005b). The status of critical habitat is discussed further in Section 8.4.3.

8.4.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.4.3.1 Recent Hydro Operations and Configuration Improvements

Changes in hydrosystem operations and configuration that have been implemented since 1998 have improved in-river conditions for SR sockeye based on rates of descaling and mortality [see Figures B-4 and B-5 in Martinson et al. 2007]. Changes have included the installation of surface bypass structures, minimum gap turbine runners, and spill deflectors; the relocation of bypass outfalls to avoid areas where predators collect; as well as other operational and structural changes (Appendix A in Corps et al. 2007b). Changes were designed to deflect fish from turbines and attract them to safer passage routes, increase the survival of juveniles that do use the turbine passage route, and reduce dissolved gas concentrations that might otherwise limit spill operations.

Despite these improvements, rates of descaling and mortality are still higher for sockeye than for other species (Martinson et al. 2007). The reasons for this difference are unknown. There are few empirical data on the route-specific survival and behavior of juvenile sockeye salmon under the recent operations and configuration of the FCRPS and Upper Snake Project. Studies with unlisted Upper Columbia River sockeye in the mid-Columbia reach have shown that juvenile sockeye migrate through the system faster than yearling or subyearling Chinook (Steig et al. 2006a, b, and 2007; Timko et al. 2007). In these studies, surface passage routes were similarly or slightly more effective for sockeye salmon than for yearling Chinook. However, data comparing two different surface passage configurations at Rocky Reach Dam indicated that sockeye were highly sensitive to the design and/or location of the surface passage entrance (Steig et al. 2003, 2006a). Because the design and configuration of entrances at the FERC-licensed dams in the mid-Columbia River differ from those at FCRPS projects, specific research is needed to develop strategies for safe passage through the latter.[4]

Based on data for other species of SR salmon and steelhead, recent modifications to FCRPS adult passage facilities, including increased reliability of water supply systems for fish ladders and improved ladder exit conditions to prevent injury and delay (Appendix A in Corps et al. 2007b), probably reduced mortality for this species. NOAA Fisheries estimates that the current survival rate of adult sockeye from Bonneville to Lower Granite dams is 81.1% (about 97.1% per project) based on an expansion of data for adult sockeye bound for Lake Wenatchee and the Okanogan River (SCA Adult Survival Estimates Appendix).

In addition to losses in the lower Columbia and Snake hydrosystem, both juvenile and adult sockeye are lost in the 462-mile migration corridor between Redfish Lake and Lower Granite Dam. Water withdrawals in the Upper Salmon River during juvenile migration are statistically related to decreased juvenile sockeye salmon survival through the reach (approximately a 20% reduction) (Arthaud et al. 2004). Of 614 adults that passed Lower Granite between 1999 and 2007, only 352 (57%) were recovered at Redfish Lake or the Sawtooth Hatchery weir (Kozakiewicz 2007). The factors responsible for these losses have not been established. However, the relatively large run size in 2000 provided an opportunity for a telemetry project to examine the migration behavior and survival of adult Snake River sockeye. Keefer et al. (2007) found that survival decreased as the season progressed and after July 13, none of the sockeye radio-tagged at Lower Granite Dam survived to the spawning grounds. The shift from relatively high survival of migrants that reached Lower Granite before mid-July to 100% loss coincided with the date that the Snake River at Anatone, Washington first reached 21 degrees C, indicating that elevated temperatures played an important role.

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[4] In 2007, the Chelan PUD released acoustic-tagged juvenile sockeye for evaluating the performance of its own systems. Because the ongoing passage study at McNary Dam uses the same technology, researchers obtained three-dimensional passage information (approach and passage behavior as well as fish passage and survival rates) for the fish marked by Chelan PUD. The USGS is currently working on these data and expects to publish preliminary findings by mid-summer (2008).

8.4.3.2 Recent Tributary Habitat Improvements

The Shoshone Bannock Tribes have been supplementing nitrogen and phosphorus and controlling non-native kokanee salmon competitors (i.e., for food resources) in the four Sawtooth Valley lakes (Redfish, Pettit, Alturas, and Stanley) since 1995. Based on water quality and biological sampling described in their annual reports (e.g., Kohler et al. 2007), these management strategies are increasing the carrying capacities of the lakes for rearing juvenile Snake River sockeye salmon. In part because Redfish and the other Sawtooth Valley lakes are naturally oligotrophic systems, nutrient supplementation has stimulated primary productivity and the development of a zooplankton community dominated by *Daphnia* spp. (Selbie et al. 2007). Juvenile *O. nerka* (anadromous and residualized sockeye) fed selectively on the large copepod *Daphnia* in Sawtooth Valley lakes during 2004 and 2006 (i.e., *Daphnia* made up a larger proportion of the diet than would be expected based on its availability in the water column), although the same pattern was not observed in 2005 (Kohler et al. 2005 and 2007, Taki et al. 2006). Also, limiting the number of female kokanee allowed to spawn in Redfish Lake has reduced grazing pressure on shared food resources.

8.4.3.3 Recent Estuary Habitat Improvements

For salmon that use a stream-type life-history strategy, restoration projects in the tidally influenced zone of the estuary between Bonneville Dam and approximately RM 40 are most likely to improve the functioning of the juvenile migration corridor. Projects that protect or restore riparian areas and breach or lower dikes and levees are likely to improve safe passage for this type of juvenile migrant. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

8.4.3.4 Recent Predator Management Improvements

Avian Predation

There are few quantitative data on rates of avian predation on SR sockeye salmon. Ryan et al. (2007) reported the numbers of PIT-tags from in-river juvenile migrants detected at Bonneville Dam and subsequently detected on estuarine bird colonies during 2006. Although the number of sockeye detected was very small compared to steelhead or Chinook, the study indicated that avian predators were consuming some Columbia basin (i.e., potentially Snake River) sockeye salmon. If so, then the Action Agencies' removal of the Caspian tern colony from Rice to East Sand Island in 1999 probably reduced predation rates on listed sockeye salmon to some small degree. PIT-tags from a few juvenile sockeye were also found on cormorant colonies in the estuary (Collis et al. 2001); this potential source of mortality has not been addressed.

Recently, Antolos et al. (2005) quantified predation on juvenile salmonids by Caspian terns nesting on Crescent Island (RM 316) in the mid-Columbia reach. Between 1,000 and 1,300 adult terns were associated with the colony during 2000 and 2001, respectively. These birds consumed approximately 465,000 juvenile salmonids in the first and approximately 679,000 in the second year. Based on PIT-tag recoveries at the colony, these were primarily steelhead from Upper Columbia River stocks. Less than 0.1% of the inriver migrating yearling Chinook from the Snake River and less than 1% of the yearling Chinook from the Upper Columbia were consumed. Presumably, a very small number of sockeye salmon, if any, were included in the "other salmonids" (i.e., not steelhead) category in the samples.

Piscivorous Fish Predation

Although predation of juvenile sockeye undoubtedly occurs, there is little direct evidence that piscivorous fish in the Columbia River consume juvenile sockeye salmon. Presumably, Zimmerman (1999) did not differentiate sockeye from "unidentified species" in the guts of pikeminnows, smallmouth bass, or walleye in the lower Snake and lower Columbia rivers because none or very few were identified. In contrast, Chinook were 29% of the prey of northern pikeminnows in lower Columbia reservoirs, 49% in the lower Snake River, and 64% downstream of Bonneville Dam. However, these observations are likely explained, in large part, by the fact that sockeye smolts make up a very small fraction of the overall number of migrating smolts (Ferguson 2006) in any given year.

8.4.3.5 Recent Hatchery Survival Improvements

The planting of fertilized eyed eggs and the release of prespawn adults for natural spawning has benefited the population through the production of unmarked smolts. Between 1991 and 1997, the number of unmarked smolts emigrating from Redfish Lake declined from levels in excess of 4,000 to only 300 individuals (IDFG 2006). No unmarked smolts were observed to emigrate from Pettit Lake until 1999, but since then, estimate that 23,000 unmarked smolts have done so. Approximately 26,000 unmarked smolts have emigrated from Redfish Lake since 1998. The IDFG estimates that in migration year 2005 alone, approximately 7,870 unmarked smolts out-migrated from Redfish Lake and 7,435 from Pettit Lake. The project sponsors are conducting genetic evaluations to confirm the origins of these fish, but hypothesize that most were derived from the prespawn adults released into Redfish Lake and the eyed-eggs planted in Pettit Lake.

8.4.3.6 Recent Harvest Rates

Non-Indian fisheries in the lower Columbia River are limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the run size of upriver sockeye stocks. Actual harvest rates over the last ten years have ranged from 0 to 0.9%, and 2.8 to 6.1%, respectively (TAC 2008, Table 15).

8.4.3.7 Status of Critical Habitat under the Environmental Baseline

A variety of human-caused and natural factors have contributed to the decline of SR sockeye salmon over the past century and have decreased the conservation value of essential features and PCEs of the species' designated critical habitat. Factors affecting the conservation value of critical habitat include passage barriers (especially high summer temperatures) in the mainstem lower Snake and Salmon rivers, passage mortality at the mainstem FCRPS dams, and high sediment loads in the upper reaches of the mainstem Salmon River. Factors affecting PCEs for spawning and rearing, juvenile and adult migration corridors are described below.

Spawning & Rearing Areas
Most of the historical spawning and rearing areas in Redfish, Pettit, and Alturas lakes lie within nearly pristine areas where habitat conditions are considered functional.

Juvenile & Adult Migration Corridors
Juvenile sockeye migrate from the Sawtooth Valley lakes during late April through May. PIT-tagged smolts from Redfish Lake recently passed Lower Granite Dam during mid-May to mid-July. Adult SR sockeye salmon entered the Columbia River in June and July and migrated upstream through the Snake and Salmon rivers, arriving at Redfish Lake in August and September. Key factors limiting the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile and adult passage mortality *[hydropower projects in the mainstem lower Snake and Columbia rivers]*

- Juvenile and adult mortality in the lower Snake River above Lower Granite Dam and in the mainstem Salmon River *[water withdrawals, temperature, and degraded riparian conditions]*

Areas for Growth & Development to Adulthood
Although SR sockeye probably spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.4.3.8 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the ESU and its designated critical habitat.

The USFS completed consultation on two projects—the Valley Road Fire (emergency consultation) and Whitebark Pine treatment in the Redfish Lake Creek watershed. The Federal Highway Administration (FHWA)/Idaho Department of Transportation (IDT) consulted on repairs at Buckhorn Bridge (Salmon River Mile Post 184).

Projects in Lower Columbia River, Estuary, and Coastal Waters

Federal agencies also completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.14.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

The effects of the habitat restoration projects and tar remediation in the lower Columbia River on the viability of the species will be positive. Other projects, including Whitebark Pine treatment, bridge repairs, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

The future federal projects that restore habitat in the lower river will have positive effects on water quality. The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

These actions, including those that are likely to have adverse short-term or even long-term adverse effects, were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat.

8.4.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho provided information on various ongoing and future or expected projects that NOAA Fisheries determined were reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin (see list of projects in Chapter 17 in Corps et al. 2007a). However, neither the State of Idaho nor NOAA Fisheries identified any habitat-related actions and programs by non-federal entities that were expected to benefit SR sockeye salmon.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.4.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the FCRPS and Upper Snake Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

The effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit on this species are included in the effects of the FCRPS, which is described in Section 8.4.5.1. See Chapter 10 of the FCRPS Biological Opinion for a discussion of this permit.

8.4.5.1 Effects of Hydro Operations & Configuration Prospective Actions

The Prospective Actions include a requirement that the Action Agencies assess the feasibility of using increased PIT-tagging for better estimates of juvenile smolt survival from Redfish Lake to Lower Granite Dam and through the mainstem FCRPS projects (RPA Action 52). This information is needed to optimize in-river passage and transport facilities for juvenile sockeye as well as for Chinook and steelhead. It will also help determine the specific actions that must be taken to address limiting factors in the mainstem Salmon River portion of the juvenile migration corridor.

Until better data are developed, NOAA Fisheries uses information developed for juvenile SR spring/summer Chinook as a surrogate for estimating the effects of the Prospective Actions in the mainstem migration corridor. Based on this information, the survival of juvenile sockeye is likely to increase with the implementation of surface passage routes at Little Goose, Lower Monumental, McNary and John Day dams in concert with training spill (amount and pattern) to provide safe egress (i.e., reduce delay and vulnerability to predators). Installing a long guide wall in The Dalles spillway tailrace will also improve egress conditions. Surface passage routes are designed to reduce juvenile travel time through the forebay of each project where predation rates are often the highest (Section 8.1.1.1). Additional benefits could pertain if faster migrating juveniles are in better condition (e.g., less stressed, greater energy reserves) upon reaching the Bonneville tailrace. Shifting the delivery of a portion of the USBR's flow augmentation water from summer to spring will slightly reduce travel time, susceptibility to predators, and stress.

Hydro Prospective Actions are likely to improve the survival of adult SR sockeye salmon between Bonneville and Lower Granite dams. These include improvements to the collection channel at The Dalles and to the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams and other improvements in section 5.3.3.1 in Corps et al. (2007a). Because temperatures in the Salmon River during late July and August are probably contributing to the loss of adult sockeye between Lower Granite Dam and the Stanley Basin (Section 8.4.3.1), the Prospective Actions also require that the Action Agencies work with appropriate parties to investigate feasibility and potentially develop a plan for ground transport of adult sockeye through this reach. If feasible, transport would provide a short-term solution while specific habitat problems are identified and addressed.

Some of the configuration changes, discussed above, correspond to ISAB recommendations to proactively address the effects of climate change. As described in Section 8.1.3, the installation of surface passage routes and other configuration improvements that reduce delay and exposure to predators also reduce exposure to warm temperatures in project forebays. The regulation of outflow temperatures at Dworshak Dam will reduce summer water temperatures at Lower Granite, and to increasingly lesser extent, at Little Goose, Lower Monumental, and Ice Harbor dams.

Effects on Species Status

The survival of both juvenile and adult SR sockeye is expected to increase under the Prospective Actions due to improvements in the mainstem migration corridor, contributing to increased adult returns to the broodstock program and to the Sawtooth Valley lakes.

Effects on Critical Habitat

The hydro Prospective Actions are expected to increase the functioning of safe passage in the juvenile and adult migration corridors. To the extent that these improvements increase the number of adults returning to spawning areas, the hydro Prospective Actions could improve water quality and forage for juveniles by increasing the return of marine derived nutrients to spawning and rearing areas (Section 8.4.3.2)

8.4.5.2 Effects of Tributary Habitat Prospective Actions

The tributary habitat Prospective Actions do not include specific projects that will improve tributary habitat used by Snake River sockeye. However, the Action Agencies will undertake a study of possible sources and locations of mortality of juvenile sockeye before they reach the Snake River as described above (Section 8.4.5.1). As sockeye smolt production increases (Section 8.4.5.5), the Action Agencies will develop habitat projects to support natural production (Appendix B.2.2 in Corps et al. 2007b).

8.4.5.3 Effects of Estuary Prospective Actions

Juvenile sockeye rear in the natal lakes for one to three years before migrating to the ocean, a stream-type life history. Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM40, restoring riparian function and access to the floodplain (see Section 5.3.3.3 in Corps et al. 2007a), are likely to improve the survival of juvenile Snake River sockeye.

Effects on Species Status

Restoration projects that are placed along the estuary corridor, with an emphasis on the upper portion of the estuary nearest to Bonneville Dam, are most likely to have a positive influence on life history diversity and spatial structure (Fresh et al 2005).

Effects on Critical Habitat

The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the conservation value of the estuary as critical habitat for this species (section 5.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time.

8.4.5.4 Effects of Predation Prospective Actions

Avian Predation

The Prospective Actions include relocating most of the Caspian terns to sites outside the Columbia basin (RPA Action 54). While this will be beneficial, the available evidence does not indicate that significant numbers of sockeye smolts have fallen prey to Caspian terns. Continued implementation and improvement of avian deterrence at mainstem dams (RPA Action 48) is also likely to increase juvenile sockeye survival by a small amount.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous Fish Predation

There is little evidence that piscivorous fish in the Columbia basin prey on juvenile sockeye salmon (see discussion in Section 8.4.3.4). The best information currently available indicates that continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) is not likely to address a limiting factor for this species. Therefore, only a small increase in survival (safe passage in the juvenile migration corridor) is likely to result from decreased predation rates.

Effects on Species Status
The predation Prospective Actions are likely to have small positive effects on the survival of juvenile sockeye salmon.

Effects on Critical Habitat
Small positive effects on survival will correspond to a small improvement in the functioning of safe passage in the juvenile migration corridor.

8.4.5.5 Effects of Hatchery Prospective Actions

The Prospective Actions include two hatchery actions that are expected to benefit Snake River sockeye:

- Continue to fund the safety-net program to achieve the interim goal of annual releases of 150,000 smolts while also continuing to implement other release strategies in nursery lakes, such as fry and parr releases, eyed-egg incubation boxes, and adult releases for volitional spawning

- Fund further expansion of the sockeye program to increase total smolt releases to between 500,000 and 1 million fish

Expanding the number of smolts released is the program's next step toward meeting the goal of amplifying the wild population. The Action Agencies will also continue to fund the other release strategies used to date, because using multiple methods increases the likelihood of success.

Effects on Species Status
The continuing and the expanded smolt releases are expected to result in an increase in the abundance and productivity of the naturally-spawning population.

Effects on Critical Habitat
The smolt releases are not expected to affect PCEs in designated critical habitat.

8.4.5.6 Effects of Harvest Prospective Actions

Management provisions for sockeye in the 2008 *U.S. v. Oregon* agreement have not changed from those in the prior agreement. Non-Indian fisheries in the lower Columbia River will be limited to a harvest rate of 1% and Treaty Indian fisheries to 5 to 7%, depending on the run size of upriver sockeye stocks (Table 8.4.5.6-1)

Table 8.4.5.6-1. Sockeye Harvest Rate Schedule.

River Mouth Sockeye Run Size	Treaty Harvest Rate	Non-Treaty Harvest Rate	Total Harvest Rate
< 50,000	5%	1%	6%
50,000 -75,000	7%	1%	8%
> 75,000	7% *	1%	8 % *

*If the upriver sockeye run size is projected to exceed 75,000 adults over Bonneville Dam, any party may propose harvest rates exceeding those specified in Part II.C.2. or Part II.C.3. of the 2008-2017 Management Agreement. The parties shall then prepare a revised biological assessment of proposed Columbia River fishery impacts on ESA-listed sockeye and shall submit it to NMFS for consultation under Section 7 of the ESA.

Effects on Species Status

The Prospective harvest rates will continue to have a small negative effect on the numbers of Snake River sockeye returning to the captive broodstock program and to spawn naturally in the Sawtooth Valley lakes.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas.

8.4.5.7 Research, Monitoring & Evaluation Prospective Actions

Please see Section 8.1.4 of this document.

8.4.6 Aggregate Effect of the Environmental Baseline, Prospective Actions, and Cumulative Effects on Snake River Sockeye

This section summarizes the basis for conclusions at the ESU level.

8.4.6.1 Recent Status of the Snake River Sockeye ESU & Critical Habitat

The Snake River sockeye salmon ESU is comprised of a single MPG and single population spawning and rearing in Redfish, Pettit, and Alturas lakes in the Sawtooth Valley, and includes artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. This population is the last remaining in a group of what were likely to have been independent populations occupying the Sawtooth Valley lakes. The Interior Columbia Basin TRT has designated this species at very high risk. The extremely low number of natural spawners and reliance on a captive Broodstock Program implemented in 1992 illustrates the high degree of risk faced by this population.

Recent annual abundances of natural-origin sockeye salmon to the Stanley Basin have been extremely low. Although residual sockeye salmon have been identified in Redfish and Pettit lakes, the abundance of the ESU is supported by adults produced through the captive propagation program. Recently, the smolt-to-adult survival of sockeye originating from the Sawtooth Valley lakes rarely has been greater than 0.3%. The current average productivity is substantially less than the productivity required for any population to be at Low (1-5%) long-term extinction risk at the minimum abundance threshold. Based on current abundance and productivity information, the Snake River sockeye salmon ESU does not meet the viability criteria for non-negligible risk of extinction over 100-year time period. Short-term extinction risk has been reduced by the captive propagation program; between 1999 and 2007, more than 355 adults returned from the ocean from captive broodstock releases – almost 20 times the number of wild fish that returned in the 1990s. The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near-term.

Ocean fishing mortality on Snake River sockeye is assumed to be zero. Non-Indian fisheries in the lower Columbia River are limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the run size of upriver sockeye stocks. Actual harvest rates over the last ten years have ranged from 0 to 0.9%, and 2.8 to 6.1%, respectively.

A draft recovery plan containing strategies to address remaining key limiting factors is expected to be completed later in 2008. Given the extremely low levels of Snake River sockeye returns, initial recovery efforts are largely focused on improving survival rates of out-migrant smolts. The Stanley Basin Sockeye Technical Oversight Committee has determined that the next step toward meeting the goal of amplifying the wild population is to increase the number of smolts released.

The major factors limiting the conservation value of critical habitat for Snake River sockeye are the effects on the migration corridor posed by the mainstem lower Snake and Columbia River hydropower system, reduced tributary stream flows and high temperatures experienced by outmigrating smolts and returning adults, and barriers to tributary migration. The Sawtooth Valley lakes lie within nearly pristine areas. The production capacity of these naturally oligotrophic systems is low, but nutrient supplementation in recent years has stimulated primary productivity and the development of a favorable zooplankton forage community. Non-native kokanee salmon directly compete for zooplankton forage in most Sawtooth Valley lakes. Ocean conditions that have affected the status of this ESU generally have been poor since 1977, improving only in the last few years.

8.4.6.2 Effects of the Prospective Actions on Snake River Sockeye & Critical Habitat

Extinction of this ESU has been prevented and the prospects for survival and recovery now depend on expanding the existing safety-net program and increasing juvenile and adult survival. The Prospective Actions are expected to result in an approximately 10-fold increase in the number of sockeye produced by the captive broodstock program, greatly increasing the number of sockeye released to the wild, and thereby increasing the likelihood of higher adult returns. The Action Agencies will continue to fund the existing broodstock program including the continued releases of 150,000 fry and parr, outplanting of eyed-egg incubation boxes, and releases of adults for volitional spawning.

The Prospective Actions include configuration changes at FCRPS dams that are likely to improve the survival of juvenile and adult sockeye salmon, although more species-specific data are needed to ensure that conditions are optimized for this species as well as Chinook and steelhead. The Prospective Actions therefore require that the Action Agencies assess the feasibility of PIT-tag marking smolts for tracking survival of this species through the FCRPS. They will also work with appropriate parties to investigate feasibility and potentially develop a plan for ground transport of adult sockeye from Lower Granite Dam to Redfish Lake to circumvent the habitat problems that are causing losses until they can be addressed.

Management provisions for sockeye in the 2008 Agreement have not changed from those in the prior *U.S. v. Oregon* Agreement. Actual harvest rates over the last ten years have ranged from 0 to 0.9% for the non-Indian and 2.8 to 6.1% for the Treaty Indian fisheries, respectively (Section 8.4.3.6).

In aggregate, the prospective actions are expected to improve the survival of juveniles and adults through the mainstem Salmon and FCRPS migration corridors (safe passage) and together with the expanded smolt release program to increase the likelihood of higher adult returns.

8.4.6.3 Cumulative Effects Relevant to the Snake River Sockeye ESU

The State of Idaho did not identify any habitat-related actions and programs in the action area by non-Federal entities that are expected to address low flows and high temperature in the mainstem Salmon River. The cumulative effects of water withdrawals and land use practices that degrade riparian conditions are likely to continue the significant adverse effects of similar past activities that contributed to the environmental baseline for this ESU.

8.4.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Sockeye Salmon ESU

The aggregate effect of the environmental baseline, the Prospective Actions, and cumulative effects will be an improvement in the viability of SR sockeye salmon. Some limiting factors will be addressed by improvements to mainstem hydrosystem passage. The installation of surface passage routes and other configuration changes that will reduce delay and exposure to predators and warm temperatures in forebays, controlling summer water temperatures at Lower Granite by regulating outflow temperatures at Dworshak Dam, also correspond to ISAB recommendations to proactively address the effects of climate change (Section 8.1.3). However, based on an evaluation of future Federal actions that have completed Section 7 consultation and cumulative effects, conditions in the Salmon River portion of the juvenile and adult migration corridors are not expected to improve. If it is feasible to trap adults at Lower Granite Dam and haul them to the Sawtooth Valley, the adverse effects of low flows and high temperatures in the mainstem Salmon can be avoided, at least for this life stage. Management provisions for sockeye in the 2008 Agreement are unchanged from those in the prior *U.S. v. Oregon* Agreement and actual harvest rates are likely to be less than those allowed, as in previous years. Taking into account the obstacles faced, the Prospective Actions provide for the survival of the species with an adequate potential for recovery.

8.4.6.5 Effect of Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

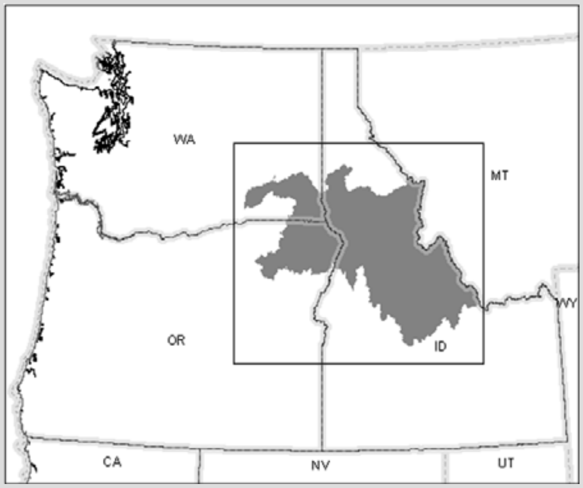
NOAA Fisheries designated critical habitat for SR sockeye salmon including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes; Alturas Lake Creek; and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. The environmental baseline within the action area, which encompasses these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR sockeye salmon. The major factors currently limiting the conservation value of critical habitat are juvenile and adult mortality at mainstem hydro projects in the lower Snake and Columbia rivers and water withdrawals, temperature, and degraded riparian conditions in the lower Snake River above Lower Granite Dam, and in the mainstem Salmon River.

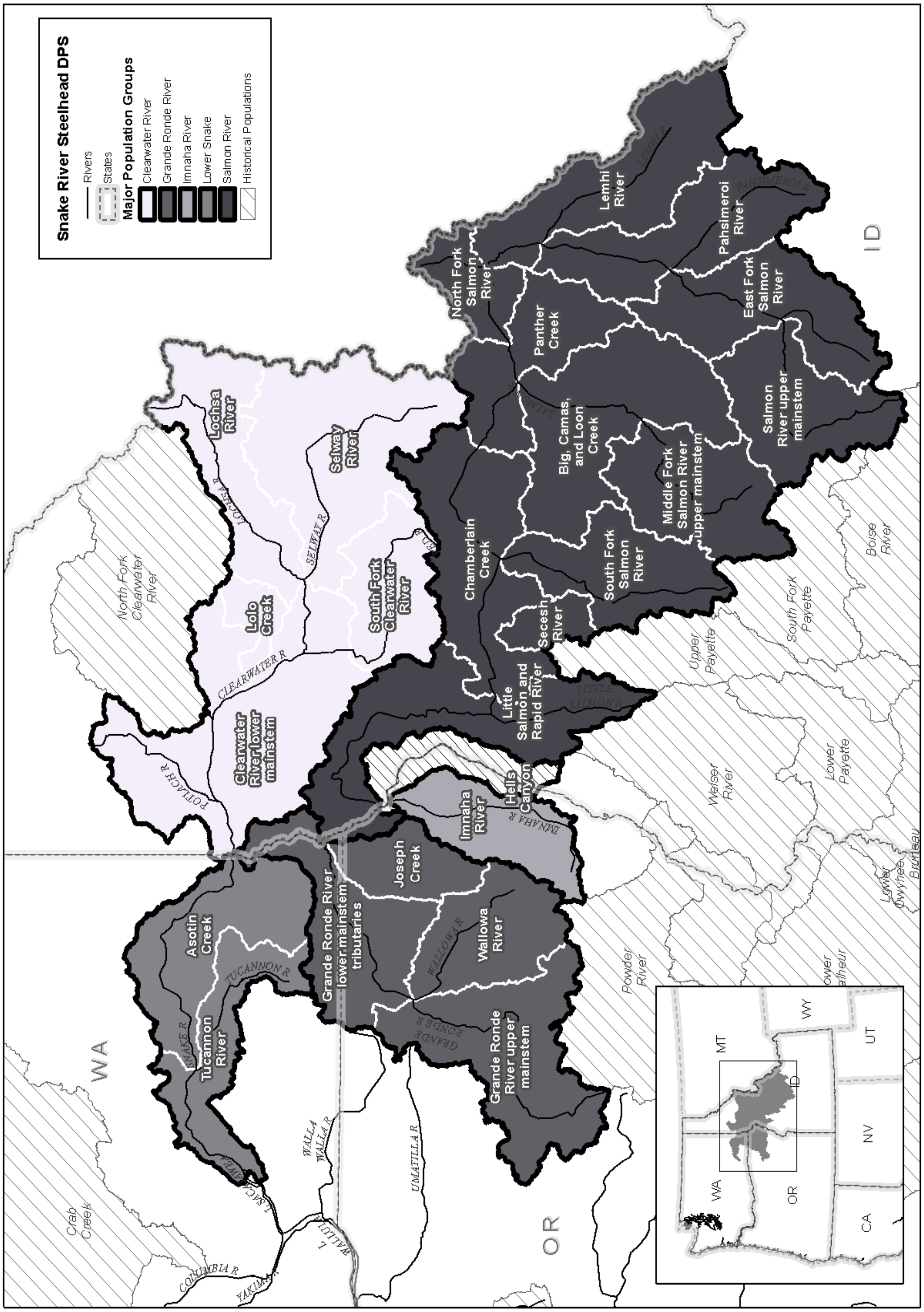
Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Habitat work in the mainstem Salmon River and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement, including the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River Sockeye ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Snake River Sockeye ESU nor result in the destruction or adverse modification of its designated critical habitat.

Section 8.5
Snake River Steelhead




Snake River Steelhead DPS
Rivers
States
Major Population Groups
Clearwater River
Grande Ronde River
Imnaha River
Lower Snake
Salmon River
Historical Populations
Lemhi River
Pahsimeroi River
North Fork Salmon River
East Fork Salmon River
Panther Creek
Salmon River upper mainstem
Big, Camas, and Loon Creek
Middle Fork Salmon River upper mainstem
Chamberlain Creek
South Fork Salmon River
Secesh River
Little Salmon and Rapid River
Hells Canyon
Lochsa River
Selway River
Lolo Creek
South Fork Clearwater River
North Fork Clearwater River
Clearwater River lower mainstem
Imnaha River
Joseph Creek
Grande Ronde River lower mainstem tributaries
Wallowa River
Grande Ronde River upper mainstem
Asotin Creek
Tucannon River
Upper Payette
South Fork Payette
Boise River
Weiser River
Lower Payette
Powder River
Crab Creek
WA
OR
ID
MT
WY
UT
NV
CA

Section 8.5
Snake River Steelhead

Species Overview

Background

The Snake River (SR) steelhead DPS includes all anadromous populations that spawn and rear in the mainstem Snake River and its tributaries between Ice Harbor and the Hells Canyon hydro complex. There are five major population groups with 24 populations. Inland steelhead in the Columbia River Basin are commonly referred to as either A-run or B-run, based on migration timing and differences in age and size at return. A-run steelhead are believed to occur throughout the steelhead streams in the Snake River Basin, and B-run are thought to produce only in the Clearwater and Salmon rivers. This DPS was listed under the ESA as threatened in 1997, reaffirmed in 2006.

Designated critical habitat for SR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in a number of tributary subbasins.

Current Status & Recent Trends

The abundance of SR steelhead has been stable or increasing for most A-run and B-run populations during the last 20 brood cycles. On average, the natural-origin components of the A-run populations have replaced themselves whereas the natural-origin components of the B-run populations have not.

Limiting Factors and Threats

Limiting factors identify the most important biological requirements of the species. Historically, the key limiting factors for the Snake River steelhead include hydropower projects, predation, harvest, hatchery effects, and tributary habitat. Ocean conditions have also affected the status of this DPS. These generally have been poor over at least the last 20 years, improving only in the last few years.

Recent Ocean and Mainstem Harvest

Few steelhead are caught in ocean fisheries. Ocean fishing mortality on Snake River steelhead is assumed to be zero. Fisheries in the Columbia River were limited to ensure that the incidental take of ESA-listed Snake River steelhead does not exceed specified rates. Non-Indian fisheries were subject to a year-round 2% harvest rate limit on A-run and a 2% harvest rate limit for B-run steelhead. Treaty Indian fall season fisheries were subject to a 15% harvest rate limit on B-run steelhead. Incidental harvest rate limits on B-run steelhead, in particular, have reduced access to harvestable stocks in fall season fisheries. Recent harvest rates on Snake River steelhead have generally been lower than what is allowed. The recent harvest rates on A-run steelhead in non-Indian and treaty Indian fisheries range from 1.0% to 1.9%, and 4.1% to 12.4%, respectively. The recent harvest rates on B-run steelhead in non-Treaty and treaty Indian fisheries range from 1.1% to 2.0%, and 3.3% to 15.6%, respectively.

8.5.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is the scientific analysis of the species' status, which forms the basis for the listing of the species as endangered or threatened.

8.5.2.1 Current Rangewide Status of the Species

SR steelhead is a threatened species composed of 24 extant anadromous populations in five major population groups (MPG). Steelhead are anadromous form of rainbow trout, which are not listed. All populations in this DPS return in the summer and are therefore referred to as "summer-run" in contrast to "winter-run" steelhead in some other DPSs. Key statistics associated with the current status of SR steelhead are summarized in Tables 8.5.2-1 through 8.5.2-4.

Limiting Factors and Threats

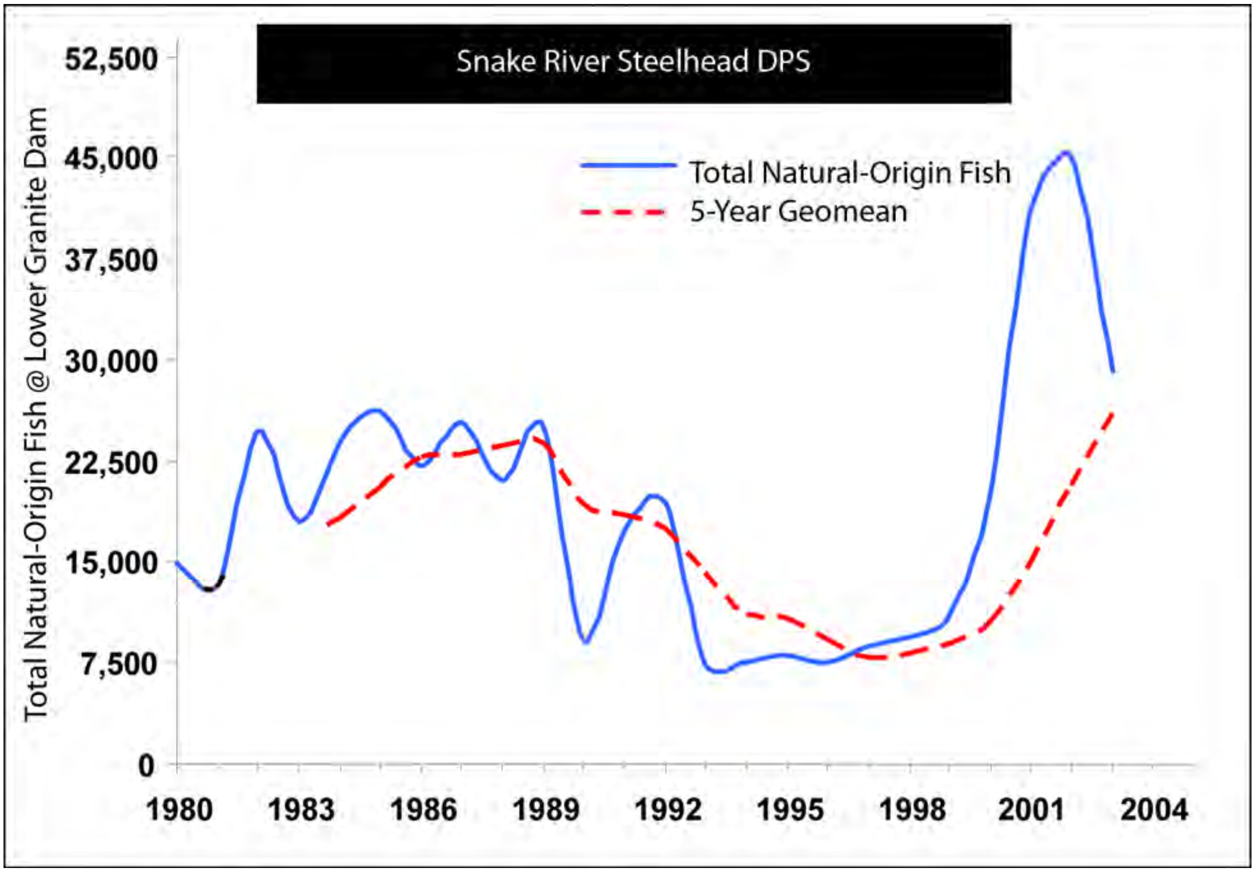
The key limiting factors and threats for Snake River steelhead include hydropower projects, predation, harvest, hatchery effects, and tributary habitat. Ocean conditions generally have been poor for this DPS over the last 20 years (at least), improving only in the last few years. Limiting factors are discussed in more detail in the context of critical habitat in Section 8.5.3.3.

Abundance

Population-specific adult population abundance is generally not available for SR steelhead due to difficulties conducting surveys in much of their range. To supplement the few population-specific estimates, the ICTRT used Lower Granite Dam counts of A-run and B-run steelhead and apportioned those to A- and B-run populations proportional to intrinsic potential habitat (Appendix A of ICTRT 2007c). The ICTRT generated 10-year geometric mean abundance estimates for two populations in the Grande Ronde MPG and reported average A-run and average B-run abundance as an indicator for the other populations. For the two Grande Ronde MPG populations, one recent average abundance exceeds the ICTRT abundance threshold and the second is below the threshold (Table 8.5.2-1). Both the A- and B-run averages are below the average abundance thresholds that the ICTRT identifies as a minimum for low risk. Abundance for Grande Ronde populations, and the average A- and B-run populations, declined to low levels in the mid-1990s, increased to levels at or above the recovery ICTRT abundance thresholds in a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 8.5.2.1-1, showing annual abundance of combined populations).

Figure 8.5.2.1-1 shows the 1980 to most recent abundance and 5-year geometric mean trends for the aggregate of all populations above Lower Granite Dam. The 5-year geometric mean increased from 1980, peaking in 1989 and decreasing throughout the 1990s. Aggregate abundance of natural-origin fish peaked in 2002 and the 5-year geometric mean has been increasing since 2000.

Figure 8.5.2.1-1. Snake River Steelhead DPS Abundance and 5-Year Geometric Mean (adopted from Fisher and Hinrichsen 2006)



"Base Period" Productivity

On average over the last 20 full brood year returns (~1980-1999 brood years [BY], including adult returns through ~2004), A-run SR steelhead populations replaced themselves (Table 8.5.2-1) when only natural production is considered (i.e., average R/S has been ≥1.0), while B-run steelhead have not. In order to ensure that the distribution of productivity estimates among MPGs is clearly stated, Table 8.5.2-1 displays the average A- and B-run SR steelhead productivities applied to each individual population. In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries [ICTRT 2007d], updated with Cooney [2008a]).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at ≤5% extinction risk for average A-run and average B-run populations (intrinsic productivity estimates in ICTRT 2007c). However, of the two individual Grande Ronde populations with sufficient data for estimates, one had sufficient intrinsic productivity to meet the ICTRT viability criteria (Joseph Creek) and the other (Upper Grande Ronde) did not.

The base period trend in abundance has been stable or increasing (Table 8.5.2-1) for both A-run and B-run populations, as indicated by median population growth rate (lambda) and BRT trend. The one exception is the Upper Grande Ronde population, which has lambda less than 1.0 (0.99) when estimated under the assumption that effectiveness of hatchery-origin and natural-origin spawners is equal (HF=1).

In summary, abundance has been stable or increasing for A-run SR steelhead over the last 20 brood years, based on R/S, lambda, and BRT trend estimates >1.0. An exception is the Upper Grande Ronde population under one assumption for lambda. For B-run SR steelhead populations, natural survival rates are not sufficient for spawners to replace themselves each generation, as indicated by average R/S estimates <1.0, but abundance has been increasing, as indicated by lambda and BRT trend.

Spatial Structure

The ICTRT characterizes the spatial structure risk of nearly all SR steelhead populations as “very low” or “low” (Table 8.5.2-2). Panther Creek is an exception with “high” risk because only 30% of the historical range is occupied and there is a significant geographical distance between the single major spawning area for this population and the location of the next population. This is largely a result of past mining operations, which are being addressed through other processes, including the EPA Blackbird Mine Superfund Site clean-up.

Diversity

The ICTRT characterizes the diversity risk of all SR steelhead populations as “low” or “moderate” (Table 8.5.2-2).

“Base Period” Extinction Risk

Draft ICTRT Current Status Summaries (ICTRT 2007d) characterize the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the “base period” described above for R/S productivity estimates, as “High” (>25% 100-year extinction risk) for all B-run populations and three A-run populations (Tucannon, Asotin, and Chamberlain Creek). The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50). Most A-run populations are characterized as having “moderate” risk (6-25% 100-year extinction risk). One population (Joseph Creek) is characterized as having a “low” risk of long-term extinction (<5% risk).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. It is not possible to evaluate short-term extinction risk for most individual populations or for average B-run populations. Table 8.5.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for average A-run populations, average B-run populations, and two individual A-run populations in the Grande Ronde MPG with sufficient data for estimates (Upper Mainstem and Joseph Creek). Short-term extinction risk is zero for the two Grande Ronde populations, 5% for average B-run populations, and >5% for average A-run populations at

QET=50. Risk is also >5% for average A-run populations at other QETs above 1.0. In order to display the distribution of extinction risk among MPGs, Table 8.5.2-3 applies the average A- and B-run extinction risk estimates to individual A- and B-run populations. This short-term extinction risk analysis is also based on the assumption that productivity observed during the "base period" will be unchanged in the future.

Quantitative Survival Gaps

The change in density-independent survival that would be necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.5.2-4. Mean base period R/S survival gaps range from no needed change for average A-run populations to approximately 25% needed survival improvements for average B-run populations. It is not possible to estimate survival changes necessary to reduce short-term extinction risk to ≤5%, as described in Chapter 7.1 and the Aggregate Analysis Appendix.

8.5.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for SR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in the following subbasins: Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grande Ronde River, Wallowa River, Lower Grande Ronde, Lower Snake/Tucannon, Lower Snake River, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon-Chamberlain, South Fork Salmon, Lower Salmon, Little Salmon, Upper Selway, Lower Selway, Lochsa, Middle Fork Clearwater, South Fork Clearwater, and Clearwater (NMFS 2005b). There are 289 watersheds within the range of this DPS. Fourteen watersheds received a low rating (see Chapter 4 for further detail), 44 received a medium rating, and 231 received a high rating of conservation value to the DPS. The lower Snake/Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified above. This corridor 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. Of the 8,225 miles of habitat areas eligible for designation, 8,049 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.5.3.3.

8.5.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.5.3.1 "Current" Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk are based on performance of populations during a 20-year "base period," ending with the 1999 brood year for average A-run steelhead and 1998 brood year for average B-run steelhead. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, Table 8.5.3-1 includes estimates of a "base-to-current" survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7 of this document. Results are presented in Table 8.5.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately 4% higher survival for both A-run and B-run populations [SCA Quantitative Analysis of Harvest Actions Appendix, based on U.S. v. Oregon estimates]) and estuary habitat projects (less than a 1% survival change, based on CA Appendix D) result in a survival improvement for all SR steelhead populations. Tributary habitat projects result in up to 8.5% survival improvements for specific populations within the DPS (CA Chapter 7, Table 7-6). In contrast, changes in collector dam configurations and transportation timing to benefit other listed species results in a 3% reduction for FCRPS survival, (based on ICTRT base survival and COMPASS analysis of current survival in the SCA Hydro Modeling Appendix) and development of tern colonies in the estuary results in less than a 1% reduction in survival for all populations. There are 16 hatchery programs for Snake River steelhead that operate as partial mitigation for impacts from FCRPS and Hells Canyon dams (Hatchery Effects Appendix). Ten of these hatchery programs, and the vast majority all steelhead hatchery production, operate to make up for lost natural production from hydro impacts. Six steelhead hatchery programs (four A-run and two B-run) add to or supplement natural spawning. These supplementation programs preserve genetic resources, but there is no analysis to show that they have increased natural-origin fish survival.

The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 0-9%, depending on the particular population (Table 8.5.3-1). This also means that the survival "gaps," described in Table 8.5.2-4, would be proportionately reduced by this amount (i.e., ["Gap" ÷ 1.00] to ["Gap" ÷ 1.09], depending on the population).

8.5.3.2 Abundance, Spatial Structure, & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.5.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as affecting the conservation value of designated critical habitat. The condition of PCEs in spawning and rearing areas and juvenile and adult migration corridors are described below.

Spawning and Rearing Areas

This species spawns in tributaries to the Snake River in southeast Washington, northeast Oregon, and Idaho. Adults enter fresh water from June to October and spawn the following spring from March to June (Thurow 1987). Emergence occurs by early June in low elevation streams and as late as mid-July at higher elevations. Snake River steelhead usually rear in the natal tributaries for two to three years before beginning their seaward migration.

The following are the major factors that limit the functioning and thus the conservation value of habitat used by SR steelhead for these purposes (i.e., spawning and juvenile rearing areas with spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Degraded tributary channel morphology *[bank hardening for roads or other development; livestock on soft riparian soils and streambanks]*

- Physical passage barriers *[culverts; pushup dams; low flows]*

- Excess sediment in gravel *[roads; agricultural and silvicultural practices; livestock on soft riparian soils and streambanks; recreation]*

- Degraded riparian condition *[grazing]*

- Reduced tributary stream flow, which limits usable stream area and alters channel morphology by reducing the likelihood of scouring flows *[water withdrawals]*

- Degraded tributary water quality including elevated summer temperatures *[water withdrawals; groundwater depletion; degraded riparian condition]*

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors and threats for this DPS in spawning and rearing areas. Some projects provided immediate benefits and some will result in long-term benefits with survival improvements accruing into the future. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving mainstem and channel habitat, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with improvements in PCE function accruing into the future.

Juvenile and Adult Migration Corridors

Factors limiting the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers *[push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles]*
- Juvenile and adult passage mortality *[hydropower projects in the mainstem lower Snake and Columbia rivers]*
- Temperature barriers *[timing of adult entry into and migration through the lower Snake River in late summer and early fall is delayed because of elevated mainstem temperatures]*
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators *[Caspian terns and double-crested cormorants]*

In the mainstem FCRPS corridor, the Action Agencies have improved safe passage for juvenile steelhead with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements listed in section 7.3.1.1 in Corps et al. (2007a). The safe passage of juvenile steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For steelhead, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 7.3.1.3 in Corps et al. 2007a).

Areas for Growth and Development to Adulthood

Although SR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River (NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.5.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Lower Snake MPG

Both of the populations within this MPG were affected by several projects, as described below.

Tucannon River

The USFS consulted on one emergency fire action and two fire salvage/timber sale projects in the Upper Tucannon watershed. The Corps proposed maintenance dredging of a barge slip at the mouth of the Snake River.

Asotin Creek

The BPA consulted on replacing a wood pole transmission line. The FHWA/WSDOT consulted on a project to replace a bridge, removing a channel constriction and thereby increase safe passage.

Grande Ronde River MPG

No Section 7 consultations were completed in the subject timeframe that would affect the Wallowa River population. Projects that affected other populations in this MPG are described below.

Grande Ronde Lower Mainstem

The USFS consulted on two projects in the Grande Ronde River—Mud Creek watershed, construction of an off-highway vehicle (OHV) trail system and a fire salvage timber sale. The USFS also consulted on two habitat restoration projects that were designed to improve conditions in the Grande Ronde River—Mud Creek, Chesnimnus Creek and Upper and Lower Joseph Creek watersheds. In one project, the USFS proposed to plant vegetation in Riparian Habitat Conservation Areas, develop offsite livestock watering facilities, replace 10 culverts identified as passage barriers or unable to withstand the 100-yr flood, maintain roads, harden four vehicle crossings, harden or otherwise protect livestock watering gaps, repair or modify 36 instream structures and remove bridge abutments. These actions were expected to reduce sediment loads, improve temperatures, riparian conditions, improve passage conditions, and to increase habitat complexity. In the second project, USFS would restore riparian habitat associated with a timber sale.

The Corps consulted on construction of a new floating dock at the Port of Clarkston on the lower Snake River.

The BLM consulted on projects to treat noxious weeds and seed riparian flats with native vegetation throughout the Lower Grande Ronde watershed and to maintain ten riparian exclosures protecting five miles of riparian from grazing in the Lower Grande Ronde.

Joseph Creek

The USFS consulted on a fuels reduction project in the Chesnimnus Creek watershed and a rangeland analysis for Joseph Creek. The USFS also consulted on two projects in the Chesnimnus Creek watershed that included habitat restoration elements: 2006 Peavine Noxious Weed Treatment and 2007 Peavine Trail Conservation.

The BLM consulted on a project to improve 100 acres of riparian along eight miles of stream in the Chesnimnus and Upper Joseph Creek watersheds.

Grande Ronde Upper Mainstem

The USFS proposed three fuel reduction projects in the Upper and Lower Catherine Creek watersheds. The USFS also proposed three grazing allotments and a rangeland analysis in the Upper Grande Ronde and Upper Grande Ronde-Five Points Creek watersheds. Additionally, the USFS consulted on a habitat restoration project in the Meadow Creek and Grande Ronde—Beaver Creek watersheds that would improve 200 acres of riparian habitat and maintain cattle exclosures.

The Corps consulted on a culvert replacement project for Oregon Highway 82 at Pierce Slough (Grande Ronde—Five Points Creek watershed). The project was expected to improve fish passage, riparian vegetation, and water quality.

Clearwater River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that would affect the North Fork Clearwater, Lolo Creek, or Lochsa River populations. Projects that affected other populations in this MPG are described below.

Lower Mainstem Clearwater

The USFS consulted on two projects, the Little Boulder Campground Hazard Tree Removal Project in the Lower Clearwater watershed and the Cottonwood Creek Bridge Repair project. The USFS also consulted on a stream crossing rehabilitation project on Webb Creek in the Lapwai Creek watershed which was designed to provide offsite water for cattle, reducing instream temperatures and improving the condition of spawning gravels.

The FHWA/IDT consulted on a road construction project in Lewiston, ID.

Selway River

The USFS consulted on a project to replace a bridge over Lookout Creek (White Cap Creek watershed).

South Fork Clearwater River

The USFS consulted on one fire salvage and timber sale project in the Red River Watershed. The USFS also proposed two fuels reduction projects that affected the Upper South Fork Clearwater River, Crooked River, and Newsome Creek watersheds which included construction of instream rock and log structures. These were designed to improve instream temperatures and forage for juvenile rearing habitat and increase the number of resting pools for adults. They also included rehabilitation of a portion of Newsome Creek and its floodplain area in the Johns Creek watershed, which was dredge-mined in 1937 to 1940. This project was designed to reduce sediment delivery from roads, remove fish passage impediments and culverts, and treat weeds. On the Red River in the Middle South Fork Clearwater River watershed, the USFS decommissioned 13 miles, improved 20 miles, and abandoned 3 miles of roads; restored soil on 8.5 acres of skid trails and landings; replaced one and removed eight other undersized culverts; and treated noxious weeds.

The Corps consulted on providing an in-water work permit for the Nez Perce County Fishing Pier in the Upper Clearwater River.

The BLM consulted on restoration projects in Johns Creek which would improve access in Telephone Creek and the East Fork American River, increase habitat complexity in summer and winter rearing habitat, increase shading and reduce water temperatures, improve spawning gravels, and improve forage conditions for rearing fish.

Salmon River MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that would affect the South Fork Salmon River; Secesh River; Big, Camas, and Loon Creeks; and Upper or Lower Mainstem Middle Fork Salmon River populations. During the summer of 2007, wildfires burned approximately 310,000 acres of forested habitat within the range of South Fork and Middle Fork Salmon River MPGs. NOAA Fisheries expects that instream habitats will experience increased temperatures, sediment, and large woody debris delivery in the near term. Recovery times to pre-existing conditions will depend on the effects of the fire at each location, which are unknown at this time. Projects that affected other populations in this MPG are described below.

Little Salmon and Rapid Rivers

The USFS consulted on construction of the Rapid River Trailhead in the Upper Little Salmon River watershed. The USFS also proposed to install a fishway at an irrigation diversion dam, which would restore fish access to approximately three miles of Squaw Creek in the Upper Little Salmon River watershed. The project would also consolidate water rights, achieving a net increase in stream flow of 4 cfs, enough to support a low temperature thermal refuge for the Little Salmon River population.

Reclamation consulted on a culvert replacement on Squaw Creek in the Little Salmon River watershed which improved access to four miles of habitat in Squaw Creek and improved habitat complexity in Squaw and Papoose creeks.

Chamberlain Creek

The USFS consulted on a timber salvage project in the Lower South Fork Salmon River watershed and a bank protection (rip-rap) project in the Rock Creek watershed.

Panther Creek

The Corps consulted on a culvert and wetlands fill project in Upper Panther Creek, which would result in the conversion of irrigated agricultural land to low density residential housing. The project was expected to increase safe passage for fish in upper Panther Creek and in the mainstem Salmon River by eliminating rapid drawdowns of irrigation ditches when water was withdrawn for irrigation. The National Resource Conservation Service proposed to rehabilitate stream habitat in Iron Creek (Upper Panther Creek watershed). The BLM consulted on watershed rehabilitation activities associated with managing waste from the abandoned Twin Peaks Mine (Lower Panther Creek).

North Fork Salmon River

The USFS consulted on a culvert replacement project in the North Fork Salmon River, designed to restore both access and the hydraulic processes that transport sediment and large wood.

Lemhi

The FHWA/IDT consulted on the construction of a pedestrian bridge. The USFS consulted on a bank stabilization project at Bog Creek Crossing (Upper Lemhi River watershed) and two projects designed to rehabilitate stream channels and their associated riparian zones in the Middle Salmon River—Carmen Creek, Middle Salmon River—Indian Creek, and Hayden Creek watersheds. NOAA Fisheries consulted with itself on providing funds to screen a water diversion on Kenney Creek (Eighteenmile Creek watershed) and a culvert replacement in Twin Creek (North Fork Salmon River watershed). The latter project was designed to restore access and the hydraulic processes that transport sediment and large woody debris.

Pahsimeroi River

The Corps consulted on a project to prevent a hatchery facility from contaminating the naturally spawning population in the upper Pahsimeroi River (disease). The BLM proposed to rehabilitate Fall Creek and its associated riparian zone (Middle Pahsimeroi River watershed). NOAA Fisheries and USFWS each consulted on projects intended to remove passage barriers by modifying water diversions in the Lower Pahsimeroi River watershed.

East Fork Salmon River

The USFS consulted on a road construction and maintenance project in the Lower East Fork Salmon River watershed, and the FHWA proposed a bridge repair/construction project over the Salmon River (Challis Creek watershed).

Imnaha River MPG

Imnaha River

The USFS consulted on an emergency fire management project in the Salmon River, a harvest/vegetation management project in the Upper Imnaha River watershed, and a bridge replacement project in the Middle Imnaha River. The USFS also consulted on granting a special use permit to private energy companies for operating and maintaining transmission lines in the Upper Imnaha River watershed which included replacing two bridges (relieving channel constrictions) and restoring local floodplain connectivity. The USFS also consulted on a culvert replacement project, also in the Upper Imnaha watershed, designed to restore access to 3.5 miles of rearing habitat.

Projects Affecting Multiple MPGs/Populations

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.5.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration

Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of Snake River steelhead that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and create thermal refuges. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including fire salvage timber sales, maintenance dredging, grazing, bridge repairs, whitebark pine treatment, dock/pier construction, and road construction/maintenance, will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PCEs. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding in any adverse modification of critical habitat.

8.5.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon, Washington, and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Little Salmon, Lolo Creek, Lower Clearwater, South Fork Clearwater, and Asotin subbasins as well as actions that should be generally beneficial throughout the DPS. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.[1] Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for Snake River steelhead. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing

[1] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.5.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.5.5.1 and 8.5.5.2. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvements, require that all hatchery programs operate under NOAA Fisheries' approved HGMPs, broodstock reform for the Tucannon and East Fork Salmon River hatchery programs, steelhead kelt reconditioning, hatchery safety-net planning and predator reduction actions, which are expected to be beneficial. Flow augmentation from the Upper Snake Projects will also provide benefits. These beneficial effects are described in Sections 8.5.5.3, 8.5.5.4, 8.5.5.7, and 8.5.5.9. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be balanced by short- and long-term beneficial effects, as described in Section 8.5.5.7. The harvest Prospective Action will either reduce survival (A-run steelhead and "allowable" harvest on B-run steelhead) or increase survival ("expected" harvest on B-run steelhead), as described in Section 8.5.5.5.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in Section 8.5.5.4, the Hatchery Effects Appendix of the SCA, and in this section. The Prospective Actions will ensure continuation of the beneficial effects of safety-net hatcheries and will reduce adverse impacts of other hatchery programs.

Effects of NOAA Fisheries' issuance of a Section 10 juvenile transportation permit are discussed in Chapter 10 of the FCRPS Biological Opinion. The expected use of transportation under the permit is included in the effects of the FCRPS Prospective Action, which is described in Section 8.5.5.1.

8.5.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5 of this document) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3).. As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the Prospective Actions in the productivity and extinction risk analysis (See Section SCA Sections 7.2.1 and 8.1.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions are expected to increase the in-river survival (from Lower Granite to the

Bonneville tailrace) of SR steelhead from 33.1% (Current) to 38.5% (Prospective), a relative change of 16.4% (SCA Hydro Modeling Appendix). The average proportion of juveniles destined for transportation is expected to drop from 81.7% to 77.1%. However, the proportion of juveniles transported within specific periods of time (in about 80% of the years when expected flows at Lower Granite Dam are expected to exceed 65 kcfs) will change substantially due to altered timing of spill and transportation operations (see RPA Table, Table 3) compared to past operations which did not consider within season variations in the SARs of transported and inriver migrating steelhead. The initial spill and transport operations in the >65 kcfs years will result in (1) no fish – other than what may be needed for research purposes - being collected and transported prior to April 21, (2) high levels (>95% of juveniles) being transported between May 7 and May 20), and (3) intermediate levels of juveniles being transported between April 21 and May 7 and after May 21. Unlike SR spring/summer Chinook salmon (see discussion in Section 8.3.5.1), the smolt-to-adult returns (BON to LGR) of transported SR steelhead are usually equal to, or higher than that of in-river migrating juveniles that survived to below Bonneville Dam throughout the smolt migration period.[2] The Prospective Actions are expected to result in a slight positive (+0.01%) increase in overall LGR to LGR SAR estimates for steelhead even though transport rates are decreasing by about 5.7% (relative to current operations). During the lowest flow years (about 20% of years when spring flows are predicted to be <65 kcfs at Lower Granite Dam), about 90% (71% to 98%) of juvenile steelhead are likely to be transported to below Bonneville Dam.[3]

Implementation of the Prospective Actions addressing hydro operations is expected to slightly reduce the average total system survival (the total percentage of fish arriving at Lower Granite Dam expected to survive to below Bonneville Dam via in-river migration and transportation) from 92.3% to 90.9% (a reduction of about 1.5%). The COMPASS model further estimates that Lower Granite Dam to Lower Granite Dam Smolt to Adult Returns (LGR-to-LGR SARs) will be reduced from about 1.82% to 1.75% (a relative decrease of 3.8%) as a result of the hydro Prospective Actions that govern spill and transport operations and their effect on migration timing to below Bonneville Dam (see discussion above and in Section 8.1).[4]

The Prospective Actions addressing hydro operation and the RM&E program should maintain the high levels of survival currently observed for adult SR steelhead migrating from Bonneville Dam

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[2] These differences do not include the substantial losses of fish migrating inriver to reach the Bonneville Dam tailrace. Including these losses would lower the expected SARs of inriver migrating fish compared to those transported. This is, and will continue to be,

[3] Only three of the 13 years (out of 70) when flows were less than 65 kcfs at Lower Granite Dam had estimated transport rates less than 90%. Closer inspection of these years indicated that the "forecasts" (used to determine the operation to be implemented for a given year in the model) were for flows > 65 kcfs (which would not trigger the "maximum" transport operation). This is a realistic situation that is faced by managers (Regional Forum, Technical Management Team) that must make operational choices based on the forecast information is available at the time.

[4] NOTE: The COMPASS model estimates SARs for in-river and transported migrants separately before combining them (with the estimated percentage of in-river and transported juveniles surviving to below Bonneville Dam) to provide an overall LGR to LGR SAR. Thus, the COMPASS model SAR estimates include (through the transport SAR estimate) the increased stray rates that are often observed for adult fish transported as juveniles (compared to stray rates of those that migrated in-river as juveniles) – a negative effect of transportation.

upstream to Lower Granite Dam. The current PIT tag based survival estimate, taking account of harvest and "natural" stray rates within this reach, is 90.1% (about 98.5% per project). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to Lower Granite Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The Prospective Hydro Actions are also likely to positively affect the survival of SR steelhead in ways that are not included in the quantitative analysis. NOAA Fisheries considers these expected benefits qualitatively in the remainder of this Section.

The Prospective Actions requiring implementation of surface passage routes at Little Goose, Lower Monumental, McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects. This is likely to result in survival improvements in the forebays of these projects, where predation rates are currently often the highest. Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case. Finally, improved tailrace egress conditions should increase the survival of migrating steelhead in tailraces where juvenile mortality rates are relatively high.

Continuing efforts under the NPMP, the program to remove fish predators, and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from Lower Granite Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem's effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to 38.5%. A portion of the 61.5% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of juvenile Snake River steelhead in a hypothetical unimpounded Columbia River would be 82%. Therefore, approximately 29% (=18/61.5) of the mortality experienced by in-river migrating juvenile steelhead is probably due to natural factors.

The direct survival rate of adults migrating through the FCRPS is already quite high. The prospective actions include additional passage improvements (to the collection channel at The Dalles and to the ladders at John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams and other improvements in Corps et al. 2007a). Adult steelhead survival from Bonneville to Lower Granite Dam will be approximately 90.1% under the Prospective Actions. With respect to kelts, the Action Agencies will prepare and implement a Kelt management Plan, including measures to increase in-river survival.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will benefit the juvenile migrants by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor and threat in the lower Columbia River below Bonneville Dam (Section 8.3.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the function of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Lochsa and South Fork Clearwater populations by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2007 a, b).

8.5.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival for all populations, except the Lower Middle Fork Tributaries population, are listed in CA Chapter 7, Table 7-8, p. 7-16. Although CA Table 7-8 indicates that the Prospective Actions will improve habitat quality for the Lower Middle Fork Tributaries population by 7%, a more realistic estimate is a 2% improvement (Table 8.5.5-1). This is because the Prospective Actions target actions only in the Big Creek watershed, which affect only a subpopulation of the entire Lower Middle Fork Tributary population. The Big Creek Watershed encompasses approximately 29% of the intrinsic potential for the Lower Middle Fork Tributaries Population. Therefore, the actions in Big Creek will result in a lower survival increase when spread over the entire population, or approximately 2% (7% X 0.291= 2%). In summary, for targeted populations in this DPS, the effect is a <1 - 16% expected increase in egg-smolt survival, depending on population. This is a result of implementing tributary habitat projects that improve habitat function quality by addressing limiting factors and threats.[5] For example, roads in the Sesech and South Fork Salmon watersheds contribute fine sediment to stream gravels and inadequate culverts at stream crossings create passage barriers. As part of their implementation of the RPA (Action 34), the Action Agencies will address this limiting factor by providing funds for decommissioning and/or improving roads and for removing and/or replacing culverts on Forest Service lands to the Nez Perce Tribe.

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access. Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts

[5] The Action Agencies identify the projects that will improve these PCEs and that they will fund by 2009 in Tables 3b; 4a; and 5a,b in Attachment B.2.2-2 to Corps et al. (2007b).

will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.5.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Snake River steelhead (stream-type life history) associated with the specific actions to be implemented from 2007-2010 is 1.4%. The survival benefit for Snake River steelhead (stream-type life history), associated with actions to be implemented from 2010 through 2018, is 4.3%. The total survival benefit for Snake River steelhead, as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats, is approximately 5.7% (Corps et al. 2007a Chapt.7.3.3.3). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will address factors that have limited the functioning of PCEs used by juvenile steelhead migrants from the Snake River. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as habitat for this species (section 7.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs needed by juvenile steelhead from the Snake River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction (Section 8.5.5.2) are expected to be minor, occur only at the project scale, and persist for a short time.

8.5.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Hatchery programs preserve genetic resources in the Tucannon, North Fork Clearwater, Pahsimeroi, and East Fork Salmon. On the other hand, hatchery programs in the Little Salmon River, mainstem Salmon River, Lemhi River, Upper Salmon River, Wallowa River, Lower Grande Ronde River, and Hells Canyon pose risks to the diversity and productivity of many populations in the DPS (SCA Hatchery Effects Appendix).

Prospective Actions include continued funding of hatcheries and the adoption of programmatic criteria, or Best Management Practices (BMPs), for operating salmon and steelhead hatchery programs. More than thirty hatchery programs in the Snake River Basin require ESA consultation and NOAA Fisheries has scheduled these consultations to follow scientific reviews by the congressionally mandated Hatchery Scientific Review Group and the United States Fish and Wildlife Service Hatchery Review Team. Hatchery reforms will be implemented in new ESA consultations informed by new science, new Hatchery and Genetic Management Plans for each program, and NOAA Fisheries guidance (see Artificial Propagation for Pacific Salmon Appendix) has established a schedule for completing new ESA consultations on more than thirty hatchery programs in the Snake River Basin and will consult on the operation of existing or new programs when Hatchery and Genetic

Management Plans (HGMPs) for each program are updated. The Action Agencies intend to adopt these programmatic criteria. Site-specific application of BMPs will be defined in HGMPs, and consultations with NOAA Fisheries will be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS Biological Assessment, Corps et al. 2007b, Page 2-44). Consultation with the Action Agencies will be initiated by February of 2010 and completed by August of 2010.

Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.5.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

There are three stock groups of summer steelhead used for harvest management including the lower river Skamania stock, upriver A-run stock, and upriver B-run stock. SR steelhead populations are designated as both A-run and B-run.

Prospective non-Treaty fisheries, pursuant to the 2008 *U.S. v. Oregon* Agreement, will be managed subject to DPS-specific harvest rate limits. Winter, spring, and summer fisheries are subject to a 2% harvest rate limit on wild steelhead from each steelhead DPS. Non-Treaty fall season fisheries are likewise subject to a 2% harvest rate limit for each steelhead DPS. The total annual harvest rate limit for A-run steelhead, for example, is 4%. This is consistent with the ESA-related management constraints that have been in place in recent years. The expected harvest impacts on non-Treaty fisheries are less than those proposed (TAC 2008). The yearly incidental catch of A-run steelhead in non-Treaty fisheries has averaged 1.6 since 1999 (Table 8.5.5.5-1). Harvest rates for non-Treaty fisheries are not expected to change over the course of this Agreement (TAC 2008).

The harvest rate on A-run steelhead in tribal spring season fisheries has averaged0.2% since 1985 (Table 8.5.5.5-1). The harvest rate in summer season fisheries averaged 2.3% since 1985 (Table 8.5.2.1.1-1). The harvest rate in fall season fisheries averaged 9.6% since 1985 and 4.2% since 1998 (Table 8.5.5.5-1). Impacts resulting from treaty-Indian fall season fisheries during this agreement are similar to the 1998-2006 average of 4.2%.

With respect to spring and summer season fisheries, increases in harvest beyond those observed in recent years are unlikely. The spring season extends through June 15. The harvest rate of A-run steelhead has been consistent and low, at approximately 0.2%, since 1985 (Table 8.5.5.5-1).

No changes in the fishery are proposed or anticipated that would lead to changes in the expected catch of steelhead.

Summer season fisheries extend through July 31. Snake River steelhead are caught regularly in ceremonial and subsistence fisheries (primarily the platform fishery), as well as in commercial fisheries targeting summer Chinook (summer Chinook that are targeted in the fishery are part of the UCR summer/fall ESU and are not listed under the ESA.). Summer Chinook were chronically depressed for decades until returns began to increase in 2001. Higher runs provided more fishing opportunity as of 2002. However, there is no evidence of an associated increase in the catch of listed steelhead. The harvest rate of summer Chinook in the tribal fishery averaged 1.5% from 1989 to 2001 and 10.9% from 2002 to 2006 (TAC 2008). During those same years, the harvest rate of steelhead averaged 2.3% and 2.4% (Table 8.5.5.5-1). As with the spring fisheries, no further changes in future fisheries are expected, as a result of the Prospective Action, that would lead to changes in the expected catch of steelhead. However, there is recent information regarding adult conversion rates from analysis of PIT-tag data, indicating that more UCR steelhead than SR steelhead are lost in upstream passage. These greater losses may be due to differential harvest rates that are not currently detectable. The losses may also be due to timing differences, passage conditions, or another combination of factors. If new evidence develops related to the catch of steelhead in the summer season, these conclusions will be reviewed.

Prospective treaty-Indian fall season fisheries will be managed using the abundance based harvest rate schedule for B-run steelhead, as contained in the 2008 Agreement (Table 8.5.5.5-2). From 1998 to 2007 treaty-Indian fall season fisheries were managed subject to a 15% harvest rate limit on B-run steelhead. Under the abundance based harvest rate schedule, harvest may vary up or down from the status quo of 15%, depending on the abundance of B-run steelhead. The harvest rate allowed under the prospective schedule is also limited by the abundance of upriver fall Chinook. The purpose of this provision is to recognize that impacts to B-run steelhead may be higher when the abundance, and thus fishing opportunity for fall Chinook, is higher and remain consistent with conservation goals. However, higher harvest rates are allowed only if the abundance of B-run steelhead is also greater than 35,000. This provision is designed to provide greater opportunity for the tribes to satisfy their treaty right, to harvest 50% of the harvestable surplus of fall Chinook, in years when conditions are generally favorable. Even with these provisions, it is unlikely that the treaty right for Chinook or steelhead can be fully satisfied. The harvest rate in tribal fall season fisheries may range from 13 to 20%. As indicated above, the non-Treaty fall season fishery harvest rate would remain fixed at 2%.

Table 8.5.5.5-1. Harvest rates of A-run steelhead in spring, summer, and fall season fisheries expressed as a proportion of the Skamania and A-run steelhead run size (TAC 2008).

Treaty Indian					Non-Indian			
Year	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
1985	0.15%	NA	19.40%	19.50%				
1986	0.08%	NA	12.60%	12.70%				
1987	0.05%	NA	14.70%	14.80%				
1988	0.18%	NA	16.10%	16.20%				
1989	0.04%	4.00%	14.90%	18.90%				
1990	0.44%	3.50%	14.10%	18.00%				
1991	0.15%	1.90%	14.40%	16.40%				
1992	0.49%	2.00%	15.20%	17.60%				
1993	0.14%	1.40%	14.60%	16.20%				
1994	0.16%	1.10%	9.70%	10.90%				
1995	0.06%	2.20%	10.00%	12.20%				
1996	0.66%	2.30%	8.40%	11.40%				
1997	0.10%	2.70%	10.10%	12.80%				
1998	0.11%	3.80%	8.40%	12.40%				
1999	0.05%	2.10%	5.20%	7.40%	0.10%	0.30%	0.60%	1.00%
2000	0.11%	1.00%	4.00%	5.10%	0.10%	0.60%	1.00%	1.70%
2001	0.09%	2.10%	3.80%	6.00%	0.10%	0.40%	0.60%	1.10%
2002	0.09%	2.10%	2.40%	4.60%	0.40%	0.40%	0.80%	1.60%
2003	0.12%	2.80%	2.50%	5.40%	0.60%	0.30%	1.00%	1.90%
2004	0.13%	3.90%	3.00%	7.00%	0.40%	0.40%	1.00%	1.80%
2005	0.05%	2.30%	3.60%	5.90%	0.40%	0.40%	0.90%	1.70%
2006	0.13%	0.80%	5.00%	6.00%	0.30%	0.40%	1.20%	1.90%
2007					0.30%	0.30%	0.80%	1.40%
1985-06 average	0.16%	2.33%	9.64%	11.70%				
1989-06 average	0.17%	2.33%	8.29%	10.79%				

	Treaty Indian				Non-Indian			
Year	**Spring Season**	**Summer Season**	**Fall Season**	**Total**	**Spring Season**	**Summer Season**	**Fall Season**	**Total**
1998-06 average	0.10%	2.32%	4.21%	6.64%	0.30%	0.40%	0.89%	1.59%

Table 8.5.5.5-2. Abundance Based Harvest Rate Schedule for B-run Steelhead (TAC 2008).

Upriver Summer Steelhead Total B Harvest Rate Schedule				
Forecast Bonneville Total B Steelhead Run Size	**River Mouth URB Run Size**	**Treaty Total B Harvest Rate**	**Non-Treaty wild B Harvest Rate**	**Total Harvest Rate**
20,000	Any	13%	2.0%	15.0%
20,000	Any	15%	2.0%	17.0%
35,000	>200,000	20%	2.0%	22.0%

B-run steelhead will be used as the primary steelhead related harvest constraint for tribal fall season fisheries and are thus the indicator stock used for management purposes. Generally, the status of B-run steelhead is worse than that of A-run steelhead. B-run steelhead are subject to higher harvest rates because they are larger and thus more susceptible to catch in gillnets. Harvest impacts on B-run steelhead generally are also higher because their timing coincides with the return of fall Chinook, the primary target of this fishery. A-run steelhead typically return a few weeks earlier and thus are less susceptible to catch. Consequently, there are no specific management constraints in tribal fisheries for A-run steelhead. Since 1998, when the 15% harvest rate limit was first implemented for B-run steelhead, the harvest rate on A-run steelhead in fall season treaty-Indian fisheries has averaged 4.2% and ranged from 5.4 to 12.4% (Table 8.5.5.5-1).

The abundance based harvest rate schedule allows the tribal harvest rate on B-run steelhead to vary from the fixed rate of 15% that has been in place since 1998, depending on the abundance of B-run steelhead and upriver fall Chinook. By evaluating historical run size, a determination can be made as to how often fisheries would be subject to the 13%, 15%, or 20% level. This retrospective analysis suggests that the annual harvest rate limit will be 15% or less 12 out of 22 years, and 20% 10 out of 22 years, and 20% 10 out of 22 years. The average allowable harvest rate on B-run steelhead from this retrospective analysis is 17.1% (Table 8.5.5.5-3).

Table 8.5.5.5-3. Retrospective analysis of allowable harvest rates for B-run steelhead in the tribal fall season fisheries.

Year	Upriver Fall Chinook Run Size	B-run Steelhead Run Size	Allowable Harvest Rate in Tribal Fall Fisheries
1985	196,500	40,870	15%
1986	281,500	64,016	20%
1987	420,600	44,959	20%
1988	340,000	81,643	20%
1989	261,300	77,604	20%
1990	153,600	47,174	15%
1991	103,300	28,265	15%
1992	81,000	57,438	15%
1993	102,900	36,169	15%
1994	132,800	27,463	15%
1995	106,500	13,221	13%
1996	143,200	18,693	13%
1997	161,700	36,663	15%
1998	142,300	40,241	15%
1999	166,100	22,137	15%
2000	155,700	40,909	15%
2001	232,600	86,426	20%
2002	276,900	129,882	20%
2003	373,200	37,229	20%
2004	367,858	37,398	20%
2005	268,744	48,967	20%
2006	230,388	74,127	20%
1985-06 average			17.10%

Although the prospective harvest rate schedule will allow for harvest in tribal fall season fisheries to increase in some years, the observed harvest rates in both the non-Treaty and treaty-Indian fisheries have generally been lower than allowed. Since 1998, fall season fisheries have been subject to a combined 17% harvest rate limit for B-run steelhead. From 1998 to 2006 the observed harvest rate averaged 12.7% (TAC 2008).

For fall season fisheries it is also necessary to consider whether there will be an increase in the harvest of A-run steelhead associated with the Prospective Action. As discussed above, B-run steelhead are used as the indicator stock for steelhead. This is done in order to limit fishery impacts in fall season fisheries. The retrospective analysis suggests that harvest rates on B-run steelhead in the treaty Indian fall season fisheries may be higher than 15% approximately half of the time. The average of the allowable harvest rate limits from the retrospective analysis is 17.1% (Table 8.5.5.5-3). This represents a 14% increase over the current harvest rate limit of 15% (17.1/15.0 = 1.14). The harvest rates on A-run steelhead will not necessarily increase, but A-run and B-run harvest rates are correlated. It is therefore reasonable to assume that A-run harvest rates will increase in proportion to B-run harvest rates. Table 8.5.5.5-1 shows the tribal fishery harvest rates for A-run steelhead in spring, summer, and fall season fisheries. Since 1998, when the current ESA limits were applied, fall season harvest rate averaged 4.2%, while the total harvest rate averaged 6.6%. Under the assumption that fall season harvest rates will increase by 14% in proportion to the expected increase for B-run steelhead, the anticipated future fall season and total harvest rates will be 4.8% (0.042 * 1.140 = 0.48) and 7.2%.

The net result for A-run populations of SR steelhead will be a small increase in the current harvest rate (from 6.6% to 7.2%), which will result in approximately a 1% reduction in survival (Harvest Appendix, based on US v Oregon memorandum). Therefore, a 0.99 current-to-future survival adjustment is applied to the prospective harvest action for A-run populations.

The net result for B-run populations of SR steelhead ranges from a 3% reduction in survival, based on the allowable harvest rate, to a 2% increase in survival, based on the expected harvest rate. Therefore, a 0.97-1.02 current-to-future survival adjustment is applied to the prospective harvest action for B-run populations.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas. This was identified as a limiting factor for the Lochsa and South Fork Clearwater populations by the remand collaboration Habitat Workgroup (Habitat Technical Subgroup 2007a, b).

8.5.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Snake River steelhead from reduction in Caspian tern nesting habitat on East Sand Island and subsequent relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 3.4% (Corps et al. 2007a Attachment F-2, Table 4).

Compensatory mortality may occur but based on the discussion in Section 8.3.5.6 it is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon and steelhead. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA, Corps et al. 2007a Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Implementation and further improvement of avian deterrence at all lower Snake and Columbia dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport-reward fishery implementation and further improvement of avian deterrence at mainstem dams are expected to improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.5.5.7 Effects of Research and Monitoring Prospective Actions

See Section 8.1.4 of this document.

8.5.5.8 Effects of Kelt Reconditioning

Effects on Species Status

Prospective Actions implementing passage improvements for juvenile salmon and steelhead, including surface passage such as RSWs and sluiceways, are likely to also benefit downstream migrating kelts. This should lead to improved survival through the FCRPS. Reduced forebay residence times, which lead to a reduction in total travel time, may also contribute to an improvement in kelt return rates. It is not possible to calculate the precise amount of improvement expected, because the interactions between improved surface passage and improved kelt survival and return rates are not fully known. However, some improvement is likely.

The Prospective Actions implementing reconditioning and transport of steelhead kelts potentially represent a much greater improvement in both outmigration survival and return rates. Reconditioning programs capture kelts and hold them in tanks where they are fed and medicated to enhance survival. Current programs either hold kelts for 3-5 weeks and release them below Bonneville or hold kelts until they are ready to spawn and release them into their natal streams. Short-term reconditioning efforts have produced average survival rates of 82% and kelt returns of 4% to the Yakima River (Hatch et al. 2006). Long-term reconditioning has produced average survival rates of 35.6%, all of which are returned to their natal stream for spawning (Hatch et al. 2006).

There is some concern over the viability of the offspring from long-term reconditioned kelts. Laboratory studies found high rates of post hatching mortality (Branstetter et al. 2006), and studies using DNA analysis to identify the parentage of outmigrating steelhead smolts (Stephenson et al. 2007) have failed to identify any offspring of reconditioned kelts among the juvenile steelhead collected from streams where reconditioned kelts were released. These studies suggest that long-term reconditioning may reduce gamete viability. It is not known if short-term reconditioned kelts may have the same problems with offspring viability; however, because they feed and mature under natural conditions it seems less likely.

Transportation of kelts involves capturing kelts, transporting them to a point downstream of Bonneville dam, and releasing them. Kelt transportation studies in the Snake River found that there was not only an improvement in FCRPS survival from 4-33% to approximately 98% in transported kelts, but transported kelts returned to Lower Granite dam at a rate of 1.7% versus in-river migrating kelts which returned at a rate of 0.5% (Boggs and Peery, 2004).

Both transportation and reconditioning of kelts require capture of downstream migrating kelts. Given kelt preference for surface passage and the potential for future implementation of surface passage routes, the number of kelts that can be collected is limited. Upper and Mid-Columbia DPSs present significant challenges to successfully collecting kelts. Existing bypass systems and transportation facilities on the Snake River dams make successful collection of Snake River steelhead more likely. An analysis by Dygert (2007) estimated that 7% (during spill) to 22% (no spill) of the upstream steelhead run could be captured at LGR as downstream migrating kelts. The Prospective Actions would employ collection at both LGR and LGS. Our analysis of the Prospective Actions (SCA Hydro Modeling Appendix) suggests that employing a combination of transportation, reconditioning, and in-stream passage improvements could increase kelt returns enough to increase the number of Snake River B-run steelhead spawners by about 6% (SCA steelhead Kelt Appendix). If logistical difficulties associated with capture of upper Columbia River steelhead kelts can be overcome, similar benefits could be expected for that DPS as well.

Effects on Critical Habitat

NOAA Fisheries will analyze any effects of the kelt reconditioning action on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.5.5.9 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.5.5.1 through 8.5.5.9 and are summarized in Table 8.5.5-1. Estuary habitat improvement projects, kelt reconditioning, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the DPS. Tributary habitat improvement projects are expected to increase survival for selected populations. The net effect, which varies by population, is 10-39% increased survival, compared to the "current" condition, and 11-40% increased survival, compared to the "base" condition.

8.5.5.10 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.5.6-1 and 8.5.6-2 and in Figures 8.5.6-1 and 8.5.6-2. In addition to these summary tables and figures, the SCA Life Cycle Modeling Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and DPS level. Also, because quantitative short-term extinction risk gaps cannot be calculated for this species, future short-term extinction risk is discussed qualitatively in subsequent sections.

8.5.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized by Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared with the importance of each population to MPG and DPS viability. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Lower Snake River MPG

This MPG consists of two extant populations (Tucannon and Asotin), one of which must be viable and the other highly viable to achieve the ICTRT's suggested MPG viability scenario. Both are A-run populations. Please see Section 7.3 for a discussion of these MPG viability scenarios.

As discussed previously, population-specific estimates are not available for populations in this MPG, so productivity and extinction risk are inferred from average A-run population estimates, coupled with Prospective Actions that are specific to each population. The estimated productivity (based on all three metrics: R/S, lambda, and BRT trend) is expected to be greater than 1.0 for both populations (Table 8.5.6-1; Figure 8.5.6-1). This means that with implementation of the Prospective Actions survival is expected to be sufficient for these populations to grow and for the abundance of spawners to trend upward. There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) and the application of average A-run estimates to these specific populations. This suggests that other qualitative information should also be considered:

- Life-stage specific survival rates are expected to improve for estuarine survival, as well as in both tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These actions address limiting factors and threats. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity greater than 1.0 for these populations are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is "low" to "moderate," as defined by the ICTRT (Table 8.5.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity sufficiently increase to levels exceeding minimum thresholds.

- The productivity estimates described above are based on mean results of analyses that assume future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both "Warm PDO" (poor) and "historical" ocean scenarios both populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2).

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

- Quantitative estimates of *base period* extinction risk indicate 21% risk at QET=50 for average A-run populations (Table 8.5.2-3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs. These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% cannot be estimated for this species. Base-to-current survival improvements range from 7 to 9%, depending on the population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 14 to 16% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for A-Run base period extinction risk ranges from 0 to 50%; Table 8.5.2-3). This suggests that other qualitative information should also be considered:

- There is no safety-net hatchery program for these populations. There is a hatchery supplementation program for the Tucannon that preserves genetic resources and reduces extinction risk in the short-term.

- The recent 10-year geometric mean abundance is unknown, but average A-run abundance was estimated by the ICTRT to be 456 fish, which is well above the 50 fish QET (Table 8.5.2-1). No years in the average A-Run data set are below 50 fish (Cooney 2008b).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Clearwater MPG

This MPG consists of five extant populations. The ICTRT recommends that four of these populations be viable or highly viable for this MPG. Key populations within this MPG include the Lower Clearwater (the only extant "large" population), Lolo Creek (the only population with both the A-run and B-run life histories), and the Selway, Lochsa, and South Fork Clearwater populations (all of which are "intermediate" sized populations). The Lower Clearwater is an A-run population, Lolo Creek has both A-run and B-run life histories, and the other extant populations are B-run. Please see Section 7.3 for a discussion of these MPG viability scenarios.

As discussed previously, population-specific estimates are not available for populations in this MPG, so productivity and extinction risk are inferred from average A-run and average B-run population estimates, coupled with Prospective Actions that are specific to each population. Estimated productivity (based on R/S) is expected to be greater than 1.0 for 3-4 populations and less than 1.0 for 1-2 populations, depending upon assumption for prospective harvest, with implementation of the Prospective Actions (Table 8.5.6-1). The Selway River population is expected to be less than 1.0 under both harvest assumptions while the Lolo Creek results depend upon prospective harvest assumption (0.99 with allowable harvest and 1.04 with expected harvest). This means that with implementation of the Prospective Actions, survival for 3-4 of the five populations is expected to be sufficient for them to grow. Lambda and the BRT abundance trend are expected to be greater than 1.0 for all five populations. This means that all populations in this MPG are expected to increase in abundance.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These actions address limiting factors and threats. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for these populations are not solely determined by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is “very low” to “moderate,” as defined by the ICTRT (Table 8.5.2-2). The MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- The productivity estimates described above are based on mean results of analyses that assume future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT “historical” ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT “Warm PDO” (poor) climate scenario, the results are nearly identical to results under recent climate conditions.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

- Quantitative estimates of *base period* extinction risk indicate 21% risk at QET=50 for average A-run populations (Table 8.5.2-3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs. Base period B-run extinction risk is estimated to be 5% at QET=50 and less than 5% at lower QET levels.

- These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% could not be estimated for this species. Base-to-current survival improvements range from 1-3%, depending on population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 10-39% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk of both A-run and B-run populations.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for A-Run base period extinction risk ranges from 0 to 50%; Table 8.5.2-3). This suggests that other qualitative information should also be considered:

- There is no safety-net hatchery program for these populations.

- The recent 10-year geometric mean abundance for these populations is unknown. However, the ICTRT estimated average A-run abundance (applicable to the Lower Clearwater population) at 456 fish and average B-run abundance at 272 fish (Table 8.5.2-1), both of which are well above the 50 fish QET. No years in either the average A-Run or average B-run data sets are below 50 fish (Cooney 2008b).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Grande Ronde MPG

This MPG consists of four extant populations. The ICTRT recommends that two of these populations be viable or highly viable for MPG viability. Key populations within this MPG include the Grande Ronde Upper Mainstem (essential, since it is the only "large" population in this MPG), Joseph Creek (least influenced by hatcheries and contributes to spatial structure in the lower portion of the MPG), and the Lower Grande Ronde Mainstem (also contributes to spatial structure in the lower portion of the MPG). The ICTRT suggests a choice among Joseph Creek and the Lower Mainstem. All four populations are A-run. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Population-specific productivity estimates are available for the Upper Grande Ronde, Wallowa, and Joseph Creek populations. Population-specific estimates are not available for the Lower Grande Ronde population, so productivity and extinction risk are inferred from average A-run population estimates, coupled with Prospective Actions that are specific to this population. The estimated productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for three of the four populations (Table 8.5.6-1; Figure 8.5.6-1). This means that with implementation of the Prospective Actions survival is expected to be sufficient for these populations to grow and for the abundance of spawners to trend upward. For the Upper Mainstem populations, all metrics except lambda, calculated with the assumption that hatchery-origin and natural-origin spawners are equally effective (HF=1), are greater than 1.0. The lambda HF=1 estimate for the Upper Mainstem is 0.99.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.6.6-1). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not solely driven by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is "very low" to "moderate," as defined by the ICTRT (Table 8.5.2-2). As long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds, the MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors.

- The productivity estimates described above are based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2). Under the ICTRT "Warm PDO" (poor) climate scenario, the results are nearly identical to results under recent climate conditions.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period short-term extinction risk indicate 21% risk at QET=50 for average A-run populations (indicative of the Lower Mainstem and Wallowa populations) and 0% extinction risk for the Joseph Creek and Upper Mainstem populations, which were estimated directly (Table 8.5.2-3).

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk for average A-run populations is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs (Table 8.5.2-3). These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% could not be estimated for this species. Base-to-current survival improvements range from 1-2%, depending on population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 11-14% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk for the populations in this MPG.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to 50% for these populations; Table 8.5.2-3). For this reason, other qualitative information is also considered:

- There is no safety-net hatchery program for these populations.

- The recent 10-year geometric mean abundance is 1226 spawners for the Upper Mainstem and 2132 spawners for Joseph Creek, both of which are far above the 50 fish QET (Table 8.5.2-1).

Abundance of the Lower Mainstem and Wallowa populations is unknown, but average A-run abundance was estimated by the ICTRT to be 456 fish, which is above the 50 fish QET. No years in the average A-Run data set are below 50 fish (Cooney 2008b).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Imnaha River MPG

This MPG consists of one population (Imnaha River), which must be highly viable to achieve the ICTRT suggested MPG viability scenario. The Imnaha population exhibits the A-run life history pattern. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Population-specific productivity estimates are available for this population. Estimated productivity (based on all three metrics: R/S, lambda, and BRT trend) is expected to be greater than 1.0 for the Imnaha population (Table 8.5.6-1; Figure 8.5.6-1). This means that with implementation of the Prospective Actions, survival is expected to be sufficient for this population to grow and for the abundance of spawners to trend upward.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.5.6-1). For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in the Imnaha River as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for this population are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is “very low” to “moderate,” as defined by the ICTRT (Table 8.5.2-2). The MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- The productivity estimates described above are based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under “historical” and “Warm PDO” (poor) ocean scenarios this population is expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2).

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Population-specific extinction risk is not available for the Imnaha population, so it is inferred from average A-run population estimates, coupled with Prospective Actions that are specific to this population. Quantitative estimates of *base period* extinction risk indicate 21% risk at QET=50 for average A-run populations (Table 8.5.2-3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk for average A-run populations is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs (Table 8.5.2-3). These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% cannot be estimated for this species. Base-to-current survival improvements are estimated to be 1% for this population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 10% current-to-prospective survival change for this population). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk.

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk range from 0 to 50% for average A-run populations; Table 8.5.2-3; Figure 8.5.6-1). For this reason, other qualitative information is also considered:

- There is no safety-net hatchery program for this population, but a supplementation hatchery program does preserves genetic resources.

- The recent 10-year geometric mean abundance for the Imnaha population is unknown, but average A-run abundance was estimated by the ICTRT to be 456 fish, which is above the 50 fish QET (Table 8.5.2-1). No years in the average A-Run data set are below 50 fish (Cooney 2008b).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Salmon River MPG

This MPG consists of 12 extant populations. The ICTRT recommends that six of these populations be viable or highly viable for MPG viability. Eight of the populations are A-run and four of the populations are B-run. Key populations within this MPG include the South Fork Salmon (only "intermediate"-sized B-run population), the Upper Middle Fork Salmon (one of two "large" B-run populations; no history of hatchery influence), and Chamberlain Creek ("basic" sized A-run population with no history of hatchery influence). The ICTRT also suggests that two of the remaining six "intermediate"-sized populations be viable or highly viable (Lower Middle Fork, Little Salmon/Rapid River, Lemhi, Pahsimeroi, East Fork Salmon, and Upper Mainstem). Additionally, the ICTRT recommends that one additional population of any size be viable or highly viable. Please see Section 7.3 for a discussion of these MPG viability scenarios.

As discussed previously, population-specific estimates are not available for populations in this MPG, so productivity and extinction risk are inferred from average A-run and average B-run population estimates, coupled with Prospective Actions that are specific to each population. Estimated productivity (based on R/S) is expected to be greater than 1.0 for 8-9 populations, depending on prospective harvest assumptions (Table 8.5.6-1; Figure 8.5.6-1). This means that survival for 8-9 populations will be sufficient for the populations to grow. The Upper Middle Fork, Lower Middle Fork, South Fork, and (under one harvest assumption) the Secesh populations are expected to have R/S <1.0. All four of these populations are B-run and it would be necessary for two of them to be viable to achieve the TRT viability scenario. All 12 populations are expected to have lambda and BRT trend greater than 1.0, meaning that abundance of spawners is expected to increase.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix; Figure 8.5.6-1). This suggests that other qualitative information should also be considered:

- Life-stage specific survival rates are expected to improve for estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.5.5.1 through 8.5.5.6. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is "very low" to "moderate," as defined by the ICTRT, for all but one population (the Pahsimeroi; Table 8.5.2-2). For the remaining populations, the MPG can achieve the ICTRT-suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- The Pahsimeroi population currently has a "high" risk, as defined by the ICTRT, for spatial structure. This risk is due to the population occupying only 30% of its historical range and because of the geographic distance between its single major spawning area and the nearest adjacent population.

- The productivity estimates described above are based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. . Under the ICTRT "historical" ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix). Under the ICTRT "Warm PDO" (poor) climate assumption, results are nearly identical to those based on recent climate conditions.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Population-specific extinction risk is not available for the populations in this MPG, so it is inferred from average A-run and average B-run population estimates, coupled with Prospective Actions that are specific to each population. Quantitative estimates of *base period* extinction risk indicate 21% risk at QET=50 for average A-run populations and 5% for average B-run populations (Table 8.5.2.3). As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Base period extinction risk for average A-run populations is estimated to be 5% risk at QET=1 and greater than 5% at all higher QETs. These estimates do not take into account current survival rates or the effects of Prospective Actions that will be implemented quickly. Survival changes necessary to reduce short-term extinction risk to 5% could not be estimated for this species. Base-to-current survival improvements range from 0-7%, depending on population. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 10-27% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk of both A-run and B-run populations

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for A-Run base period extinction risk ranges from 0 to 50%; Table 8.5.2-3). For this reason, other qualitative information is also considered:

- There is no safety-net hatchery program for any of these populations, except the East Fork Salmon A-run population. This program increases the number of natural spawners and reduces extinction risk in the short-term.

- The recent 10-year geometric mean abundance for these populations is unknown. However, the ICTRT estimated average A-run abundance at 456 fish and average B-run abundance at 272 fish (Table 8.5.2-1), both of which are above the 50 fish QET. No years in either the average A-Run or average B-run data set are below 50 fish (Cooney 2008b).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

8.5.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Snake River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.5.7.1 Potential For Recovery

The future status of all populations and MPGs of SR steelhead will be improved compared to their current status through the implementation of Prospective Actions with beneficial effects, as described in Sections 8.5.5, 8.5.6, and 8.5.7.2. These actions include reduction of avian and fish predation, estuary habitat improvements, kelt reconditioning of B-run steelhead, and tributary habitat improvements for most populations. These beneficial actions also completely offset the slightly decreased A-run population survival associated with the harvest Prospective Action. For B-run populations, the harvest Prospective Action may represent decreased survival, which is offset by the beneficial actions if the "allowable" harvest rate is implemented. Conversely, it may represent increased B-run steelhead survival if the "expected" harvest rate is implemented (Section 8.5.5.5). Hydro actions are expected to remain at current survival levels. Therefore, the status of the DPS as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This conclusion takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.5.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this DPS.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.5.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatchery programs, and degradation of tributary and estuary habitat. The high spatial structure risk for the Panther Creek population is largely a result of past mining operations, which are being addressed through other processes including the EPA Blackbird Mine Superfund Site cleanup. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions appropriately considered cumulative effects and also address limiting factors and threats. The ICTRT has indicated that the longer some hatchery programs continue, the more likely their effects will limit recovery potential. As described in Section 8.5.5.4, several ongoing hatchery programs that affect this DPS pose risks to diversity and natural productivity. The Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce the likelihood of longer-term problems associated with continuing hatchery programs although subject to future hatchery-specific consultations after which these benefits may be realized.

The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat, which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Some of the problems limiting recovery of SR steelhead, such as genetic diversity concerns, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years.

Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In sum, these qualitative considerations suggest that the SR steelhead DPS will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion. However, quantitative information is extremely limited for the Snake River steelhead DPS because of the difficulty of counting redds or fish during the spring and early summer spawning period. The ICTRT was able to estimate trends for only four populations in the Grande Ronde and Imnaha MPGs and abundance for only two populations. All other population estimates are inferred from average A-run and B-run estimates of base productivity, which are derived from dam counts and assumptions about the distribution of spawners within the DPS. These average base period estimates were then coupled with population-specific improvements in the Prospective Actions to derive population-specific estimates of prospective effects.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of hatchery supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, 11 of which are described in Section 8.5.5.4, but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S estimates incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

As described in Section 8.5.6, with implementation of the Prospective Actions, R/S, lambda, and the BRT trend are expected to be greater than 1.0 for three of the four of the populations in the Imnaha and Grande Ronde MPGs for which the ICTRT developed population-specific base period estimates (Table 8.5.6-1 and Figure 8.5.6-1). For the fourth population, Grande Ronde Upper Mainstem, estimates were either greater than 1.0 or were very close (0.99). A-run populations and 2-4 of the eight B-run populations (depending on prospective harvest assumptions) are expected to have R/S greater than 1.0, based on average A- and B-run base productivity. This equates to R/S greater than 1.0 for 18-20 of the 24 populations with estimates. The 4-6 populations with estimates less than 1.0 are all composed of B-run steelhead and are components of the Clearwater and Salmon River MPGs. R/S is expected to be greater than 1.0 for all of the important populations identified by the ICTRT in the other three MPGs in this DPS.

Populations for which R/S is expected to be greater than 1.0 generally have estimates that are considerably greater than 1.0 (mean approximately 1.20). By providing additional benefits to stronger populations, the Prospective Actions help offset problems with poorly performing populations, supporting the viability of the DPS as a whole.

Some important caveats that apply to all three quantitative estimates are as follows:

- As described above, population-specific productivity is available for only four populations in the MPG – the remaining population estimates are extrapolations of average A- and B-run estimates from the ICTRT.

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over longer than a 10-year period), so quantitative estimates of prospective R/S and BRT trend may be low.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.5.6-2). Under the ICTRT "Warm PDO" (poor) climate assumption, results are nearly identical to the results under the recent climate assumption.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S and the BRT trend are expected to be greater than 1.0 at the upper 95% confidence limits for all populations and R/S and the BRT trend are expected to be less than 1.0 for all populations at the lower 95% confidence limits (SCA Aggregate Analysis Appendix; Figure 8.5.6-2). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors discussed above indicates that the DPS as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. All populations are expected to increase in abundance in the future, based on lambda and BRT trends. NOAA Fisheries cannot demonstrate quantitatively by R/S >1.0, that all populations (including important populations in two MPGs) will have natural productivity sufficient to replace themselves and grow as a result of the actions considered in the aggregate analysis. However, the great majority of populations are likely to increase in abundance and enough populations are likely to be increasing to conclude that the DPS as a whole will be trending toward recovery.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the DPS being on a trend toward recovery.

8.5.7.2 Short-Term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through net survival improvements resulting from the Prospective Actions and a continuation of other current management actions, as described above and in Sections 8.5.3 and 8.5.5.

As described above and in Section 8.5.6, abundance is expected to be increasing for all populations and natural productivity (R/S) is expected to be sufficient for most populations to grow (Table 8.5.6-1). Recent abundance levels for average A-run and B-run populations are estimated to be 456 and 272 spawners, respectively, which is well above the QET levels under consideration (Table 8.5.2-1). These factors also indicate a decreasing risk of extinction.

Hatchery supplementation programs preserve genetic resources and reduce short-term extinction risk by increasing abundance of four A-run and two B-run populations in the Tucannon, North Fork Clearwater, Pahsimeroi, and East Fork Salmon rivers. These programs insure that the affected populations will not go extinct in the short-term, although as described above they would increase diversity risk to the DPS if continued over a long time period.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24-year) extinction risk also support this conclusion.

As described in Section 8.2.6, short-term extinction risk derived from performance during the base period is 0% at QET=50 for the two populations in this DPS for which population-specific estimates are available (Upper Grande Ronde and Joseph Creek; Table 8.5.2-3). For all other A-run populations, base period-derived short-term extinction risk is based on the A-run average: 21% at QET=50 and 5% at QET=1. As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. B-run base extinction risk was estimated to be 5% at QET=50. These estimates assume no continued supplementation.

It was not possible to determine the survival improvements needed to reduce extinction risk to 5% or less for any populations except those already below 5% during recent years. Base-to-current survival improvements range from 0-9%, depending on population. Some additional improvements will also accrue from Prospective Actions that are likely to be implemented immediately (an unknown proportion of the 10-39% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they will reduce the base period extinction risk of both A-run and B-run populations.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0% to 50% for average A-run populations (Table 8.5.2-3). This uncertainty indicates that it is important also to consider qualitative factors in reaching conclusions.

Taken together, the combination of all the factors above indicates that the DPS as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. NOAA Fisheries cannot demonstrate quantitatively that all populations or all MPGs will have a low risk, primarily because of data limitations and significant uncertainty in the estimates for base period performance. However, the combination of recent abundance estimates for average populations, expected survival improvements, expected positive trends for most populations, and supplementation programs that reduce short-term risk for some populations, indicate that enough populations are likely to have a low enough risk to conclude that the DPS, as a whole, will have a low risk of short-term extinction.

8.5.7.3 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for SR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in the following subbasins: Hells Canyon, Imnaha River, Lower

Snake/Asotin, Upper Grande Ronde River, Wallowa River, Lower Grande Ronde, Lower Snake/Tucannon, Lower Snake River, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon-Chamberlain, South Fork Salmon, Lower Salmon, Little Salmon, Upper Selway, Lower Selway, Lochsa, Middle Fork Clearwater, South Fork Clearwater, and Clearwater. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for SR steelhead. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Snake and Columbia rivers; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at Little Goose, Lower Monumental, McNary, and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators), will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v Oregon* Agreement, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Snake River Steelhead DPS is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Snake River Steelhead DPS nor result in the destruction or adverse modification of its designated critical habitat.

Table 8.5.2-1. Status of SR steelhead with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY). Italicized estimates represent application of average A-run and B-run estimates to individual A-run and B-run populations lacking population-specific estimates.

			Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
ESU	**MPG**	**Population**	Most Recent 10-yr Geomean Abundance[1]	Years Included In Geomean	ICTRT Recovery Abundance Threshold[1]	Average R/S: 20-yr non-SAR adj.; non-delimited[2]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0)[3]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1)[3]	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current[4]	Lower 95% CI	Upper 95% CI
Snake River Steelhead	Average "A-Run" Populations (only 14 years)		456	1995-2004	1000	1.09	0.56	2.12	1.05	0.50	2.23	1.05	0.50	2.23	1.01	0.94	1.22
	Average "B-Run" Populations (only 13 years)		272	1995-2004	1000	0.80	0.52	1.22	1.00	0.63	1.58	1.00	0.63	1.58	0.96	0.90	1.10
	Lower Snake	Tucannon (A, but below LGR)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Asotin (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
	Imnaha River	Imnaha R. (A)			1000	1.45	0.94	2.24	1.06	0.82	1.37	1.06	0.82	1.37	1.03	0.99	1.14
	Grande Ronde	Upper Mainstem (A)	1226	1997-2006	1500	0.93	0.65	1.33	0.99	0.83	1.17	0.96	0.81	1.13	0.99	0.95	1.07
		Lower Mainstem (A)			*1000*	*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Joseph Cr. (A)	2132	1996-2005	500	1.26	0.84	1.89	1.05	0.82	1.35	1.05	0.82	1.35	1.01	0.97	1.11
		Wallowa R. (A)			1000	1.28	0.94	1.75	1.05	0.82	1.34	1.04	0.81	1.34	1.03	0.99	1.20
	Clearwater River	Lower Mainstem (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Lolo Creek (A & B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		Lochsa River (B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		Selway River (B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		South Fork (B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		North Fork - (Extirpated)															
	Salmon River	Little Salmon/Rapid (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Chamberlain Cr. (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Secesh River (B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		South Fork Salmon (B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		Panther Creek (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Lower Middle Fork Tribs (B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		Upper Middle Fork Tribs (B)				*0.80*	*0.52*	*1.22*	*1.00*	*0.63*	*1.58*	*1.00*	*0.63*	*1.58*	*0.96*	*0.90*	*1.10*
		North Fork (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Lemhi River (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Pahsimeroi River (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		East Fork Salmon (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*
		Upper Mainstem (A)				*1.09*	*0.56*	*2.12*	*1.05*	*0.50*	*2.23*	*1.05*	*0.50*	*2.23*	*1.01*	*0.94*	*1.22*

1 Most recent year for 10-year geometric mean abundance is 2003-2005, depending upon the population. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from the ICTRT (2007c).
2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 years (Upper Grande Ronde,Imnaha River, Wallowa River, and Joseph Creek) or 13-14 years (average A- and B-run), as described in Cooney (2008a).
3 Median population growth rate (lambda) during the most recent period of approximately 20 years from Cooney (2008b). Actual years in estimates vary by population.
4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008b).

Table 8.5.2-2. Status of SR steelhead with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure[1]	ICTRT Current Risk For Diversity[1]	10-yr Average % Natural-Origin Spawners[2]
Snake River Steelhead	Average "A-Run" Populations (only 14 years)				
	Average "B-Run" Populations (only 13 years)				
	Lower Snake	Tucannon (A, but below LGR)	Currently Low Risk	Currently Moderate Risk	
		Asotin (A)	Currently Low Risk	Currently Moderate Risk	
	Imnaha River	Imnaha R. (A)	Currently Very Low Risk	Currently Moderate Risk	1.00
	Grande Ronde	Upper Mainstem (A)	Currently Very Low Risk	Currently Moderate Risk	0.86
		Lower Mainstem (A)	N/A	N/A	
		Joseph Cr. (A)	Currently Very Low Risk	Currently Low Risk	1.00
		Wallowa R. (A)	Currently Very Low Risk	Currently Low Risk	1.00
	Clearwater River	Lower Mainstem (A)	Currently Very Low Risk	Currently Low Risk	
		Lolo Creek (A & B)	Currently Low Risk	Currently Moderate Risk	
		Lochsa River (B)	Currently Very Low Risk	Currently Low Risk	
		Selway River (B)	Currently Very Low Risk	Currently Low Risk	
		South Fork (B)	Currently Low Risk	Currently Moderate Risk	
		North Fork - (Extirpated)			
	Salmon River	Little Salmon/Rapid (A)	Currently Very Low Risk	Currently Low Risk	
		Chamberlain Cr. (A)	Currently Low Risk	Currently Low Risk	
		Secesh River (B)	Currently Very Low Risk	Currently Low Risk	
		South Fork Salmon (B)	Currently Low Risk	Currently Low Risk	
		Panther Creek (A)	Currently High Risk (Only occupy 30% of historic range, gap between single MaSA and adjacent pops)	Currently Moderate Risk	
		Lower Middle Fork Tribs (B)	Currently Low Risk	Currently Moderate Risk	
		Upper Middle Fork Tribs (B)	Currently Very Low Risk	Currently Low Risk	
		North Fork (A)	Currently Low Risk	Currently Moderate Risk	
		Lemhi River (A)	Currently Low Risk	Currently Moderate Risk	
		Pahsimeroi River (A)	Currently Moderate Risk	Currently Moderate Risk	
		East Fork Salmon (A)	Currently Very Low Risk	Currently Moderate Risk	
		Upper Mainstem (A)	Currently Very Low Risk	Currently Moderate Risk	

1 ICTRT conclusions for Snake River steelhead are from draft versions of ICTRT Current Status Summaries (ICTRT 2007d)
2 Average fractions of natural-origin natural spawners are from the ICTRT (2007c).

Table 8.5.2-3. Status of SR steelhead with respect to extinction risk. Extinction risk is estimated from performance during the "base period" of the approximately 20 most recent brood years. Italicized estimates represent application of average A-run and B-run estimates to individual A-run and B-run populations lacking population-specific estimates.

			24-Year Extinction Risk											
ESU	**MPG**	**Population**	Risk (QET=1)[1]	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10)[1]	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30)[1]	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50)[1]	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Snake River Steelhead	Average "A-Run" Populations (only 14 years)		0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
	Average "B-Run" Populations (only 13 years)		0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
	Lower Snake	Tucannon (A, but below LGR)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Asotin (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
	Imnaha River	Imnaha R. (A)	*0.05*	*0.00*	*0.28*	*0.10*	*0.00*	*0.37*	*0.16*	*0.00*	*0.44*	*0.21*	*0.00*	*0.49*
	Grande Ronde	Upper Mainstem (A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		Lower Mainstem (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Joseph Cr. (A)	0.00	0.00	0.03	0.00	0.00	0.10	0.00	0.00	0.15	0.00	0.00	0.19
		Wallowa R. (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
	Clearwater River	Lower Mainstem (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Lolo Creek (A & B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Lochsa River (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Selway River (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		South Fork (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		North Fork - (Extirpated)												
	Salmon River	Little Salmon/Rapid (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Chamberlain Cr. (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Secesh River (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		South Fork Salmon (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Panther Creek (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Lower Middle Fork Tribs (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		Upper Middle Fork Tribs (B)	0.00	0.00	0.18	0.02	0.00	0.29	0.03	0.00	0.36	0.05	0.00	0.41
		North Fork (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Lemhi River (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Pahsimeroi River (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		East Fork Salmon (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49
		Upper Mainstem (A)	0.05	0.00	0.28	0.10	0.00	0.37	0.16	0.00	0.44	0.21	0.00	0.49

1 Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the SCA Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

Table 8.5.2-4. Changes in density-independent survival of SR steelhead ("gaps") necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for SR steelhead. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated "gaps" are based on population performance during the "base period" of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%. Italicized estimates represent application of average A-run and B-run estimates to individual A-run and B-run populations lacking population-specific estimates.

ESU	MPG	Population	Survival Gap For Average R/S=1.0[1]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0@ HF=1[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0[3]	Upper 95% CI	Lower 95% CI	Survival Gap for 24-Yr Ext. Risk <5% (QET=1)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=10)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=30)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=50)[4]
Snake River Steelhead		Average "A-Run" Populations (only 14 years)	0.92	1.80	0.47	0.79	>10	0.03	0.79	>10	0.03	0.94	1.35	0.41				
		Average "B-Run" Populations (only 13 years)	1.25	1.91	0.82	1.00	7.88	0.13	1.00	7.88	0.13	1.21	1.60	0.66				
	Lower Snake	Tucannon (A, but below LGR)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Asotin (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
	Imnaha River	Imnaha R. (A)	*0.69*	*1.07*	*0.45*	0.77	2.50	0.24	0.77	2.50	0.24	*0.89*	*1.07*	*0.56*				
	Grande Ronde	Upper Mainstem (A)	1.08	1.55	0.75	1.07	2.28	0.50	1.23	2.65	0.57	1.07	1.24	0.75				
		Lower Mainstem (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Joseph Cr. (A)	0.79	1.19	0.53	0.81	2.50	0.26	0.81	2.50	0.26	0.94	1.12	0.62				
		Wallowa R. (A)	*0.78*	*1.07*	*0.57*	0.82	2.46	0.27	0.83	2.54	0.27	*0.89*	*1.04*	*0.44*				
	Clearwater River	Lower Mainstem (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Lolo Creek (A & B)-assume B	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		Lochsa River (B)	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		Selway River (B)	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		South Fork (B)	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		North Fork - (Extirpated)																
	Salmon River	Little Salmon/Rapid (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Chamberlain Cr. (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Secesh River (B)	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		South Fork Salmon (B)	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		Panther Creek (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Lower Middle Fork Tribs (B)	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		Upper Middle Fork Tribs (B)	*1.25*	*1.91*	*0.82*	1.00	7.88	0.13	1.00	7.88	0.13	*1.21*	*1.60*	*0.66*				
		North Fork (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Lemhi River (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Pahsimeroi River (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		East Fork Salmon (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				
		Upper Mainstem (A)	*0.92*	*1.80*	*0.47*	0.79	>10	0.03	0.79	>10	0.03	*0.94*	*1.35*	*0.41*				

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.5.2-1.

2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.5.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.5.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap could not be calculated for this species.

Table 8.5.3-1. Proportional changes in SR steelhead average base period survival expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

			Base-to-Current Adjustment (Divisor)							
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2]	Estuary Habitat[3]	Bird Predation[4]	Marine Mammal Predation[5]	Harvest[6]	Hatcheries[7]	Total[8]
Snake River Steelhead	Average "A-Run" Populations (only 14 years)									
	Average "B-Run" Populations (only 13 years)									
	Lower Snake	Tucannon (A, but below LGR)	0.966	1.065	1.003	0.996	1.000	1.041	1.00	1.07
		Asotin (A)	0.966	1.085	1.003	0.996	1.000	1.041	1.00	1.09
	Imnaha River	Imnaha R. (A)	0.966	1.001	1.003	0.996	1.000	1.041	1.00	1.01
	Grande Ronde	Upper Mainstem (A)	0.966	1.020	1.003	0.996	1.000	1.041	1.00	1.02
		Lower Mainstem (A)	0.966	1.001	1.003	0.996	1.000	1.041	1.00	1.01
		Joseph Cr. (A)	0.966	1.020	1.003	0.996	1.000	1.041	1.00	1.02
		Wallowa R. (A)	0.966	1.020	1.003	0.996	1.000	1.041	1.00	1.02
	Clearwater River	Lower Mainstem (A)	0.966	1.025	1.003	0.996	1.000	1.041	1.00	1.03
		Lolo Creek (A & B)	0.966	1.005	1.003	0.996	1.000	1.040	1.00	1.01
		Lochsa River (B)	0.966	1.005	1.003	0.996	1.000	1.040	1.00	1.01
		Selway River (B)	0.966	1.007	1.003	0.996	1.000	1.040	1.00	1.01
		South Fork (B)	0.966	1.015	1.003	0.996	1.000	1.040	1.00	1.02
		North Fork - (Extirpated)								
	Salmon River	Little Salmon/Rapid (A)	0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01
		Chamberlain Cr. (A)	0.966	1.000	1.003	0.996	1.000	1.041	1.00	1.00
		Secesh River (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		South Fork Salmon (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		Panther Creek (A)	0.966	1.000	1.003	0.996	1.000	1.041	1.00	1.00
		Lower Middle Fork Tribs (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		Upper Middle Fork Tribs (B)	0.966	1.000	1.003	0.996	1.000	1.040	1.00	1.00
		North Fork (A)	0.966	1.000	1.003	0.996	1.000	1.041	1.00	1.00
		Lemhi River (A)	0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01
		Pahsimeroi River (A)	0.966	1.065	1.003	0.996	1.000	1.041	1.00	1.07
		East Fork Salmon (A)	0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01
		Upper Mainstem (A)	0.966	1.005	1.003	0.996	1.000	1.041	1.00	1.01

1 From SCA Hydro Modeling Appendix Based on differences in average base and current smolt-to-adult survival estimates.
2 From CA Chapter 7, Table 7-6.

3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Current 2 S/Baseline 2 S" approach, as described in Attachment F-2.
5 From SCA Marine Mammal Appendix. No populations in this DPS are winter-run.
6 From SCA Quantitative Analysis of Harvest Actions Appendix). Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup, modified to reflect the current maximum harvest rate for B-run steelhead.
7 Hatchery changes are discussed qualitatively.
8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

Table 8.5.5-1. Proportional changes in SR steelhead survival expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

			Current-to-Future Adjustment (Divisor)									
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2] (2007-2017)	Estuary Habitat[3]	Bird Predation[4]	Pike-minnow Predation[5]	Kelt Reconditioning[6]	Marine Mammal[7]	Allowable Harvest8	Expected Harvest[8]	Hatcheries9
Snake River Steelhead	Average "A-Run" Populations (only 14 years)											
	Average "B-Run" Populations (only 13 years)											
	Lower Snake	Tucannon (A, but below LGR)	1.00	1.05	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Asotin (A)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
	Imnaha River	Imnaha R. (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
	Grande Ronde	Upper Mainstem (A)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Lower Mainstem (A)	1.00	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Joseph Cr. (A)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Wallowa R. (A)	1.00	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
	Clearwater River	Lower Mainstem (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Lolo Creek (A & B)	1.00	1.08	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		Lochsa River (B)	1.00	1.16	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		Selway River (B)	1.00	1.01	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		South Fork (B)	1.00	1.14	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		North Fork - (Extirpated)										
	Salmon River	Little Salmon/Rapid (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Chamberlain Cr. (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Secesh River (B)	1.00	1.06	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		South Fork Salmon (B)	1.00	1.01	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		Panther Creek (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Lower Middle Fork Tribs (B)	1.00	1.02	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		Upper Middle Fork Tribs (B)	1.00	1.00	1.06	1.03	1.01	1.06	1.00	0.97	1.02	1.00
		North Fork (A)	1.00	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Lemhi River (A)	1.00	1.03	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Pahsimeroi River (A)	1.00	1.09	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		East Fork Salmon (A)	1.00	1.02	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Upper Mainstem (A)	1.00	1.06	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00

Table 8.5.5-1. Continued.

			Current-to-Future Adjustment (Divisor)				High	Low
ESU	MPG	Population	Non-Hydro With Allowable Harvest[10]	Non-Hydro With Expected Harvest[10]	Total (Allowable Harvest)[11]	Total (Expected Harvest)[11]	Total Base-Current and Current-Future[12]	Total Base-Current and Current-Future[12]
Snake River Steelhead	Average "A-Run" Populations (only 14 years)							
	Average "B-Run" Populations (only 13 years)							
	Lower Snake	Tucannon (A, but below LGR)	1.15	1.15	1.16	1.16	1.24	1.24
		Asotin (A)	1.14	1.14	1.14	1.14	1.25	1.25
	Imnaha River	Imnaha R. (A)	1.10	1.10	1.10	1.10	1.11	1.11
	Grande Ronde	Upper Mainstem (A)	1.14	1.14	1.14	1.14	1.17	1.17
		Lower Mainstem (A)	1.11	1.11	1.11	1.11	1.12	1.12
		Joseph Cr. (A)	1.14	1.14	1.14	1.14	1.17	1.17
		Wallowa R. (A)	1.11	1.11	1.11	1.11	1.13	1.13
	Clearwater River	Lower Mainstem (A)	1.10	1.10	1.10	1.10	1.13	1.13
		Lolo Creek (A & B)	1.23	1.29	1.23	1.29	1.24	1.30
		Lochsa River (B)	1.32	1.39	1.32	1.39	1.33	1.40
		Selway River (B)	1.15	1.21	1.15	1.21	1.16	1.22
		South Fork (B)	1.30	1.36	1.30	1.36	1.32	1.39
		North Fork - (Extirpated)						
	Salmon River	Little Salmon/Rapid (A)	1.10	1.10	1.10	1.10	1.11	1.11
		Chamberlain Cr. (A)	1.10	1.10	1.10	1.10	1.11	1.11
		Secesh River (B)	1.21	1.27	1.21	1.27	1.21	1.27
		South Fork Salmon (B)	1.14	1.20	1.15	1.20	1.15	1.21
		Panther Creek (A)	1.10	1.10	1.10	1.10	1.11	1.11
		Lower Middle Fork Tribs (B)	1.16	1.22	1.16	1.22	1.17	1.23
		Upper Middle Fork Tribs (B)	1.14	1.20	1.14	1.20	1.14	1.20
		North Fork (A)	1.10	1.10	1.10	1.10	1.11	1.11
		Lemhi River (A)	1.13	1.13	1.13	1.13	1.14	1.14
		Pahsimeroi River (A)	1.20	1.20	1.20	1.20	1.28	1.28
		East Fork Salmon (A)	1.12	1.12	1.12	1.12	1.13	1.13
		Upper Mainstem (A)	1.17	1.17	1.17	1.17	1.18	1.18

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates.
2 From CA Chapter 7, Table 7-6.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Prospective 2 S/Current 2 S" approach, as described in Attachment F-2.
5 From CA Appendix F, Attachment F-1.
6 From SCA Steelhead Kelt Appendix
7 From Supplemental Comprehensive Analysis, SCA Marine Mammal Appendix. No populations in this DPS are winter-run.
8 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
9No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.

10 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.
11 Same as Footnote 8, except it is calculated from all Prospective Actions, including hydro actions.
12 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.8.3-1.

Table 8.5.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for SR steelhead.

Expected Harvest Assumption:

ESU	MPG	Population	20-Yr R/S Recent Climate[1]	20-yr lambda Recent Climate @ HF=0[2]	20-yr lambda Recent Climate @ HF=1[3]	1980-Current BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
Snake River Steelhead	Average "A-Run" Populations (only 14 years)									
	Average "B-Run" Populations (only 13 years)									
							Need 1 HV and 1 V:			
	Lower Snake	Tucannon (A, but below LGR)	1.34	1.10	1.10	1.25	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
	Lower Snake	Asotin (A)	1.36	1.11	1.11	1.27	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
	Imnaha River	Imnaha R. (A)	1.60	1.08	1.08	1.14	Must be HV	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
							Need 1 HV and 1 V:			
	Grande Ronde	Upper Mainstem (A)	1.09	1.02	0.99	1.16	Must be HV or V	Three metrics >1, but lambda with HF=1 assumption is 0.99.	Currently Very Low Risk	Currently Moderate Risk
	Grande Ronde	Lower Mainstem (A)	1.22	1.08	1.08	1.13	1 of these 2 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Both populations in this group meet criteria.	N/A	N/A
	Grande Ronde	Joseph Cr. (A)	1.48	1.09	1.09	1.19	1 of these 2 populations must be HV or V	All three metrics >1. Both populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
	Grande Ronde	Wallowa R. (A)	1.45	1.07	1.07	1.16	"Maintained" Population	All three metrics >1	Currently Very Low Risk	Currently Low Risk
							Need 1 HV and 3 V:			
	Clearwater River	Lower Mainstem (A)	1.23	1.08	1.08	1.15	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Very Low Risk	Currently Low Risk
	Clearwater River	Lolo Creek (A & B)	1.04	1.06	1.06	1.25	Must be HV or V	All three metrics >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Moderate Risk
	Clearwater River	Lochsa River (B)	1.12	1.08	1.08	1.34	2 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average B-run base productivity. Two of three populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
	Clearwater River	Selway River (B)	0.98	1.05	1.05	1.17	2 of these 3 populations must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
	Clearwater River	South Fork (B)	1.11	1.08	1.08	1.33	2 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average B-run base productivity. Two of three populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk
	Clearwater River	North Fork - (Extirpated)								
							Need 1 HV and 5 V:			
	Salmon River	Upper Middle Fork Tribs (B)	0.96	1.04	1.04	1.15	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
	Salmon River	Chamberlain Cr. (A)	1.20	1.08	1.08	1.12	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Low Risk
	Salmon River	South Fork Salmon (B)	0.97	1.04	1.04	1.16	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Low Risk
	Salmon River	Panther Creek (A)	1.20	1.08	1.08	1.12	1 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. All three populations in this group meet criteria.	Currently High Risk (Only occupy 30% of historic range, gap between single MaSA and adjacent pops)	Currently Moderate Risk
	Salmon River	Secesh River (B)	1.02	1.06	1.06	1.22	1 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average B-run base productivity. All three populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
	Salmon River	North Fork (A)	1.20	1.08	1.08	1.12	1 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. All three populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
	Salmon River	Lower Middle Fork Tribs (B)	0.98	1.05	1.05	1.17	2 of these 6 populations must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Moderate Risk
	Salmon River	Little Salmon/Rapid (A)	1.21	1.08	1.08	1.13	2 of these 6 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
	Salmon River	Lemhi River (A)	1.24	1.09	1.09	1.16	2 of these 6 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
	Salmon River	Pahsimeroi River (A)	1.40	1.11	1.11	1.30	2 of these 6 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Moderate Risk	Currently Moderate Risk
	Salmon River	East Fork Salmon (A)	1.23	1.08	1.08	1.15	2 of these 6 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk
	Salmon River	Upper Mainstem (A)	1.28	1.09	1.09	1.19	2 of these 6 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Four of 5 populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk

Table 8.5.6.1-1. Continued.

Allowable Harvest Assumption:

ESU	MPG	Population	20-Yr R/S Recent Climate[1]	20-yr lambda Recent Climate @ HF=0[2]	20-yr lambda Recent Climate @ HF=1[3]	1980-Current BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
Snake River Steelhead	Average "A-Run" Populations (only 14 years)									
	Average "B-Run" Populations (only 13 years)									
							Need 1 HV and 1 V:			
	Lower Snake	Tucannon (A, but below LGR)	1.34	1.10	1.10	1.25	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Asotin (A)	1.36	1.11	1.11	1.27	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Moderate Risk
	Imnaha River	Imnaha R. (A)	1.60	1.08	1.08	1.14	Must be HV	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
							Need 1 HV and 1 V:			
	Grande Ronde	Upper Mainstem (A)	1.09	1.02	0.99	1.16	Must be HV or V	Three metrics >1, but lambda with HF=1 assumption is 0.99.	Currently Very Low Risk	Currently Moderate Risk
		Lower Mainstem (A)	1.22	1.08	1.08	1.13	1 of these 2 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Both populations in this group meet criteria.	N/A	N/A
		Joseph Cr. (A)	1.48	1.09	1.09	1.19		All three metrics >1. Both populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		Wallowa R. (A)	1.45	1.07	1.07	1.16	"Maintained" Population	All three metrics >1	Currently Very Low Risk	Currently Low Risk
							Need 1 HV and 3 V:			
	Clearwater River	Lower Mainstem (A)	1.23	1.08	1.08	1.15	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Very Low Risk	Currently Low Risk
		Lolo Creek (A & B)	0.99	1.05	1.05	1.19	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Lochsa River (B)	1.07	1.07	1.07	1.28	2 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average B-run base productivity. One of two populations in this group to meet criteria.	Currently Very Low Risk	Currently Low Risk
		Selway River (B)	0.93	1.03	1.03	1.11		R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		South Fork (B)	1.06	1.06	1.06	1.27		All three metrics >1. Estimates assume average B-run base productivity. Two of three populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
		North Fork - (Extirpated)								
							Need 1 HV and 5 V:			
	Salmon River	Upper Middle Fork Tribs (B)	0.91	1.03	1.03	1.10	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		Chamberlain Cr. (A)	1.20	1.08	1.08	1.12	Must be HV or V	All three metrics >1. Estimates assume average A-run base productivity.	Currently Low Risk	Currently Low Risk
		South Fork Salmon (B)	0.92	1.03	1.03	1.10	Must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Low Risk
		Panther Creek (A)	1.20	1.08	1.08	1.12	1 of these 3 populations must be HV or V	All three metrics >1. Estimates assume average A-run base productivity. Two of three populations in this group to meet criteria.	Currently High Risk (Only occupy 30% of historic range, gap between single MaSA and adjacent pops)	Currently Moderate Risk
		Secesh River (B)	0.97	1.04	1.04	1.16		R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Very Low Risk	Currently Low Risk
		North Fork (A)	1.20	1.08	1.08	1.12		All three metrics >1. Estimates assume average A-run base productivity. Two of three populations in this group to meet criteria.	Currently Low Risk	Currently Moderate Risk
		Lower Middle Fork Tribs (B)	0.93	1.03	1.03	1.12	2 of these 6 populations must be HV or V	R/S <1 but lambda and BRT trend >1. Estimates assume average B-run base productivity.	Currently Low Risk	Currently Moderate Risk
		Little Salmon/Rapid (A)	1.21	1.08	1.08	1.13		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Very Low Risk	Currently Low Risk
		Lemhi River (A)	1.24	1.09	1.09	1.16		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Low Risk	Currently Moderate Risk
		Pahsimeroi River (A)	1.40	1.11	1.11	1.30		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Moderate Risk	Currently Moderate Risk
		East Fork Salmon (A)	1.23	1.08	1.08	1.15		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk
		Upper Mainstem (A)	1.28	1.09	1.09	1.19		All three metrics >1. Estimates assume average A-run base productivity. Four of five populations in this group meet criteria.	Currently Very Low Risk	Currently Moderate Risk

1 Calculated as the base period 20-year R/S productivity from Table 8.5.2-1, multiplied by the total base-to-future survival multiplier in Table 8.5.5-1.
2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.5.2-1, multiplied by the total base-to-future survival multiplier in Table 8.5.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.5.2-1, multiplied by the total base-to-future survival multiplier in Table 8.5.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
4 From ICTRT (2007c), Attachment 2
5 From Table 8.5.2-2.

Figure 8.5.6-1. Summary of prospective mean R/S estimates for SR steelhead under the "recent" climate assumption, including 95% confidence limits.

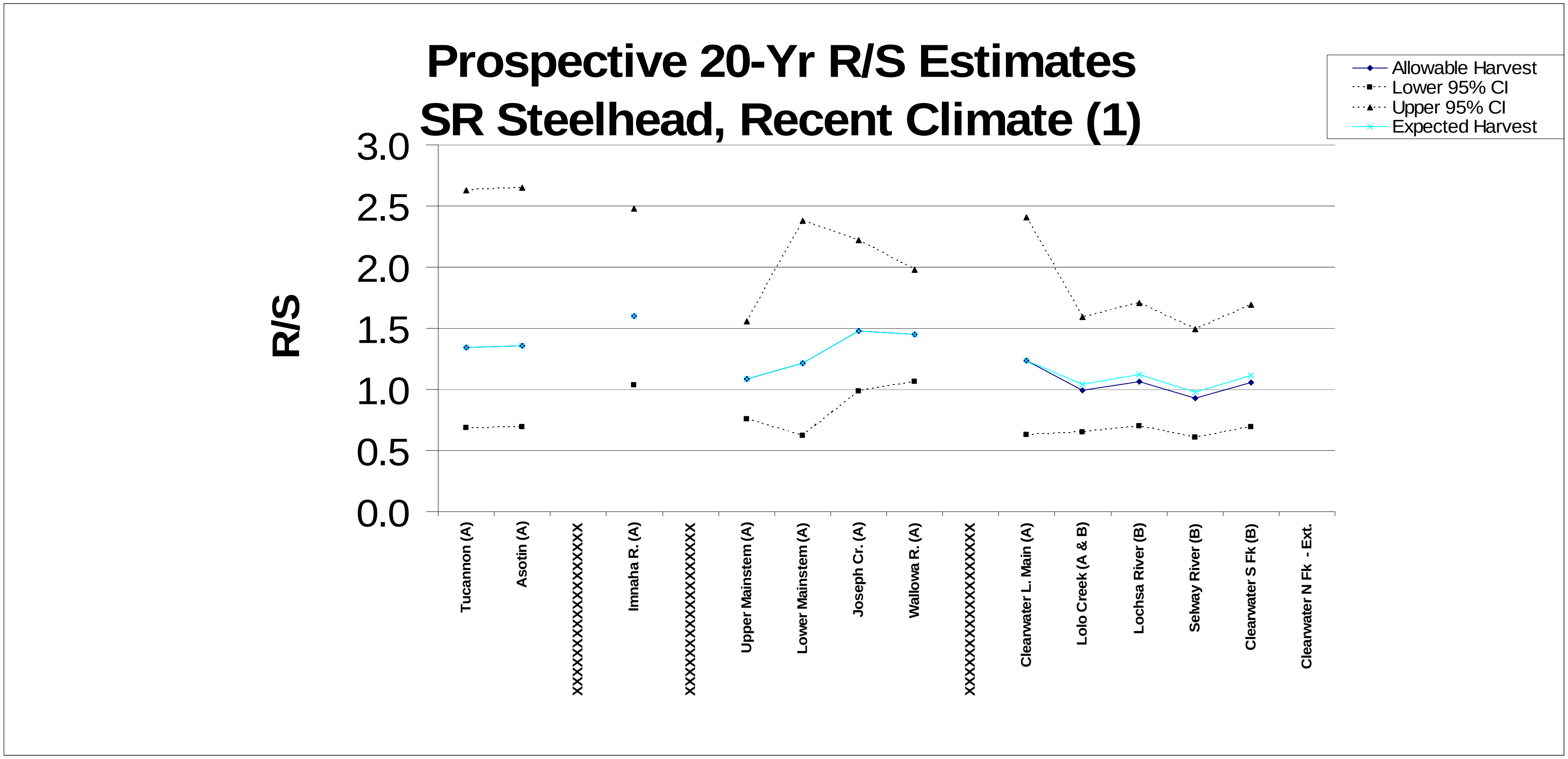


Figure 8.5.6-1. Continued.

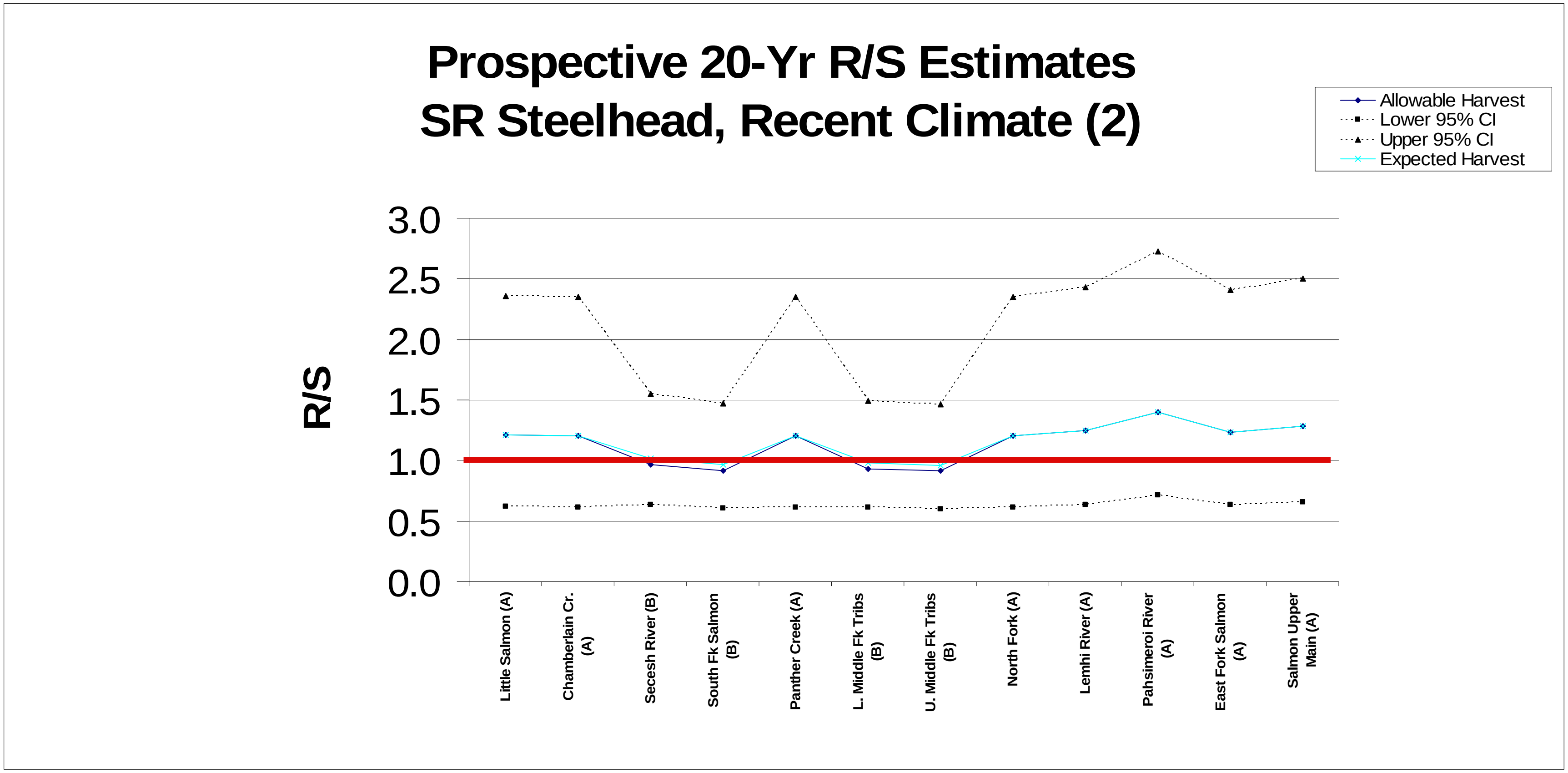


Figure 8.5.6-2. Summary of prospective mean R/S estimates for SR steelhead under three climate assumptions.

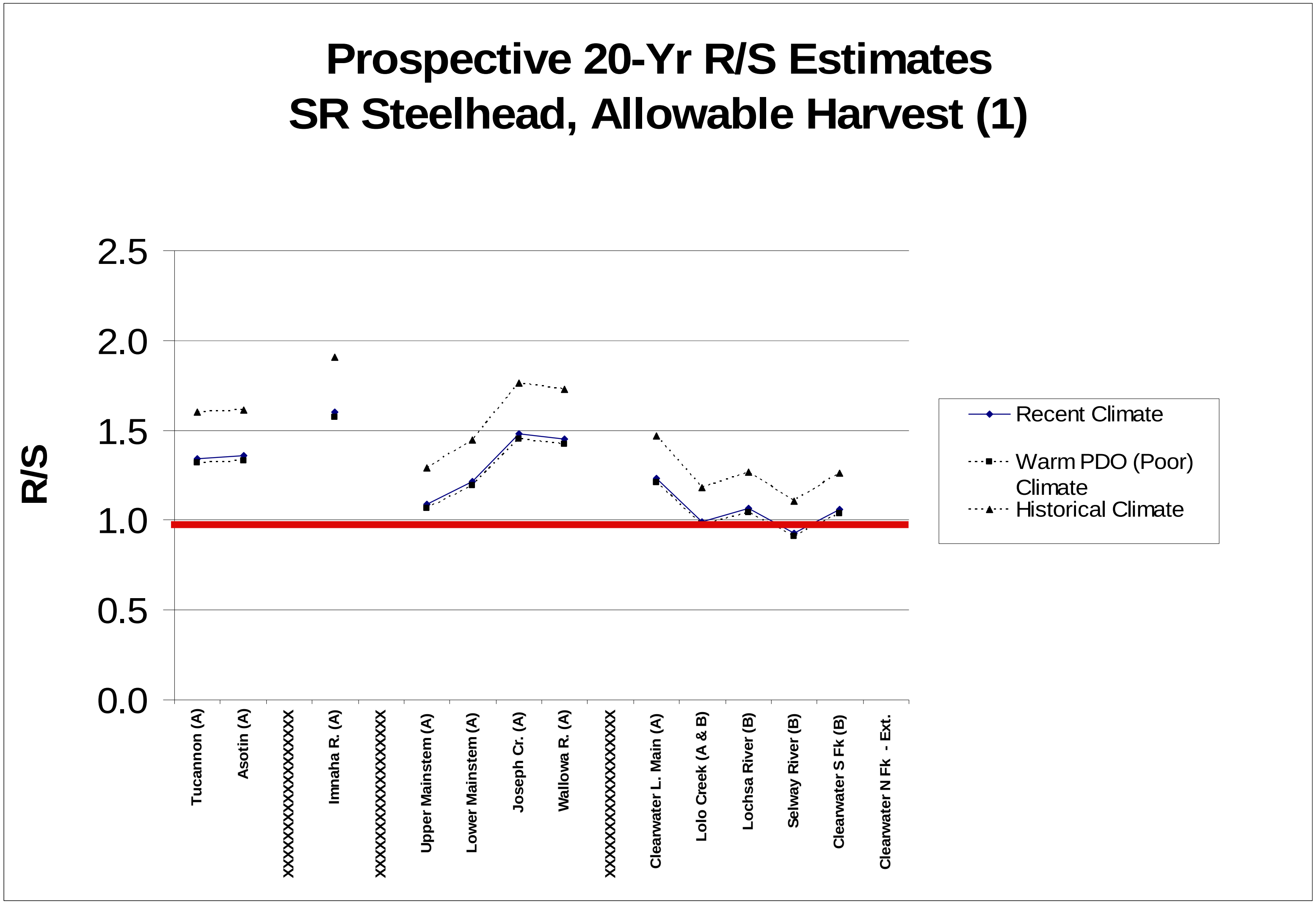
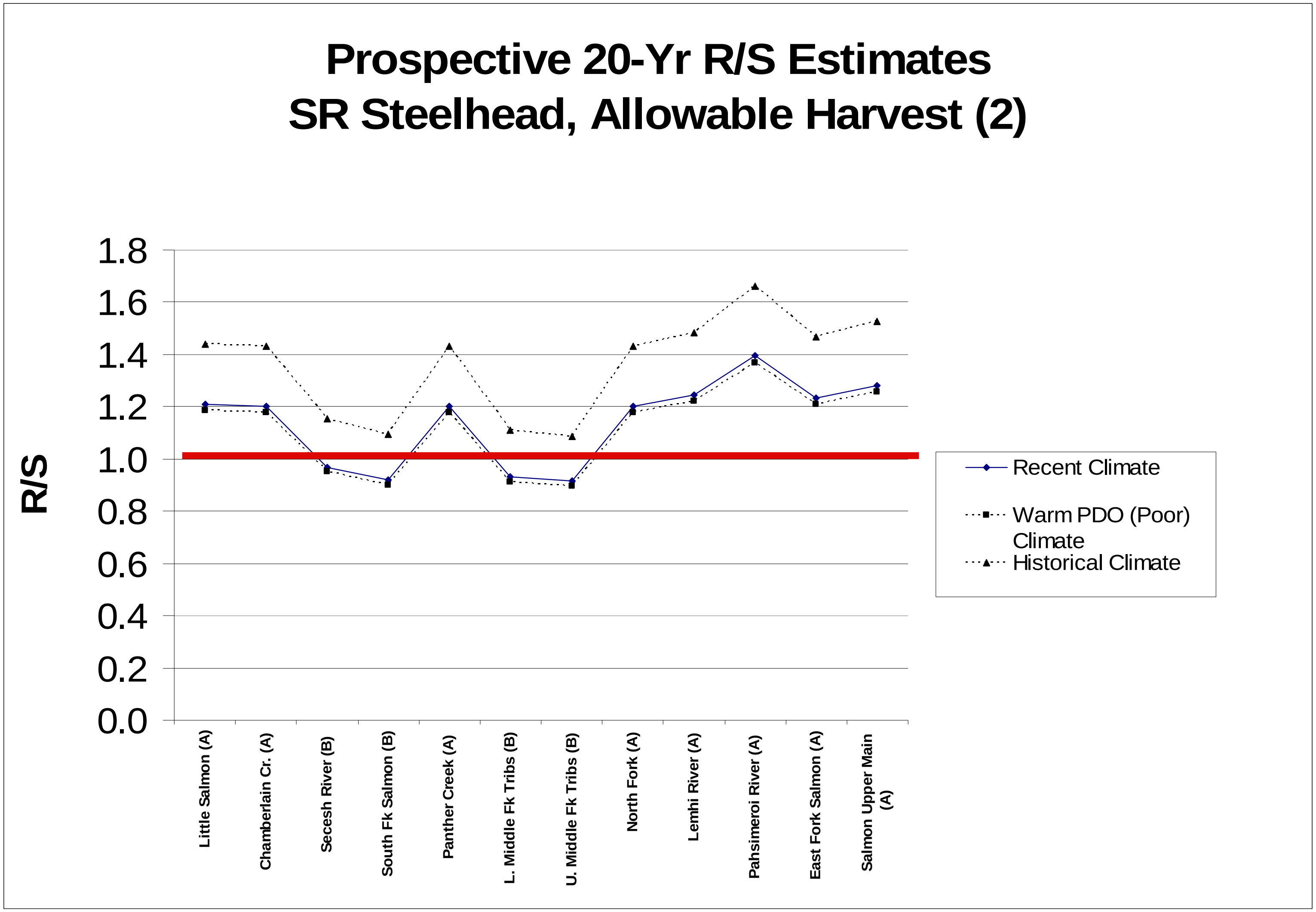


Figure 8.5.6-2. Continued.



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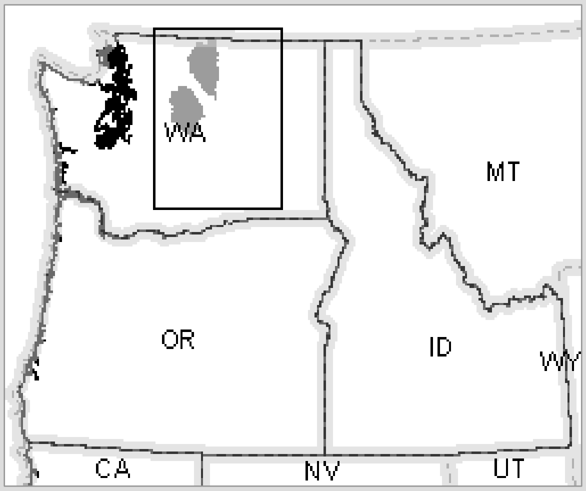
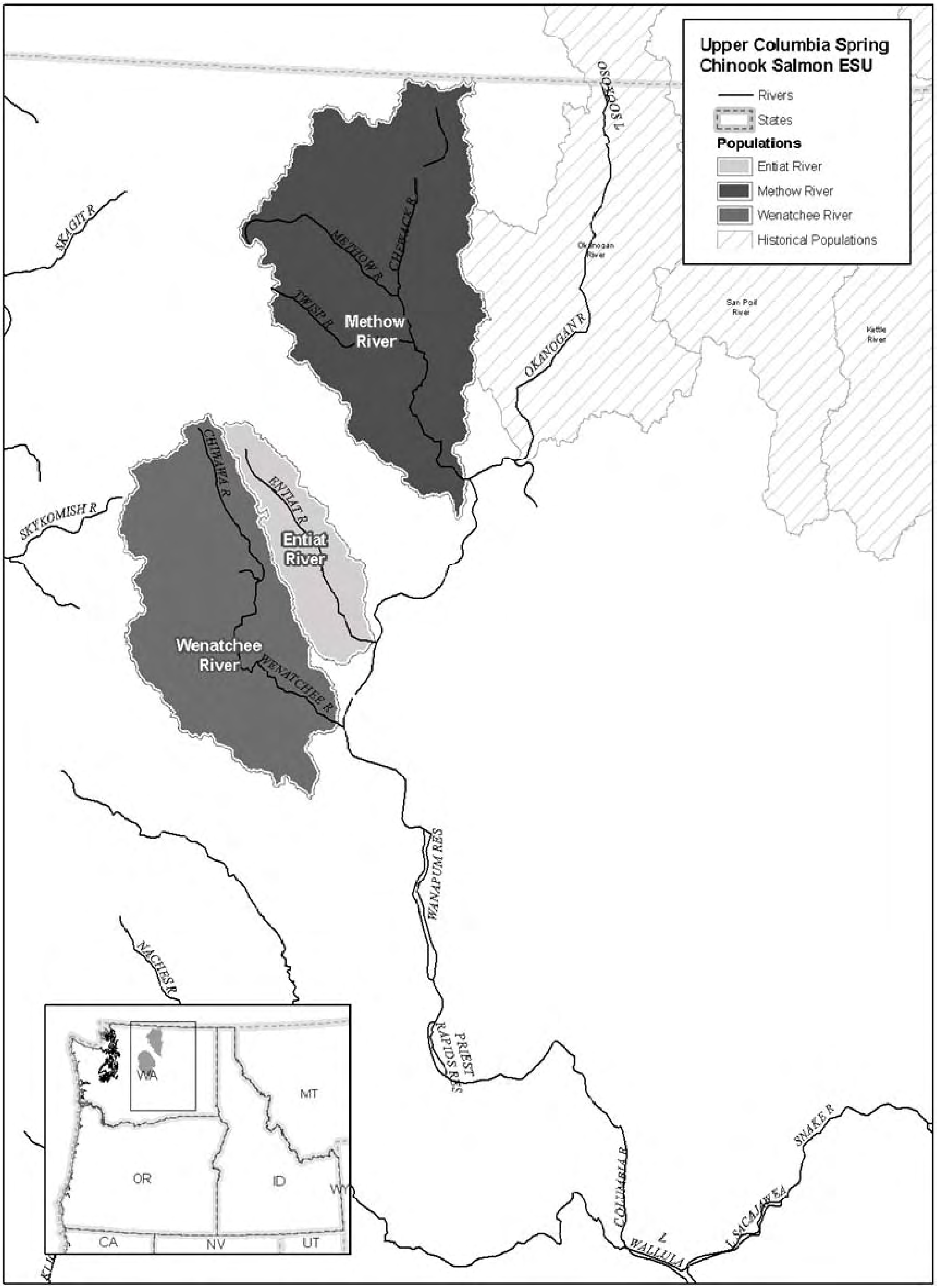
Section 8.6
Upper Columbia River Spring Chinook Salmon




Upper Columbia Spring Chinook Salmon ESU
Rivers
States
Populations
Entiat River
Methow River
Wenatchee River
Historical Populations
Methow River
Entiat River
Wenatchee River
METHOW R
CHEWACK R
TWISP R
CHIWAWA R
ENTIAT R
WENATCHEE R
SKAGIT R
SKYKOMISH R
OKANOGAN R
L OSOYOOS
NACHES R
WANAPUM RES
PRIEST RAPIDS RES
COLUMBIA R
L WALLULA
L SACAJAWEA
SNAKE R
WA
OR
ID
MT
CA
NV
UT

Section 8.6
Upper Columbia River Spring Chinook Salmon

Species Overview

Background

The Upper Columbia River (UCR) spring Chinook salmon ESU consists of one major population group (MPG) composed of three existing and one extinct population. These fish spawn and rear in the mainstem Columbia River and its tributaries between Rock Island and Chief Joseph dams. The latter, completed in 1961, now blocks the upriver migration of this species. For 20 years prior to that, migration was blocked by Grand Coulee Dam. Upper Columbia River spring Chinook were listed as endangered under the ESA in 1999, reaffirmed in 2005.

Designated critical habitat for UCR spring Chinook includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam and several tributary subbasins.

Current Status & Recent Trends

Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above (Wenatchee and Methow) or near (Entiat) the recovery abundance thresholds in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s. Jack counts in 2007, an indicator of future adult returns, were at the highest level since 1977.

Limiting Factors and Threats

The key limiting factors and threats for the UCR spring Chinook include hydropower projects, predation, harvest, hatchery effects, degraded estuary habitat, and degraded tributary habitat. Ocean conditions, which have also affected the status of this ESU generally have been poor over the last 20 years, improving only recently.

Recent Ocean and Mainstem Harvest

The ocean fishery mortality affecting Upper Columbia River spring Chinook is low, and for practical purposes, assumed to be zero. Incidental take occurs in spring season fisheries in the mainstem Columbia River, which are intended to target harvestable hatchery and natural-origin stocks. The fisheries were limited to assure that incidental take does not exceed a rate of 5.5 to 17%. The average take in recent years, however, has been 10.7%.

8.6.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is with the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.6.2.1 Current Rangewide Status of the Species

UCR spring Chinook is an endangered species composed of three extant populations in one major population group (MPG). All three populations must be viable to achieve the delisting criteria in the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007). Key statistics associated with the current status of UCR spring Chinook salmon are summarized in Tables 8.6.2-1 through 8.6.2-4.

Limiting Factors & Threats

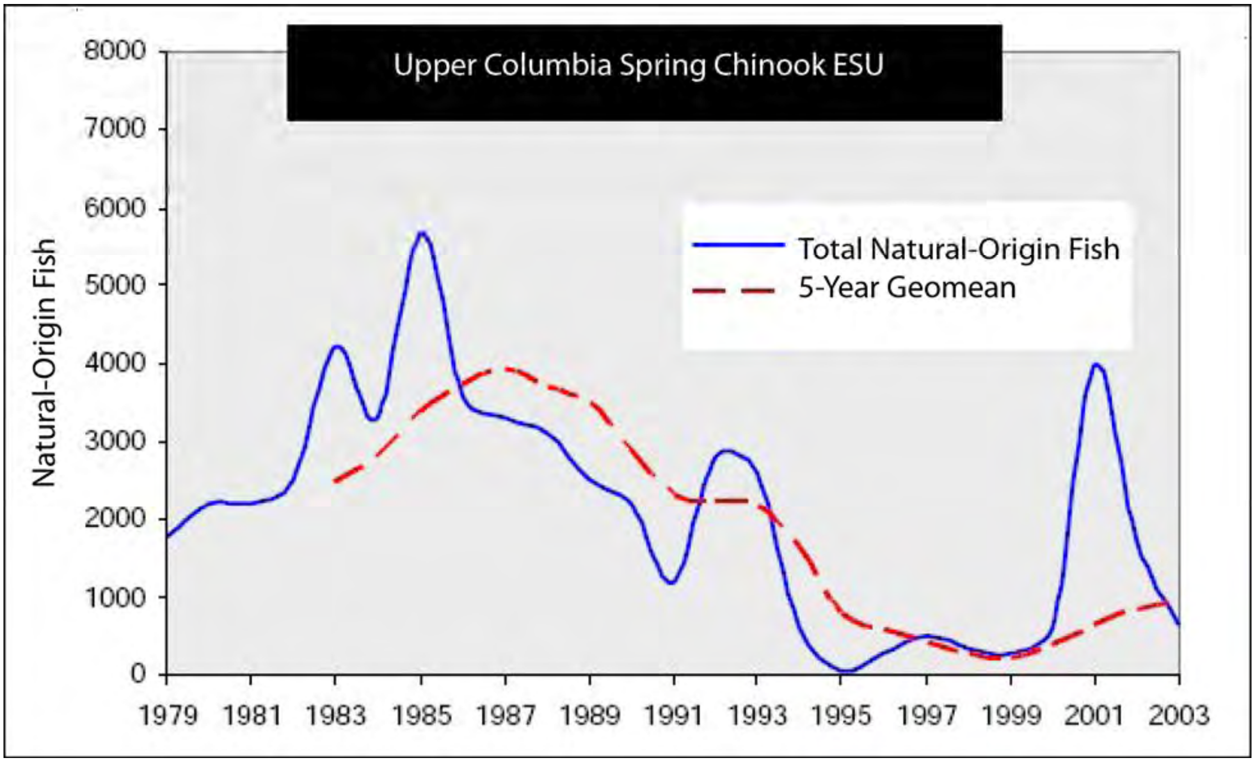
The key limiting factors and threats for the UCR spring Chinook include hydropower projects, predation, harvest, hatchery effects, degraded estuary habitat, and degraded tributary habitat. Ocean conditions have also affected the status of this ESU and generally have been poor for this ESU over the last 20 years, improving only in the last few years. Limiting factors are discussed in detail in the context of the conservation value of critical habitat in Section 8.6.3.3.

Abundance

For all populations, average abundance over the recent 10-year period is below the average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.6.2-1).[1] Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above (Wenatchee and Methow) or near (Entiat) the recovery abundance thresholds in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 8.6.1.1-1), which shows annual abundance of combined populations. The 5y-year geometric mean peaked in 1987, and continuously decreased until 1999 (Figure 8.6.1.1-1). The 5-year geometric mean remains low as of 2003 (Figure 8.6.1.1-1). Recently, 2007 UCR spring Chinook jack counts, an indicator of future adult returns, have increased to their highest level since 1977.

[1] BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for "no jeopardy" determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Figure 8.6.1.1-1. Upper Columbia River Spring Chinook Abundance Trends (Corps et al. 2007a, Chapter 8, Figure 8.2 showing annual abundance of combined populations).



"Base Period" Productivity

On average over the last 20 full brood year returns (1979-1998 brood years [BY], including adult returns through 2003), UCR spring Chinook populations have not replaced themselves (Table 8.6.2-1). This is true when only natural production is considered (i.e., average R/S has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries [ICTRT 2007d], updated with Cooney [2007b]).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at ≤5% extinction risk (ICTRT 2007c).

The BRT trend in abundance and median population growth rate (lambda) calculated with HF=1 also indicates a decline during this period for all three populations (Table 8.6.2-1). Lambda, when calculated with the HF=0 assumption, does indicate an increasing trend for the Methow population, but not for the Wenatchee and Entiat populations (Table 8.6.2-1). The HF=1 and the HF=0 lambda calculation assumptions are alternatives regarding the effectiveness of hatchery-origin natural spawners, relative to natural-origin natural spawners, as discussed in Section 7.1.1.2.

Spatial Structure

The ICTRT characterizes the spatial structure risk to UCR spring Chinook populations as “low” or “moderate” (Table 8.6.2-2).

Diversity

The ICTRT characterizes the diversity risk to all UCR spring Chinook populations as “high” (Table 8.6.2-2). The high risk is a result of reduced genetic diversity from homogenization of populations that occurred under the Grand Coulee Fish Maintenance Project in 1939-1943. In recent years, straying hatchery fish, compositing fish for broodstock, low proportion of natural-origin fish in some broodstocks and a high proportion of hatchery fish on the spawning grounds have contributed to the high genetic diversity risk. Discontinuation of the Entiat hatchery program in 2007 addresses a major limiting factor and is expected to benefit Entiat Chinook productivity and diversity.

“Base Period” Extinction Risk

The ICTRT Current Status Summaries (ICTRT 2007d) characterizes the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the “base period” described above for R/S productivity estimates, as “High” (>25% 100-year extinction risk) for all three UCR spring Chinook populations. The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. Table 8.6.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for the Wenatchee and Entiat populations. It is not possible to estimate short-term extinction risk for the Methow population using the methods employed in this analysis. This short-term extinction risk analysis is based also on the assumption that productivity observed during the “base period” will be unchanged in the future. At QET=50, the Wenatchee population has approximately a 2% risk while the Entiat population has greater than a 5% risk of extinction. Confidence limits on these estimates are extremely high, ranging from 0 to over 80% risk of extinction.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. At QET levels below 50 spawners, the results are more optimistic. The Entiat population has less than 5% risk of short-term extinction when QET=10 or less.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. When hatchery supplementation is assumed to continue at current levels for those populations affected by hatchery programs, short-term extinction risk is lower as evidenced by analyses for SR spring/summer Chinook, SR fall Chinook, and UCR steelhead (Hinrichsen 2008, included as Attachment 1 in the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival (See Table 7.4.1) necessary for quantitative indicators of productivity to be greater than 1.0 and for extinction risk to be less than 5% are displayed in Table 8.6.2-4. Mean base period R/S survival gaps range from 34-40%, lambda survival gaps range from no needed change to 54% needed survival improvement, and BRT trend survival gaps range from 37-69%. Because short-term extinction risk is <5% for the Wenatchee population, there is no extinction risk gap at QET=50. However, survival would have to improve approximately 47% for the Entiat population to have <5% risk at QET=50 and survival would have to improve 4% at QET=30.

8.6.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for UCR spring Chinook includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Methow, Upper Columbia/Entiat, and Wenatchee (NMFS 2005b). There are 31 watersheds within the range of this ESU. Five watersheds received a medium rating and 26 received a high rating of conservation value to the ESU (see Chapter 4 for more detail). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified above. This corridor 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. Of the 1,002 miles of habitat areas eligible for designation, 974 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.6.3.3.

8.6.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.6.3.1 "Current" Productivity & Extinction Risk under the Environmental Baseline

Because the action area as described in Chapter 5 encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk are based on performance of populations during a 20-year "base period," ending with the 1998 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone

Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, and since 1998, the Comprehensive Analysis includes estimates of a "base-to-current" survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7 of this document. Results are presented in this document, in Table 8.6.3-1.

Briefly, reduction in the average base period harvest rate (estimated to result in a 4% survival increase [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), improvements in both FCRPS and Public Utility District (PUD) dam configuration and operation (approximately a 24-43% survival increase, based on ICTRT base survival and COMPASS analysis of current survival in SCA Hydro Modeling Appendix), and estuary habitat projects (a less than 1% survival change, based on CA Appendix D) result in a survival improvement for all UCR spring Chinook populations. Tributary habitat projects and changes in hatchery operations result in approximately a 2% survival improvement for all three populations (Corps et al. 2007a Chapter 8, Table 8-5). In contrast, the development of tern colonies in the estuary in recent years results in less than 1% reduction in survival for all populations. Additionally, increased adult Chinook predation by marine mammals (primarily California sea lions) in the Columbia River immediately downstream of Bonneville Dam has resulted in approximately a 3% reduction in survival for UCR spring Chinook salmon populations (SCA Marine Mammal Appendix).

Hatchery programs have been operated in each of the three ESU populations, but their effect on the base-to-current status of each of these populations has varied. For more information, see the Salmonid Hatchery Inventory and Effects Evaluation Report (NMFS 2004b). Over the base period, hatchery programs in the Wenatchee have reduced short-term extinction risk on the one hand and have imposed hybridization and the loss of genetic variation on the other. In the Entiat, genetic studies have shown that the natural population has been subject to outbreeding depression because the Entiat National Fish Hatchery (NFH) used Carson stock fish for broodstock. This program was discontinued in 2007 and adult returns from the last juvenile releases in 2006 will cease after 2010. For the Methow, the threat of outbreeding depression has been reduced since the phasing-out of Carson broodstock beginning in 2001. The PUD-funded hatchery program in the Methow basin started in 1992, using local fish for broodstock. Over the base period, this program has reduced short-term extinction risk while it has imposed hybridization and the loss of genetic variation.

The CA (Corps et al. 2007a) assumes a 1% survival change for the Methow population, based on the Winthrop NFH transition from Carson stock to a local Methow stock. Although this is an improvement, it fails to fully complete the transition in broodstock practices for two reasons. First, both the NFH and the PUD programs still rely on a high percentage of hatchery-origin fish for broodstock, and second, they use a composite stock (i.e., a combination of Methow and Chewuch River fish). This practice homogenizes Methow Chinook, breaking down genetic differentiation and posing a continued risk to the fitness of the natural population. Therefore, the 1% survival benefit assumed in the CA/BA is not anticipated in the SCA.

The net result of all base-to-current changes is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 28-47%, depending on the particular population (Table 8.6.3-1). This also implies that the survival "gaps" described in Table 8.6.2-4 would be reduced proportionally by this amount (i.e., ["Gap" ÷ 1.28] to ["Gap" ÷ 1.47], depending on the population).

8.6.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section. For further detail please see the Rangewide Status section of this Chapter.

8.6.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as reducing the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by UCR spring Chinook salmon. Although land and water management activities have improved, factors such as dams, diversions, roads and railways, agriculture (including livestock grazing), residential development, and forest management continue to threaten the conservation value of critical habitat for this species in some locations in the upper Columbia basin.

Spawning & Rearing Areas

UCR spring Chinook spawn and rear in the major tributaries to the Columbia River between Rock Island and Chief Joseph dams. Adults reach the spawning areas from April through July and hold in tributaries until late summer. Spawning peaks in mid- to late-August (UCSRB 2007). The majority of juvenile spring Chinook rear in their natal tributaries, although a significant proportion (30-40%) emigrate downstream to the Wenatchee mainstem to complete freshwater rearing (ICTRT 2007d). Juvenile spring Chinook spend a year in freshwater before migrating to salt water in the spring of their second year of life. The following are the major factors that have limited the functioning and thus the conservation value of habitat used by UCR spring Chinook salmon for these purposes (i.e., spawning sites with water quantity and quality and substrate supporting spawning, incubation and larval development; rearing sites with water quality, water quantity, floodplain connectivity, forage, and natural cover allowing juveniles to access and use the areas needed to forage, grow, and develop behaviors that help ensure their survival):

- Physical passage barriers [*mortality at hydroelectric projects in the mainstem Columbia River; water withdrawals and unscreened diversions*]

- Excess sediment in spawning gravels and in substrates that support forage organisms [*land and water management activities*]

- Loss of habitat complexity, off-channel habitat and large, deep pools due to sedimentation and loss of pool-forming structures [*degraded riparian and channel function*]

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors for this ESU in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with improvements in PCE function accruing into the future.

Juvenile & Adult Migration Corridors

Adults begin to return from the ocean in early spring and enter upper Columbia tributaries during April through July. Juvenile spring Chinook migrate to salt water in the spring of their second year of life. Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers [*push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles*]

- Juvenile and adult passage mortality [*hydropower projects in the mainstem Columbia River*]

- Pinniped predation on adults due to habitat changes in the lower river [*existence and operation of Bonneville Dam*]

- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS migration corridor, the Action Agencies have improved safe passage through the hydrosystem for yearling Chinook with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville dams and other configuration improvements listed in section 5.3.1.1 in Corps et al. (2007a). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the absolute survival of spring-run Chinook by 5.5%. Thus, the continuing negative impact of sea lions will likely be approximately a 3% reduction from base period survival for spring Chinook populations.

The safe passage of yearling Chinook through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For these salmon, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 8.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although UCR spring Chinook spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River NMFS (2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.6.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Mainstem Mid-Columbia Hydroelectric Projects

NOAA Fisheries completed ESA Section 7(a)(2) consultations on its issuance of incidental take permits to Douglas and Chelan County Public Utility Districts in support of the proposed Anadromous Fish Agreements and Habitat Conservation Plans (HCPs) for the Wells, Rocky Reach, and Rock Island hydroelectric projects in the mid-Columbia reach on August 12, 2003. Under the HCPs, Douglas and Chelan County PUDs agreed to use a long-term adaptive management process to achieve a 91% combined adult and juvenile survival standard for each salmon and steelhead ESU migrating through each project. In addition, compensation for up to 9% unavoidable project mortality is provided through hatchery and tributary programs, with compensation for up to 7% mortality provided through hatchery programs and compensation for up to 2% provided through tributary habitat improvement programs.

In May 2004, NOAA Fisheries also completed an ESA Section 7 consultation on FERC’s proposed amendment to the existing license for the Grant County PUD’s Priest Rapids Hydroelectric Project, which permitted implementation of an interim protection plan, including interim operations for Wanapum and Priest Rapids dams. Under this biological opinion and incidental take statement, NOAA Fisheries expects that project-related mortalities (i.e., direct, indirect, and delayed mortality resulting from project effects) for both hydro projects combined will not exceed 24.5% for juvenile UCR spring Chinook salmon. NOAA Fisheries also expects that implementation of the interim protection plan will result in mortality rates of no more than 2% per project or 4% combined for adult UCR spring Chinook salmon.

Thus, NOAA Fisheries expects the cumulative mortality through the mid-Columbia reach of juvenile UCR spring Chinook to be 18% for the Wenatchee population; 24% for the Entiat population; and 27% for the Methow population. The total mortality rates (natural and project-related) of adult UCR spring Chinook salmon are expected to be 2% for adult spring Chinook returning to the Wenatchee and Entiat rivers and 3% for fish returning to the Methow.

Wenatchee River

A number of forest management activities relevant to this consultation have also undergone consultation and are included in the baseline. The USFS proposed fuels reduction projects in the White River – Little Wenatchee and Wenatchee River – Nason Creek watersheds, respectively, and a fire salvage timber sale in the Lower Wenatchee River watershed. The USFS also proposed a habitat restoration project in the Natapoc Ridge Forest (Wenatchee River – Nason Creek and Chiwawa River watersheds). The USFS' project to relocate White River Road and stabilize the streambank used large woody debris to increase habitat complexity (White River – Little Wenatchee River watershed). Another USFS project, replacing three culverts along Sand and Little Camas creeks (Lower Wenatchee River watershed), improved passage and partially restored natural channel-forming processes. The USFS completed one project 2007 under its programmatic consultation (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): a road decommissioning to improve riparian habitat and the connection to the floodplain along one mile of Clear Creek in the Chiwawa River watershed.

The FHWA/WSDOT consulted on a road construction project in the Wenatchee River – Icicle Creek watershed and a culvert replacement along Mill Creek (Wenatchee River – Nason Creek) to improve fish passage.

In the Lower Wenatchee watershed, NOAA Fisheries consulted on the restoration of off-channel habitat; the USFWS funded the installation of a fishway on Peshastin Creek, designed to provide access to spawning and rearing habitat; and the Corps consulted on a fish passage enhancement project. The Corps also proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River – Lynch Coulee, and Columbia River – Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River – Lynch Coulee and Columbia River – Sand Hollow mainstem reaches).

As part of the Grant PUD interim protection plan, NOAA Fisheries consulted with itself on the issuance of an ESA Section 10 permit issued jointly to Grant PUD, WDFW, and The Confederated Tribes and Bands of the Yakama Nation on the implementation of an artificial propagation (hatchery) program to supplement the spring Chinook salmon spawning aggregate in the White River.[2]

[2] Five major spawning areas contribute to the Wenatchee spring Chinook population. These are the White River, Chiwawa River, Nason Creek, Little Wenatchee River, and upper Wenatchee River spawning aggregates.

As part of the Chelan and Douglas PUD's HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the spawning aggregate in the Chiwawa River. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon and sockeye salmon and endangered steelhead in the Wenatchee basin, which could have effects on natural-origin spring Chinook, resulting in issuance of an ESA Section 10 permits. Inclusive with these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Wenatchee basin.

The USFW consulted on the implementation of a hatchery program rearing out-of-ESU Carson stock spring Chinook salmon at Leavenworth NFH to provide fish for terminal-area harvest. The BPA consulted on funding the Yakama Nation Tribes' hatchery program to reintroduce coho salmon to the Wenatchee basin. BPA underwent a separate consultation on the operation of a juvenile fish trap to monitor all salmonid species in Nason Creek.

Entiat River

The USFS proposed a campground and summer home vegetation management project in the lower Entiat River watershed and habitat restoration activities in the Columbia River – Lynch Coulee portion of the mainstem Columbia River. NOAA Fisheries consulted with itself on funding for a project in the lower Entiat River watershed that included building an overflow structure in an existing irrigation canal to improve fish passage; adding boulders and large wood to increase habitat complexity in a side channel; reconnecting the river and its floodplain; and enhancing the recruitment of spawning gravels.

The FHWA/WSDOT proposed road maintenance along State Route 28 (Sunset Highway), Eastside Corridor, East Wenatchee (Lake Entiat mainstem reach).

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River – Lynch Coulee, and Columbia River – Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River – Lynch Coulee and Columbia River – Sand Hollow mainstem reaches).

Methow River

The USFS consulted on a total of three timber sales in the Upper and Lower Chewuch and Twisp River watersheds; a grazing allotment plan for the Lower Chewuch and Middle Methow River watersheds; and a vegetation management plan for the Lower Methow River watershed. The USFS also consulted on projects to restore habitat damaged by grazing in the Lower Chewuch River watershed, improve passage (by replacing a diversion dam) into seven miles of Little Bridge Creek (Twisp River watershed), and modify an irrigation ditch for access to nine miles of habitat in a wilderness area (Middle Methow River watershed). The USFS completed two projects during 2007 under its programmatic consultation with NOAA Fisheries (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): decommissioning and relocating the Twisp

River/North Creek Trail to improve five acres of riparian habitat and installing a culvert in Reynolds Creek to allow access to four miles of stream.

Reclamation consulted on leasing water from the Chewuch Canal Company (Lower Chewuch River watershed) to improve instream flows. The FHWA/WSDOT proposed a bridge rehabilitation project on Buttermilk Creek Road in the Twisp River watershed.

The FERC consulted on a license amendment for the Wells hydroelectric project—land easements for 11 irrigation diversions from Lake Entiat with new or improved fish screens.

As part of the Chelan and Douglas PUD's HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the spawning aggregates in the Methow, Chewuch, and Twisp Rivers. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon, and endangered steelhead in the Methow basin, which could have effects on natural-origin spring Chinook. These consultations resulted in the issuance of an ESA Section 10 permit. Inclusive with these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Methow basin.

The USFWS consulted on the implementation of a supplementation hatchery program rearing listed spring Chinook salmon at Winthrop NFH. They also consulted on the implementation of a hatchery program rearing listed UCR steelhead at Winthrop NFH.

The BPA consulted on funding the Yakama Nation Tribes' hatchery program to reintroduce Coho salmon to the Methow basin. Reintroduction could effect the natural population of spring Chinook salmon in the basin.

Projects Affecting Multiple Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.6.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of UCR spring Chinook salmon that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and increase instream flows. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects such as hydroelectric generation (including the FERC-licensed hydro projects in the mid-Columbia River), forest thinning, road construction/maintenance, dock and pier construction, hatchery programs, and grazing will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PCEs. However, all of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.6.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect one or more of the listed species or associated critical habitat in the Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Entiat, Methow, and Wenatchee populations as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.[3] Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to significantly improve conditions for Upper Columbia River spring Chinook. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

[3] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

8.6.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.6.5.1, 8.6.5.2, and 8.6.5.5. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions, which are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in this section. There are no Federal safety-net hatchery programs for UCR spring Chinook salmon.

8.6.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the Prospective Actions effects in the productivity and extinction risk analysis (See SCA Sections 7.2.1 and 8.1.1.3)

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions is expected to increase the in-river survival (McNary to the Bonneville tailrace) of UCR spring Chinook salmon from 66.7% (Current) to 72.6% (Prospective), a relative change of 8.8% (SCA Hydro Modeling Appendix).[4] Transportation at McNary Dam is only expected to occur in 1 of 70 years, < 2% of the time, when flows at McNary are less than 125 kcfs. In this unlikely circumstance, about 70.6% of the juveniles arriving at McNary Dam would be transported (see Table 11.7 of the FCRPS Biological Opinion). Based on the very positive benefits observed from transportation study results from the Snake River during the extremely low flow conditions of 2001, NOAA Fisheries anticipates a similar, albeit somewhat smaller benefit, would exist from transportation at McNary Dam.

The COMPASS model estimates, combined with in-river migrant survivals through the non-Federal mainstem projects and smolt-to-adult returns (McNary Dam to the ocean and back to Rock Island Dam (assuming SR spring/summer Chinook salmon post-Bonneville survival relationships as a surrogate) will likely increase from about 0.58 to 0.63% (a relative improvement of 8.5%) for

[4] For UCR spring Chinook salmon, the in-river survival estimate and total system survival estimate are virtually identical because fish are not likely to be transported in 69 out of 70 years (>98% of the time) in the 70-year water record.

Wenatchee River fish; 0.53 to 0.58% (a relative improvement of 9.6%) for Entiat River fish; and 0.51 to 0.56% (a relative improvement of 9.7%) for Methow and Okanogan River fish. These increases are a result of the Prospective Actions and mid-Columbia PUD actions being implemented.

This improvement, combined with the expected survival improvements resulting from actions being implemented as a result of the completed biological opinions on the existence and operation of the five mid-Columbia mainstem projects (NMFS 2006e and SCA Hydro Modeling Appendix,) are expected to increase the relative survival of in-river migrants to the Bonneville tailrace by 8.8% (Wenatchee population) and 10.0% (Entiat, Methow, and Okanogan populations).

The Prospective Actions addressing hydro operation and the RM&E program should maintain the high levels of survival currently observed for adult UCR spring Chinook salmon migrating from Bonneville Dam upstream to McNary Dam. The current PIT tag based survival estimate, taking account of harvest and "natural" stray rates within this reach, is 90.1% (about 96.6% per project) (BA Table 2.1). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to McNary Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The Prospective Hydro Actions are also likely to positively affect the survival of UCR spring Chinook salmon, as a result of the construction of gas abatement structures at Chief Joseph Dam (reduction of future total dissolved gas levels), in ways that are not included in the quantitative analysis. NOAA Fisheries considers these expected benefits, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects. This is likely to result in survival improvements in the forebays of these projects, where predation rates often are currently the highest (see Section 8.1.1). Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from McNary Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem's effects on water quality, water quantity, water velocity, project injury and mortality, and predation, will increase to 72.6%. A portion of the 27.4% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling Chinook would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of yearling UCR spring Chinook in a hypothetical, unimpounded Columbia River from McNary Dam to Bonneville Dam would be 89.5%. Therefore, approximately 38.3% (10.5%/27.4%) of the mortality experienced by in-river migrating juvenile Chinook salmon is probably due to natural factors.

The direct survival rate of adults through the FCRPS is already relatively high. The prospective actions include additional passage improvements (to the ladders at John Day and McNary dams and other improvements. Adult spring Chinook survival from Bonneville to Priest Rapids Dam will be approximately 90.1% under the Prospective Actions.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. Shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit the yearling migrants in the lower Columbia River, reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.6.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the functioning of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Wenatchee population by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2006b).

8.6.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Chapter 8, Table 8-7, p. 8-12. For targeted populations in this ESU the effect is a 3 to 22% expected increase in low density egg-smolt survival, depending on population, as a result of implementing tributary habitat Prospective Actions that improve habitat function by addressing significant limiting factors and threats.[5] For example, the Action Agencies will address limiting factors by replacing barrier culverts and screen irrigation pumps in the Wenatchee, Entiat, and Methow subbasins (Table 1-b in Attachment B.2.2-2 to Corps et al. 2007b). These passage projects in many instances will enable juvenile spring-run Chinook to access rearing habitat in tributaries that are too small to support spawning, but are generally more productive per unit area for rearing than are mainstem settings. The Action Agencies will also fund channel complexity projects and restore streamflows. Channel complexity projects include reconnecting oxbows that were isolated by highway and railroad construction in the Upper Wenatchee (Nason Creek in particular) and reconnecting small side channel habitats in the Methow and Entiat that have been stranded as a consequence of mainstem channel incision.

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[5] The Action Agencies identified the projects that will improve these PCEs and that they will fund by 2009 in Tables 1a and 5a,b in Attachment B.2.2-2 to Corps et al. (2007b).

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access.

Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.6.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Upper Columbia River Spring-run Chinook (stream-type life history) associated with the specific Prospective Actions to be implemented from 2007-2010 is 1.4%. The survival benefit for Upper Columbia River Spring-run Chinook (stream-type life history) associated with actions to be implemented from 2010 through 2018 is 4.3%. The total survival benefit for Upper Columbia River Spring-run Chinook as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats is approximately 5.7% (Chapter 8.3.3.3 in Corps et al. 2007a). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will provide habitats needed by yearling Chinook migrants from the upper Columbia River to increase life history diversity and spatial structure. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the conservation value of the estuary as habitat for this species (Section 8.3.3.3 in Corps et at. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by yearling Chinook from the upper Columbia River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (Section 8.6.5.2).

8.6.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

A qualitative assessment of the Prospective Actions was provided in Section 8.3.3.5, page 8-15, of the CA. The hatchery Prospective Actions consist of continued funding of hatcheries as well as reforms to current federally funded programs that will be identified in future ESA consultations (see Tier 2 actions in the BA).

The Prospective Actions require the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs (see Appendix E of Corps et al. 2007a and SCA Artificial Propagation for Pacific Salmon Appendix) NOAA Fisheries cannot consult on the operation of existing or new programs until Hatchery and Genetic Management Plans are updated and consultation is initiated (consultations will be initiated and submitted to NOAA Fisheries by January 2009 and completed by July 2009). The FCRPS Action Agencies intend to adopt this programmatic criteria for funding decisions on future mitigation programs for the FCRPS that incorporate BMPs, and site specific application of BMPs, will be defined in ESA Section 7, Section 10, and Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the FCRPS Action Agencies as cooperating agencies (FCRPS Biological Assessment, page 2-44). Available information, principles, and guidance for operating hatchery programs are described in Appendix E of the CA and Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPS are expected to: 1) integrate hatchery mitigation and conservation objectives; 2) preserve genetic resources; and 3) accelerate trends toward recovery as limiting factors and threats are fixed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.6.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

Under the Prospective Action the harvest of UCR spring Chinook will vary from year-to-year depending on an abundance-based harvest rate schedule (Table 8.6.5.5-1). Harvest will depend on the total abundance of upriver spring, natural-origin SR spring/summer Chinook, and may be further limited by natural-origin Upper Columbia River spring Chinook (see Table 8.6.5.5-1 footnote 4). The allowable harvest rate will range from 5.5 to 17%. As indicated in Table 8.6.5.5-1, most of the prospective harvest will occur in treaty Indian fisheries.

Table 8.6.5.1-1. Abundance-based harvest rate schedule for upriver spring Chinook and Snake River spring/summer Chinook in spring management period fisheries (TAC 2008).

Harvest Rate Schedule for Chinook in Spring Management Period					
Total Upriver Spring and Snake River Summer Chinook Run Size	**Snake River Natural Spring/Summer Chinook Run Size[1]**	**Treaty Zone 6 Total Harvest Rate[2,5]**	**Non-Treaty Natural Harvest Rate[3]**	**Total Natural Harvest Rate[4]**	**Non-Treaty Natural Limited Harvest Rate[4]**
<27,000	<2,700	5.0%	<0.5%	<5.5%	0.5%
27,000	2,700	5.0%	0.5%	5.5%	0.5%
33,000	3,300	5.0%	1.0%	6.0%	0.5%
44,000	4,400	6.0%	1.0%	7.0%	0.5%
55,000	5,500	7.0%	1.5%	8.5%	1.0%
82,000	8,200	7.4%	1.6%	9.0%	1.5%
109,000	10,900	8.3%	1.7%	10.0%	
141,000	14,100	9.1%	1.9%	11.0%	
217,000	21,700	10.0%	2.0%	12.0%	
271,000	27,100	10.8%	2.2%	13.0%	
326,000	32,600	11.7%	2.3%	14.0%	
380,000	38,000	12.5%	2.5%	15.0%	
434,000	43,400	13.4%	2.6%	16.0%	
488,000	48,800	14.3%	2.7%	17.0%	

1. If the Snake River natural spring/summer forecast is less than 10% of the total upriver run size, the allowable mortality rate will be based on the Snake River natural spring/summer Chinook run size. In the event the total forecast is less than 27,000 or the Snake River natural spring/summer forecast is less than 2,700, Oregon and Washington would keep their mortality rate below 0.5% and attempt to keep actual mortalities as close to zero as possible while maintaining minimal fisheries targeting other harvestable runs.
2. Treaty Fisheries include: Zone 6 Ceremonial, subsistence, and commercial fisheries from January 1-June 15. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.
3. Non-Treaty Fisheries include: Commercial and recreational fisheries in Zones 1-5 and mainstem recreational fisheries from Bonneville Dam upstream to the Hwy 395 Bridge in the Tri-Cities and commercial and recreation SAFE (Selective Areas Fisheries Evaluation) fisheries from January 1-June 15; Wanapum tribal fisheries, and Snake River mainstem recreational fisheries upstream to the Washington-Idaho border from April through June. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.
4. If the Upper Columbia River natural spring Chinook forecast is less than 1,000, then the total allowable mortality for treaty and non-treaty fisheries combined would be restricted to 9% or less. Whenever Upper Columbia River natural fish restrict the total allowable mortality rate to 9% or less, then non-treaty fisheries would transfer 0.5% harvest rate to treaty fisheries. In no event would non-treaty fisheries go below 0.5%

harvest rate.
5. The Treaty Tribes and the States of Oregon and Washington may agree to a fishery for the Treaty Tribes below Bonneville Dam not to exceed the harvest rates provided for in this Agreement.

The prospective harvest schedule is similar to that used in 2001, as well as in the most recent 2005 to 2007 Agreement. Since 2001, the allowable harvest rates ranged from 5.5 to 17%. The 2001 schedule did not include SR summer Chinook as part of the abundance indicator. The 2005 schedule was modified to included SR summer Chinook, but the abundance levels were adjusted accordingly to provide a comparable level of harvest for the adjusted run size. The harvest rate schedule proposed for use in 2008 and beyond differs from the 2005 schedule only in that it adjusts the allocations between the treaty-Indian and non-treaty fisheries.

Harvest rates under the Prospective Actions will be the same as they have been in recent years. Therefore, no additional current-to-future survival adjustment is necessary for the prospective harvest action for this species.

It is also pertinent to consider the potential effects of conservative management. Fisheries directed at upriver spring Chinook can be managed with relative precision. Catch is tracked on a daily basis, and runsize estimates can be adjusted in-season using counts at Bonneville dam. Since 2001, actual harvest rates have ranged between 1.1 and 2.6% less then those allowed (Table 8.3.5.5-2). Any analysis that assumes that the allowed harvest rates will always be fully used would therefore be conservative.

Table 8.6.5.5-2. Actual harvest rate on UCR spring Chinook, and those allowed under the applicable abundance based harvest rate schedule (Actual HR from TAC 2008).

Year	Actual HR (%)	Allowed HR (%)	Difference (%)
2001	14.6	16.0	1.4
2002	12.7	14.0	1.3
2003	9.4	12.0	2.6
2004	10.8	12.0	1.2
2005	7.9	9.0	1.1
2006	8.0	10.0	2.0

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, identified as a limiting factor for the Wenatchee population (Habitat Technical Subgroup 2006b).

8.6.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Upper Columbia River spring-run Chinook from reduction in Caspian tern nesting habitat on East Sand Island and relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 2.1% (CA Attachment F-2, Table 4). Compensatory mortality may occur, but based on the discussion in 8.3.5.6, it is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (Corps et al. 2007a Appendix F). Continued implementation and improvement of avian deterrence at all lower Columbia River dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island will further reduce predation on yearling Chinook, improving the status of safe passage in the juvenile migration corridor. These fish migrate over the deep water channel adjacent to the East Sand Island colony, which has made them especially vulnerable to predation. The benefit of this action will be long term.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery, and continued implementation and improvement of avian deterrence at mainstem dams are expected to improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.6.5.7 Effects of Research & Monitoring Prospective Actions

See Section 8.1.4 of this document.

8.6.5.8 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to the estimation of base-to-current survival improvements. The estimates of "prospective" expected survival changes resulting from the action are described in Sections 8.6.5.1 through 8.6.5.8 and are summarized in Table 8.6.5-1. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the ESU. Tributary habitat improvement projects are also expected to increase survival for all three populations. The net effect, which varies by population, is 22-46% increased survival, compared to the "current" condition, and 56-99% increased survival, compared to the "base" condition.

8.6.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.6.6-1 and 8.6.6-2 and in Figures 8.6.6-1 through 8.6.6-4. In addition to these summary tables and figures, the SCA Life Cycle Modeling Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and ESU level.

8.6.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized by Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and ESU viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

The Eastern Cascades MPG is the only MPG within the Upper Columbia River Spring Chinook ESU. Because there is only one MPG, Section 8.6.7 applies to both the Eastern Cascades MPG and the entire Upper Columbia River Spring Chinook ESU. As described in Section 8.6.2.1, all three populations must be viable to achieve the delisting criteria in the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007).

8.6.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Upper Columbia River Spring Chinook ESU

This section summarizes the basis for conclusions at the ESU level.

8.6.7.1 Potential for Recovery

It is likely that the Upper Columbia River Chinook ESU will trend toward recovery.

The future status of all three extant populations and the single MPG of UCR Chinook will be improved compared to their current status. This will be done through a reduction of adverse effects of the FCRPS and Upper Snake projects, as well as the implementation of Prospective Actions with beneficial effects, as described in Sections 8.6.5, 8.6.6, and 8.6.7.2. These beneficial actions include reduction of avian and fish predation, estuary habitat improvements, hatchery reform and tributary habitat improvements for each population. Therefore, the status of the ESU as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.6.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this ESU.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.6.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatcheries, and degradation of tributary and estuary habitat. The ICTRT has indicated concerns for all three populations relative to high diversity risk, including legacy effects of historical hatchery practices. The Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce the likelihood of longer-term problems associated with continuing hatchery programs although subject to future hatchery-specific consultations after which these benefits may be realized. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions appropriately considered cumulative effects also address limiting factors and threats. The harvest Prospective Action is to implement a *U.S. v. Oregon* harvest rate schedule that is expected to result in no change from the current harvest rates in the environmental baseline.

Some of the problems limiting recovery of UCR Chinook, such as the effects of legacy hatchery practices, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements that reasonably can be implemented within the next 10 years.

Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

In sum, these qualitative considerations suggest that the UCR Chinook ESU will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of some of the metrics indicating a trend toward recovery also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, such as those affecting all three extant UCR Chinook populations (Section 8.6.5.4), but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S calculations incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

R/S is expected to be greater than 1.0 for all three UCR Chinook populations after implementation of the Prospective Actions (Table 8.6.6.1-1, Figure 8.6.6-1).

Population growth rate (lambda) and BRT trend estimates are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. These estimates require fewer assumptions and less data than R/S estimates, but may also be limited by data quality. All three populations in this ESU are expected to have lambda greater than 1.0 and two of three populations are expected to have a BRT trend greater than 1.0 (Table 8.6.6-1). This indicates that in general these populations are expected to continue to increase in abundance in the future. In contrast to R/S estimates, the lambda and BRT trend estimates are at least partially explained by second generation hatchery progeny (F_2 generation) spawning naturally.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S, lambda, and BRT trend may be low.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate and its effects on early ocean survival will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT "historical" scenario, all three metrics are expected to be greater than 1.0 for all three populations (SCA Aggregate Analysis Appendix; Figure 8.6.6-2). With the "Warm PDO" (poor) ocean scenario, all three populations are expected to have R/S greater than 1.0, two of three populations are expected to have BRT trend and lambda (HF=0) greater than 1.0, and no populations are expected to have lambda greater than 1.0 if hatchery-origin spawners are assumed equally as effective as natural-origin spawners.

- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, all three metrics are expected to be less than 1.0 at the lower 95% confidence limit and greater than 1.0 at the upper 95% confidence limit for all populations (SCA Aggregate Analysis Appendix; Figure 8.6.6-1). These results suggest that it also is important to consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors indicates that the ESU as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements.

Quantitative estimates indicate that all UCR Chinook populations will be increasing (indicated by R/S) as a result of the actions considered in the aggregate analysis. It is also likely that abundance will increase given the aggregate effects, including a continuing supplementation program (indicated by BRT trend and lambda).

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the ESU being on a trend toward recovery.

8.6.7.2 Short-term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Action and a continuation of other current management actions, as described above and in Section 8.6.5.

As described above and in Section 8.6.7.1, abundance is expected to be stable or increasing and populations are expected to grow as indicated by R/S, lambda, and two of three BRT trend estimates. Recent abundance levels are estimated between 59 and 222 spawners, depending on population, which is above the QET levels under consideration (Table 8.6.2-1). These factors also indicate a decreasing risk of extinction.

Continuing hatchery reforms will likely contribute to reduced risk and improving viability for all three Chinook populations in this ESU through hatchery reform generally will be analyzed in future consultations, as described above. However, some important changes are already taking place (e.g., discontinued use of Carson stock in the Entiat). For the Wenatchee population, the White River spawning area is one of the only locations with any evidence of genetic differentiation from other areas in the entire Upper Columbia ESU (ICTRT 2007b), and investments in the White River program are expected to decrease extinction risks associated with spatial distribution and diversity and buffer the Wenatchee population against environmental variability. For the Entiat, the hatchery program using incompatible Carson stock fish was discontinued in 2007. This was identified as a major limiting factor for Entiat spring Chinook. Adult returns from juvenile releases prior to 2007 should cease after 2010 and the fitness of Entiat spring Chinook is expected to improve as hatchery returns and outbreeding depression declines. For the Methow, the threat of outbreeding depression and reduced fitness is declining since the phasing-out of Carson broodstock beginning in 2001. Additional reforms would reduce threats to genetic diversity within the Methow population that can buffer the population from fluctuations in environmental conditions and to fitness reductions when a high proportion of the natural spawners are of hatchery-origin. New ESA consultations for Action Agency funded hatchery programs leading to the implementation of more hatchery reform are to be completed by June 2009 and NOAA Fisheries guidance (Artificial Propagation for Pacific Salmon Appendix) is expected to help shape those consultations.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

Quantitative estimates of extinction risk indicate <5% risk at QET=50 for the Wenatchee population, regardless of the schedule for implementing the Prospective Actions (Table 8.6.1-2; Figure 8.6.6-3). No quantitative estimates are available for the Methow population, but because its abundance and trend are similar to that of the Wenatchee population, it is likely to have similar extinction risk. For the Entiat, estimated short-term extinction risk is <5% at QET=50, if all Prospective Actions are assumed to occur immediately, and >5% if no Prospective Actions occur immediately (Table 8.6.6.1-2). An additional 8% survival change is needed to reduce extinction risk to <5% under the latter assumption. Implementation of all Prospective Actions is expected to result in an additional 46% survival improvement for this population (Table 8.6.5-1).

These estimates assume no continued supplementation and assume that the population will be extinct if it falls below 50 fish for four years in a row (QET=50). It is likely that short-term extinction risk is lower than that calculated above when continued supplementation is considered (see, for example, the UCR steelhead analysis in Section 8.7.7 and Hinrichsen 2008, which is Attachment 1 to the Aggregate Analysis Appendix), but such an analysis was not conducted for this ESU. Similarly, as discussed in Section 7.1.1, QET levels less than 50 may be relevant to short-term extinction risk, particularly for smaller populations like the Entiat. Short-term extinction risk for the Entiat under continuing current management conditions is expected to be less than 5% at QET levels of 30 spawners or less (Table 8.6.5-1; Figure 8.6.6-3).

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While NOAA Fisheries does not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0% to approximately 80% at QET=50 (Table 8.6.2-3). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

This summary of quantitative extinction risk estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario both populations are expected to have ≤ 5% risk at QET=50 (Aggregate Analysis Appendix; Figure 8.6.6-4). Under the ICTRT "Warm PDO" climate scenario, in which all years are anomalously warm, the results are very similar to those under the "recent" climate scenario, as described above.

Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

Taken together, the combination of all the factors above indicates that the ESU as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered, along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in a lower short-term extinction risk than in recent years. Quantitative estimates available for two populations indicate that UCR Chinook from the Wenatchee population will have a low risk even without implementation of any Prospective Actions, while some improvements would need to occur quickly for the Entiat population to have low risk at QET=50. Only about one-sixth of the survival improvement expected from the Prospective Action would need to occur quickly, which is a reasonable expectation given the nature of several of the actions. No Prospective Actions would be needed for low short-term risk of the Entiat population at QET=30. Because of similar abundance and trends, the Methow population likely has similar extinction risk as the Wenatchee population. Additionally, it is likely that short-term extinction risk in the Methow and Wenatchee is low given continuation of current supplementation programs. The combination of recent abundance estimates, expected survival improvements, expected positive trends for these populations, and supplementation programs that reduce short-term risk indicate the three populations in this ESU are likely to have a low enough risk of extinction to conclude that the ESU as a whole will have a low risk of short-term extinction.

8.6.7.3 Effect of Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for UCR spring Chinook salmon including all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Methow, Upper Columbia/Entiat, and Wenatchee. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for UCR spring Chinook. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Columbia River; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, and excess sediment in gravel in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at McNary and John Day dams, in concert with training spill to provide safe egress provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat spring Chinook in the tailrace of Bonneville Dam will do the same for adults. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v Oregon* Agreement, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Upper Columbia River Spring Chinook ESU is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Upper Columbia Spring Chinook ESU nor result in the destruction or adverse modification of its designated critical habitat

Table 8.6.2-1. Status of UCR spring Chinook salmon with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

			Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
ESU	MPG	Population	Most Recent 10-yr Geomean Abundance[1]	Years Included In Geomean	ICTRT Recovery Abundance Threshold[1]	Average R/S: 20-yr non-SAR adj.; non-delimited[2]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0)[3]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1)[3]	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current[4]	Lower 95% CI	Upper 95% CI
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	222	1994-2003	2000	0.75	0.46	1.22	0.96	0.61	1.51	0.91	0.61	1.36	0.89	0.83	0.95
		Methow R.	180	1994-2003	2000	0.73	0.42	1.27	1.02	0.59	1.78	0.94	0.58	1.53	0.90	0.80	1.01
		Entiat R.	59	1994-2003	500	0.72	0.49	1.05	0.97	0.72	1.31	0.92	0.71	1.21	0.93	0.89	0.98
		Okanogan R. (extirpated)															

1 Most recent year for 10-year geometric mean abundance is 2003. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from ICTRT (2007c).
2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 brood years in Cooney (2007). Actual years in average vary by population.
3 Median population growth rate (lambda) during the most recent period of approximately 20 years. Actual years in estimate vary by population. Lambda estimates are from Cooney (2008c).
4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008c).

Table 8.6.2-2. Status of UCR spring Chinook salmon with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure[1]	ICTRT Current Risk For Diversity[1]	10-yr Average % Natural-Origin Spawners[2]
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops hatchery straying; high proportion hatchery fish)	0.62
		Methow R.	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops hatchery straying; high proportion hatchery fish)	0.52
		Entiat R.	Currently Moderate Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops hatchery straying; high proportion hatchery fish)	0.69
		Okanogan R. (extirpated)			

1 ICTRT conclusions for UCR spring Chinook are from ICTRT Current Status Summaries (ICTRT 2007d)
2 Average fractions of natural-origin natural spawners are from ICTRT (2007c).

Table 8.6.2-3. Status of UCR spring Chinook salmon with respect to extinction risk. Extinction risk is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

			24-Year Extinction Risk											
ESU	MPG	Population	Risk (QET=1)[1]	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10)[1]	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30)[1]	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50)[1]	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	0.00	0.00	0.42	0.00	0.00	0.64	0.01	0.00	0.78	0.02	0.00	0.82
		Methow R.												
		Entiat R.	0.00	0.00	0.18	0.01	0.00	0.42	0.07	0.00	0.69	0.19	0.00	0.82
		Okanogan R. (extirpated)												

1 Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

Table 8.6.2-4. Changes in density-independent survival ("gaps") necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for UCR spring Chinook salmon. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated "gaps" are based on population performance during the "base period" of approximately the last 20 brood years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0[1]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0@ HF=1[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0[3]	Upper 95% CI	Lower 95% CI	Survival Gap for 24-Yr Ext. Risk <5% (QET=1)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=10)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=30)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=50)[4]
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.34	2.17	0.82	1.23	9.60	0.16	1.54	9.53	0.87	1.69	2.28	1.26	0.13	0.29	0.49	0.65
		Methow R.	1.37	2.40	0.79	0.90	10.91	0.07	1.30	11.34	1.00	1.63	2.75	0.96				
		Entiat R.	1.40	2.05	0.95	1.13	4.33	0.30	1.43	4.73	0.90	1.37	1.72	1.10	0.32	0.63	1.04	1.47
		Okanogan R. (extirpated)																

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.6.2-1.
2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.6.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.
3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.6.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.
4 Extinction risk survival gap is calculated as the exponent of a Beverton-Holt "a" value from a production function that would result in 5% risk, divided by the exponent of the base period Beverton-Holt "a" value. Estimates are from Hinrichsen (2008), in the Aggregate Analysis Appendix.

Table 8.6.3-1. Proportional changes in average base period survival of UCR Chinook salmon expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

			Base-to-Current Adjustment (Survival Multiplier)							
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2]	Estuary Habitat[3]	Bird Predation[4]	Marine Mammal Predation[5]	Harvest[6]	Hatcheries[7]	Total Base-to-Current Survival Multiplier[8]
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.25	1.02	1.00	1.00	0.97	1.04	1.00	1.28
		Methow R.	1.43	1.02	1.00	1.00	0.97	1.04	1.00	1.47
		Entiat R.	1.32	1.02	1.00	1.00	0.97	1.04	1.00	1.36
		Okanogan R. (extirpated)								

1 From SCA Hydro Appendix. Based on differences in average base and current smolt-to-adult survival estimates for both FCRPS and PUD dams.
2 From CA Chapter 8, Table 8-7.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Current 2 S/Baseline 2 S" approach, as described in Attachment F-2.
5 From SCA Marine Mammal Appendix
6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
7 No quantitative hatchery effects.
8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

Table 8.6.5-1. Proportional changes in survival of UCR spring Chinook salmon expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

			Current-to-Future Adjustment (Survival Multiplier)									
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2] (2007-2017)	Estuary Habitat[3]	Bird Predation[4]	Pike-minnow Predation[5]	Hatcheries[6]	Non-Hydro Current-to-Future Survival Multiplier[7]	Total Current-to-Future Survival Multiplier[8]		Total Base-to-Future Survival Multiplier[9]
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.09	1.03	1.06	1.02	1.01	1.00	1.13	1.22		1.56
		Methow R.	1.10	1.06	1.06	1.02	1.01	1.00	1.16	1.27		1.86
		Entiat R.	1.10	1.22	1.06	1.02	1.01	1.00	1.33	1.46		1.99
		Okanogan R. (extirpated)										

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates for both FCRPS and PUD dams.
2 From CA Chapter 8, Table 8-9.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Prospective 2 S/Current 2 S" approach, as described in Attachment F-2.
5 From CA Appendix F, Attachment F-1.
6 No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.
7 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.
8 Same as Footnote 7, except it is calculated from all Prospective Actions, including hydro actions.
9 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.6.3-1.

Table 8.6.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for UCR spring Chinook.

ESU	MPG	Population	20-Yr R/S Recent Climate[1]	20-yr lambda Recent Climate @ HF=0[2]	20-yr lambda Recent Climate @ HF=1[3]	1980-Current BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	1.17	1.05	1.00	0.98	Must be HV or V	R/S and lambda >1; BRT trend <1	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops, hatchery straying; high proportion hatchery fish)
		Methow R.	1.36	1.17	1.08	1.03	Must be HV or V	All three metrics >1	Currently Low Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops, hatchery straying; high proportion hatchery fish)
		Entiat R.	1.42	1.13	1.08	1.09	Must be HV or V	All three metrics >1	Currently Moderate Risk	Currently High Risk (Reduced genetic diversity from homogenization of pops, hatchery straying; high proportion hatchery fish)
		Okanogan R. (extirpated)								

1 Calculated as the base period 20-year R/S productivity from Table 8.6.2-1, multiplied by the total base-to-future survival multiplier in Table 8.6.5-1.
2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.6.2-1, multiplied by the total base-to-future survival multiplier in Table 8.6.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.6.2-1, multiplied by the total base-to-future survival multiplier in Table 8.6.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
4 From ICTRT (2007a), Attachment 2
5 From Table 8.6.2-2

Table 8.6.6.1-2. Summary of prospective estimates relevant to the survival prong of the jeopardy standard for UCR spring Chinook. Numbers represent additional survival improvements (remaining "gaps") to reduce 24-year extinction risk to 5% or less. Numbers less than 1.0 indicate that no additional survival changes are necessary.

			Extinction - Based Only On Current Adjustment - Not Influenced By RPA[1]				Extinction - Based On Current Adjustment and RPA Prospective Actions[2]					
ESU	MPG	Population	24-yr Extinction Risk Gap for ≤5% at QET=1	24-yr Extinction Risk Gap for ≤5% at QET=10	24-yr Extinction Risk Gap for ≤5% at QET=30	24-yr Extinction Risk Gap for ≤5% at QET=50	24-yr Extinction Risk Gap for ≤5% at QET=1	24-yr Extinction Risk Gap for ≤5% at QET=10	24-yr Extinction Risk Gap for ≤5% at QET=30	24-yr Extinction Risk Gap for ≤5% at QET=50	ICTRT MPG Viability Scenario	Survival Prong Notes for Extinction Risk
Upper Columbia Spring Chinook Salmon	Eastern Cascades	Wenatchee R.	0.10	0.23	0.38	0.51	0.08	0.19	0.31	0.42	Must be HV or V	<5% risk at QET=50 without reliance on immediate RPA actions
		Methow R.									Must be HV or V	No short-term extinction risk estimates
		Entiat R.	0.24	0.46	0.76	1.08	0.16	0.32	0.52	0.74	Must be HV or V	<5% risk at QET=50 if some Prospective Actions implemented immediately; otherwise, >5% risk
		Okanogan R. (extirpated)										

1 These estimates assume that only actions that have already occurred can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.6.2-4, divided by the total base-to-current survival multiplier in Table 8.6.3-1.
2 These estimates assume that the Prospective Actions to be implemented in the next 10 years can contribute to reducing short-term extinction risk. Calculated as the base period 5% extinction risk gap from Table 8.6.2-4, divided by the total base-to-future survival multiplier in Table 8.6.5-1.
3 From ICTRT (2007a), Attachment 2

Figure 8.6.6-1. Summary of prospective mean R/S estimates for UCR spring Chinook salmon under the "recent" climate assumption, including 95% confidence limits.

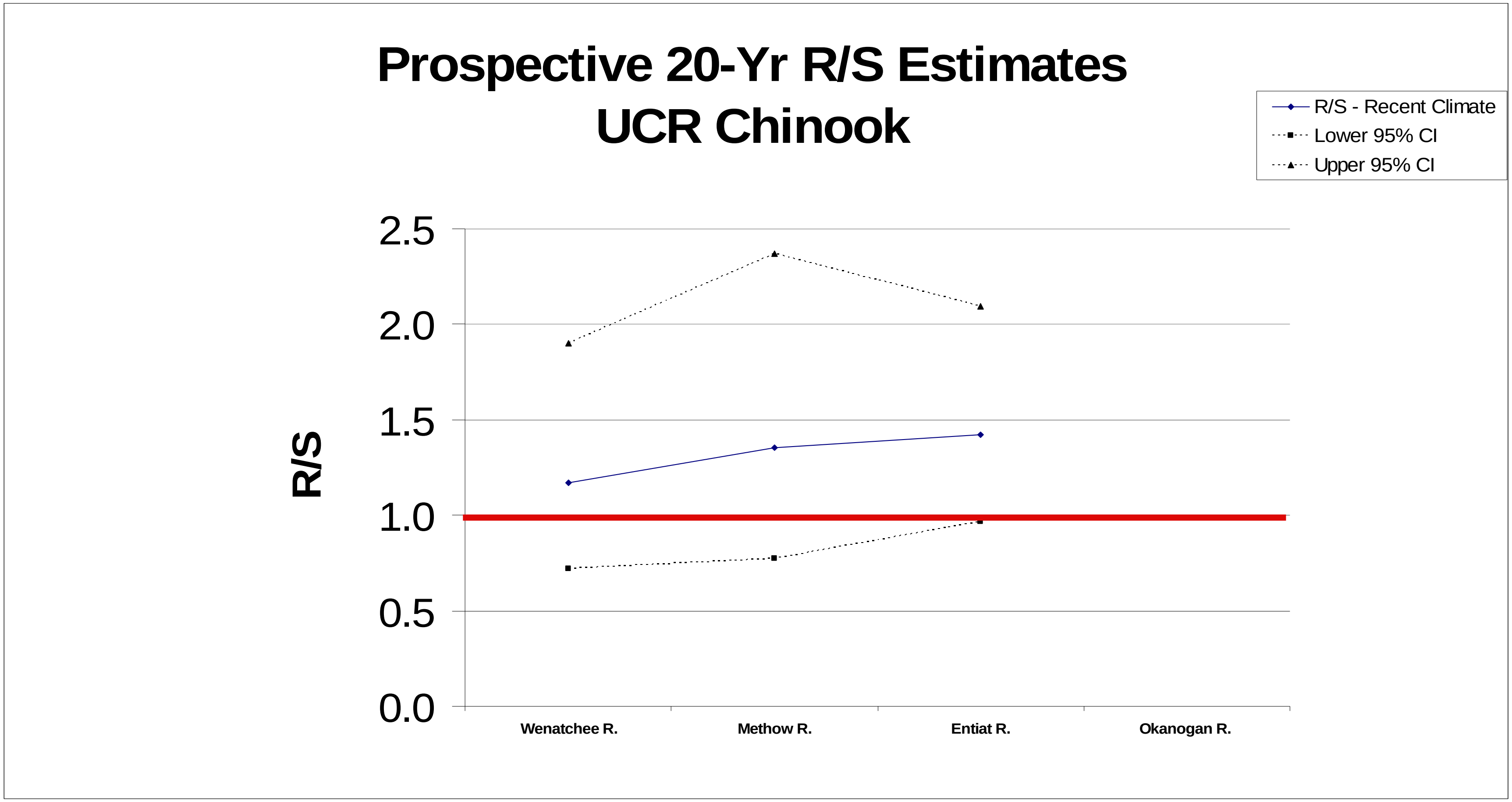


Figure 8.6.6-2. Summary of prospective mean R/S estimates for UCR Spring Chinook salmon under three climate assumptions.

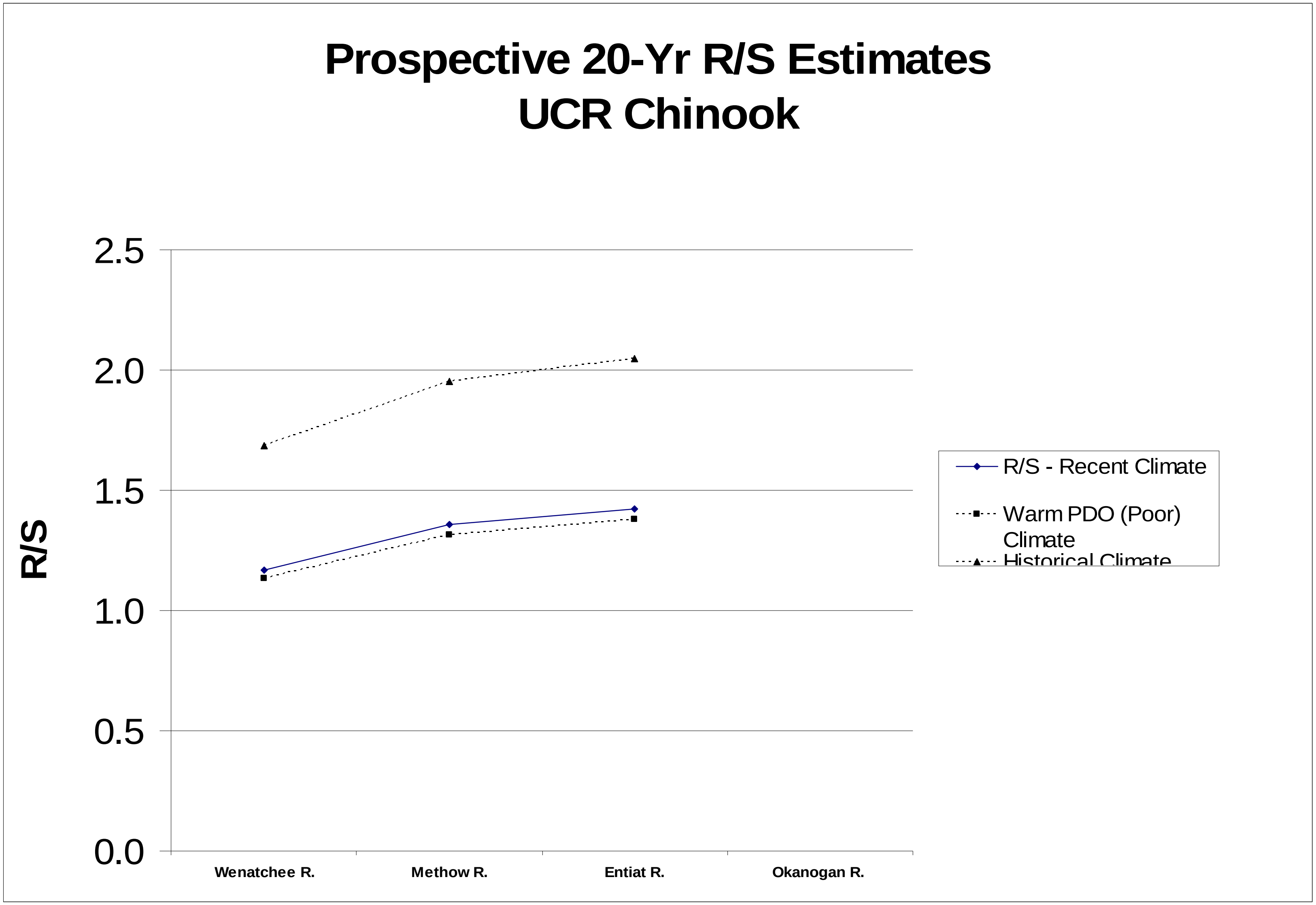


Figure 8.6.6-3. Summary of prospective 5% 24-year extinction risk gap estimates for UCR spring Chinook salmon under the "recent" climate assumption, showing effects of three alternative quasi-extinction thresholds (QET).

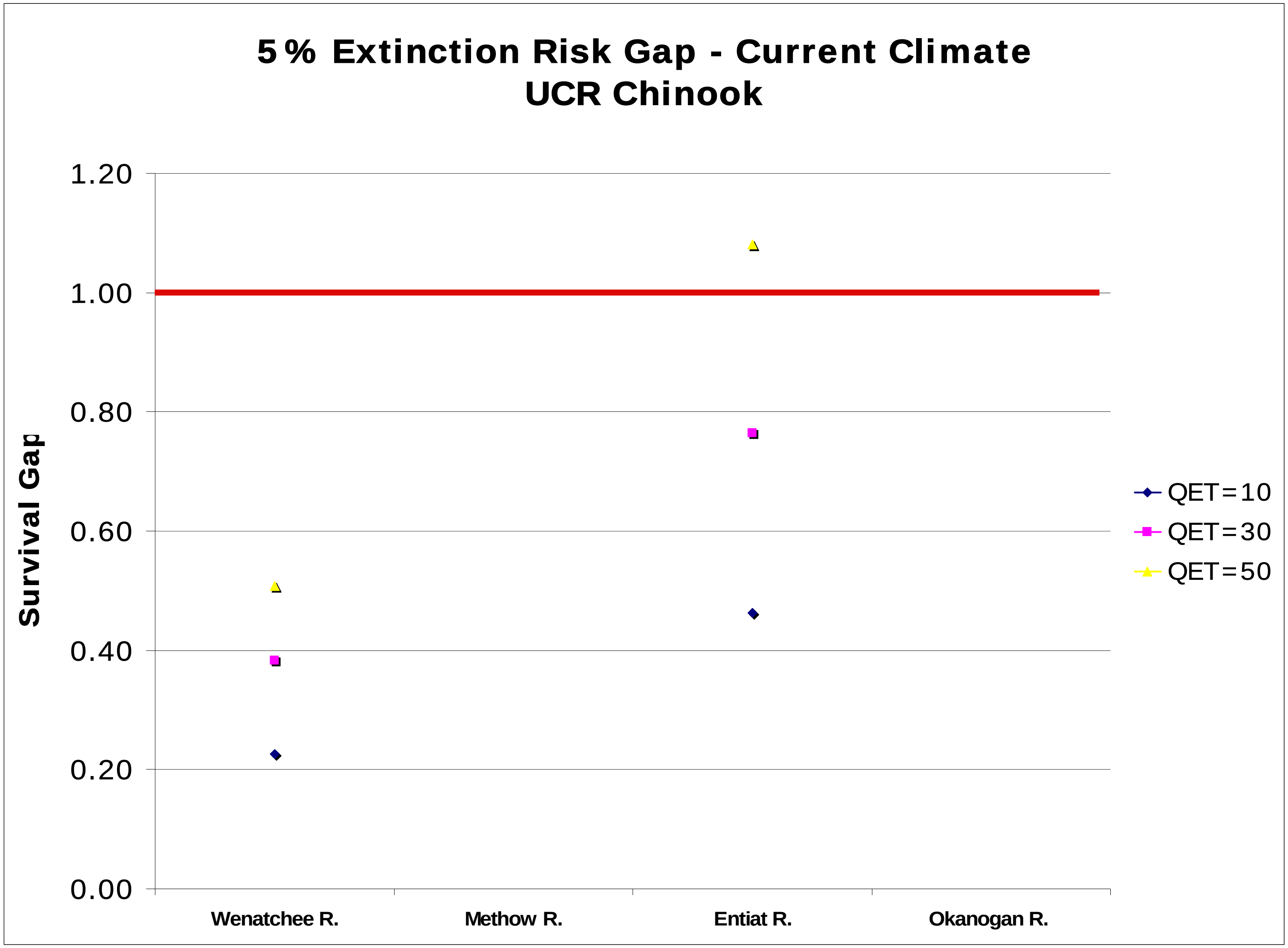
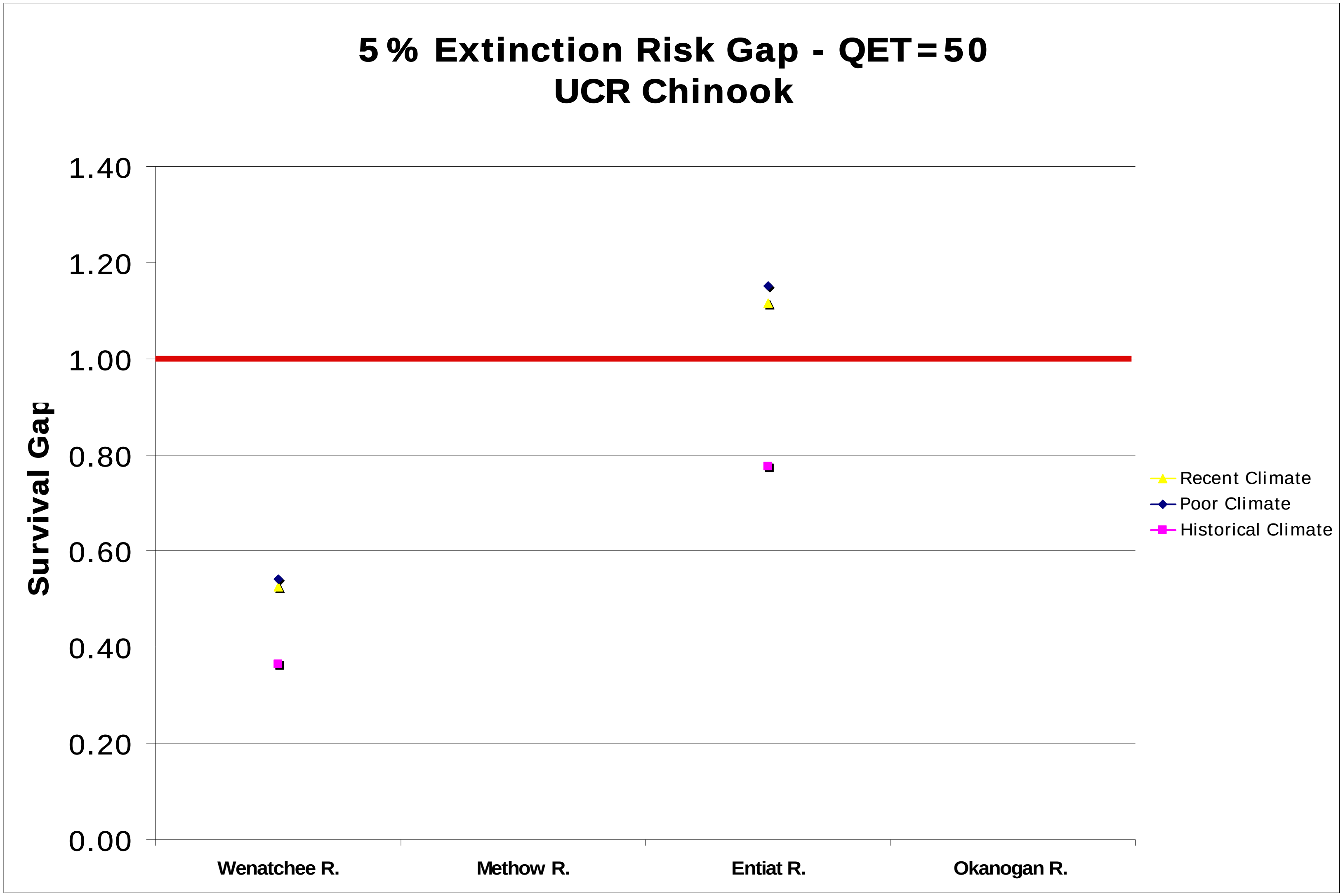


Figure 8.6.6-4. Summary of prospective 5% 24-year extinction risk gap estimates for UCR spring Chinook salmon under three climate assumptions.



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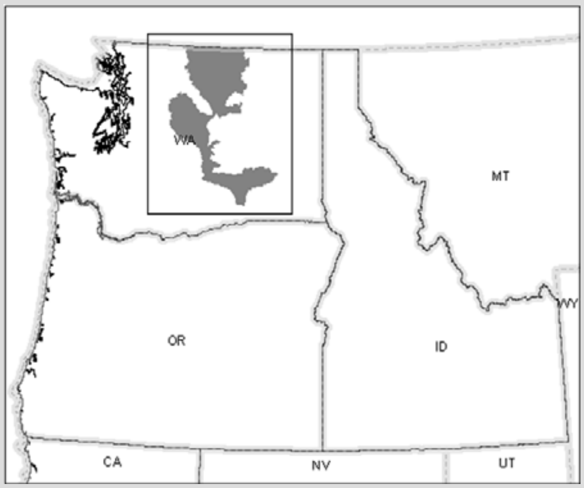
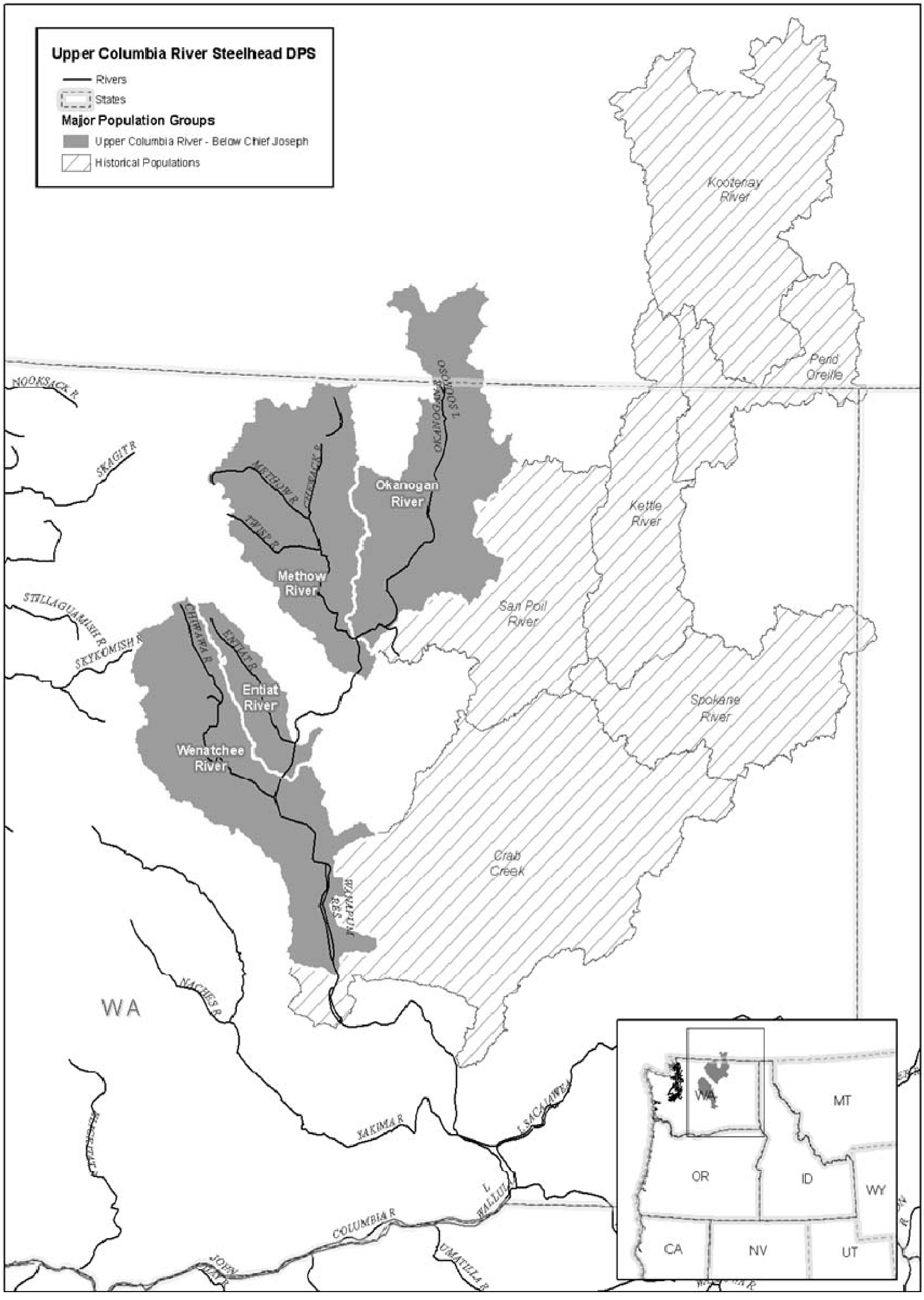
Section 8.7
Upper Columbia River Steelhead




Upper Columbia River Steelhead DPS
Rivers
States
Major Population Groups
Upper Columbia River - Below Chief Joseph
Historical Populations
Kootenay River
Pend Oreille
Kettle River
San Poil River
Spokane River
Crab Creek
Okanogan River
Methow River
Entiat River
Wenatchee River
WA
MT
OR
ID
WY
CA
NV
UT

Section 8.7
Upper Columbia River Steelhead

Species Overview

Background

The Upper Columbia River (UCR) steelhead DPS includes all anadromous populations that spawn and rear in the middle reaches of the rivers and tributaries draining the eastern slope of the Cascade Mountains upstream of Rock Island Dam. There are four populations in a single major population group. The Upper Columbia River steelhead DPS was listed under the ESA as endangered in 1997.

Hatchery steelhead have been released into the Methow and Okanogan since the late 1960s and into the Wenatchee and Entiat systems since the 1970s. Through the 1980s, operations were designed to accommodate harvest and there was no attempt to limit introgression of hatchery fish into the native populations. In many cases, the hatchery broodstock originated from outside the upper Columbia area. Naturally spawning hatchery fish were not adapted to local conditions, which most likely limited their effectiveness and depressed the production of the population as a whole. While there is no precise means to measure the full effect of these practices, they likely contributed substantially to the current low recruits-per-spawner (R/S) productivities for naturally spawning fish.

Since the early 1990s, hatchery programs that operate in the Wenatchee, Methow, and Okanogan basins have implemented reforms to support steelhead conservation and recovery. No hatchery fish are released into the Entiat and the hatchery broodstocks in other watersheds are now composed exclusively of steelhead from the Upper Columbia DPS. The hatchery programs are managed to preserve natural genetic resources.

Designated critical habitat for UCR steelhead includes all Columbia River estuarine areas and river reaches upstream to Chief Joseph Dam and several tributary subbasins.

Current Status & Recent Trends

Upper Columbia River (UCR) steelhead is an endangered species composed of the anadromous *O. mykiss* in four extant populations in one major population group (MPG). For all populations, abundance over the most recent 10-year period is below the thresholds that the ICTRT has identified as a minimum for recovery. Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above or near the recovery abundance thresholds (all populations except the Okanogan) in a few years in the early 2000s, and is now at levels intermediate to those of the mid-1990s and early 2000s. Abundance since 2001 has substantially increased for the DPS as a whole.

Limiting Factors and Threats

The key limiting factors and threats for UCR steelhead include hydropower projects, predation, harvest, hatchery effects, degraded tributary habitat and degraded estuary habitat. Ocean conditions generally have been poor for this DPS over the last 20 years, improving only in the last few years.

Recent Ocean and Mainstem Harvest

Few steelhead are caught in ocean fisheries. Ocean fishing mortality on UCR steelhead is assumed to be zero. Upriver summer steelhead, which include UCR steelhead, are categorized as A-run or B-run based on run timing and age and size characteristics. UCR are all A-run fish.

Fisheries in the Columbia River are limited to assure that the incidental take of ESA-listed Upper Columbia River steelhead does not exceed specified rates. Non-Treaty fisheries are subject to a 2% harvest rate limit on A-run steelhead. Treaty Indian fall season fisheries are subject to a 15% harvest rate limit on B-run steelhead, but were not subject to a particular A-run harvest rate constraint since B-run steelhead are generally more limiting. Recent harvest rates on Upper Columbia River steelhead in non-Treaty and treaty Indian fisheries ranged from 1.0% to 1.9%, and 4.1% to 12.4%, respectively.

8.7.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.7.2.1 Current Rangewide Status of the Species

Upper Columbia River (UCR) steelhead is an endangered species composed of the anadromous *O. mykiss* in four extant populations in one major population group (MPG). All four populations must be viable to achieve the delisting criteria in the Upper Columbia River Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007). Key statistics associated with the current status of UCR steelhead are summarized in Tables 8.7.2-1 through 8.7.2-4. Upriver summer steelhead, which include UCR steelhead, are categorized as A-run or B-run based on run timing and age and size characteristics. UCR steelhead are all A-run fish.

Limiting Factors & Threats

The key limiting factors and threats for UCR steelhead include hydropower projects, predation, harvest, hatchery effects, degraded tributary habitat and degraded estuary habitat. Ocean conditions generally have been poor for this DPS over the last 20 years, improving only in the last few years. Limiting factors are discussed in detail in the context of critical habitat in Section 8.7.3.3.

Abundance

For all populations, average abundance over the most recent 10-year period is below the average abundance thresholds that the ICTRT has identified as a minimum for low risk (Table 8.7.2-1).[1] Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above or near the recovery abundance thresholds (all populations except the Okanogan) in a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 8.7.2.1-1, showing annual abundance of combined populations).

Aggregate abundance of the four populations and a rolling 5-year geometric mean of abundance for the DPS are shown in Figure 8.7.2.1-1. Geometric mean abundance since 2001 has substantially increased for the DPS as a whole. Geomean abundance of natural-origin fish for the 2001 to 2003 period was 3,643 compared to 1,146 for the 1996 to 2000 period, a 218 percent improvement (Fisher and Hinrichsen 2006). The recent geomean abundance was influenced by exceptional returns in 2002, yet returns of natural-origin adults have been well above the 1996 to 2000 geomean in years since 2000.

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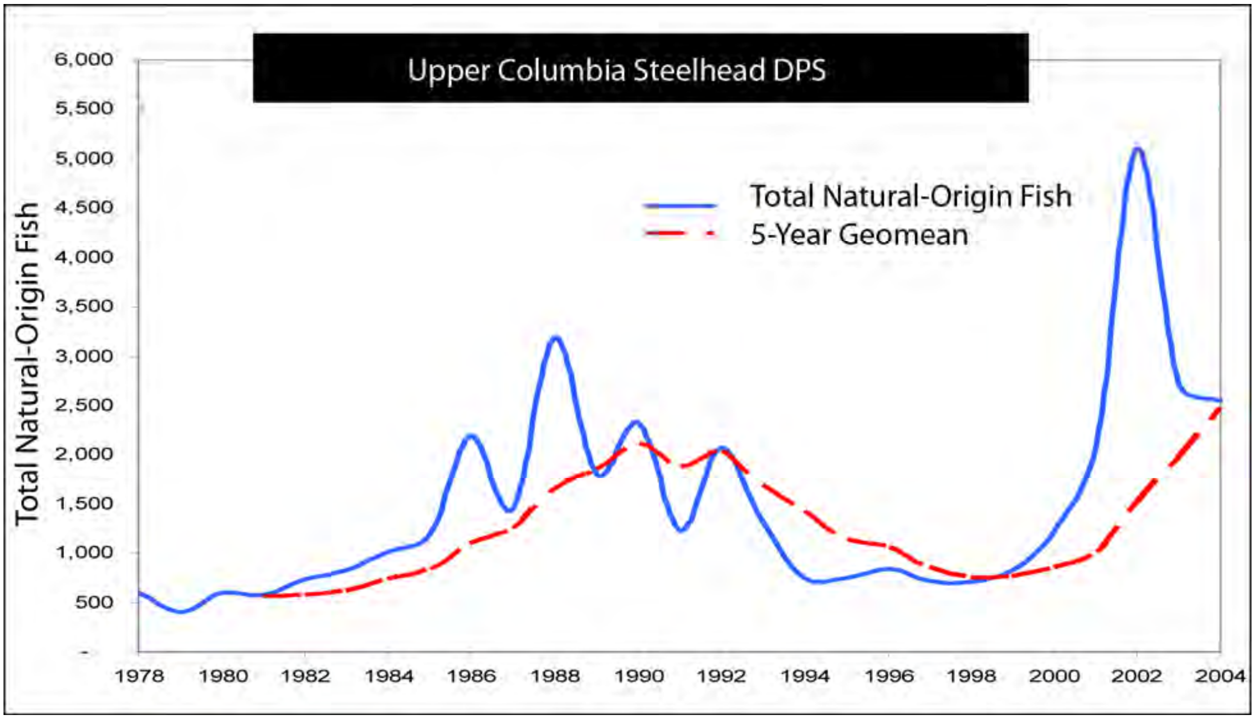
[1] BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for "no jeopardy" determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 6, 2006 (NMFS 2006h, i).

Figure 8.7.2.1-1. Upper Columbia River Steelhead Population Trends, 1978 to 2004 (adopted from Fisher and Hinrichsen 2006)



"Base Period" Productivity

On average over the last 20 full brood year returns (1980/81 through 1999/2000 brood years [BY], including adult returns through 2004-2005), UCR steelhead populations have not replaced themselves (Table 8.7.2-1) when only natural production is considered (i.e., average R/S has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries [ICTRT 2007d] updated with Cooney [2008a]).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at <5% extinction risk (ICTRT 2007c).

The BRT trend in abundance and median population growth rate (lambda) calculated with an assumption that hatchery-origin natural spawners are not successful (HF=0) indicates an increase in abundance during this period for all three populations for which trend can be estimated (Table 8.7.2-1). Lambda, when calculated with an assumption that hatchery-origin and natural-origin natural spawners are equally effective (HF=1), indicated a declining trend similar to that of R/S (Table 8.7.2-1).

Spatial Structure

The ICTRT has characterized the spatial structure risk to UCR steelhead populations as "low" for the Wenatchee and Methow, "moderate" for the Entiat, and "high" for the Okanogan (Table 8.7.2-2). The ICTRT considers the risk high for the Okanogan population because only the lower of two major spawning areas in the United States is occupied.

Diversity

The ICTRT has characterized the diversity risk to all UCR steelhead populations as "high" (Table 8.7.2-2). The high risk is a result of reduced genetic diversity from homogenization of populations that occurred during the Grand Coulee Fish Maintenance Project from 1939-1943 and then again from 1960 to as recently as 1981 (Chapman et al. 1994). Additionally, the Methow and Okanogan populations have particularly high proportions of hatchery-origin spawners, and recent monitoring data suggests that hatchery fish may be straying into non-target areas, likely contributing to the continued homogenization of the populations.

"Base Period" Extinction Risk

The draft ICTRT Current Status Summaries (ICTRT 2007d) have characterized the long-term (100 year) extinction risk, calculated from productivity of populations during the "base period" described above for R/S productivity estimates, as "High" (>25% 100-year extinction risk) for all four UCR steelhead populations. The ICTRT defined the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. Table 8.7.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for each population. This short-term extinction risk analysis is also based on the assumption that productivity observed during the "base period" will be unchanged in the future. At QET=50 all populations have >5% risk of short-term extinction. Confidence limits on these estimates are extremely wide, ranging from 0 to 100% risk of extinction.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. At QET=30 and QET=10 all populations have >5% risk of short-term extinction.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. If hatchery supplementation is assumed to continue at current levels for those populations affected by hatchery programs, short-term extinction risk is lower (Hinrichsen 2008, included as attachment 1 of the SCA Aggregate Analysis Appendix). This analysis indicates that short-term extinction risk at QET=50 is at or near 0% if continued supplementation is assumed for all except the Entiat population. However, dependence on hatcheries for more than three or four generations (9-16 years for UCR Steelhead), poses an increased risk to population diversity (ICTRT 2007d).

Quantitative Survival Gaps

The change in density-independent survival that would be necessary for quantitative indicators of productivity to be greater than 1.0 are displayed in Table 8.7.2-4. Mean base period R/S survival gaps range from 20% to over 700%, Under the HF=0 assumption, there is no survival gap for lambda, nor is there a survival gap for BRT trend. However, under the HF=1 assumption, the lambda gap ranges from 160% to nearly 500%.

Survival gaps for 24-year extinction risk could not be calculated using the methods employed in this analysis. However, based on the high base period risk it is likely that these gaps would be very large. An analysis that assumed that hatchery supplementation would continue indicated close to 0% risk of short-term extinction for all but the Entiat population (see above), so there would be no extinction risk gap for three populations if continued supplementation is assumed.

8.7.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for UCR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and Upper Columbia/Priest Rapids (NMFS 2005b). There are 42 watersheds within the range of this DPS. Three watersheds received a low rating, 8 received a medium rating, and 31 received a high rating of conservation value to the DPS (see Chapter 4 for more detail). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 11 of the high value watersheds identified above. This corridor 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. Of the 1,332 miles of habitat areas eligible for designation, 1,262 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.7.3.3.

8.7.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.7.3.1 "Current" Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section, estimates of productivity and extinction risk were based on performance of populations during a 20-year "base period," ending with the 1999 or 2000 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and the continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, the CA includes estimates of a "base-to-current" survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Chapter 7.1 of this document. Results are presented in Table 8.7.3-1.

Briefly, reduction in the average base period harvest rate of natural origin fish (estimated at approximately a 4% survival change [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), improvements in both FCRPS and Public Utility District (PUD) dam configuration and operation (approximately a 8% to 25% survival change, based on ICTRT base survival and COMPASS analysis of current survival in CA Appendix B), and estuary habitat projects (a less than 1% survival change, based on CA Appendix D) result in a survival improvement for all UCR steelhead populations. Tributary habitat projects result in approximately 2-6% survival improvements, depending on population (CA Chapter 9, Table 9-7). In contrast, development of tern colonies in the estuary in recent years results in less than a 1% reduction in survival for all populations.

NOAA Fisheries reviewed hatchery information for the period 1936 to present, including the origin, number and location of hatchery origin fish (HOF) releases. In 1998, the goal of all the hatchery programs in the UCR steelhead DPS changed from providing fish for harvest to also conserving the genetic resources and reducing short-term extinction risk and increasing HOF fitness or effectiveness. Before 1998, all hatchery programs fell into Category 1 (HOF<30% as effective as natural origin fish [NOF]) and HOF were planted in areas to accommodate fisheries, not promote HOF effectiveness (i.e., the majority of releases were not in prime steelhead production areas). After 1998, hatchery program reforms were initiated for each of the four steelhead populations. Additionally, starting in 1998 tributary fisheries were curtailed until a plan was developed that addressed impacts on ESA listed fish. Currently, ESA Section 10 permit #1395 authorizes steelhead fisheries targeting surplus hatchery fish in the Wenatchee, Methow, and Okanogan when natural-origin fish returns meet criteria established in the steelhead management plan.

The CA suggests a range of 52 to 113% survival improvement to the Wenatchee population from hatchery reforms that began in 1998 (CA Table 9-7). Hatchery reforms of PUD-funded programs in the Wenatchee basin include using broodstock collected only from the Wenatchee River, with a substantially increased proportion of natural-origin fish in the broodstock; released fish in primary steelhead production areas (to promote effectiveness); and mechanisms to manage hatchery returns on spawning grounds in years of high survival. Future reforms, called for in the 50-year Habitat Conservation Plan, include increased rearing and acclimation on Wenatchee basin surface water to improve survival and homing fidelity. PUD-funded RM&E actions are also called for and are anticipated to reduce risk associated with the hatchery program.

The “low” hatchery effectiveness estimate for the Wenatchee population used in Table 9-4 of the CA (1.52) is reasonable. When re-calculated with updated historical hatchery fractions from the ICTRT (Cooney 2008a), the estimate changes to 1.60 (SCA Quantitative Analysis of Hatchery Actions Appendix). Available information does not support effectiveness estimates greater than 0.3 for HOF before 1998. HOF effectiveness was likely lower than 0.3 based on historical release practices and absent estimates of HOF straying into primary steelhead production areas.

The CA suggests a range of 56 to 150% survival improvement to the Entiat population based on hatchery reforms in place since 1998 (CA Table 9-7). Releases of hatchery steelhead from the PUD funded program in the Entiat River ended in 1997 as a hatchery reform measure. Based on limited telemetry studies, the Entiat population may have continued to be affected by hatchery steelhead from other programs, particularly the Wenatchee program, that stray into the Entiat River. The reform measure to increase rearing and acclimation of the hatchery program in the Wenatchee basin is expected to benefit Entiat population productivity and diversity by increasing homing fidelity to the Wenatchee and thus reducing Wenatchee hatchery steelhead straying into the Entiat. Estimates of prospective productivity improvements are disadvantaged by lack of spawner composition data and uncertainties over the implementation and effectiveness of reforms to reduce straying.

The proportion of natural spawners made up of hatchery-origin fish is an important variable in estimating productivity changes. The FCRPS Action Agencies use ICTRT estimates of natural spawner composition for the Entiat, and these estimates are based on very limited data. Data for the Entiat is the least robust of any escapement data for basins in the upper Columbia because they are based only on dam count and tributary turn-off estimates. The last HOF releases into the Entiat were in 1999, and it is reasonable to assume that HOF on the spawning grounds declined after 2002. After 2002, the only HOF spawning in the Entiat were strays. Most strays are thought to be hatchery steelhead from the Wenatchee. Facilities have not been built to acclimate them to Wenatchee water before they are released to migrate to the ocean. Therefore, they are expected to stray more when they return as adults. Less than 10% HOF strays spawning naturally in the Entiat is a reasonable goal, but it will take time before improvements are operational (e.g., the construction of acclimation ponds in the Wenatchee) and the effectiveness of these improvements can be established. Based on the termination of hatchery steelhead releases in the Entiat (the last returns from hatchery releases were in 2004), NOAA Fisheries assumes a future hatchery fraction of 0.22 to 0.50.

For the period prior to hatchery program termination, available information does not support effectiveness estimates >0.3. After termination, stray HOF in the Entiat originate from Category 1 hatchery programs, but since these fish are not from the Entiat, the effectiveness of stray HOF would be < 0.3. Considering all this information, NOAA Fisheries estimates a survival change of 0-18% to +56% for the Entiat, based on hatchery management changes (SCA Quantitative Analysis of Hatchery Actions Appendix).

The Methow population has a PUD funded program at Wells Hatchery and an Action Agency funded program at Winthrop NFH. In 1998, the goals of both programs changed from primarily providing fish for harvest to conserving genetic resources and increasing hatchery fish fitness or effectiveness. Both programs use broodstock collected at Wells Dam, which combines fish returning to the Methow and Okanogan basins. The Federal program at Winthrop NFH releases steelhead from the hatchery facility. The PUD funded program uses tank trucks to release steelhead at multiple locations in the Methow basin. The Winthrop NFH receives eyed eggs from the PUD funded program that are progeny of hatchery-by-hatchery fish crosses, while the PUD program maximizes and retains progeny of hatchery-by-natural fish crosses.

Before 1998, the programs fell into Category 1 (HOF<30% as effective as NOF) and HOF were planted in areas to accommodate fisheries, not promote HOF effectiveness (i.e., the majority of releases were not in prime steelhead production areas). After 1998, the broodstock included some NOF (Category 3) and the PUD funded program altered release locations to include steelhead production areas (to promote effectiveness). In recent years, NOF in broodstock have increased to about 30% in the PUD funded program. However, this program continues to be a composite of the Methow and Okanogan populations (not an optimum practice for a hatchery program intended to promote genetic diversity and improve natural survival). A further reform has been the transfer of eggs from earliest maturing broodstock, which are always hatchery-origin fish (this is thought to be a legacy effect of historical hatchery operation protocols that selected for early maturing fish in the broodstock) to the Ringold Program in the Middle Columbia River. Redd surveys in the Methow River have not found a difference in spawn timing between HOF and HOR (Snow and Humling 2006).

For the Methow population, available information would not support effectiveness estimates greater than 0.3 for HOF before 1998. HOF effectiveness was likely lower than 0.3 based on release practices and the reliance on HOF for broodstock (i.e., hatchery domestication effects). After 1998, HOF effectiveness may be incrementally increasing over time, but still is likely to be quite low in the 0.30 to 0.45 range (the upper end of the Araki et al. 2007b range for a Category 3 program). This results in survival multipliers between 17 and 55% for the Methow population (SCA Quantitative Analysis of Hatchery Actions Appendix).

The Okanogan population is supplemented by two hatchery programs, the PUD funded Wells program and a relatively new program operated by the Colville Tribes. Similar to the situation in the Methow, prior to 1998 the program fell into Category 1 (HOF<30% as effective as NOF) and HOF were planted in areas to accommodate fisheries, not to promote HOF effectiveness (i.e., the majority of juvenile releases were not in prime steelhead production areas). After 1998, the steelhead program at Wells Hatchery has increased the use of NOF for broodstock. This is beneficial except that the broodstock is a composite of different spawning aggregates and different populations (not an optimum practice for a hatchery program intended to conserve genetic resources and increase HOF fitness or effectiveness).

The Colville Tribes have begun a relatively small hatchery program in Omak Creek to promote local adaptation in the Okanogan Basin. This program uses broodstock collected from Omak Creek or the Okanogan River. Overall, these hatchery reforms are beneficial, but for the Okanogan basin in particular, increases in natural productivity will depend on improvements in spawning and rearing habitat conditions. The available information does not support effectiveness estimates greater than 0.3 for HOF before 1998. HOF effectiveness was likely lower than 0.3 based on release practices and the propagation of multiple generations of HOF. Since 1998, HOF effectiveness may be incrementally increasing over time, but is still likely to be quite low, in the 0.30 to 0.45 range (the upper end of the Araki et al. range for a Category 3 program). Supplementation levels and spawner composition data provided in Table 9-5 are used for this analysis except that “post-1998” relative effectiveness should be up to 0.45, not 0.5. This results in survival multipliers between 34 and 88% for the Okanogan population (SCA Quantitative Analysis of Hatchery Actions Appendix).

Another important parameter in estimating natural productivity and assessing risk is the composition of natural spawners (i.e., the proportion of natural spawners composed of HOF and NOF). In this analysis for the Wenatchee, Methow and Okanogan basins, NOAA Fisheries uses available data from supplementation levels over the “most recent 10 years” (Table 8.7.2-1). Assumptions in Table 9-4 of the CA that supplementation will be “significantly reduced from recent averages” and that the proportion of natural spawners composed of HOF will decline dramatically, depend on the increased abundance of natural-origin natural spawners in each basin and on future Hatchery and Genetic Management Plans that reduce the proportion of natural spawners composed of HOF as the abundance of natural-origin fish increases.

The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to increase 83 to 159% for the Wenatchee, Methow, and Okanogan populations (Table 8.2.3-1). This also means that the survival "gaps" described in Table 8.2.2-4 would be proportionately reduced by this amount (i.e., ["Gap" ÷ 1.83] to ["Gap" ÷ 2.59], depending on the population and the hatchery effectiveness assumption). For the Entiat population, survival changes would be expected to range from a 2% decline to a 55% increase

8.7.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.7.3.3 Status of Critical Habitat Under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by UCR steelhead. Although land and water management activities have improved, factors such as dams, diversions, roads and railways, agriculture (including livestock grazing), residential development, and forest management continue to threaten the conservation value of critical habitat for this species in some locations in the upper Columbia basin.

Spawning & Rearing Areas

UCR steelhead spawn and rear in the major tributaries to the Columbia River between Rock Island and Chief Joseph dams. Adults reach spawning areas in late spring. Newly emerged fry move about considerably as they seek suitable rearing habitat, moving downstream in the fall in search of suitable overwintering habitat (Chapman et al. 1994). Fry use stream margins and cascades and larger juvenile life stages use progressively deeper and faster water, sheltering behind boulders in the highest gradient riffles and cascades. Most juvenile steelhead spend two or three years in freshwater before migrating to salt water. The following are the major factors that have limited the functioning and thus the conservation value of habitat used by UCR steelhead for these purposes (i.e., spawning sites with water quantity and quality and substrate supporting spawning, incubation and larval development; rearing sites with water quality, water quantity, floodplain connectivity, forage, and natural cover allowing juveniles to access and use the areas needed to forage, grow, and develop behaviors that help ensure their survival):

- Physical passage barriers *[mortality at hydroelectric projects in the mainstem Columbia River; water withdrawals and unscreened diversions]*

- Excess sediment in spawning gravels and in substrates that support forage organisms *[land and water management activities]*

- Loss of habitat complexity, off-channel habitat and large, deep pools due to sedimentation and loss of pool-forming structures *[degraded riparian and channel function]*

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors and threats for this DPS in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

Juvenile & Adult Migration Corridors

Adults begin to return from the ocean in early spring and enter upper Columbia tributaries during April through July. Juvenile steelhead migrate to salt water in the spring of their second year of life. Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers *[push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles]*

- Juvenile and adult passage mortality *[hydropower projects in the mainstem Columbia River]*

- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators *[Caspian terns and double-crested cormorants]*

In the mainstem FCRPS corridor, the Action Agencies have improved safe passage for juvenile steelhead with the construction and operation of surface bypass routes at Bonneville Dam and other configuration improvements listed in Section 5.3.1.1 in Corps et al. (2007a).

The safe passage of juvenile steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For these salmonids, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 9.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although UCR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River NMFS (2005b). Therefore, the effects of the Prospective Actions on PCEs in areas for growth and development to adulthood are not considered further in this consultation.

8.7.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Mainstem Mid-Columbia Hydroelectric Projects

NOAA Fisheries completed ESA Section 7(a)(2) consultations on its issuance of incidental take permits to Douglas and Chelan County Public Utility Districts in support of the proposed Anadromous Fish Agreements and Habitat Conservation Plans (HCPs) for the Wells, Rocky Reach, and Rock Island hydroelectric projects in the mid-Columbia reach on August 12, 2003. Under the HCPs, Douglas and Chelan County PUDs agreed to use a long-term adaptive management process to achieve a 91% combined adult and juvenile survival standard for each salmon and steelhead DPS migrating through each project. In addition, compensation for up to 9% unavoidable project mortality is provided through hatchery and tributary programs, with compensation for up to 7% mortality provided through hatchery programs and compensation for up to 2% provided through tributary habitat improvement programs.

In May 2004, NOAA Fisheries also completed an ESA Section 7 consultation on FERC’s proposed amendment to the existing license for the Grant County PUD’s Priest Rapids Hydroelectric Project, which permitted implementation of an interim protection plan, including interim operations for Wanapum and Priest Rapids dams. Under this biological opinion and incidental take statement, NOAA Fisheries expects that project-related mortalities (i.e., direct, indirect, and delayed mortality resulting from project effects) for both hydro projects combined will not exceed 23.2% for juvenile UCR steelhead. NOAA Fisheries also expects that implementation of the interim protection plan will result in mortality rates of no more than 3% per project or 6% combined for adult UCR steelhead.

Thus, NOAA Fisheries expects the cumulative mortality through the mid-Columbia reach of juvenile UCR steelhead will be 19% for the Wenatchee population; 22% for the Entiat population; and 25% for the Methow population. The total mortality rates (natural and project-related) of adult UCR steelhead are expected to be 4% for adult steelhead returning to the Wenatchee River, 5% for those returning to the Entiat, and 6% for those returning to the Methow.

Wenatchee River

The USFS proposed fuels reduction projects in the White River–Little Wenatchee and Wenatchee River – Nason Creek watersheds, respectively, as well as a fire salvage timber sale in the Lower Wenatchee River watershed. The USFS also proposed a habitat restoration project in the Natapoc Ridge Forest (Wenatchee River–Nason Creek and Chiwawa River watersheds). The USFS' project to relocate White River Road and stabilize the streambank used large woody debris to increase habitat complexity (White River–Little Wenatchee River watershed). Another USFS project, replacing three culverts along Sand and Little Camas creeks (Lower Wenatchee River watershed), improved passage and partially restored natural channel-forming processes. The USFS completed one project in 2007 under its programmatic consultation (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): a road decommissioning to improve riparian habitat and the connection to the floodplain along one mile of Clear Creek in the Chiwawa River watershed.

The FHWA/WSDOT consulted on a road construction project in the Wenatchee River–Icicle Creek watershed and a culvert replacement along Mill Creek (Wenatchee River–Nason Creek) to improve fish passage.

In the Lower Wenatchee watershed, NOAA Fisheries consulted on the restoration of off-channel habitat; the USFWS funded the installation of a fishway on Peshastin Creek, designed to provide access to spawning and rearing habitat; and the Corps consulted on a fish passage enhancement project. The Corps also proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River-Lynch Coulee, and Columbia River–Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River–Lynch Coulee and Columbia River–Sand Hollow mainstem reaches).

As part of the Chelan and Douglas PUD's HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the UCR steelhead population in the Wenatchee basin. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon, sockeye salmon, and endangered spring Chinook salmon in the Wenatchee basin, which could have effects on natural-origin steelhead, resulting in the issuance of ESA Section 10 permits. Inclusive with these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Wenatchee basin.

The BPA consulted on funding the Yakama Nation Tribes' hatchery program to reintroduce Coho salmon to the Wenatchee basin, which could affect natural-origin steelhead in the Wenatchee basin.

Entiat River

The USFS proposed a campground and summer home vegetation management project in the lower Entiat River watershed and habitat restoration activities in the Columbia River – Lynch Coulee portion of the mainstem Columbia River. NOAA Fisheries consulted with itself on funding for a project in the lower Entiat River watershed that included building an overflow structure in an existing irrigation canal to improve fish passage; adding boulders and large wood to increase habitat complexity in a side channel; reconnecting the river and its floodplain; and enhancing the recruitment of spawning gravels.

The FHWA/WSDOT proposed road maintenance along State Route 28 (Sunset Highway), Eastside Corridor, East Wenatchee (Lake Entiat mainstem reach).

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River–Lynch Coulee, and Columbia River–Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River–Lynch Coulee and Columbia River–Sand Hollow mainstem reaches).

Methow River

The USFS consulted on a total of three timber sales in the Upper and Lower Chewuch and Twisp River watersheds; a grazing allotment plan for the Lower Chewuch and Middle Methow River watersheds; and a vegetation management plan for the Lower Methow River watershed. The USFS also consulted on projects to restore habitat damaged by grazing in the Lower Chewuch River watershed, improve passage (by replacing a diversion dam) into seven miles of Little Bridge Creek (Twisp River watershed), and modify an irrigation ditch for access to nine miles of habitat in a wilderness area (Middle Methow River watershed). The USFS completed two projects during 2007 under its programmatic consultation with NOAA Fisheries (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): decommissioning and relocating the Twisp River/North Creek Trail to improve five acres of riparian habitat and installing a culvert in Reynolds Creek to allow access to four miles of stream.

Reclamation consulted on leasing water from the Chewuch Canal Company (Lower Chewuch River watershed) to improve instream flows. The FHWA/WSDOT proposed a bridge rehabilitation project on Buttermilk Creek Road in the Twisp River watershed.

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River–Lynch Coulee, and Columbia River–Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River–Lynch Coulee and Columbia River–Sand Hollow mainstem reaches).

The FERC consulted on a license amendment for the Wells hydroelectric project—land easements for 11 irrigation diversions from Lake Entiat with new or improved fish screens.

As part of the Chelan and Douglas PUD's HCPs described above, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the UCR steelhead population in the Methow basin. NOAA Fisheries conducted two separate consultations on hatchery programs of unlisted summer Chinook salmon and endangered spring Chinook salmon in the Methow basin that could have effects on natural-origin steelhead. These resulted in the issuance of ESA Section 10 permits. Included in these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Methow basin.

The USFW consulted on the implementation of a hatchery program rearing listed steelhead at Winthrop NFH. They also consulted on the implementation of a hatchery program rearing listed spring Chinook salmon at Winthrop NFH.

The BPA consulted on funding the Yakama Nation Tribes' hatchery program to reintroduce coho salmon to the Methow basin that could affect natural-origin steelhead in the Methow basin.

Okanogan

The Corps consulted on a project to install a boat ramp on the Okanogan River (Upper Okanogan River watershed). The FHWA/WSDOT consulted on projects to improve the road between Loomis and Oroville (Upper Okanogan River) and to replace the Salmon Creek Bridge (Salmon Creek watershed).

As part of the Chelan and Douglas PUD's HCPs described, NOAA Fisheries consulted on the issuance of an ESA Section 10 permit jointly to Chelan and Douglas PUDs and WDFW on the implementation of an artificial propagation program to supplement the UCR steelhead population in the Okanogan basin. NOAA Fisheries also conducted a separate consultation on a hatchery program of unlisted summer Chinook salmon in the Okanogan basin that could affect the natural population of steelhead. Included in these consultations were actions to monitor and evaluate the effects of the hatchery programs on the natural salmon and steelhead populations in the Okanogan basin.

The Bureau of Indian Affairs (BIA) consulted on funding the Colville Tribe's hatchery supplementation program in Omak Creek.

Projects Affecting Multiple Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.7.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of UCR steelhead that will improve access to blocked habitat, prevent entrainment into irrigation pipes, increase channel complexity, and increase instream flows. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including hydroelectric generation, forest thinning, road construction/maintenance, dock and pier construction, hatchery programs, and grazing will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Other types of Federal projects such as hydroelectric generation (including the FERC-licensed hydro projects in the mid-Columbia River), forest thinning, road construction/maintenance, dock and pier construction, hatchery programs, and grazing will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding adverse modifications of critical habitat.

8.7.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Washington and Idaho identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Entiat, Methow, Okanagan, and Wenatchee populations as well as actions that will be generally beneficial throughout the DPS. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.[2] Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to significantly improve conditions for the Upper Columbia River steelhead. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of

[2] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.7.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Sections 8.7.5.1, 8.7.5.2, and 8.7.5.5. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvements and predator reduction actions, which are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the Hatchery Effects Appendix of the SCA and in this section.

8.7.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions projects are also included in this analysis. These effects on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the effects in the productivity and extinction risk analysis (See SCA Sections 7.2.1 and 8.8.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions is expected to increase the in-river survival (from McNary to the Bonneville tailrace) of UCR steelhead from 47.9% (Current) to 52.8% (Prospective), a relative change of 10.2%. Transportation at McNary Dam is expected to occur only in 1 of 70 years, < 2% of the time, when flows at McNary are less than 125 kcfs). In this unlikely circumstance, about 75.7% of the juveniles arriving at McNary Dam would likely be transported (see Table 11.7 of the FCRPS Biological Opinion). Based on the very positive benefits observed from transportation study results from the Snake River during the extremely low flow conditions of 2001, NOAA Fisheries anticipates a similar, albeit somewhat smaller, benefit would exist from transportation at McNary Dam.

The COMPASS model estimates that (combined with in-river migrant survivals through the non-Federal mainstem projects) smolt-to-adult returns (McNary Dam to the ocean and back to Rock Island Dam - assuming SR steelhead post-Bonneville survival relationships as a surrogate) will likely increase from 0.58% to 0.63% for Wenatchee River fish (a relative improvement of about 8.5%); 0.53% to 0.58% (a relative improvement of 9.6%) for Entiat River fish; and 0.51% to 0.56% (a relative improvement of 9.7%) for Methow and Okanogan River fish.

These increases are a result of the Prospective Actions and the expected survival improvement from actions implemented as a result of completed biological opinions on the existence and operation of the five mid-Columbia mainstem hydro projects (NMFS 2006e; SCA Hydro Modeling Appendix). These actions are expected to increase the relative survival of in-river migrants to the Bonneville tailrace by approximately 23.5% for the four populations.

The Prospective Hydro Actions addressing hydro operation and the RM&E program should maintain or improve the levels of survival currently observed for adult UCR steelhead migrating from Bonneville Dam upstream to McNary Dam. The current PIT tag based survival estimate, taking account of harvest and “natural” stray rates within this reach, is 84.5% (about 94.5% per project). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to McNary Dam migration corridor) that currently exists is not expected to be affected by the Prospective Actions.

The hydro Prospective Actions also are likely to positively affect the survival of UCR steelhead in ways that are not included in the quantitative analysis. To be clear, NOAA Fisheries considers these expected benefits, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at McNary and John Day dams in concert with training spill (amount and pattern) to provide safe egress should reduce juvenile travel times within the forebays of the individual projects, where predation rates are currently often the highest (see Section 8.1). This is likely to result in survival improvements. Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case. Finally, improved tailrace egress conditions should increase the survival of migrating steelhead smolts in tailraces where juvenile mortality rates are relatively high.

Prospective Actions implementing passage improvements for juvenile salmon and steelhead, including surface passage such as RSWs and sluiceways, also are likely to benefit downstream migrating kelts. This should lead to improved survival through the FCRPS. Reduced forebay residence times, which lead to a reduction in total travel time, may also contribute to an improvement in kelt return rates. It is not possible to calculate the precise amount of improvement expected, because the interactions between improved surface passage and improved kelt survival and return rates is not well known. However, some improvement is likely.

The Prospective Actions governing reconditioning and transport of steelhead kelts potentially represent a much greater improvement in both outmigration survival and return rates. Reconditioning programs capture kelts and hold them in tanks, where they are fed and medicated to enhance survival. Current programs either hold kelts for 3 to 5 weeks and release them below Bonneville, or hold kelts until they are ready to spawn and release them into their natal streams. Short-term reconditioning efforts have produced average survival rates of 82% and kelt returns of 4% to the Yakima River (Hatch et al. 2006). Long-term reconditioning has produced average survival rates of 35.6%, all of which are returned to their natal stream for spawning (Hatch et al. 2006).

There is some concern over the viability of the offspring from long-term reconditioned kelts. Laboratory studies found high rates of post hatching mortality (Branstetter et al. 2006), and studies using DNA analysis to identify the parentage of outmigrating steelhead smolts (Stephenson et al. 2007) have failed to identify any offspring of reconditioned kelts among the juvenile steelhead collected from streams where reconditioned kelts were released. These studies suggest that long-term reconditioning may reduce gamete viability. It is not known if short-term reconditioned kelts may have the same problems with offspring viability; however, because they feed and mature under natural conditions it seems less likely.

Transportation of kelts involves capturing kelts, transporting them to a point downstream of Bonneville dam, and releasing them. Kelt transportation studies in the Snake River found that not only was there an improvement in FCRPS survival of between 4-33% to actual survival of approximately 98% in transported kelts, but also transported kelts returned to Lower Granite dam at a rate of 1.7% versus in-river migrating kelts, which returned at a rate of 0.5% (Boggs and Peery, 2004).

Both transportation and reconditioning of kelts require capture of downstream migrating kelts. Given kelt preference for surface passage and the potential for future implementation of surface passage routes, the number of kelts that can be collected is limited. Upper and Mid-Columbia DPSs present significant challenges to successfully collecting kelts. Existing bypass systems and transportation facilities on the Snake River dams make successful collection of Snake River steelhead more likely. An analysis by Dygert (2007) estimated that 7% (during spill) to 22% (no spill) of the upstream steelhead run could be captured at LGR as downstream migrating kelts. The hydro Prospective Actions would employ collection at both LGR and LGS. NOAA Fisheries analysis of the Prospective Actions suggests that employing a combination of transportation, reconditioning, and in-stream passage improvements could increase kelt returns enough to increase the number of Snake River B-run steelhead spawners by approximately 6%. If logistical difficulties associated with capture of Upper Columbia River steelhead kelts can be overcome, similar benefits could be expected for that DPS as well.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from McNary Dam to the tailrace of Bonneville Dam, which is an index of the hydrosystem's effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to 52.8%. A portion of the 47.2% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of UCR steelhead in a hypothetical, unimpounded Columbia River would be 90.6%. Therefore, approximately 20% (9.4%/47.2%) of the expected mortality experienced by in-river migrating juvenile steelhead is probably due to natural factors.

The direct survival rate of adults through the FCRPS is already relatively high. The prospective actions include additional passage improvements (e.g., to the ladders at John Day and McNary dams). Adult steelhead survival from Bonneville to Priest Rapids Dam will be approximately 84.5% under the Prospective Actions. With respect to kelts, the Action Agencies will prepare and implement a Kelt management Plan, including measures to increase in-river survival.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to yearling migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.7.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the function of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Wenatchee population by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2006b).

8.7.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Table 9-9, p. 9-14. For targeted populations in this DPS the effect is a 4-14% expected increase in egg-smolt survival, depending on population, as a result of implementing the Prospective Actions tributary habitat projects, which improve habitat function by addressing significant limiting factors and threats.[3] Based on the ICTRT population-level criteria (ICTRT 2007a), projects that restore the number of, or improve the size, quality or access to, major and minor spawning areas could have a beneficial effect on population spatial structure. The Action Agencies will address limiting factors by replacing barrier culverts and screen irrigation pumps in the Wenatchee, Entiat, and Methow subbasins (Table 1-b in Attachment B.2.2-2 to Corps et al. 2007b). These passage projects in many instances will enable juvenile steelhead to access rearing habitat in tributaries that are too small to support spawning, but are generally more productive per unit area for rearing than are mainstem settings. The Action Agencies will also fund channel complexity projects and restore streamflows. Channel complexity projects include reconnecting oxbows that were isolated by highway and railroad construction in the Upper Wenatchee (Nason Creek in particular) and reconnecting small side channel habitats in the Methow and Entiat that have been stranded as a consequence of mainstem channel incision.

Effects on Critical Habitat

As describe above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of habitat that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space and safe passage/access.

Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.7.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for Upper Columbia River steelhead (stream-type life history) associated with the specific Prospective Actions to be implemented from 2007 to 2010 is 1.4%. The survival benefit for Upper Columbia River steelhead (stream-type life history) associated with actions to be implemented from 2010 through 2018 is 4.3%. The total survival benefit for Upper Columbia River steelhead as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats is approximately 5.7% (CA Section 9.3.3.3). Estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40 will provide habitats used by juvenile steelhead migrants from the upper

[3] The Action Agencies identified the projects that will improve these PCEs and that they will fund by 2009 in Tables 1a; 4c; and 5a,b in Attachment B.2.2-2 to Corps et al. (2007b).

Columbia River to increase life history, diversity and spatial structure. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as critical habitat for this species (section 9.3.3.3 in Corps et al. 2007c). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by juvenile steelhead from the Upper Columbia River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (Section 8.7.5.2). The estuary Prospective Actions will address factors that have limited the functioning of PCEs in the estuary needed by juvenile steelhead from the upper Columbia River

8.7.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Qualitative assessment of the Prospective Actions was provided in Section 9.3.3.5, page 9-18, of the CA. The hatchery Prospective Actions consist of continued funding of hatcheries as well as a new hatchery program in the Okanogan basin and a new kelt reconditioning program for the Wenatchee, Entiat, and Methow populations. Each of these programs will be subject to ESA consultation based on an HGMP developed through BMPs.

The Prospective Actions include the continued funding of hatcheries and the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated. The Action Agencies intend to adopt these programmatic criteria for funding decisions on future mitigation programs for the FCRPS that incorporate BMPs. Site-specific application of BMPs will be defined in ESA Section 7, Section 10, and Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (FCRPS Biological Assessment, page 2-44). Available information, principles, and guidance for operating hatchery programs are described in Appendix E of the CA and the SCA Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

The Federal hatchery program in the Upper Columbia preserves genetic resources and reduces short-term extinction risk (SCA Hatchery Effects Appendix). Increasing dependence on the hatchery poses longer-term risk to population diversity and productivity. NOAA Fisheries expects that hatchery reform measures will include a plan for reducing the dependence on hatchery fish to spawn naturally as the abundance of natural-origin fish increases.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.7.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

There are three stock groups of summer steelhead used for management including the lower river Skamania stock, upriver A-run stock, and upriver B-run stock. All UCR steelhead populations are designated A-run steelhead.

Prospective non-Treaty fisheries, pursuant to the 2008 *U.S. v. Oregon* Agreement, will be managed subject to DPS-specific harvest rate limits. Winter, spring, and summer fisheries are subject to a 2% harvest rate limit on wild steelhead from each steelhead DPS. Non-Treaty fall season fisheries are likewise subject to a 2% harvest rate limit for each steelhead DPS. The total annual harvest rate limit for A-run steelhead, for example, is 4%. This is consistent with ESA-related management. The expected harvest impacts on non-Treaty fisheries are less than those proposed. The yearly incidental catch of A-run steelhead in non-Treaty fisheries has averaged 1.6 since 1999 (Table 8.7.5.5-1). Harvest rates for A-run steelhead in non-Treaty fisheries are not expected to change over the course of this Agreement (TAC 2008).

There are no specific harvest rate limits for tribal fisheries on steelhead during the spring or summer seasons which extend through July 31. Some impacts, however, do occur. The harvest rate on A-run steelhead in tribal spring season fisheries has averaged 0.2% from 1985 (Table 8.7.5.5-1). The harvest rate in summer season fisheries averaged 2.3% since 1985 (Table 8.7.5.5-1). The harvest rate in fall season fisheries averaged 9.6% since 1985 and 4.2% since 1998 (Table 8.7.5.5-1). Impacts resulting from treaty-Indian fall season fisheries during this agreement are likely similar to the 1998-2006 average of 4.2%.

With respect to spring and summer season fisheries, increases in harvest beyond those observed in recent years are unlikely. The spring season extends through June 15. The harvest rate of A-run steelhead has been consistent and low, at approximately 0.2% since 1985 (Table 8.7.5.5-1). No changes in the fishery are proposed or anticipated that would lead to changes in the expected catch of steelhead.

Summer season fisheries extend through July 31. Steelhead are caught regularly in ceremonial and subsistence fisheries (primarily the platform fishery), as well as in commercial fisheries targeting summer Chinook (summer Chinook that are targeted in the fishery are part of the UCR summer/fall ESU and are not listed under the ESA). Summer

Chinook were chronically depressed for decades until returns began to increase in 2001. As of 2002, higher runs provided more fishing opportunity. However, there is no evidence of an associated increase in the catch of listed steelhead. The harvest rate of summer Chinook in the tribal fishery averaged 1.5% from 1989 to 2001, and 10.9% from 2002 to 2006 (TAC 2008). During those same years, the harvest rate of steelhead averaged 2.3% to 2.4% (Table 8.7.5.5-1). As with spring fisheries, no further changes in future fisheries are expected as a result of the Prospective Action that would lead to changes in the expected catch of steelhead. However, as a result of PIT-tag data, there is recent information regarding adult conversion rates that indicate that more UCR steelhead than SR steelhead are lost in upstream passage. The greater losses may be due to differential harvest rates that currently are not detectable. It is also plausible that the losses are due to timing differences, passage conditions, or some combination of factors. If new evidence develops related to the catch of steelhead in the summer season, these conclusions will be reviewed.

Table 8.7.5.5-1. Harvest rates of A-run steelhead in spring, summer, and fall season fisheries expressed as a proportion of the Skamania and A-run steelhead run size (TAC 2008).

Year	Treaty Indian				Non-Indian			
	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
1985	0.15%	NA	19.40%	19.50%				
1986	0.08%	NA	12.60%	12.70%				
1987	0.05%	NA	14.70%	14.80%				
1988	0.18%	NA	16.10%	16.20%				
1989	0.04%	4.00%	14.90%	18.90%				
1990	0.44%	3.50%	14.10%	18.00%				
1991	0.15%	1.90%	14.40%	16.40%				
1992	0.49%	2.00%	15.20%	17.60%				
1993	0.14%	1.40%	14.60%	16.20%				
1994	0.16%	1.10%	9.70%	10.90%				
1995	0.06%	2.20%	10.00%	12.20%				
1996	0.66%	2.30%	8.40%	11.40%				
1997	0.10%	2.70%	10.10%	12.80%				
1998	0.11%	3.80%	8.40%	12.40%				
1999	0.05%	2.10%	5.20%	7.40%	0.10%	0.30%	0.60%	1.00%
2000	0.11%	1.00%	4.00%	5.10%	0.10%	0.60%	1.00%	1.70%
2001	0.09%	2.10%	3.80%	6.00%	0.10%	0.40%	0.60%	1.10%
2002	0.09%	2.10%	2.40%	4.60%	0.40%	0.40%	0.80%	1.60%
2003	0.12%	2.80%	2.50%	5.40%	0.60%	0.30%	1.00%	1.90%
2004	0.13%	3.90%	3.00%	7.00%	0.40%	0.40%	1.00%	1.80%
2005	0.05%	2.30%	3.60%	5.90%	0.40%	0.40%	0.90%	1.70%
2006	0.13%	0.80%	5.00%	6.00%	0.30%	0.40%	1.20%	1.90%
2007					0.30%	0.30%	0.80%	1.40%
1985-06 average	0.16%	2.33%	9.64%	11.70%				
1989-06 average	0.17%	2.33%	8.29%	10.79%				
1998-06 average	0.10%	2.32%	4.21%	6.64%	0.30%	0.40%	0.89%	1.59%

Prospective treaty-Indian fall season fisheries will be managed using the abundance based harvest rate schedule for B-run steelhead contained in the 2008 Agreement (Table 8.7.5.5-2). From 1998 to 2007 treaty-Indian fall season fisheries were managed subject to a 15% harvest rate limit on B-run steelhead. Under the abundance-based harvest rate schedule, harvest may vary from the status quo of 15%, depending on the abundance of B-run steelhead. The harvest rate allowed under the prospective schedule is also limited by the abundance of upriver fall Chinook. The purpose of this provision is to recognize that impacts on B-run steelhead may be higher when the abundance, and thus fishing opportunity for fall Chinook, is higher and remain consistent with conservation goals. However, higher harvest rates are allowed only if the abundance of B-run steelhead is also greater than 35,000. This provision is designed to provide the tribes with greater opportunity to satisfy their treaty right to harvest 50% of the harvestable surplus of fall Chinook in years when conditions are favorable. Even with these provisions, it is unlikely that the treaty right for Chinook steelhead can be fully satisfied. The harvest rate in tribal fall season fisheries may range from 13 to 20%. As indicated above, the non-Treaty fall season fishery harvest rate will remain fixed at 2%.

8.7.5.5-2. Abundance Based Harvest Rate Schedule for B-run Steelhead (TAC 2008).

Upriver Summer Steelhead Total B Harvest Rate Schedule				
Forecast Bonneville Total B Steelhead Run Size	**River Mouth URB Run Size**	**Treaty Total B Harvest Rate**	**Non-Treaty wild B Harvest Rate**	**Total Harvest Rate**
20,000	Any	13%	2.0%	15.0%
20,000	Any	15%	2.0%	17.0%
35,000	>200,000	20%	2.0%	22.0%

B-run steelhead will be used as the primary steelhead related harvest constraint for tribal fall season fisheries, and thus are the indicator stock used for management purposes. Generally, the status of B-run steelhead is poorer than that of A-run steelhead. B-run steelhead are subject to higher harvest rates because they are larger and thus more susceptible to catch in gillnets. Harvest impacts on B-run steelhead typically are higher because their timing coincides with the return of fall Chinook. A-run steelhead generally return a few weeks earlier, resulting in less susceptibility to catch. Consequently, there are no specific management constraints in tribal fisheries for A-run steelhead. Since 1998, when the 15% harvest rate limit was first implemented for B-run steelhead, the harvest rate on A-run steelhead in fall season treaty-Indian fisheries has averaged 4.2% and ranged from 5.4 to 12.4% (Table 8.7.5.5-1).

The abundance-based harvest rate schedule allows tribal harvest rate on B-run steelhead to vary from the fixed rate of 15% that has been in place since 1998, depending on the abundance of B-run steelhead and upriver fall Chinook. By evaluating historical run size data, a determination can be made as to how often fisheries would be subject to the 13%, 15%, or 20% level. This retrospective analysis suggests that the annual harvest rate limit will be 15% or less 12 out of 22 years, and 20% 10 out of 22 years. The primary limiting constraint from this retrospective analysis is the abundance of upriver fall Chinook. The average allowable harvest rate on B-run steelhead from this retrospective analysis is 17.1% (Table 8.7.5.5-3).

Table 8.7.5.5-3. Retrospective analysis of allowable harvest rates for B-run steelhead in the tribal fall season fisheries (Upriver fall Chinook run size from TAC 2008, Table 7; B-run Steelhead run size from TAC 2008, Table 12).

Year	Upriver Fall Chinook Run Size	B-run Steelhead Run Size	Allowable Harvest Rate in Tribal Fall Fisheries
1985	196,500	40,870	15%
1986	281,500	64,016	20%
1987	420,600	44,959	20%
1988	340,000	81,643	20%
1989	261,300	77,604	20%
1990	153,600	47,174	15%
1991	103,300	28,265	15%
1992	81,000	57,438	15%
1993	102,900	36,169	15%
1994	132,800	27,463	15%
1995	106,500	13,221	13%
1996	143,200	18,693	13%
1997	161,700	36,663	15%
1998	142,300	40,241	15%
1999	166,100	22,137	15%
2000	155,700	40,909	15%
2001	232,600	86,426	20%
2002	276,900	129,882	20%

Year	Upriver Fall Chinook Run Size	B-run Steelhead Run Size	Allowable Harvest Rate in Tribal Fall Fisheries
2003	373,200	37,229	20%
2004	367,858	37,398	20%
2005	268,744	48,967	20%
2006	230,388	74,127	20%
1985-06 average			17.1%

Although the prospective harvest rate schedule will allow the harvest in tribal fall season fisheries to increase in some years, the observed harvest rates in both the non-Treaty and treaty- Indian fisheries have been lower than the allowed rates. Since 1998, the fall season fisheries have been subject to a combined 17% harvest rate limit on B-run steelhead. From 1998 to 2006 the observed harvest rate has averaged 12.7% (TAC 2008).

For fall season fisheries it is necessary to consider whether there will be an increase in the harvest of A-run steelhead associated with the Prospective Action. As discussed above, B-run steelhead are used as the indicator stock for steelhead. This is done in order to limit fishery impacts in fall season fisheries. The retrospective analysis suggests that harvest rates on B-run steelhead in the treaty-Indian fall season fisheries may be higher than 15% approximately half of the time. The average of the allowable harvest rate limits from the retrospective analysis is 17.1% (Table 8.7.5.5-3). This represents a 14% increase over the current harvest rate limit of 15% (17.1/15.0 = 1.14). Harvest rates on A-run steelhead will not necessarily increase, but A-run and B-run harvest rates are correlated. It is therefore reasonable to assume that A-run harvest rates will increase in proportion to B-run harvest rates. Table 8.7.5.5-1 shows the tribal fishery harvest rates for A-run steelhead in spring, summer, and fall season fisheries. Since 1998 when the current ESA limits were applied, the fall season harvest rate averaged 4.2% while the total harvest rate averaged 6.6%. Under the assumption that fall season harvest rates will increase by 14% in proportion to the expected increase for B-run steelhead, the anticipated future fall season and total harvest rates will be 4.8% (0.042 * 1.140 = 0.48) and 7.2%.

The net result will be a small increase in the current harvest rate (from 6.6% to 7.2%), which will result in approximately a 1% reduction in survival (Harvest Appendix, based on *U.S. v. Oregon* memorandum). Therefore, a 0.99 current-to-future survival adjustment is applied to the prospective harvest action for this species.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, identified as a limiting factor for the Wenatchee population (see Habitat Technical Work Group 2006b).

8.7.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to Upper Columbia River steelhead from reduction in Caspian tern nesting habitat on East Sand Island and relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 3.4 % (CA Attachment F-2, Table 4). Compensatory mortality may occur, but based on the discussion in 8.3.5.6, it is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon and steelhead by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Columbia dams will continue to reduce the number of smolts taken by birds in project forebays and tail races (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continuation of the increased reward structure in the sport-reward fishery, and continued implementation and improvement of avian deterrence at mainstem dams are expected to improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.7.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of this document.

8.7.5.8 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of "prospective" expected survival changes resulting from the Prospective Actions are described in Sections 8.7.5.1 through 8.7.5.8 and are summarized in Table 8.7.5-1. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the DPS. Tributary habitat improvement projects are also expected to increase survival for all three populations. The net effect, which varies by population, is 36 to 54% increased survival, compared to the "current" condition, and 43 to 299% increased survival, compared to the "base" condition.

8.7.5.9 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.7.6-1 and 8.7.6-2 and in Figures 8.7.6-1 and 8.7.6-2. In addition to these summary tables and figures, the SCA Aggregate Analysis Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007 Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and DPS level. Additionally, because quantitative short-term extinction risk gaps could not be calculated for this species, future short-term extinction risk is discussed qualitatively in subsequent sections.

8.7.6 Aggregate Effect of the Environmental Baseline, Prospective Actions, & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and DPS viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

The Eastern Cascades MPG is the only MPG within the Upper Columbia River steelhead DPS. Because there is only one MPG, Section 8.7.7 applies to both the Eastern Cascades MPG and the entire Upper Columbia River steelhead DPS. All four populations must be viable to achieve the delisting criteria in the Upper Columbia River Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007).

8.7.7 Aggregate Effect of the Environmental Baseline, Prospective Actions, & Cumulative Effects on the Upper Columbia River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.7.7.1 Potential For Recovery

It is likely that the Upper Columbia River steelhead DPS will trend toward recovery.

The future status of all four populations in the single MPG of UCR steelhead will be improved compared to their current status. It will be improved through a reduction of adverse effects associated with FCRPS and Upper Snake Projects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.7.5, 8.7.6, and 8.7.7.2. These actions include reduction of avian and fish predation, estuary habitat improvements, kelt reconditioning, and tributary habitat improvements for each population. These beneficial actions also completely offset the slightly decreased survival associated with the harvest Prospective Action. Therefore, the status of the DPS as a whole is expected to improve compared to its current condition and move closer toward a recovered condition. This expectation takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.5.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this DPS.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.7.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatcheries, and degradation of tributary and estuary habitat. Prospective habitat improvements will initiate and at least partially correct ICTRT concerns regarding high spatial structure risk for the Okanogan population. The ICTRT has indicated concerns for all four populations relative to high diversity risk, including legacy effects of historical hatchery practices. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions that are appropriately considered cumulative effects also address limiting factors and threats. The harvest Prospective Action is to implement a *U.S. v. Oregon* harvest rate schedule that is expected to result in only a very small change from the current harvest rates in the environmental baseline.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Some of the problems limiting recovery of UCR steelhead, such as the effects of legacy hatchery practices, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent significant improvements to address these factors and they can be reasonably implemented within the next 10 years.

Additionally, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. This includes a new steelhead study in the Methow to determine hatchery fish effectiveness compared to natural-origin fish and to determine the effects of hatchery fish on population productivity. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In sum, these qualitative considerations suggest that the UCR steelhead DPS will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of some of the metrics indicating a trend toward recovery, discussed below, also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of hatchery supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, such as those affecting all four UCR steelhead populations (Section 8.7.5.4), but R/S may be the best indicator of the ability of populations to be self-sustaining without hatchery supplementation. R/S calculations incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

R/S is expected to be less than 1.0 for all four populations after implementation of the Prospective Actions, except under the high base-to-current hatchery assumption for the Entiat population (Table 8.7.6.1-1; Figure 8.7.6-1). Additional management actions would have to more than double the average survival rate to achieve mean R/S greater than 1.0 for the Okanogan and Methow populations.

This result takes into account the range of base-to-current survival improvements estimated to result from changes in hatchery practices that have already been implemented. However, if the percentage of natural-origin fish on the spawning grounds increases, then it is likely that further increases in productivity, as reflected in the R/S estimates, would occur.

The present analysis does not include any assumptions about future reductions in the hatchery-origin fraction of natural spawners, although such improvements are likely as a result of future changes in Federal and non-Federal hatchery practices. The CA included such an analysis, which demonstrated that if hatchery fractions were to be reduced sufficiently in the future, R/S estimates could be greater than 1.0 for three of the four populations. NOAA Fisheries acknowledges the potential that R/S could be greater than 1.0 for these populations when the natural-origin abundance increases and dependence on hatcheries can be reduced. Since some of the changes are outside the authority of the Action Agencies, and have not yet been fully consulted upon, the potential benefits from such changes have not been included here.

It is, however, important to recognize that the Action Agencies have made substantial progress, within their control, in addressing the factors affecting this DPS. The estimate of juvenile survival through Federal dams in the lower Columbia River under the Prospective Actions is 53% and the estimate of survival through a free-flowing river of equal length is 88% (Section 8.7.5.1). Since achieving a R/S rate of greater than 1.0 will require doubling the survival of the natural spawners for some populations, it is apparent that additional Federal hydropower management actions alone cannot bring this DPS to recovery. It is a reasonable hypothesis that productivity in this DPS is being limited by reduced quality and quantity of spawning and rearing habitat and the residual effects of past Federal and non-Federal hatchery practices using non-native broodstock. The corrective measures already adopted in hatchery practices, together with additional reforms to increase the percentage of natural-origin fish on the spawning grounds and improved hatchery broodstock practices, are likely to reduce these residual effects and increase productivity. However, multiple generations of these better hatchery practices may be required before productivity improves to an adequate level.

Population growth rate (lambda) and BRT trend estimates, as calculated in this analysis, are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. These estimates require fewer assumptions and less data than R/S estimates, but may also be limited by data quality. Because of the hatchery assumptions these metrics may be less indicative of a trend toward recovery than R/S for populations significantly influenced by hatchery programs, since recovery implies self-sustaining populations absent continuing hatchery supplementation. In particular, lambda as calculated in this analysis has limited utility since the UCR steelhead populations are so heavily supplemented.

All three populations in this DPS for which estimates were possible have lambda (HF=0) and BRT trends that are expected to be greater than 1.0 with implementation of the Prospective Actions (Table 8.7.6.1-1). This indicates that these populations are expected to continue to increase in abundance in the future, but the contrast in R/S and these trend estimates suggests that the future increase is at least partially explained by second generation hatchery progeny (F_2 generation) spawning naturally. Lambda estimates that assume that the effectiveness of hatchery-origin spawners is equal to that of hatchery-origin spawners (HF=1) results in estimates similar to R/S estimates, with all populations less than 1.0.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S, lambda, and BRT trend may be low.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the "historical" ocean scenario, 1-2 of the four populations are expected to have R/S trend greater than 1.0, depending upon hatchery base-to-current assumption, compared to all four less than 1.0 under the recent ocean climate scenario (SCA Aggregate Analysis Appendix; Figure 8.7.6-2). Under the ICTRT "Warm PDO" (poor) results are very similar to results based on the current climate scenario, described above.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S is expected to be less than 1.0 at the lower 95% confidence limit and greater than 1.0 at the upper 95% confidence limit for two of the four populations (SCA Aggregate Analysis Appendix; Figure 8.7.6-1). Confidence limits for lambda and BRT trend are variable, but also generally include a range above and below 1.0. These results suggest that it also is important to consider qualitative factors in reaching conclusions.

Taken together, the combination of all the qualitative and quantitative factors discussed above indicates that the DPS as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements.

NOAA Fisheries cannot demonstrate quantitatively that UCR steelhead populations will be increasing without hatchery supplementation (indicated by R/S and lambda with HF=1) as a result of the actions considered in the aggregate analysis, but it is likely that abundance will increase given the aggregate effects, including a continuing supplementation program (indicated by BRT trend and lambda with HF=0). The impact from historic hatchery practices on this species has likely been significant, as has mortality associated with Federal and non-Federal hydropower projects in the mainstem Columbia River. However, the difference in current status between Upper Columbia River Spring Chinook Salmon and Upper Columbia River steelhead populations is telling. Listed fish from both species pass through the same hydrosystem. Both occupy habitat that has been similarly impacted by human activity. Biological differences between the species generally do not account for the great discrepancy in their status in the Upper Columbia River, as evidenced by the similar status of SR spring/summer Chinook salmon and SR steelhead. The status of Upper Columbia River steelhead, as evidenced by recruit-per-spawner productivity and other base period biological indicators, is generally much worse than the status of Upper Columbia River Spring Chinook Salmon. Three factors that distinguish steelhead from spring Chinook salmon populations in the Upper Columbia River are harvest rates between 50-90% until the early 1980s, the extremely high proportion of hatchery fish in historical steelhead spawning populations, and the homogenization of hatchery broodstock due to past and present (for the Methow population) broodstock collection practices. To the extent that hatchery practices have contributed to current low productivities for the Wenatchee, Entiat, Methow, and Okanogan populations, hatchery reforms already underway in the Wenatchee (i.e., the use of Wenatchee steelhead for broodstock and reforms to reduce straying into the Entiat) and Prospective Actions to develop a local broodstock for the Methow and Okanogan are expected to improve the situation for the Wenatchee, Entiat, Methow and Okanogan populations. Substantial reduction in the homogenization of the Methow population will require reforms at Winthrop NFH and in the Wells Hatchery program (a hatchery program not funded by the Action Agencies).

It will take a considerable time before legacy hatchery effects are resolved and diversity risk is reduced. Similarly, it will take some time for habitat and other improvements to take effect, which will be necessary before managers conclude that dependence on hatcheries can be reduced. When survival increases and natural-origin abundance grows, dependence on the hatcheries to supplement natural spawning can be reduced (i.e., the fraction of hatchery-origin fish on the spawning grounds can be reduced), in which case it appears that the natural productivity as indicated by R/S will be positive. In the meantime, the current supplementation program, as indicated by expected BRT trend greater than 1.0, suggests that the DPS will be increasing in abundance and trending toward recovery.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the DPS being on a trend toward recovery.

8.7.7.2 Short-Term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through survival improvements resulting from the Prospective Actions and a continuation of other current management actions in the environmental baseline, as described above and in Sections 8.7.3 and 8.7.5.

As described above, abundance is expected to be stable or increasing and populations are expected to grow as indicated by lambda and the BRT trend. Recent abundance levels are estimated between 94 and 900 spawners, depending on the population, which is well above the QET levels under consideration (Table 8.7.2-1). These factors also indicate a decreasing risk of extinction.

A well-run conservation hatchery program in the Wenatchee reduces short-term extinction risk for the Wenatchee steelhead population. There is no hatchery program for the Entiat. Hatchery programs in the Methow and Okanogan use a composite of listed fish and preserve genetic resources, but they do not currently follow optimum broodstock practices for improving diversity for the Methow and Okanogan populations. The Prospective Actions address only one hatchery program in the Methow basin at Winthrop NFH. Reforms of this program are expected as an outcome of several hatchery program review processes.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. These include a new hatchery effectiveness and effects study in the Methow. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

As described in Section 8.2.6, extinction risk after implementing the Prospective Actions cannot be estimated quantitatively. However, because base period extinction risk (assuming no future supplementation) is extremely high, it is likely that short-term extinction risk under the Prospective Actions would also be high if calculated in the same manner. These estimates assume that all hatchery supplementation ceases, which is not a reasonable assumption. Because hatchery supplementation programs now in place will preserve genetic resources into the future, short-term extinction risk is negligible. The sensitivity analysis of Hinrichsen (2008), included as Attachment 1 of the SCA Aggregate Analysis Appendix, indicates that there is 0% chance of short-term extinction risk at QET=50 under continued supplementation for three of the four populations if supplementation programs continue under current management plans. Short-term extinction risk for the Entiat population would be greatly reduced, but would still be greater than 5%.

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0% to near 100% for some populations (Table 8.7.2-3). This uncertainty indicates that it is important to also consider qualitative factors in reaching conclusions.

Taken together, the combination of all the factors above indicates that the DPS as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. NOAA Fisheries cannot demonstrate quantitatively that UCR steelhead will have a low risk if all supplementation ceases. However, both qualitative considerations and quantitative sensitivity analyses indicate that short-term extinction risk is low given continuation of current supplementation programs. The combination of recent abundance estimates for average populations, expected survival improvements, expected positive trends for most populations, and supplementation programs that reduce short-term risk indicate that these populations are likely to have a low enough risk of extinction to conclude that the DPS as a whole will have a low risk of short-term extinction.

8.7.7.3 Aggregate Effect of the Environmental Baseline, Prospective Actions, & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for UCR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam as well as specific stream reaches in the following subbasins: Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and Upper

Columbia/Priest Rapids. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for UCR steelhead. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Columbia River; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem, tributary and estuary land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established to serve the intended conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at McNary and John Day dams, in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles. Habitat work in tributaries used for spawning and rearing and in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v Oregon* Agreement, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Upper Columbia River Steelhead DPS is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of Upper Columbia River Steelhead DPS nor result in the destruction or adverse modification of its designated critical habitat.

Table 8.7.2-1. Status of UCR steelhead with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

			Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
ESU	**MPG**	**Population**	Most Recent 10-yr Geomean Abundance[1]	Years Included In Geomean	ICTRT Recovery Abundance Threshold[1]	Average R/S: 20-yr non-SAR adj.; non-delimited[2]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0)[3]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1)[3]	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current[4]	Lower 95% CI	Upper 95% CI
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	900	1997-2006	1000	0.35	0.22	0.55	1.07	0.83	1.38	0.80	0.62	1.03	1.04	1.00	1.11
		Methow (Summer A)	281	1997-2006	1000	0.21	0.15	0.30	1.09	0.83	1.43	0.67	0.56	0.81	1.07	1.03	1.14
		Entiat (Summer A)	94	1997-2006	500	0.52	0.37	0.73	1.05	0.82	1.36	0.81	0.67	0.97	1.04	1.01	1.12
		Okanogan (Summer A)	104	1997-2006	1000	0.08	0.06	0.11									

1 Most recent year for 10-year geometric mean abundance is 2004-2005, depending upon population. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from ICTRT (2007c).
2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 years in Cooney (2008a). Actual years in average vary by population.
3 Median population growth rate (lambda) during the most recent period of approximately 20 years. Actual years in estimate vary by population. Lambda estimates are from Cooney (2008b).
4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in Cooney (2008b).

Table 8.7.2-2. Status of UCR steelhead with respect to spatial structure and diversity VSP factors.

ESU	**MPG**	**Population**	**ICTRT Current Risk For Spatial Structure[1]**	**ICTRT Current Risk For Diversity[1]**	**10-yr Average % Natural-Origin Spawners[2]**
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.40
		Methow (Summer A)	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.10
		Entiat (Summer A)	Currently Moderate Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.20
		Okanogan (Summer A)	Currently High Risk (Only occupy lower halves of 2 US MaSAs)	Currently High Risk (Homogenization of historical populations and high hatchery %)	0.06

1 ICTRT conclusions for UCR steelhead are from draft ICTRT Current Status Summaries (ICTRT 2007d).
2 Average fractions of natural-origin natural spawners are from the ICTRT (2007c).

Table 8.7.2-3. Status of UCR steelhead with respect to extinction risk. Extinction risk is estimated from performance during the "base period" of the 20 most recent brood years (approximately 1980 BY – 1999 BY).

			24-Year Extinction Risk											
ESU	MPG	Population	Risk (QET=1)[1]	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10)[1]	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30)[1]	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50)[1]	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - (Summer A)	0.01	0.00	0.38	0.06	0.00	0.59	0.19	0.00	0.84	0.27	0.00	0.92
		Methow (Summer A)	0.00	0.00	0.82	0.07	0.00	0.99	0.28	0.00	1.00	0.47	0.02	1.00
		Entiat (Summer A)	0.53	0.00	0.67	0.80	0.00	0.95	0.95	0.01	1.00	0.99	0.10	1.00
		Okanogan (Summer A)	0.93	0.18	1.00	1.00	0.56	1.00	1.00	0.71	1.00	1.00	0.77	1.00

1 Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), in the SCA Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

Table 8.7.2-4. Changes in density-independent survival of UCR steelhead ("gaps") necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for UCR steelhead. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated "gaps" are based on population performance during the "base period" of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0[1]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0@ HF=1[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0[3]	Upper 95% CI	Lower 95% CI	Survival Gap for 24-Yr Ext. Risk <5% (QET=1)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=10)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=30)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=50)[4]
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	2.85	4.45	1.83	0.75	2.34	0.24	2.76	8.78	0.86	0.85	0.99	0.63				
		Methow (Summer A)	4.68	6.63	3.30	0.69	2.33	0.20	5.90	>10	2.60	0.75	0.88	0.56				
		Entiat (Summer A)	1.93	2.71	1.38	0.80	2.50	0.25	2.60	5.90	1.14	0.84	0.97	0.61				
		Okanogan (Summer A)	12.65	18.17	8.81													

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.7.2-1.
2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.7.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.
3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.7.2-1) ^ Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.
4 Extinction risk survival gap could not be calculated for this species (see Aggregate Analysis Appendix).

Table 8.7.3-1. Proportional changes in average base period survival of UCR steelhead expected from completed actions and current human activities that are likely to continue into the future. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

			Base-to-Current Adjustment (Divisor)									
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2]	Estuary Habitat[3]	Bird Predation[4]	Marine Mammal Predation[5]	Harvest[6]	"Low" Hatcheries[7]	"High" Hatcheries[7]	Total (Low Hatchery)[8]	Total (High Hatchery)[9]
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee (Summer A)	1.08	1.02	1.00	1.00	1.00	1.04	1.60	1.60	1.83	1.83
		Methow (Summer A)	1.25	1.02	1.00	1.00	1.00	1.04	1.17	1.55	1.55	2.06
		Entiat (Summer A)	1.13	1.02	1.00	1.00	1.00	1.04	0.82	1.30	0.98	1.55
		Okanogan (Summer A)	1.25	1.06	1.00	1.00	1.00	1.04	1.34	1.88	1.85	2.59

1 From SCA hydro appendix. Based on differences in average base and current smolt-to-adult survival estimates for both FCRPS and PUD dams.
2 From CA Chapter 9, Table 9-7.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the
"Current 2 S/Baseline 2 S" approach, as described in Attachment F-2.
5 SCA Marine Mammal Appendix. No populations in this DPS are winter-run.
6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
6 From SCA Quantitative Analysis of Hatchery Actions Appendix
8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column, except for the high hatchery estimate.
9 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column, except for the low hatchery estimate.

Table 8.7.5-1. Proportional changes in survival of UCR steelhead expected from the Prospective Actions. Factors greater than 1.0 result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

			Current-to-Future Adjustment (Divisor)									
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2] (2007-2017)	Estuary Habitat[3]	Bird Predation[4]	Pike-minnow Predation[5]	Kelt Reconditioning[6]	Marine Mammal[7]	Allowable Harvest8	Expected Harvest[8]	Hatcheries9
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	1.23	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Methow (Summer A)	1.23	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Entiat (Summer A)	1.23	1.08	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Okanogan (Summer A)	1.23	1.14	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00

			Current-to-Future Adjustment (Divisor)					High	Low
ESU	MPG	Population	Non-Hydro With Allowable Harvest[10]	Non-Hydro With Expected Harvest[10]	Total (Allowable Harvest)[11]	Total (Expected Harvest)[11]		Total Base-Current and Current-Future[12]	Total Base-Current and Current-Future[12]
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	1.14	1.14	1.41	1.41		2.58	2.58
		Methow (Summer A)	1.14	1.14	1.41	1.41		2.18	2.89
		Entiat (Summer A)	1.19	1.19	1.46	1.46		1.43	2.26
		Okanogan (Summer A)	1.25	1.25	1.54	1.54		2.85	3.99

1 From SCA Hydro Modeling Appendix. Based on differences in average current and prospective smolt-to-adult survival estimates for both FCRPS and PUD dams.
2 From CA Chapter 9, Table 9-9.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Prospective 2 S/Current 2 S" approach, as described in Attachment F-2.
5 From CA Appendix F, Attachment F-1.
6 SCA Kelt Reconditioning Appendix
7 SCA Marine Mammal Appendix. No populations in this DPS are winter-run.
8 From SCA Harvest Appendix. Primary source: memorandum from US v. Oregon ad hoc technical workgroup.
9 No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative .
10 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.
11 Same as Footnote 10, except it is calculated from all Prospective Actions, including hydro actions.
12 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multipliers (with high and low hatchery estimates) from Table 8.7.3-1.

Table 8.7.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for UCR steelhead. Low and high productivity estimates are a result of the range of changes in hatchery-origin spawner effectiveness from the base to the current conditions, as described in Section 8.7.3.1 and CA Section 9.3.1.5.

Low Base-to-Current Hatchery Adjustment

			Low Base-to-Current Hatchery Adjustment							
ESU	MPG	Population	20-Yr R/S Recent Climate[1]	20-yr lambda Recent Climate @ HF=0[2]	20-yr lambda Recent Climate @ HF=1[3]	1980-Current BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	0.90	1.32	0.98	2.67	Two must be HV and 1 must be V	Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <1	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Methow (Summer A)	0.47	1.29	0.80	2.32		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <3	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Entiat (Summer A)	0.74	1.14	0.88	1.48		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <4	Currently Moderate Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Okanogan (Summer A)	0.23					R/S<1	Currently High Risk (Only occupy lower halves of 2 US MaSAs)	Currently High Risk (Homogenization of historical populations and high hatchery %)

High Base-to-Current Hatchery Adjustment

			High Base-to-Current Hatchery Adjustment							
ESU	MPG	Population	20-Yr R/S Recent Climate[1]	20-yr lambda Recent Climate @ HF=0[2]	20-yr lambda Recent Climate @ HF=1[3]	1980-Current BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
Upper Columbia River Steelhead	Eastern Cascades	Wenatchee - Hatch =1 (Summer A)	0.90	1.32	0.98	2.67	Two must be HV and 1 must be V	Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <3	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Methow (Summer A)	0.62	1.38	0.85	3.08		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <5	Currently Low Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Entiat (Summer A)	1.17	1.26	0.97	2.35		Lambda HF=0 and BRT trend >1, but R/S and Lambda HF=1 <6	Currently Moderate Risk	Currently High Risk (Homogenization of historical populations and high hatchery %)
		Okanogan (Summer A)	0.32					R/S<1	Currently High Risk (Only occupy lower halves of 2 US MaSAs)	Currently High Risk (Homogenization of historical populations and high hatchery %)

1 Calculated as the base period 20-year R/S productivity from Table 8.7.2-1, multiplied by the total base-to-future survival multiplier in Table 8.7.5-1.
2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.7.2-1, multiplied by the total base-to-future survival multiplier in Table 8.7.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.7.2-1, multiplied by the total base-to-future survival multiplier in Table 8.7.5-1, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
4 From ICTRT (2007c), Attachment 2
5 From Table 8.7.2-2

Figure 8.7.6-1. Summary of prospective mean R/S estimates for UCR steelhead under the "recent" climate assumption, including 95% confidence limits.

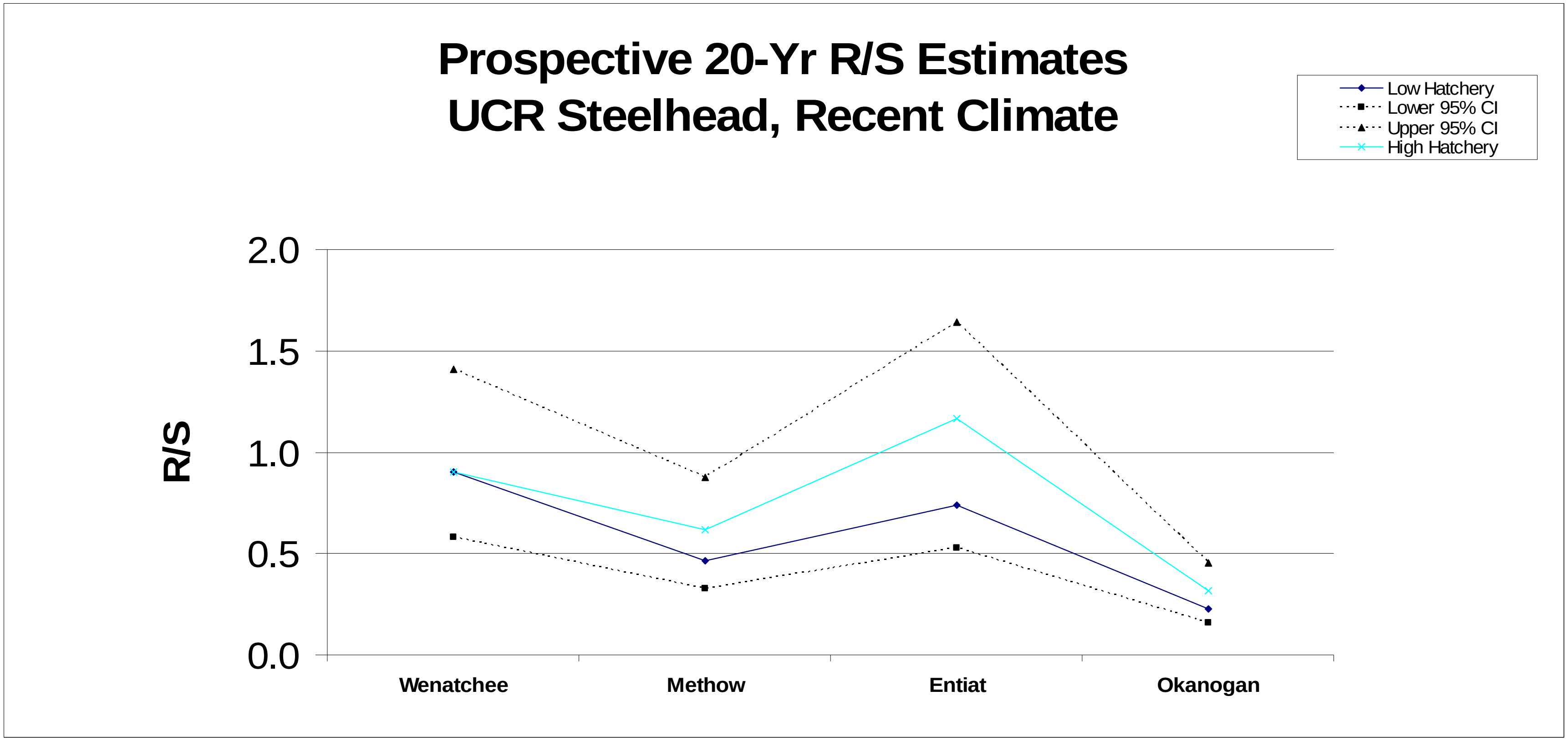
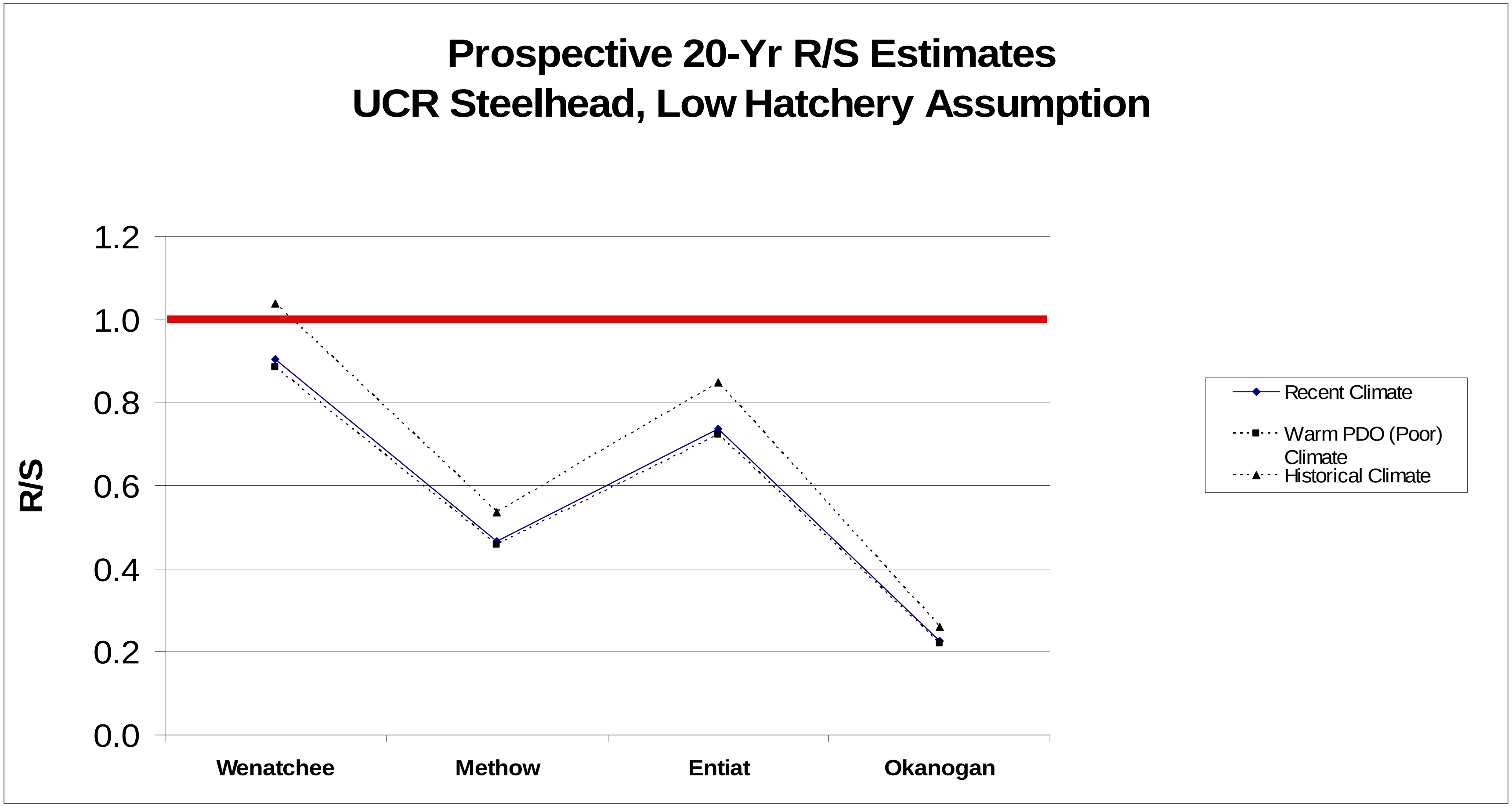
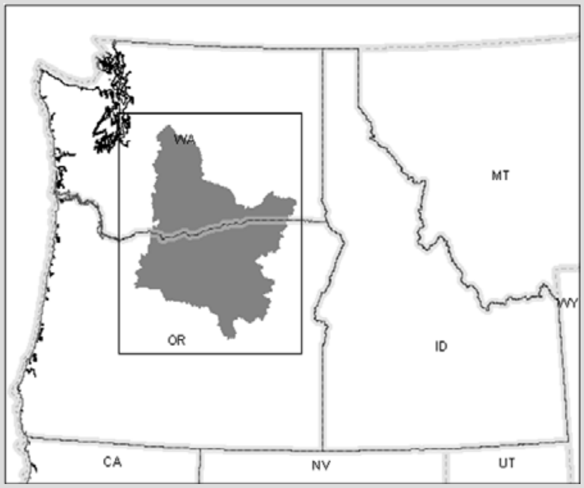
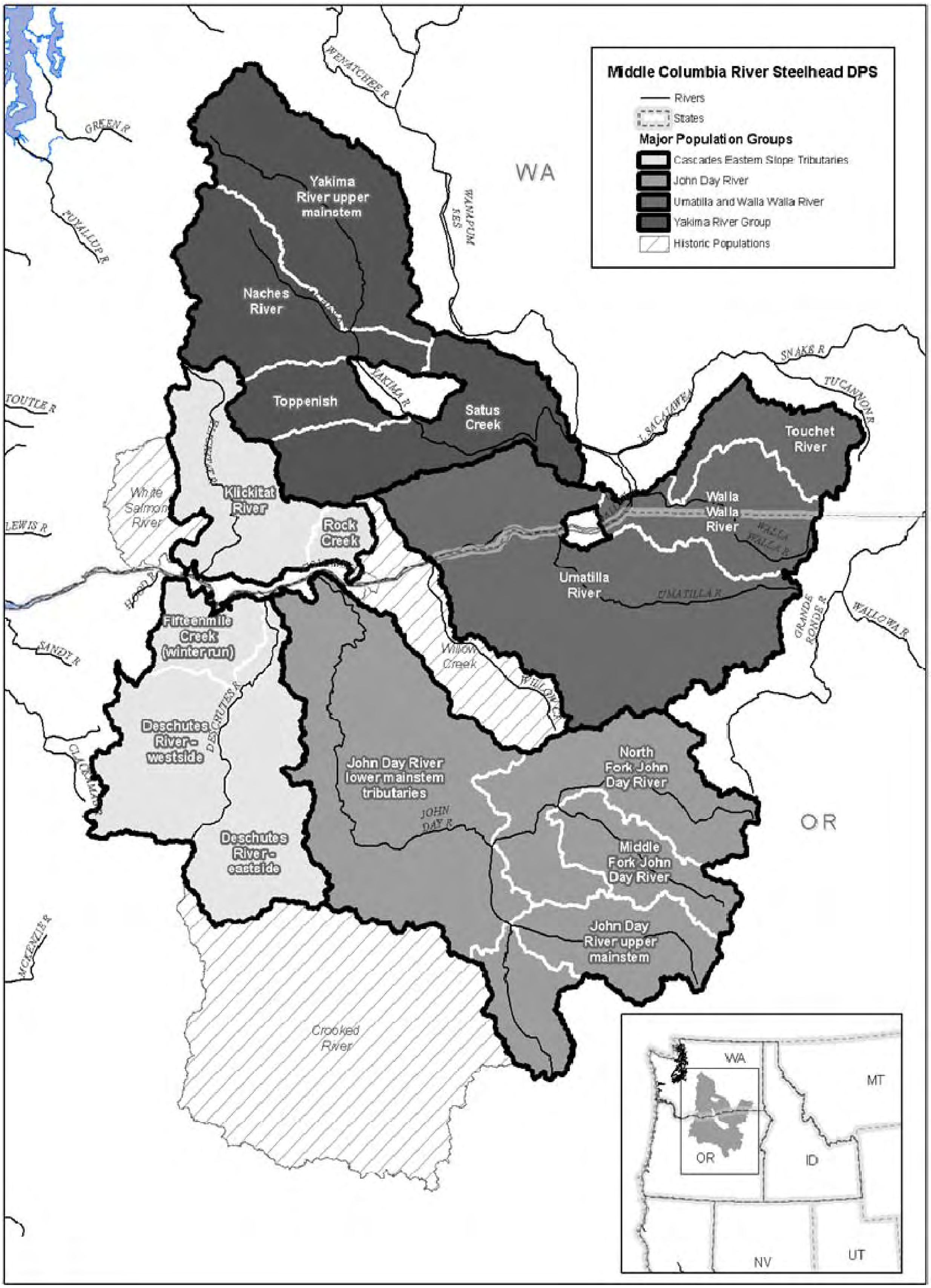


Figure 8.7.6-2. Summary of prospective mean R/S estimates for UCR steelhead under three climate assumptions.



Section 8.8
Middle Columbia River Steelhead




Middle Columbia River Steelhead DPS
Rivers
States
Major Population Groups
Cascades Eastern Slope Tributaries
John Day River
Umatilla and Walla Walla River
Yakima River Group
Historic Populations
WA
OR
Yakima River upper mainstem
Naches River
Toppenish
Satus Creek
Klickitat River
Rock Creek
White Salmon River
Touchet River
Walla Walla River
Umatilla River
Fifteenmile Creek (winter run)
Deschutes River - westside
Deschutes River - eastside
Willow Creek
John Day River lower mainstem tributaries
North Fork John Day River
Middle Fork John Day River
John Day River upper mainstem
Crooked River
WENATCHEE R
GREEN R
PUYALLUP R
WANAPUM SES
SNAKE R
TUCANNON R
YAKIMA R
TOUTLE R
LEWIS R
HOOD R
SANDY R
CLACKAMAS R
DESCHUTES R
MCKENZIE R
UMATILLA R
WALLA WALLA R
WILLOW CR
GRANDE RONDE R
WALLOWA R
JOHN DAY R
MT
ID
NV
UT

Section 8.8
Middle Columbia River Steelhead

Species Overview

Background

The Middle Columbia River (MCR) Steelhead DPS includes anadromous populations in Oregon and Washington subbasins upstream of the Hood and Wind River systems to and including the Yakima River. There are four major population groups with 17 populations in this DPS. Almost all populations are summer-run fish; two winter-run populations return to the Klickitat and Fifteenmile Creek watersheds. Blockages have prevented access to sizable historical production areas in the Deschutes, White Salmon, and White Salmon rivers. The Middle Columbia River Steelhead DPS was listed under the ESA as threatened in 1999, reaffirmed in 2006.

Designated critical habitat for MCR steelhead includes all Columbia River estuarine and river reaches proceeding upstream to the confluence of the Yakima River and a number of tributary subbasins.

Current Status & Recent Trends

During the most recent 10-year period for which trends in abundance could be estimated, they were positive for approximately half of the populations and negative for the remainder. On average, when only natural production is considered, most of the MCR steelhead populations have replaced themselves.

Limiting Factors and Threats

Historically, the key limiting factors for MCR steelhead include mainstem hydropower projects, tributary habitat and hydropower, water storage projects, predation, hatchery effects, harvest, and estuary conditions. Ocean conditions have been generally poor over most of the last 20 years, improving only in the last few years.

Recent Ocean and Mainstem Harvest

Few steelhead are caught in ocean fisheries. Ocean fishing mortality on Middle Columbia River steelhead is assumed to be zero. The MCR steelhead DPS is made up of mostly summer run populations, although there are a few populations with winter run timing. The summer run populations are all categorized as A-run based on run timing and age and size characteristics.

Fisheries in the Columbia River are limited to assure that the incidental take of ESA-listed Middle Columbia River steelhead does not exceed specified rates. Non-Treaty fisheries were subject to a 2% harvest rate limit on A-run steelhead. Treaty Indian fall season fisheries were subject to a 15% harvest rate limit on B-run steelhead, but were not subject to a particular A-run harvest rate constraint since B-run steelhead are generally more limiting. Recent harvest rates on Middle Columbia River A-run steelhead in non-Treaty and treaty Indian fisheries ranged from 1.0% to 1.9%, and 4.1% to 12.4%, respectively.

The yearly incidental catch of winter-run steelhead populations in non-Treaty fisheries has averaged 1.9% and has ranged from 0.2 to 9.3% since 2001. The high harvest rate observed in 2002 (i.e. 9.3%) was due to a lack of proper in-season management guidelines. These guidelines were subsequently corrected in 2003 and have been in place since that time. The yearly incidental take of winter-run steelhead populations in tribal fisheries, which is limited to winter populations above Bonneville Dam, has averaged 2.2% and has ranged from 0.8 to 5.8% since 2001.

8.8.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point is the scientific analysis of species' status, which forms the basis for the listing of the species as endangered or threatened.

8.8.2.1 Current Rangewide Status of the Species

Middle Columbia River (MCR) steelhead is a threatened species composed of 17 extant anadromous populations in four major population groups (MPG). Key statistics associated with the current status of MCR steelhead are summarized in Tables 8.8.2-1 through 8.8.2-4. Upriver summer steelhead, which include UCR steelhead, are categorized as A-run or B-run based on run timing and age and size characteristics. MCR steelhead are all A-run fish.

Limiting Factors & Threats

The key limiting factors and threats for MCR steelhead include hydropower projects, tributary habitat and in-basin hydropower, predation, hatchery effects, harvest and estuary conditions. Ocean conditions generally have been poor over most of the last 20 years, improving only in the last few years. Limiting factors and threats are discussed in detail in the context of critical habitat in Section 8.8.3.3.

Abundance

For three of the 14 populations with estimates of recent abundance, average abundance over the most recent 10-year period is above the average abundance thresholds that the ICTRT identifies as a minimum for low risk (Table 8.8.2-1).[1] The remaining 11 populations have lower average abundance than the ICTRT abundance thresholds. Abundance for most populations was relatively high during the late 1980s, declined to low levels in the mid-1990s, and increased to levels similar to the late 1980s during the early 2000s (Figure 8.8.2-1, showing annual abundance of combined populations).

Figure 8.8.2-1 shows the aggregate abundance of all populations and rolling 5-year geometric mean of abundance for the DPS as a whole. The 1980 to 2002 and the 1990 to 2002 DPS-level trends indicate a declining trend over 1980 to 2002 and an increasing trend for 1990-2002. Geometric mean abundance since 2001 has substantially increased for the DPS as a whole. Geomean abundance of natural-origin fish for the 2001 to the most recent period was 17, 553 compared to 7, 228 for the 1996 to 2000 period, a 143 percent improvement (all aggregate population abundance trend information from Fisher and Hinrichsen 2006). The 5-year geometric mean in 2002 was still less than the 5-year geometric mean in 1988.

[1] BRT and ICTRT products were developed as primary sources of information for the development of delisting or long-term recovery goals. They were not intended as the basis for setting goals for "no jeopardy" determinations. Although NOAA Fisheries considers the information in the BRT and ICTRT documents in this consultation, its jeopardy determinations are made in a manner consistent with the Lohn memos dated July 12, and September 11, 2006 (NMFS 2006h, i).

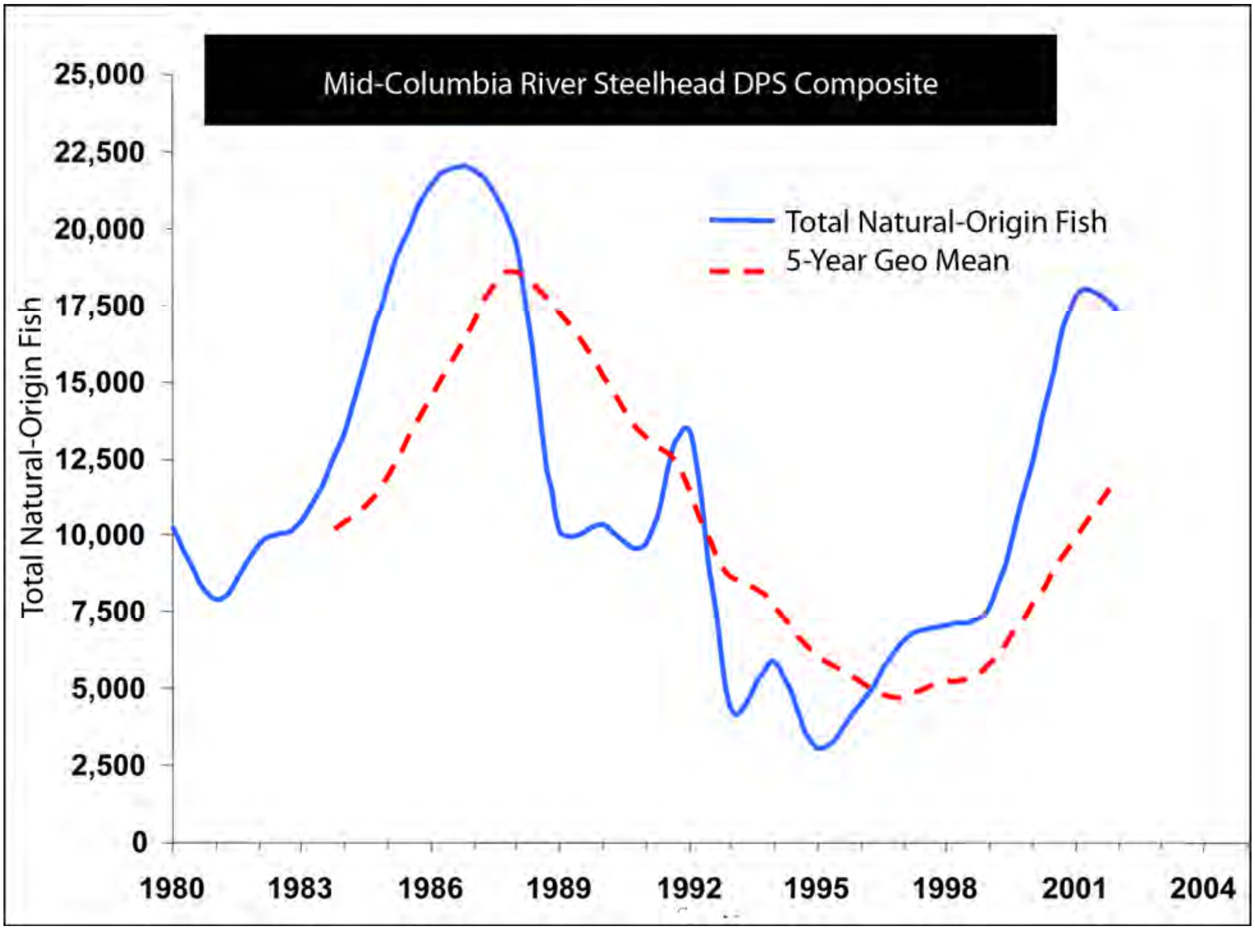


Figure 8.8.2-1. Middle Columbia River Steelhead Abundance Trends (adopted from Fisher and Hinrichsen 2006).

"Base Period" Productivity

Over the last 20 full brood year returns, of the MCR steelhead populations for which estimates are available, most have replaced themselves (R/S>1.0) and a few have not (R/S<1.0; Table 8.8.2-1) when only natural production is considered. These estimates are based on brood years [BY] starting in 1979-1985, depending on population, and ending in 1998 or 1999, including adult returns through 2004 or 2005. In general, R/S productivity was relatively high during the early 1980s, lower during the late 1980s and 1990s, and high again in the most recent brood years (Cooney 2008a)

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at $\leq$5% extinction risk for most of the populations and has been at or above the identified levels for a few (ICTRT 2007c).

The BRT trend in abundance was at or above1.0 during this period for about half of the populations for which this trend could be estimated and less than 1.0 for the remainder (Table 8.8.2-1). Estimates of median population growth rate (lambda) when calculated with the assumption that the effectiveness of hatchery-origin and natural-origin spawners are equal (HF=1; Table 8.8.2-1) were similar to the BRT trend results. Under the HF=0 assumption, most populations have population growth rates greater than 1.0.

Spatial Structure

The ICTRT characterizes the spatial structure risk to MCR steelhead populations as "very low" to "moderate" for all populations except the Upper Yakima (Table 8.8.2-2). This population has "high" diversity risk because 7 of 10 historical major spawning areas are not occupied.

Diversity

The ICTRT characterizes the diversity risk to all but one MCR steelhead population as "low" to "moderate" (Table 8.8.2-2). The Upper Yakima is rated as having "high" diversity risk because of introgression with resident *O. mykiss* and loss of presmolt migration pathways.

"Base Period" Extinction Risk

The draft ICTRT Current Status Summaries (ICTRT 2007d) have characterized the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations during the "base period" described above for R/S productivity estimates, as "Moderate" (6-25% 100-year extinction risk) for most MCR steelhead populations. One population (North Fork John Day) has "very low" (<1%) risk and four populations (Rock Creek, Touchet, Toppenish, and Upper Yakima) have "high" (>25%) risk. The ICTRT defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50).

The ICTRT assessments are framed in terms of long-term viability and do not directly incorporate short-term (24-year) extinction risk or specify a particular QET for use in analyzing short-term risk. Table 8.8.2-3 displays results of an analysis of short-term extinction risk at four different QET levels (50, 30, 10, and 1 fish) for each population. This short-term extinction risk analysis is also based on the assumption that productivity observed during the "base period" will be unchanged in the future. At QET=50, most of the populations, for which short-term risk could be estimated, had <5% risk of short-term extinction. Confidence limits on these estimates are extremely wide, ranging from 0 to 100% risk of extinction for some populations.

A QET of less than 50 may also be considered a reasonable indicator of short-term risk, as discussed in Section 7.1.1.1. However, for this species, alternative QET estimates had no effect on the number of populations with <5% risk of short-term extinction.

The short-term and ICTRT long-term extinction risk analyses assume that all hatchery supplementation ceases immediately. As described in Section 7.1.1.1, this assumption is not representative of hatchery management under the Prospective Actions. A more realistic assessment of short-term extinction risk will take hatchery programs into consideration, either qualitatively or quantitatively. If hatchery supplementation is assumed to continue at current levels for those populations affected by hatchery programs, short-term extinction risk is likely to be lower, as evidenced by analyses for SR fall Chinook, SR spring/summer Chinook, and UCR steelhead (Hinrichsen 2008, included as Attachment 1 of the Aggregate Analysis Appendix).

Quantitative Survival Gaps

The change in density-independent survival that would be necessary for quantitative indicators of productivity to be greater than 1.0 are displayed in Table 8.8.2-4. Mean base period R/S survival gaps range from no needed change to 16%, no needed change to a 21% improvement for lambda, and BRT trend survival gaps range from no change to 26%. It is not possible to estimate survival changes necessary to reduce short-term extinction risk to ≤5% using the methods employed in this analysis, as described in Chapter 7. However, because base extinction risk is <5% for most populations, there would be no gap except for a few populations.

8.8.2.2 Rangewide Status of Critical Habitat

Designated critical habitat for MCR steelhead includes all Columbia River estuarine areas and river reaches in the following subbasins: Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, and Upper Columbia/Priest Rapids (NMFS 2005b). There are 114 watersheds within the range of this DPS. Nine watersheds received a low rating, 24 received a medium rating, and 81 received a high rating of conservation value to the DPS (see Chapter 4 for more detail). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in three of the high value watersheds identified above. This corridor 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. Of the 6,529 miles of habitat areas eligible for designation, 5,815 miles of stream are designated critical habitat. The status of critical habitat is discussed further in Section 8.8.3.3.

8.8.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

8.8.3.1 "Current" Productivity & Extinction Risk

Because the action area encompasses nearly the entire range of the species, the status of the species in the action area is nearly the same as the rangewide status. However, in the Rangewide Status section estimates of productivity and extinction risk were based on performance of populations during a 20-year “base period,” ending with the 1998 or 1999 brood year. The environmental baseline, on the other hand, includes current and future effects of Federal actions that have undergone Section 7 consultation and continuing effects of completed actions (e.g., continuing growth of vegetation in fenced riparian areas resulting in improved productivity as the riparian area becomes functional).

Quantitative Estimates

Because a number of ongoing human activities have changed over the last 20 years, the CA includes estimates of a “base-to-current” survival multiplier, which adjusts productivity and extinction risk under the assumption that current human activities will continue into the future and all other factors will remain unchanged. Details of base-to-current adjustments are described in Section Chapter 7.1 of this document. Results are presented in Table 8.8.3-1.

Briefly, reduction in the average base period harvest rate (estimated at approximately a 4% survival change [SCA Harvest Appendix, based on *U.S. v. Oregon* estimates]), improvements in dam configuration and operation (approximately a 0-2% [2] survival change, based on ICTRT base survival and COMPASS analysis of current survival in Corps et al. 2007a Appendix B), and estuary habitat projects (a less than 1% survival change, based on Corps et al. 2007a Appendix D) result in a survival improvement for all MCR steelhead populations. Tributary habitat projects result in approximately 0-4% survival improvements, depending on population (CA Chapter 10, Table 10-8). A conservation hatchery program for the Umatilla population, (see SCA Hatchery Effects Appendix,) and a kelt reconditioning program affecting four Yakima River populations improved survival, but the effects could not be quantified. In contrast, development of tern colonies in the estuary in recent years results in less than a 1% reduction in survival for all populations. Also, marine mammal predation probably reduced survival by 8% for the one winter-run population to which quantitative estimates can be applied (Fifteenmile Creek).

The net result is that, if these human-caused factors continue into the future at their current levels and all other factors remain constant, survival would be expected to decrease 19% for the Fifteenmile Creek population and increase 4-10% for the other populations (Table 8.8.3-1). This also means that the survival “gaps” described in Table 8.8.2-4 would be proportionately reduced by this amount (i.e., [“Gap” ÷ 1.01] to [“Gap” ÷ 1.22], depending on the population).

[2] These numbers probably underestimate the survival improvements made between the base and current periods because they depend upon “average per project survival estimates.” This approach may overestimate base period survival at the larger Columbia River projects. Thus these estimates should be viewed as conservative, showing smaller survival improvements than are likely to have actually occurred.

8.8.3.2 Abundance, Spatial Structure & Diversity

The description of these factors under the environmental baseline is identical to the description of these factors in the Rangewide Status section.

8.8.3.3 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Tributary habitat conditions vary widely among the various drainages occupied by MCR steelhead. Although land and water management activities have improved, factors such as dams, diversions, roads and railways, agriculture (including livestock grazing), residential development, and forest management continue to threaten the conservation value of critical habitat for this species in some locations in the upper Columbia basin.

Spawning & Rearing Areas

Middle Columbia River steelhead spawn and rear in tributaries to the Columbia River upstream from the Wind River to and including the Yakima (but excluding the Snake) River. Almost all populations are summer-run fish. Juveniles from most of the populations in this DPS rear in the tributaries for 1 to 2 years before outmigrating. The following are the major factors that have limited the functioning and thus the conservation value of habitat used by MCR steelhead for these purposes (i.e., spawning sites with water quantity and quality and substrate supporting spawning, incubation and larval development; rearing sites with water quality, water quantity, floodplain connectivity, forage, and natural cover allowing juveniles to access and use the areas needed to forage, grow, and develop behaviors that help ensure their survival):

- Tributary barriers *[push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles]*

- Excess sediment in spawning gravels and in substrates that support forage organisms *[land and water management activities]*

- Loss of habitat complexity, off-channel habitat and large, deep pools due to sedimentation and loss of pool-forming structures *[degraded riparian and channel function]*

- Degraded water quality *[toxics from agricultural runoff; high temperatures due to water withdrawal/return practices]*

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors and threats for this DPS in spawning and rearing areas. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

Juvenile & Adult Migration Corridors

Adults begin to return from the ocean in early spring and enter upper Columbia tributaries during April through July. Juvenile steelhead migrate to salt water in the spring of their second year of life. Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers *[push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles]*

- Juvenile and adult mainstem passage mortality *[hydropower projects in the mainstem Columbia River; northern pikeminnows and other fish predators]*

- Pinniped predation on adults due to habitat changes in the lower river *[existence and operation of Bonneville Dam and an increased sea lion population]*

- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators [*Caspian terns and double-crested cormorants*]

In the mainstem FCRPS migration corridor, the FCRPS Action Agencies have improved safe passage through the hydrosystem for juvenile steelhead from the mid-Columbia River with the configuration and operational improvements listed in section 10.3.1.1 in Corps et al. (2007a).

The safe passage of juvenile steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown since that time. For these salmonids, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 10.3.1.3 in Corps et al. 2007a). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult winter steelhead in the tailrace of Bonneville Dam (NMFS 2008d).[3] This action is expected to increase the survival of winter steelhead by 7.6%.

Areas for Growth & Development to Adulthood

Although MCR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the mouth of the Columbia River

[3] Winter-run steelhead return to the Klickitat River and Fifteenmile Creek watersheds.

NMFS (2005b). Therefore, the effects of the Prospective Actions on PCEs in areas for growth and development to adulthood are not considered further in this consultation.

8.8.3.4 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

John Day River MPG

Lower Mainstem John Day

The USFS consulted on three grazing allotment projects and one culvert replacement project in the Lower John Day River—Kahler Creek watershed.

The Corps consulted on the permit for replacing boat docks at Philippi Park at River Mile 3 on the John Day River (Lower John Day River—McDonald Ferry watershed) and a culvert replacement in Wheeler Creek (Lower John Day River—Kahler Creek watershed). The latter project included the construction of step pools and rock weirs to enhance fish passage conditions.

The National Park Service consulted on two pest management projects in the Bridge Creek and Lower John Day River—Clarno Rapids watersheds, respectively. The BLM replaced a push-up dam with a screened water withdrawal facility that allows safe passage and planted cottonwoods along three stream miles to improve shading and provide a future source of LWD in Bridge Creek (Bridge Creek watershed). BLM also consulted on projects to fence off one stream mile in the Lower John Day River – Scott Canyon watershed and to convert an agricultural field to perennial grasses and cottonwood trees in the Lower John Day River – Butte Creek watershed. Both projects were intended to improve riparian conditions including cooler water temperatures. The cottonwoods will provide a future source of LWD.

North Fork John Day

The USFS consulted on eight grazing allotment projects in the North Fork John Day River - Big Creek, Upper Camas Creek, Lower Camas Creek, and North Fork John Day River-Potamus Creek, Wall Creek, and Cottonwood Creek watersheds. The USFS also consulted on a project to reroute the Round Meadows Trail in the Upper Camas Creek and a vegetation management project in the Wall Creek watershed. In Granite Creek, the USFS proposed to move historical mine tailings from Clear Creek (Granite Creek watershed), reconnect the creek with its floodplain, and install large woody debris. The latter project was expected to improve cover, shade, and forage conditions.

The BLM consulted on two bridge repair/replacement projects in the North Fork John Day River - Potamus Creek watershed, one at Skull Canyon and one at Stoney Creek. Both projects included stormwater runoff facilities. The FHWA/ODOT consulted on a culvert retrofit on Beech Creek in the

Cottonwood Creek and projects to replace the Monument and Kimberly bridges in the Lower North Fork John Day River watersheds. The culvert retrofit was expected to enable year-round safe passage and shade (from riparian plantings). The bridge replacements increased the amount of impervious surface at each site but also reduced chronic stormwater inputs and restored shade and cover conditions along the streambank (tree plantings).

Middle Fork John Day

The USFS consulted on three culvert replacement projects on Bridge Creek and Lunch Creek in the Upper Middle Fork John Day River watershed; all were designed to improve fish passage. The USFS also consulted on two riparian planting projects (Flood Meadows and Southeast Galena) in the Camp Creek watershed and two grazing allotment projects in the Big Creek and Long Creek watersheds, respectively.

The FHWA/ODOT consulted on a project to remove four culverts, build four bridges, and improve the stream channel and riparian vegetation on Bridge Creek in the Upper Middle Fork John Day River watershed. The project was expected to restore passage and riparian function and to otherwise improve stream channel function.

South Fork John Day

The USFWS consulted on the effects of water withdrawals and herbicide applications related to managing the Philip W. Schneider Wildlife Area in the Murderers Creek watershed. The project was expected to have small, local negative effects on water quantity, water temperatures, and water quality and sublethal effects on fish condition.

The BLM consulted on a project to develop springs in upland areas of the Middle South Fork John Day watershed, improving streambank and riparian conditions.

Upper Mainstem John Day

The USFS consulted on three grazing allotment projects in the Upper John Day River, Canyon Creek, and Laylock Creek watersheds, respectively. The Corps consulted on a bank stabilization project along 110 feet of the south bank of the John Day River (Laylock Creek watershed) and the installation of stream barbs at River Mile 236 (Upper Middle John Day watershed). The latter project was designed to reduce erosion and support the re-establishment of riparian vegetation by moving flow away from the south bank. The FHWA/ODOT consulted on culvert retrofits at seven locations in Beech Creek (Beech Creek watershed) which were designed to improve fish passage. Riparian plantings were expected to increase shade and thereby to lower instream temperatures. The National Park Service consulted on a vegetation management project in the Rock Creek watershed.

Yakima River Group MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the Toppenish River population.

Yakima River Upper Mainstem

The USFS consulted on a timber sale in the Upper Yakima River watershed and a fuels reduction project and two mining plan projects in the Middle Yakima River watershed. The Corps consulted on permits for a bank stabilization project in the Upper Yakima watershed; maintenance dredging and bank stabilization in the Tenaway River watershed; erosion control and habitat restoration; breakwater, dock, and boat ramp repairs; and installation of a natural gas pipeline in the Middle Yakima River watershed; two fish passage projects in the Yakima River – Umatanum Creek watershed; and dredging at an irrigation withdrawal in the mainstem Columbia River (Upper Lake Wallula). The BLM consulted on campground construction in the Yakima River – Umatanum Creek watershed.

The Department of the Army consulted on several projects at the Yakima Training Center in the Middle Yakima River watershed: a plan for erosion control and resource sustainability, the use of military explosives, facilities repairs, bridge repairs, bank stabilization and riparian improvements, and a plan to modify aerial fire suppression requirements.

The NRCS consulted on habitat restoration in the Yakima River – Umatanum Creek watershed. Reclamation consulted on a fish ladder at a diversion dam, a watercraft barrier at an irrigation wasteway water diversion, a permit for a bank protection structure (Middle Yakima River watershed), and a project to dredge an approach channel and canal to a pumping plant (Upper Lake Wallula).

Naches River

The USFS consulted on a recreation management plan for the Little Naches River watershed and a habitat restoration project in the Naches River – Rattlesnake Creek watershed. USFWS consulted on a wildlife area management plan, the Corps consulted on a bank protection and enhancement project, and Reclamation consulted on bridge repairs and a project to improve fish passage and reduce fallback at a diversion dam in the Naches River – Tieton River watershed. The FHWA/WSDOT consulted on road construction and NOAA Fisheries consulted with itself on funding a barrier removal project in the Ahtanum Creek watershed. The Department of the Army consulted on several projects at the Yakima Training Center in the Upper Lower Yakima River watershed involving the use of military explosives and erosion control. Reclamation consulted on the acquisition of water rights in the Upper Lower Yakima River watershed and a project to dredge an approach channel and canal to a pumping plant (Upper Lake Wallula). The Corps consulted on dredging at an irrigation withdrawal structure in the mainstem Columbia River (Upper Lake Wallula).

Satus Creek

The USFWS consulted on management of a wildlife refuge in the Yakima River – Spring Creek watershed. The Department of the Army consulted on an erosion control project at the Yakima Training Center and the Corps consulted on a permit for a diffuser at a waste disposal site in the Yakima River – Cold Creek watershed. The Corps also consulted on dredging at an irrigation withdrawal structure in the mainstem Columbia River (Upper Lake Wallula). Reclamation consulted on a project to dredge an approach channel and canal to a pumping plant (Upper Lake Wallula).

Walla Walla & Umatilla Rivers MPG

Umatilla River

The USFWS consulted on management of a wildlife refuge (Upper Lake Umatilla) and a wildlife area (Lower Umatilla River watershed). The Corps consulted on construction of a pipeline and a dredging project in the Upper Lake Umatilla watershed; construction of a fuel dock and improvements to fish passage at a water withdrawal location in the Middle Lake Umatilla watershed; fish passage improvements on the West Fork of Birch Creek (Birch Creek watershed); bank stabilization and riparian improvements; repair of a railroad bridge and two road construction/maintenance projects in the Umatilla River – Alkali Canyon watershed; and repair/construction of a boat ramp in the Lower Umatilla River watershed.

The USFS consulted on road construction/maintenance in the Upper Umatilla River watershed, Reclamation consulted on a gravel removal project at a fish weir in the McKay Creek watershed. The FHWA/ODOT consulted on a culvert replacement in the McKay Creek watershed and structural improvements at a highway interchange in the Umatilla River – Alkali watershed.

Willow Creek

The Corps consulted on construction of a commercial dock in the Lower Lake Umatilla watershed.

Walla Walla River

The BLM consulted on a recreation management plan for the Upper Walla Walla River watershed. FHWA/WSDOT consulted on a road construction project in the Mill Creek – Walla Walla River watershed and a bridge replacement project in the Cottonwood Creek watershed. The Corps consulted on several projects in the Cottonwood Creek watershed: several culvert replacements, replacement of a push-up dam at a water diversion, and bridge replacements. All of these projects were expected to improve fish passage. The USFWS consulted on a stream rehabilitation project in Cottonwood Creek.

Touchet River

The Corps consulted on a fish passage project in the Upper Touchet River watershed; a bridge repair project with habitat enhancement elements (LWD, habitat heterogeneity, substrate availability) in the Middle Touchet watershed; and fire suppression in the Upper Touchet watershed.

Cascade Eastern Slope Tributaries MPG

NOAA Fisheries did not complete any Section 7 consultations in the subject timeframe that affect the White Salmon River, Klickitat River, Deschutes West, Deschutes East, Crooked River or Rock Creek populations.

Fifteenmile Creek

The Corps consulted on permits to dredge a culvert outlet and to drill exploratory holes for a bridge repair project in the Fifteenmile Creek watershed, improve railroad facilities in the Fivemile Creek watershed, replace culverts in the Middle Columbia River – Mill Creek watershed, and build a waterfront park and excavate a retention basin in the Mosier Creek watershed. The USFS consulted on a grazing allotment in the Middle Columbia River – Mosier Creek watershed.

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.8.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

Federal agencies are implementing numerous projects within the range of MCR steelhead. Some will improve access to blocked habitat, riparian condition, increase channel complexity, and increase instream flows. These projects will benefit the viability of the affected populations by improving abundance, productivity, and spatial structure. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks).

Other types of Federal projects, including grazing allotments, dock and pier construction, and bank stabilization will be neutral or have short- or even long-term adverse effects on viability. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Future Federal restoration projects will improve the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PCEs. However, all of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding in any adverse modification of critical habitat.

8.8.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington identified and provided information on various ongoing and future or expected projects that NOAA Fisheries has determined are reasonably certain to occur and will affect recovery efforts in the Interior Columbia Basin. These are detailed in the lists of projects that appear in Chapter 17 of the FCRPS Action Agencies' Comprehensive Analysis which accompanied their Biological Assessment Corps et al. 2007a). They include tributary habitat actions that will benefit the Walla Walla, Deschutes, North Fork John Day, and other populations as well as actions that should be generally beneficial throughout the DPS. Generally, all of these actions are either completed or ongoing and are thus part of the environmental baseline, or are reasonably certain to occur.[4] Many address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to significantly improve conditions for Middle Columbia River steelhead. These effects can only be considered qualitatively, however.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for Prospective Actions, non-federal actions with cumulative effects are likely to include water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and

[4] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.8.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in Section 8.8.5.1 and 8.8.5.5. The Prospective Actions will ensure that adverse effects of the FCRPS and Upper Snake projects will be reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions, which are expected to be beneficial. These beneficial effects are described in Sections 8.8.5.2, 8.8.5.3, and 8.8.5.6. Some RM&E actions may have short-term minor adverse effects, but these will be balanced by short- and long-term beneficial effects, as described in Section 8.8.5.7.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix. The Prospective Actions will ensure continuation of the beneficial effects of supplementation hatcheries and will reduce adverse impacts of other hatchery programs.

8.8.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Effects on Species Status

Except as noted below, all hydro effects described in the environmental baseline (Chapter 5) are expected to continue through the duration of the Prospective Actions.

The effects of the Prospective Actions projects also are included in this analysis. These effects on mainstem flows have been included in the HYDSIM modeling used to create the 70-year water record for input into the COMPASS model (Section 8.1.1.3). As such, the effect of diminished spring-time flows on juvenile migrants is aggregated in the COMPASS model results used to estimate the effects of the Prospective Actions in the productivity and extinction risk analysis (see SCA Sections 7.2.1 and 8.1.1.3).

Based on COMPASS modeling of hydro operations for the 70-year water record, full implementation of the Prospective Actions (compared to the Current condition) is expected to increase the in-river survival of MCR steelhead by 0.3%, 5.1%, 8.2% and 10.2% for those populations migrating through the one to four dams in the lower Columbia River.[5] Transportation at McNary Dam is expected to

[5] For MCR steelhead, the in-river survival estimate and total system survival estimate are virtually identical because no fish are likely to be transported in 69 out of 70 years (>98% of the time) in the 70-year water record. This is even truer for MCR steelhead than for UCR steelhead because the great majority of the populations enter the Columbia

occur in only 1 of 70 years, < 2% of the time, when flows at McNary are less than 125 kcfs. In this unlikely circumstance, about 75.7% of the juveniles from the Yakima and Walla Walla River populations arriving at McNary Dam would likely be transported (see Table 11.7 of the FCRPS Biological Opinion [NMFS 2008a]). Based on the very positive benefits observed from transportation study results from the Snake River during the extremely low flow conditions of 2001, NOAA Fisheries anticipates a similar, albeit somewhat smaller, benefit would exist from transportation at McNary Dam.

Because this DPS migrates through only one to four mainstem hydro projects, NOAA Fisheries does not have confidence that the SR steelhead post-Bonneville survival relationships could be used as a surrogate for estimating SARs for MCR steelhead populations. NOAA Fisheries made no attempt to estimate SARS for this DPS with the COMPASS model, thus assuming that no differences in post-Bonneville survival would be observed between the Current and Prospective conditions.

The Prospective Actions addressing hydro operation and the RM&E program should maintain the high levels of survival currently observed for adult MCR steelhead migrating from Bonneville Dam upstream to MCN Dam. The current PIT tag based survival estimate, taking account of harvest and "natural" stray rates within this reach, is approximately 98.5% per project (a total of 95.6 %, 97.0%, and 98.5% for fish passing three, two, and one projects, respectively). Any delayed mortality of adults (mortality that occurs outside of the Bonneville Dam to McNary Dam migration corridor) that currently exists is not expected to be affected by the hydro Prospective Actions.

The Prospective Actions are also likely to positively affect the survival of Mid-Columbia steelhead in ways that are not included in the quantitative analysis. To be clear, NOAA Fisheries considers these expected benefits, but has not been able to quantify these effects.

The Prospective Actions requiring implementation of surface passage routes at McNary and John Day dams, in concert with training spill (amount and pattern) to provide safe egress, should reduce juvenile travel times within the forebays of the individual projects for Yakima and Walla Walla river populations (which migrate through both dams) and for the Umatilla and John Day river populations (which migrate through John Day dam alone). This is likely to result in survival improvements in the forebays of these projects, where predation rates currently are often the highest. Taken together, surface passage routes should increase juvenile migration rates through the migration corridor, and likely improve overall post-Bonneville survival of in-river migrants. Faster migrating juveniles may be less stressed than is currently the case. Finally, improved tailrace egress conditions should increase the survival of migrating fall Chinook smolts in tailraces where juvenile mortality rates are relatively high.

Continuing efforts under the NPMP and continuing and improved avian deterrence at mainstem dams will also address sources of juvenile mortality. In-river survival from McNary Dam to the

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River downstream of McNary Dam and are therefore not subject to transportation under any circumstance (only the Yakima and Walla Walla River populations enter the mainstem Columbia River upstream of McNary Dam).

tailrace of Bonneville Dam, which is an index of the hydrosystem's effects on water quality, water quantity, water velocity, project mortality, and predation, will increase to 52.4% for fish passing four dams and to 90.3% for fish passing one dam. A portion of the 9.7% to 47.6% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a hypothetical free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of MCR steelhead in a hypothetical unimpounded Columbia River would be 90.6% for fish migrating through four dams. Therefore, approximately 19.7% (9.4%/47.6%) of the expected mortality experienced by in-river juvenile steelhead migrating through four dams is probably due to natural factors.

The direct survival rate of adults through the FCRPS is already quite high. The prospective actions include additional passage improvements (to the ladders at John Day and McNary dams and other improvements in section 10.3.1.1 in Corps et al. 2007a). Adult steelhead survival from Bonneville to above McNary Dam will be approximately 95.6% under the Prospective Actions. With respect to kelts, the Action Agencies will prepare and implement a Kelt management Plan, including measures to increase in-river survival.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to juvenile migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.8.3.3).

Effects on Critical Habitat

The Prospective Actions described above will improve the function of safe passage in the juvenile and adult migration corridors by addressing water quantity, water velocity, project mortality, and exposure to predators. To the extent that the hydro Prospective Actions result in more adults returning to spawning areas, water quality and forage for juveniles could be affected by the increase in marine-derived nutrients. This was identified as a limiting factor for the Klickitat population by the Remand Collaboration Habitat Technical Subgroup (Habitat Technical Subgroup 2006b).

8.8.5.2 Effects of Tributary Habitat Prospective Actions

Effects on Species Status

The population-specific effects of the tributary habitat Prospective Actions on survival are listed in CA Chapter 10, Table 10-8, p. 10-15 Corps et al. (2007a). For targeted populations in this DPS, the effect is a <1% - 4% expected increase in egg-smolt survival, depending on population, as a result of implementing the tributary habitat Prospective Actions, which improve habitat function by addressing significant limiting factors and threats. For example, as part of the John Day Watershed Restoration project, the Action Agencies will remove passage barriers and improve water quality and riparian habitat. Under the Oregon Fish Screen Project, they will install and replace out-dated fish screens and other passage devices at irrigation diversions in the John Day, Umatilla, and Walla Walla subbasins. In the Yakima, they will screen diversions, install fish passage at migration barriers, and secure riparian easements.

Effects on Critical Habitat

As described above, the tributary habitat Prospective Actions will address factors that have limited the functioning and conservation value of areas that this species uses for spawning and rearing. PCEs expected to be improved are water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage/access. Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long term.

8.8.5.3 Effects of Estuary Prospective Actions

Effects on Species Status

The estimated survival benefit for MCR steelhead (stream-type life history) associated with the specific actions to be implemented from 2007-2010 is 1.4 %. The survival benefit for MCR steelhead (stream-type life history) associated with specific Prospective Actions to be implemented from 2010 through 2018 is 4.3 %. The total survival benefit for MCR steelhead as a result of Prospective Actions implemented to address estuary habitat limiting factors and threats is approximately 5.7% (CA Section 10.3.3.3). These benefits will be derived from estuary habitat restoration projects implemented in the reach between Bonneville Dam and approximately RM 40. The Action Agencies have specified 14 projects to be implemented by 2009 that will improve the value of the estuary as habitat for this species (section 10.3.3.3 in Corps et al. 2007a). These include restoring riparian function and access to tidal floodplains.

Effects on Critical Habitat

The estuary habitat Prospective Actions will address factors that have limited the functioning of PCEs needed by juvenile steelhead from the mid-Columbia River. Restoration actions in the estuary will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (Section 8.8.5.2).

8.8.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Population-specific effects of the hatchery Prospective Actions on survival of MCR steelhead are not quantitatively evaluated by the FCRPS Action Agencies in the Comprehensive Analysis.

Qualitative assessment of the Prospective Actions is provided in Section 10.3.3.5, pages 10-18, of the CA. The hatchery Prospective Actions consist of continued funding of hatcheries as well as reforms to current federally funded programs that will be identified in future ESA consultations (see Tier 2 actions in the BA). Current federally funded programs include one conservation hatchery program, a kelt reconditioning program, and two harvest mitigation programs.

The Prospective Actions require the adoption of programmatic criteria or BMPs for operating salmon and steelhead hatchery programs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated. The FCRPS Action Agencies intend to adopt these programmatic criteria for funding decisions on future mitigation programs for the FCRPS that incorporate BMPs, and site specific application of BMPs will be defined in ESA Section 7, Section 10, and Section 4(d) limits with NOAA Fisheries to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies (Corps et al. 2007b, page 2-44). ESA consultations for more than one hundred hatchery programs in the Columbia Basin funded by the Action Agencies are to be completed by June 2010. For middle Columbia hatchery programs, consultations are to be initiated in July 2009 and completed by January 2010. Available information and principles and guidance for operating hatchery programs are described in Appendix E of the CA and in SCA Artificial Propagation for Pacific Salmon Appendix. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.8.5.5 Effects of Harvest Prospective Actions

Effects on Species Status

There are three stocks of summer steelhead used for management, including the lower river Skamania stock, upriver A-run stock, and upriver B-run stock. All UCR steelhead populations are designated A-run steelhead. Two populations of the MCR steelhead DPS are winter run populations.

Prospective non-Treaty fisheries, pursuant to the 2008 *U.S. v. Oregon* Agreement, will be managed subject to DPS-specific harvest rate limits. Winter, spring, and summer fisheries are subject to a 2% harvest rate limit on wild steelhead from the Lower Columbia River, Upper Willamette River, and Middle Columbia River steelhead DPS. Non-Treaty fall season fisheries are likewise subject to a 2% harvest rate limit for each steelhead DPS with summer run populations (A-run and B-run). The total annual harvest rate limit for A-run steelhead, for example, is 4%, and 2% for the winter-run population of the MCR steelhead DPS. This is consistent with the ESA-related management. The expected harvest impacts on non-Treaty fisheries are less than those proposed. The incidental catch of winter-run steelhead in non-Treaty winter, spring and summer season fisheries has averaged 1.9% since 1999 (Table 8.8.5.5-1). The yearly incidental catch of A-run steelhead in non-Treaty fisheries has averaged 1.6 since 1999 (Table 8.8.5.5-1). Harvest rates are not expected to change over the course of this Agreement (TAC 2008).

Table 8.8.5.5-1. Harvest rates of A-run steelhead in spring, summer, and fall season fisheries expressed as a proportion of the Skamania and A-run steelhead run size (TAC 2008).

Year	Treaty Indian				Non-Indian			
	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
1985	0.15%	NA	19.40%	19.50%				
1986	0.08%	NA	12.60%	12.70%				
1987	0.05%	NA	14.70%	14.80%				
1988	0.18%	NA	16.10%	16.20%				
1989	0.04%	4.00%	14.90%	18.90%				
1990	0.44%	3.50%	14.10%	18.00%				
1991	0.15%	1.90%	14.40%	16.40%				
1992	0.49%	2.00%	15.20%	17.60%				
1993	0.14%	1.40%	14.60%	16.20%				
1994	0.16%	1.10%	9.70%	10.90%				
1995	0.06%	2.20%	10.00%	12.20%				
1996	0.66%	2.30%	8.40%	11.40%				
1997	0.10%	2.70%	10.10%	12.80%				
1998	0.11%	3.80%	8.40%	12.40%				
1999	0.05%	2.10%	5.20%	7.40%	0.10%	0.30%	0.60%	1.00%
2000	0.11%	1.00%	4.00%	5.10%	0.10%	0.60%	1.00%	1.70%
2001	0.09%	2.10%	3.80%	6.00%	0.10%	0.40%	0.60%	1.10%
2002	0.09%	2.10%	2.40%	4.60%	0.40%	0.40%	0.80%	1.60%
2003	0.12%	2.80%	2.50%	5.40%	0.60%	0.30%	1.00%	1.90%

Year	Treaty Indian				Non-Indian			
	Spring Season	Summer Season	Fall Season	Total	Spring Season	Summer Season	Fall Season	Total
2004	0.13%	3.90%	3.00%	7.00%	0.40%	0.40%	1.00%	1.80%
2005	0.05%	2.30%	3.60%	5.90%	0.40%	0.40%	0.90%	1.70%
2006	0.13%	0.80%	5.00%	6.00%	0.30%	0.40%	1.20%	1.90%
2007					0.30%	0.30%	0.80%	1.40%
1985-06 average	0.16%	2.33%	9.64%	11.70%				
1989-06 average	0.17%	2.33%	8.29%	10.79%				
1998-07 average	0.10%	2.32%	4.21%	6.64%	0.30%	0.40%	0.89%	1.59%

There are no specific harvest rate limits for tribal fisheries on steelhead during the spring or summer seasons which extend through July 31. Some impacts, however, do occur. The harvest rate for tribal winter season fisheries (generally February 1 - March 21) from 2001 to 2007 averaged 2.2% and has ranged from 0.8% to 5.8% (Table 8.8.5.5-2). The spring season extends through June 15. The harvest rate of A-run steelhead for tribal spring season fisheries has been consistent and low, at approximately 0.16% since 1985 (Table 8.8.5.5-1). The harvest rate in summer season fisheries averaged 2.3% since 1985 (Table 8.8.5.5-1). The harvest rate in fall season fisheries averaged 9.64% since 1985 and 4.21% since 1998 (Table 8.8.5.5-1). Impacts resulting from treaty-Indian fall season fisheries during this agreement are similar to the 1998-2006 average of 4.21%. Harvest rates are not expected to change over the course of this Agreement (TAC 2008).

Table 8.8.5.5-2. Treaty Indian harvest rates of winter-run steelhead expressed as a proportion of the unmarked winter-run steelhead counts at Bonneville Dam in the winter season (TAC 2008).

Harvest Year	Rate
2001	3.4%
2002	0.3%
2003	5.8%
2004	0.8%
2005	0.8%
2006	1.8%
2007	2.3%
Average 2001-2007	2.2%

With respect to spring and summer season fisheries, increases in harvest beyond those observed in recent years are unlikely. The spring season extends through June 15. The harvest rate of A-run steelhead has been consistent and low, at approximately 0.2% since 1985 (Table 8.8.5.5-1). No changes in the fishery are proposed or anticipated that would lead to changes in the expected catch of steelhead.

Summer season fisheries extend through July 31. Snake River steelhead are caught regularly in ceremonial and subsistence fisheries (primarily the platform fishery), as well as in commercial fisheries targeting summer Chinook (summer Chinook that are targeted in the fishery are part of the UCR summer/fall ESU and are not listed under the ESA). Summer Chinook were chronically depressed for decades until returns began to increase in 2001. Higher runs provided more fishing opportunity beginning in 2002. However, there is no evidence of an associated increase in the catch of steelhead. The harvest rate of summer Chinook in the tribal fishery averaged 1.5% from 1989 to 2001, and 10.9% from 2002 to 2006 (TAC 2008, Table 6). During those same years, the harvest rate of steelhead averaged 2.3% to 2.4% (Table 8.8.5.5-1). As with the spring fisheries, no further changes in future fisheries are expected as a result of the Prospective Action that would lead to changes in the expected catch of steelhead. However, as a result of analysis from recent PIT-tag data, there is information regarding adult conversion rates that indicates that more UCR steelhead than SR steelhead are lost in upstream passage. It may be that the greater losses are due to differential harvest rates that are not currently detectable. It is also plausible that the losses are due to timing differences, passage conditions, or some combination of factors. If new evidence develops related to the catch of steelhead in the summer season, these conclusions will be reviewed.

Prospective treaty-Indian fall season fisheries will be managed using the abundance-based harvest rate schedule for B-run steelhead contained in the 2008 Agreement (Table 8.8.5.5-3). From 1998 to 2007 treaty-Indian fall season fisheries were managed subject to a 15% harvest rate limit on B-run steelhead. Under the abundance based harvest rate schedule, harvest may vary up or down from the status quo of 15%, depending on the abundance of B-run steelhead. The harvest rate allowed under the prospective schedule is also limited by the abundance of upriver fall Chinook. The purpose of this provision is to recognize that impacts to B-run steelhead may be higher when the abundance, and thus fishing opportunity for fall Chinook, is higher and remain consistent with conservation goals. However, higher harvest rates are allowed only if the abundance of B-run steelhead is also greater than 35,000. This provision is designed to provide greater opportunity for the tribes to satisfy their treaty right to harvest 50% of the harvestable surplus of fall Chinook in years when conditions are favorable. Even with these provisions, it is unlikely that the treaty right for Chinook or steelhead can be fully satisfied. The harvest rate for B-run steelhead in tribal fall season fisheries may range from 13 to 20%. As indicated above, the non-Treaty fall season fishery harvest rate for B-run steelhead will remain fixed at 2%.

Table 8.8.5.5-3. Abundance Based Harvest Rate Schedule for B-run Steelhead (TAC 2008).

Upriver Summer Steelhead Total B Harvest Rate Schedule				
Forecast Bonneville Total B Steelhead Run Size	**River Mouth URB Run Size**	**Treaty Total B Harvest Rate**	**Non-Treaty Wild B Harvest Rate**	**Total Harvest Rate**
20,000	Any	13%	2.0%	15.0%
20,000	Any	15%	2.0%	17.0%
35,000	>200,000	20%	2.0%	22.0%

As in the past, B-run steelhead will be used as the primary steelhead related harvest constraint for tribal fall season fisheries, and thus are the indicator stock used for management purposes. Generally, the status of B-run steelhead is worse than that of A-run steelhead. B-run steelhead are subject to higher harvest rates because they are larger and thus more susceptible to catch in gillnets. Harvest impacts on B-run steelhead typically are higher because their timing coincides with the return of fall Chinook. A-run steelhead typically return a few weeks earlier, reducing their susceptibility to catch. Consequently, there are no specific management constraints in tribal fisheries for A-run steelhead. Since 1998, when the 15% harvest rate limit was first implemented for B-run steelhead, the harvest rate on A-run steelhead in fall season treaty-Indian fisheries has averaged 4.21% and ranged from 5.4% to 12.4% (Table 8.8.5.5-1).

The abundance based harvest rate schedule allows the tribal harvest rate on B-run steelhead to vary from the fixed rate of 15% that has been in place since 1998, depending on the abundance of B-run steelhead and upriver fall Chinook. By evaluating historical run size data, a determination can be made as to how often fisheries will be subject to the 13%, 15%, or 20% level. This retrospective analysis suggests that the annual harvest rate limit will be 15% or less 12 out of 22 years, and 20% 10 out of 22 years. The primary limiting constraint from this retrospective analysis will be the abundance of upriver fall Chinook. The average allowable harvest rate on B-run steelhead from this retrospective analysis is 17.1% (Table 8.8.5.5-4).

Table 8.8.5.5-4. Retrospective analysis of allowable harvest rates for B-run steelhead in the tribal fall season fisheries (Upriver fall Chinook run size from TAC 2008, Table 7; B-run Steelhead run size from TAC 2008).

Year	Upriver Fall Chinook Run Size	B-run Steelhead Run Size	Allowable Harvest Rate in Tribal Fall Fisheries
1985	196,500	40,870	15%
1986	281,500	64,016	20%
1987	420,600	44,959	20%
1988	340,000	81,643	20%
1989	261,300	77,604	20%
1990	153,600	47,174	15%
1991	103,300	28,265	15%
1992	81,000	57,438	15%
1993	102,900	36,169	15%
1994	132,800	27,463	15%
1995	106,500	13,221	13%
1996	143,200	18,693	13%
1997	161,700	36,663	15%
1998	142,300	40,241	15%
1999	166,100	22,137	15%
2000	155,700	40,909	15%
2001	232,600	86,426	20%
2002	276,900	129,882	20%
2003	373,200	37,229	20%
2004	367,858	37,398	20%
2005	268,744	48,967	20%
2006	230,388	74,127	20%
1985-06 average			17.10%

Although the prospective harvest rate schedule will allow the harvest in tribal fall season fisheries to increase in some years, the observed harvest rates in both the non-Treaty and treaty-Indian fisheries have generally been lower than the allowed rates. Since 1998, fall season fisheries have been subject to a combined 17% harvest rate limit on B-run steelhead. From 1998 to 2006 the observed harvest rate has averaged 12.7% (TAC 2008, Table 39).

For fall season fisheries, it is necessary to consider whether there will be an increase in the harvest of A-run steelhead associated with the Prospective Action. As discussed above, B-run steelhead are used as the indicator stock for steelhead. This is done in order to limit fishery impacts in fall season fisheries. The retrospective analysis suggests that harvest rates on B-run steelhead in the treaty-Indian fall season fisheries may be higher than 15% approximately half of the time. The average of the allowable harvest rate limits from the retrospective analysis is 17.1% (Table 8.8.5.5-4). This represents a 14% increase over the current harvest rate limit of 15% (17.1/15.0 = 1.14). The harvest rates on A-run steelhead will not necessarily increase, but A-run and B-run harvest rates are correlated. It is therefore reasonable to assume that A-run harvest rates will increase in proportion to B-run harvest rates. Table 8.8.5.5-1 shows the tribal fishery harvest rates for A-run steelhead in spring, summer, and fall season fisheries. Since 1998, when the current ESA limits were applied, the yearly fall season treaty-Indian harvest rate averaged 4.2% while the total treaty-Indian harvest rate averaged 6.6%. Under the assumption that fall season harvest rates will increase by 14% in proportion to the expected increase for B-run steelhead, the anticipated future fall season and total harvest rates will be 4.8% (0.042 * 1.140 = 0.48) and 7.2%.

The net result will be a small increase in the current harvest rate (from 6.6% to 7.2%), which will result in approximately a 1% reduction in survival (Harvest Appendix, based on US v Oregon memorandum). Therefore, a 0.99 current-to-future survival adjustment is applied to the prospective harvest action for this species.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor and will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas. This was identified as a limiting factor from the Klickitat population by the Remand Collaboration Habitat Workgroup (Habitat Technical Subgroup 2006b).

8.8.5.6 Effects of Predation Prospective Actions

Effects on Species Status

The estimated relative survival benefit attributed to MCR steelhead from reduction in Caspian tern nesting habitat on East Sand Island and relocation of most of the terns to sites outside the Columbia River Basin (RPA Action 45) is 3.4 % (CA Attachment F-2, Table 4). Compensatory mortality may occur but based on the discussion in 8.3.5.6 is unlikely to significantly affect the results of the action.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Continued implementation of the base Northern Pikeminnow Management Program and continuation of the increased reward structure in the sport-reward fishery (RPA Action 43) should further reduce consumption rates of juvenile salmon and steelhead by northern pikeminnow. This decrease in consumption is likely to equate to an increase in juvenile migrant survival of about 1% relative to the current condition (CA Appendix F, Attachment F-1: Benefits of Predation Management on Northern Pikeminnow). Continued implementation and improvement of avian deterrence at all lower Columbia River dams will continue to reduce the numbers of smolts taken by birds in project forebays and tailraces (RPA Action 48).

Effects on Critical Habitat

Reductions in Caspian tern nesting habitat and management of cormorant predation on East Sand Island, continued implementation of the base Northern Pikeminnow Management Program, continued implementation and improvement of avian deterrence at mainstem dams, and the continuation of the increased reward structure in the sport-reward fishery are expected to improve the long-term conservation value of critical habitat by increasing the survival of juvenile salmonids (safe passage PCE) within the migration corridor.

8.8.5.7 Effects of Kelt Reconditioning Prospective Actions

Effects on Species Status

Effects of the FCRPS outmigrating adult steelhead kelts are not well known but are thought to be significant as both turbine passage survival and passage through juvenile collection and bypass systems are poor. Comparing recent juvenile bypass system kelt counts before and after increases in spring spill and the installation of surface bypass facilities (e.g., RSWs) suggest that steelhead kelts may benefit from spring spill and surface bypass improvements included in the Prospective Actions. However, no definitive information is available to clearly demonstrate such effects. The prospective kelt reconditioning program is likely to increase the number of spawning adult MCR steelhead, but it is not possible to estimate a survival rate change at this time because of uncertainty regarding the percentage of the run that can be collected.

Prospective passage improvements for juvenile salmon and steelhead, including surface passage such as RSWs and sluiceways, are also likely to benefit downstream migrating kelts. This should lead to improved survival through the FCRPS. Reduced forebay residence times which lead to a reduction in total travel time may also contribute to an improvement in kelt return rates. It is not possible to calculate the precise amount of improvement expected, because the interaction between improved surface passage and improved kelt survival and return rates is poorly known. However, some improvement is likely.

The Prospective Actions implementing the reconditioning and transport of steelhead kelts potentially represent a much greater improvement in both outmigration survival and return rates. Reconditioning programs capture kelts and hold them in tanks where they are fed and medicated to enhance survival. Current programs either hold kelts for 3-5 weeks and release them below Bonneville, or hold kelts until they are ready to spawn and release them into their natal streams. Short-term reconditioning efforts have produced average survival rates of 82% and kelt returns of 4% to the Yakima River (Hatch et al. 2006). Long-term reconditioning has produced average survival rates of 35.6%, all of which are returned to their natal stream for spawning (Hach et al. 2006).

There is some concern over the viability of the offspring from long-term reconditioned kelts. Laboratory studies found high rates of post hatching mortality (Branstetter et al. 2006), and studies using DNA analysis to identify the parentage of outmigrating steelhead smolts (Stephenson et al. 2007) have failed to identify any offspring of reconditioned kelts among the juvenile steelhead collected from streams where reconditioned kelts were released. These studies suggest that long-term reconditioning may reduce gamete viability. It is not known if short-term reconditioned kelts may have the same problems with offspring viability; however, because they feed and mature under natural conditions it seems less likely.

Effects on Critical Habitat

NOAA Fisheries will analyze any effects of the kelt reconditioning actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.8.5.8 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of this document.

8.8.5.9 Summary: Quantitative Survival Changes Expected From All Prospective Actions

Expected changes in productivity and quantitative extinction risk are calculated as survival improvements in a manner identical to estimation of the base-to-current survival improvements. The estimates of “prospective” expected survival changes resulting from the Prospective Actions are described in Sections 8.8.5.1 through 8.8.5.7 and are summarized in Table 8.8.5-2. Improvements in hydro operation and configuration, estuary habitat improvement projects, and further reductions in bird and fish predation are expected to increase survival above current levels for all populations in the DPS. Tributary habitat improvement projects are also expected to increase survival for all three populations. The net effect, which varies by population, is 15-37% increased survival, compared to the “current” condition, and 11-39% increased survival, compared to the “base” condition.

8.8.5.10 Aggregate Analysis of Effects of All Actions on Population Status

Quantitative Consideration of All Factors at the Population Level

NOAA Fisheries considered an aggregate analysis of the environmental baseline, cumulative effects, and Prospective Actions. The results of this analysis are displayed in Tables 8.8.6-1 and 8.8.6-2 and in Figures 8.8.6-1 and 8.8.6-2. In addition to these summary tables and figures, the SCA Aggregate Analysis Appendix includes more detailed results, including 95% confidence limits for mean estimates, sensitivity analyses for alternative climate assumptions, metrics relevant to ICTRT long-term viability criteria, and comparisons to other metrics suggested in comments on the October 2007

Draft Biological Opinion. Additional qualitative considerations that generally apply to multiple populations are described in the environmental baseline, cumulative effects, and effects of the Prospective Actions sections and these are reviewed in subsequent discussions at the MPG and DPS level. Additionally, because quantitative short-term extinction risk gaps could not be calculated for this species, future short-term extinction risk is discussed qualitatively in subsequent sections.

8.8.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects, Summarized By Major Population Group

In this section, population-level results are considered along with results for other populations within the same MPG. The multi-population results are compared to the importance of each population to MPG and DPS viability. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Yakima MPG

This MPG consists of four extant populations, one of which should be highly viable and one of which should be viable to achieve the ICTRT's suggested MPG viability scenario. Either the Naches River or the Upper Yakima should be viable because these are the only two "large" populations. Please see Section 7.3 of this document for a discussion of these MPG viability scenarios.

Productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for all populations in this MPG under the Prospective Actions, meaning that with implementation of the Prospective Actions the population is expected to replace itself and grow (Table 8.8.6.1-1; Figure 8.8.6-1). There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1[SCA Aggregate Analysis Appendix; Figure 8.8.6-1]), for some populations. For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in each tributary as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Action. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure is "very low" to "moderate," as defined by the ICTRT, for all populations except the Upper Yakima (Table 8.8.2-2). That population has "high" spatial structure risk because 7 of 10 historical major spawning areas are not occupied.

- Current risk associated with diversity is "low" to "moderate," as defined by the ICTRT, for all populations except the Upper Yakima (Table 8.8.2-2). That population has been affected by introgression from planted resident rainbow trout and out-of-basin steelhead. While these practices have stopped, legacy effects continue.

- For these populations, it will take longer than 10 years to resolve the problems that must be addressed in order to have higher productivity. In particular, reduced access to historic spawning areas and reduced genetic diversity will take longer than 10 years to resolve.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both the ICTRT "historical" and "Warm PDO" (poor) ocean scenarios, all Yakima MPG populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.8.6-2).

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate 0-1% risk of short-term extinction at QET=50 for the Satus Creek population (Table 8.8.2-3). Quantitative estimates of base period extinction risk indicate 34-79% risk of short-term extinction at QET=50 for the other three populations. The survival gap needed to reduce this risk to <5% is unknown, but may be greater than the 10% base-to-current survival improvement and the proportion of the 26% Prospective Actions survival improvement that will result from immediate actions.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses indicate the base period extinction risk would be >5% for the upper Yakima, Toppenish, and Naches populations at all QET levels considered in this analysis (Table 8.8.2-3).

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk at QET=50 range from 0% to near 100% for some populations; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- There are no safety-net hatchery programs for these populations to further reduce extinction risk.
- A kelt reconditioning program affects all four populations in this MPG and is expected to provide an unquantifiable survival improvement.
- The recent 10-year geometric mean abundance has been above the 50 fish QET level (85-472) for all four populations (Table 8.8.2-1). Only the Upper Yakima population has dropped below 50 fish during the available time series (Cooney 2008a).
- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Cascades Eastern Slopes MPG

This MPG consists of five extant populations, one of which should be highly viable and three of which should be viable to achieve the ICTRT's suggested MPG viability scenario. Key populations in this MPG include Fifteenmile Creek because it is the only winter steelhead population and the Deschutes River Westside population because it is the only "large" population. The Klickitat and Deschutes River Eastside populations are the only two "intermediate" sized populations and they are important because two "intermediate" populations should be viable to meet the ICTRT's suggested viability criteria. One historic population (Crooked River) has been extirpated and a second (White River) is functionally extirpated. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for the three populations with sufficient data to make estimates, under the Prospective Actions (Table 8.8.6.1-1; Figure 8.8.6-1), meaning that with implementation of the Prospective Actions these populations are expected to replace themselves and grow. These three populations (Deschutes West, Deschutes East, and Fifteenmile) are among the critical populations identified by the ICTRT.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1, SCA Aggregate

Analysis Appendix; Figure 8.8.6-1) for some populations. For this reason, other qualitative information is also considered:

- Life-stage specific survival rates are expected to improve for mainstem hydro survival, estuarine survival and survival in tributaries as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Actions. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. It also indicates that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure is "very low" to "moderate," as defined by the ICTRT, for all populations (Table 8.8.2-2). Current risk associated with diversity is "low" to "moderate," as defined by the ICTRT, for all populations. The MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT "historical" ocean scenario, both Eastern Cascades Slopes MPG populations for which estimates are available are expected to have R/S, lambda, and BRT trend greater than 1.0, as under recent climate conditions, but the resulting productivity estimates are higher (SCA Aggregate Analysis Appendix; Figure 8.8.6-2). Under the ICTRT "Warm PDO" (poor) climate scenario, all productivity metrics are also expected to be greater than 1.0, except for lambda, under the assumption that effectiveness of hatchery-origin spawners is equal to that of natural-origin spawners (HF=1), for the Deschutes West population. In this case the estimate was 0.99.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trends for this species, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate 0-1% risk of short-term extinction at QET=50 for the Deschutes West and Fifteenmile populations (Table 8.8.2-3). However, there is an estimate of 53% risk of short-term extinction at QET=50 for the Deschutes East population. The survival gap needed to reduce this risk to <5% is unknown, but may be greater than the 5% base-to-current survival improvement for this population and the proportion of the 19% Prospective Actions survival improvement that will result from immediate actions. No estimates are available for the Rock Creek and Klickitat populations. However, the ICTRT identified the Rock Creek population as one with a high (>25%) risk of long-term (100-year) extinction.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. Sensitivity analyses indicate >5% base short-term extinction risk for the Deschutes East population at all evaluated QET levels (Table 8.8.2-3).

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (95% confidence limits for base period extinction risk at QET=50 range from 0% to 100% for some populations; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- The recent 10-year geometric mean abundance has been well above the 50 fish QET level (456-1599) for the three populations for which 10-year averages are available (Table 8.8.2-1). None of these populations have dropped below 50 fish during the available time series (Cooney 2008b).

- Population abundance is expected to increase in the future for all populations for which trends could be calculated, as a result of actions already completed and additional Prospective Actions (see above).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Walla Walla/Umatilla MPG

This MPG consists of three extant populations, one of which should be highly viable and one of which should be viable to achieve the ICTRT's suggested MPG viability scenario. The Umatilla population is important because it is the only "large" population in the MPG. One historic population (Willow Creek) has been extirpated. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Productivity based on all three metrics (R/S, lambda, and BRT trend) is expected to be greater than 1.0 for the Umatilla population, which is the only population with sufficient data to make estimates, under the Prospective Actions. (Table 8.8.6.1-1; Figure 8.8.6-1). This means that with implementation of the Prospective Actions, these populations are expected to replace themselves and grow.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicate productivity >1 while lower 95% confidence intervals indicate productivity <1; SCA Aggregate Analysis Appendix) for this population. For this reason, other qualitative information is also considered:

- Life-stage-specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in each tributary as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Action. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. They also indicate that estimates of productivity >1 for the Umatilla, and by inference the other populations, are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure is "low" to "moderate," as defined by the ICTRT, for all populations (Table 8.8.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for this factor, as long as productivity is adequate.

- Current risk associated with diversity is "moderate," as defined by the ICTRT, for all populations (Table 8.8.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for this factor, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both the ICTRT "historical" and "Warm PDO" (poor) ocean assumptions, the Umatilla population is expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.8.6-2).

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate 0% risk of short-term extinction at QET=50 for the Umatilla and Walla Walla populations (Table 8.8.2-3). No estimates are available for the Touchet population. However, the ICTRT identified the Touchet population as one with high (>25%) risk of long-term (100-year) extinction.

As discussed in Section 7.1.1.1, QET levels less than 50 fish may be relevant to short-term extinction risk. It was not possible to estimate extinction risk or generate sensitivity analyses to alternative QET levels for the Touchet population.

There is uncertainty associated with quantitative estimates of extinction risk because of the range of statistical results (95% confidence limits for base period extinction risk at QET=50 range from 0% to 37% for these populations; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- There is a conservation hatchery program for the Umatilla population to further reduce short-term extinction risk.

- The recent 10-year geometric mean abundance has been well above the 50 fish QET level (1003, 1472) for the two populations for which 10-year averages are available (Umatilla and Walla Walla; Table 8.8.2-1). Neither of these populations has dropped below 50 fish during the available time series (Cooney 2007).

- Population abundance is expected to increase in the future for the Umatilla population, which is the only one for which trends could be calculated, as a result of actions already completed and additional Prospective Actions (see above).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

John Day MPG

This MPG consists of five extant populations, one of which should be highly viable and two of which should be viable to achieve the ICTRT's suggested MPG viability scenario. The North Fork John Day and Lower John Day populations are important because they are the only "large" and "very large" populations in the MPG. One historic population (Willow Creek) has been extirpated. The Middle Fork and Upper Mainstem populations are important because they are the only "intermediate" sized populations, one of which must be viable to achieve the ICTRT's viability criteria. Please see Section 7.3 for a discussion of these MPG viability scenarios.

Productivity, based on all three metrics (R/S, lambda, and BRT trend), is estimated to be greater than 1.0 for all five populations (Table 8.8.6.1-1; Figure 8.8.6-1), meaning that with implementation of the Prospective Actions these populations are expected to replace themselves and grow.

There is considerable uncertainty regarding the reliability of quantitative estimates of productivity because of the broad range of statistical results (e.g., upper 95% confidence limits indicates productivity >1 while lower 95% confidence intervals indicates productivity <1 for some populations [SCA Aggregate Analysis Appendix; Figure 8.8.6-1]). For this reason, other qualitative information is also considered:

- Life-stage-specific survival rates are expected to improve for mainstem hydro survival, estuarine survival, and survival in each tributary as a result of the Prospective Actions, as described in Sections 8.8.5.1 through 8.8.5.7. These actions address limiting factors and threats and more than offset the slight reduction in survival expected from the harvest Prospective Action. These survival improvements indicate that, other factors being equal, survival over the life cycle should also increase. They also indicate that estimates of productivity >1 for these populations are not determined solely by favorable environmental conditions.

- Current risk associated with spatial structure and diversity is "very low" to "moderate," as defined by the ICTRT, for all populations (Table 8.8.2-2). The MPG can achieve the ICTRT suggested viability scenario with moderate risk for these factors, as long as abundance and intrinsic productivity increase sufficiently to levels exceeding minimum thresholds

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under both the ICTRT "historical" and "Warm PDO" (poor) ocean scenarios, all John Day MPG populations are expected to have R/S, lambda, and BRT trend greater than 1.0 (SCA Aggregate Analysis Appendix; Figure 8.8.6-2).

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change are considered qualitatively by comparing actions to ISAB climate change recommendations, as described below.

- The Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3, some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects may include restoration and protection of areas that function as thermal refugia and estuary habitat projects may include dike removal and opening off-channel habitat to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

Quantitative estimates of base period extinction risk indicate <5% risk of short-term extinction at QET=50 for all five populations (Table 8.8.2-3).

There is considerable uncertainty associated with quantitative estimates of extinction risk because of the broad range of statistical results (e.g., 95% confidence limits for base period extinction risk at QET=50 range from 0% to 69% for the South Fork John Day population; Table 8.8.2-3). For this reason, other qualitative information is also considered:

- There are no safety-net hatchery programs in this MPG.

- The recent 10-year geometric mean abundance has been above the 50 fish QET level (259-1800) for all populations (Table 8.8.2-1). None of these populations has dropped below 50 fish during the available time series (Cooney 2008b).

- As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

8.8.7 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on the Middle Columbia River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.8.7.1 Potential for Recovery

It is likely that the Middle Columbia River steelhead DPS will trend toward recovery.

The future status of all populations and MPGs of MCR steelhead will be improved compared to their current status through the reduction of adverse effects associated with the FCRPS and Reclamation's Upper Snake projects and the implementation of Prospective Actions with beneficial effects, as described in Sections 8.8.5, 8.8.6, and 8.8.7.2. These beneficial actions include reduction of avian and fish predation, estuary habitat improvements, kelt reconditioning, and tributary habitat improvements for most populations. These beneficial actions also completely offset the slightly decreased survival associated with the harvest Prospective Action. Therefore, the status of the DPS as a whole is expected to improve compared to its current condition and to move closer to a recovered condition. This conclusion also takes into account some short-term adverse effects of Prospective Actions related to habitat improvements (Section 8.8.5.3) and RM&E (Section 8.1.4). These adverse effects are expected to be small and localized and are not expected to reduce the long-term recovery potential of this DPS.

The Prospective Actions described above address limiting factors and threats and will reduce their negative effects. As described in Section 8.8.1, key limiting factors and threats affecting the current status of this species (abundance, productivity, spatial structure, and diversity) include: hydropower development, predation, harvest, hatchery programs, and degradation of tributary and estuary habitat. In addition to Prospective Actions, Federal actions in the environmental baseline and non-Federal actions that are appropriately considered cumulative effects also address limiting factors and threats.

The Prospective Actions also include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change. As described in Section 8.1.3 some important improvements include installation of surface spill structures and other passage improvements to reduce delay and exposure to warm temperatures in project forebays in the lower Columbia River. Tributary habitat projects include restoration and protection of areas that function as thermal refugia and estuary habitat projects include dike removal and opening off-channel habitat, which in some cases is likely to encourage increased hyporheic flow. Additionally, Prospective Actions include evaluation of pertinent new information on climate change and effects of that information on limiting factors and project prioritization. Prospective Actions also include investigation of impacts of possible climate change scenarios and inclusion of pertinent information in hydrological forecasting for operation of the FCRPS.

The ICTRT has indicated that the longer hatchery programs are expected to subsidize natural spawners, the more likely their effects will threaten recovery. As described in Section 8.8.5.4, some ongoing hatchery programs that affect this DPS pose risks to diversity and natural productivity. The

Prospective Actions include measures to ensure that hatchery management changes that have been implemented in recent years will continue, that safety-net hatchery programs will continue, and that further hatchery improvements will be implemented to reduce threats to productivity and diversity from continued reliance on hatchery programs to subsidize natural spawning. Some of the problems limiting recovery of MCR steelhead, such as spatial structure and genetic diversity concerns for the Upper Yakima population, will probably take longer than 10 years to correct. However, actions included in the Prospective Actions represent improvements that can be implemented reasonably within the next 10 years.

In addition, the Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In sum, these qualitative considerations suggest that the MCR steelhead DPS will be trending toward recovery when aggregate factors are considered. In addition to these qualitative considerations, quantitative estimates of metrics indicating a trend toward recovery also support this conclusion.

Return-per-spawner (R/S) estimates are indicative of natural survival rates (i.e., the estimates assume no future effects of supplementation). As such, they are somewhat conservative for populations with ongoing supplementation programs, 11 of which are described in Section 8.8.5.4, but R/S may be the best indicator of the ability of populations to be self-sustaining. R/S estimates incorporate many variables, including age structure and fraction of hatchery-origin spawners by year. The availability and quality of this information varies, so in some cases R/S estimates are less certain than lambda and BRT trend metrics.

As described in Section 8.8.6, with implementation of the Prospective Actions, R/S is expected to be greater than 1.0 for all 12 of the populations for which there are quantitative estimates (Table 8.8.6.1-1).

Population growth rate (lambda) and BRT trend estimates, as calculated in this analysis, are indicative of abundance trends of natural-origin and combined-origin spawners, assuming that current supplementation programs continue. These estimates require fewer assumptions and less data than R/S estimates, but may also be limited by data quality. Because of the hatchery assumptions these metrics may be less indicative of a trend toward recovery than R/S for populations significantly influenced by hatchery programs, since recovery requires self-sustaining populations.

As described in Section 8.8.6, all 12 populations in this DPS with population-specific estimates have lambda and BRT trends that are expected to be greater than 1.0 with implementation of the Prospective Actions.

Some important caveats that apply to all three quantitative estimates are as follows:

- Not all beneficial effects of the Prospective Actions could be quantified (e.g., habitat improvements that accrue over a longer than 10-year period), so quantitative estimates of prospective R/S, lambda, and BRT trend may be low.

- This summary of quantitative productivity estimates is based on mean results of analyses that assume that future ocean climate will be identical to that of approximately the last 20 years. As described in Section 7.1.1, these recent ocean conditions have been much worse for salmon and steelhead survival than have historical conditions. Under the ICTRT "historical" ocean scenario, all populations are expected to have R/S, lambda, and BRT trend greater than 1.0, as under recent climate conditions, but the resulting productivity estimates are higher (SCA Aggregate Analysis Appendix; Figure 8.8.6-2). Under the ICTRT "Warm PDO" climate scenario, all populations but one are also expected to have all three metrics greater than 1.0, with only slightly lower productivity estimates than under recent climate conditions. The lambda (HF=1) metric, which assumes that hatchery-origin spawners and natural-origin spawners are equally effective, for the Deschutes West population would be 0.99.

- Changes in climate affecting freshwater life stages could not be captured in the quantitative analysis, which leads to an over-estimate of the likely future trend, as discussed in Section 7.1.1. However, freshwater effects of climate change were considered qualitatively by comparing actions to ISAB climate change recommendations, as described above.

- The mean results represent the most likely future condition but they do not capture the range of uncertainty in the estimates. Under recent climate conditions, R/S estimates for most populations are expected to be greater than 1.0 at the upper 95% confidence limits and less than 1.0 at the lower 95% confidence limits (SCA Aggregate Analysis Appendix). The uncertainty in quantitative estimates indicates that it is important to take qualitative factors into account.

Taken together, the combination of all the qualitative and quantitative factors indicates that the DPS as a whole is likely to trend toward recovery when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. Quantitative estimates of R/S, population growth rate, and BRT trend support this conclusion.

This does not mean that recovery will be achieved without additional improvements in various life stages. As discussed in Chapter 7, increased productivity will result in higher abundance, which in turn will lead to an eventual decrease in productivity due to density effects, until additional improvements resulting from recovery plan implementation are expressed. However, the survival changes in the Prospective Actions and other continuing actions in the environmental baseline and cumulative effects will ensure a level of improvement that results in the DPS being on a trend toward recovery.

8.8.7.2 Short-Term Extinction Risk

It is likely that the species will have a low short-term extinction risk.

Short-term (24 year) extinction risk of the species is expected to be reduced, compared to extinction risk during the recent period, through net survival improvements resulting from the Prospective Actions and a continuation of other current management actions, as described above and in Section 8.8.5.

As described above and in Section 8.8.6, abundance is expected to be increasing for all populations and natural productivity (R/S) is expected to be sufficient for all populations to grow. Recent abundance levels are estimated to be between 92 and 1800 spawners, depending on population, all of which are above the QET levels under consideration (Table 8.8.2-1). These factors also indicate a decreasing risk of extinction.

There is a conservation hatchery program for the Umatilla population, which reduces the likelihood of short-term extinction risk. However, over time this level of supplementation results in a higher level of long-term risk to diversity and natural productivity than would occur in an unsupplemented population.

The Prospective Actions include a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important Prospective Actions, such as lower Columbia River hydro project improvements and tributary habitat actions. Additionally, the Prospective Actions include implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year time frame.

In addition to these qualitative considerations, quantitative estimates of short-term (24 year) extinction risk also support this conclusion.

As described in Section 8.2.6, short-term extinction risk derived from performance during the base period is 0-2% at QET=50 for 10 of the 14 populations in this DPS for which estimates are available. The four populations with base period extinction risk greater than 5% are the Upper Yakima, Naches, Toppenish, and Deschutes East populations. Three of these populations are in the Yakima MPG, which suggests that this MPG is at particularly high extinction risk. It was not possible to determine the survival improvements needed to reduce extinction risk to 5% for these populations. However, base-to-current survival improvements range from 5-10% for these populations. Some additional improvements from Prospective Actions that are likely to be implemented immediately will also accrue (an unknown proportion of the 19-26% current-to-prospective survival change). While the effect of these survival changes on reducing short-term extinction risk to <5% cannot be quantified, they should reduce the base period extinction risk significantly.

The mean base period short-term extinction risk estimates represent the most likely future condition but they do not capture the range of uncertainty in the estimates. While we do not have confidence intervals for prospective conditions, the confidence intervals for the base condition range from near 0 to 100% for some populations. This uncertainty indicates that it is important also to consider qualitative factors in reaching conclusions.

As with productivity estimates, quantitative consideration of changes in climate on freshwater life-stage survival were not possible, which likely leads to an under-estimate of risk. However, NOAA Fisheries qualitatively considered whether Prospective Actions would implement proactive measures recommended by the ISAB for reducing risk due to climate change. As described above, the Prospective Actions include measures that correspond to ISAB recommendations to proactively reduce the effects of climate change.

Taken together, the combination of all the factors above indicates that the DPS as a whole is likely to have a low risk of short-term extinction when the environmental baseline and cumulative effects are considered along with implementation of the Prospective Actions. The status of the species has been improving in recent years, compared to the base condition, and abundance is expected to increase in the future as a result of additional improvements. These improvements result in lower short-term extinction risk than in recent years. Quantitative results indicate that most populations and MPGs will have low short-term extinction risk. The most troubling result is that three of the four populations in the Yakima MPG have a high base period extinction risk that may not be reduced sufficiently by current and Prospective Actions. However, all Yakima MPG populations are expected to have productivities greater than 1.0, in fact with R/S ranging from 1.4 to 2.0 (Table 8.8.6.1-1), and these estimates indicate that abundance should increase and risk should decrease as the Prospective Actions are implemented. The combination of recent abundance estimates, expected survival improvements, expected positive trends for all populations, quantitative risk estimates, and a conservation hatchery program for the Umatilla population, indicate that enough populations are likely to have a low enough risk to conclude that the DPS as a whole will have a low risk of short-term extinction.

8.8.7.3 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat

NOAA Fisheries designated critical habitat for MCR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Yakima River as well as specific stream reaches in the following subbasins: Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, and Upper Columbia/Priest Rapids. The environmental baseline within the action area, which encompasses all of these subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for MCR steelhead. The major factors currently limiting the conservation value of critical habitat are juvenile mortality at mainstem hydro projects in the lower Columbia River; avian predation in the estuary; and physical passage barriers, reduced flows, altered channel morphology, excess sediment in gravel, and high summer temperatures in tributary spawning and rearing areas.

Although some current and historical effects of the existence and operation of the hydrosystem, tributary and estuary land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, implementation of surface passage routes at McNary and John Day dams in concert with training spill to provide safe egress (i.e., avoid predators) will improve safe passage in the juvenile migration corridor. Reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat winter steelhead will do the same for adults from the Fifteenmile and one of the Klickitat populations. Habitat work in tributaries used for spawning and rearing an in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. In addition, a number of actions in the mainstem migration corridor and in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement). There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. The species is expected to survive until these improvements are implemented, as described in "Short-term Extinction Risk," above.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement, the effects of the environmental baseline, and any cumulative effects, NOAA Fisheries determines (1) that the Middle Columbia River Steelhead DPS is expected to survive with an adequate potential for recovery and (2) that the affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Middle Columbia River Steelhead DPS nor result in the destruction or adverse modification of its designated critical habitat.

Table 8.8.2-1. Status of MCR steelhead with respect to abundance and productivity VSP factors. Productivity is estimated from performance during the "base period" of the 15-20 most recent brood years (approximately 1980-1985 BY through 1998-1999 BY, depending on population).

			Abundance			R/S Productivity			Lambda			Lambda			BRT Trend		
ESU	MPG	Population	Most Recent 10-yr Geomean Abundance[1]	Years Included In Geomean	ICTRT Recovery Abundance Threshold[1]	Average R/S: 20-yr non-SAR adj.; non-delimited[2]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=0)[3]	Lower 95% CI	Upper 95% CI	20-yr Median Population Growth Rate (lambda; HF=1)[3]	Lower 95% CI	Upper 95% CI	Ln+1 Regression Slope: 1980 - Current[4]	Lower 95% CI	Upper 95% CI
Mid Columbia Steelhead	Yakima	Upper Yakima	85	1995-2004	1500	1.02	0.69	1.51	1.01	0.74	1.39	1.01	0.74	1.39	1.01	0.95	1.17
		Naches	472	1995-2004	1500	1.02	0.69	1.51	1.02	0.74	1.41	1.00	0.72	1.39	1.02	0.96	1.18
		Toppenish	322	1995-2004	500	1.46	0.89	2.39	1.09	0.76	1.57	1.07	0.74	1.55	1.09	1.02	1.32
		Satus	379	1995-2004	1000	0.86	0.62	1.20	0.98	0.76	1.25	0.96	0.75	1.23	0.98	0.93	1.12
	Eastern Cascades	Deschutes W.	456	1996-2005	1000	0.92	0.67	1.25	1.02	0.81	1.29	0.97	0.78	1.20	0.99	0.96	1.17
		Deschutes E.	1599	1996-2005	1000												
		Klickitat			1000												
		Fifteenmile Cr.	703	1996-2005	500	1.17	0.84	1.63	1.03	0.83	1.28	1.03	0.83	1.28	1.03	0.98	1.15
		Rock Cr.			500												
		White Salmon - Extirpated															
	Umatilla/Walla Walla	Umatilla	1472	1995-2004	1500	0.94	0.73	1.22	1.04	0.86	1.25	0.99	0.83	1.17	1.01	0.98	1.13
		Walla-Walla	650	1996-2005	1000												
		Touchet			1000												
	John Day	Lower Mainstem	1800	1996-2005	2250	1.24	0.76	2.04	1.01	0.71	1.43	1.00	0.71	1.41	0.98	0.94	1.14
		North Fork	1740	1996-2005	1500	1.17	0.79	1.75	1.00	0.80	1.26	1.00	0.79	1.25	0.99	0.95	1.16
		Upper Mainstem	524	1996-2005	1000	1.07	0.71	1.59	0.99	0.77	1.28	0.99	0.77	1.27	0.95	0.92	1.03
		Middle Fork	756	1996-2005	1000	1.17	0.82	1.69	1.01	0.80	1.27	1.00	0.79	1.26	0.97	0.93	1.06
		South Fork	259	1996-2005	500	0.99	0.64	1.54	0.99	0.74	1.33	0.98	0.74	1.32	0.95	0.91	1.09

1 Most recent year for 10-year geometric mean abundance is 2004-2005, depending upon population. ICTRT abundance thresholds are average abundance levels that would be necessary to meet ICTRT viability goals at <5% risk of extinction. Estimates and thresholds are from ICTRT (2007c)
2 Mean returns-per-spawner are estimated from the most recent period of approximately 20 years in Cooney (2008a). Actual years in average vary by population.
3 Median population growth rate (lambda) during the most recent period of approximately 20 years Actual years in estimate vary by population. Lambda estimates are from Cooney (2008b).
4 Biological Review Team (Good et al. 2005) trend estimates and 95% confidence limits updated for recent years in the Aggregate Analysis Appendix, Cooney (2008b).

Table 8.8.2-2. Status of MCR steelhead with respect to spatial structure and diversity VSP factors.

ESU	MPG	Population	ICTRT Current Risk For Spatial Structure[1]	ICTRT Current Risk For Diversity[1]	10-yr Average % Natural-Origin Spawners[2]
Mid Columbia Steelhead	Yakima	Upper Yakima	Currently High Risk (7 of 10 historical MaSAs are not occupied)	Currently High Risk (Introgression with resident O. mykiss and loss of presmolt migration pathways)	0.98
		Naches	Currently Low Risk	Currently Moderate Risk	0.94
		Toppenish	Currently Moderate Risk	Currently Moderate Risk	0.94
		Satus	Currently Low Risk	Currently Moderate Risk	0.94
	Eastern Cascades	Deschutes W.	Currently Very Low Risk	Currently Moderate Risk	0.74
		Deschutes E.	Currently Low Risk	Currently Moderate Risk	0.61
		Klickitat	Currently Low Risk	Currently Moderate Risk	
		Fifteenmile Cr.	Currently Very Low Risk	Currently Low Risk	1.00
		Rock Cr.	Currently Moderate Risk	Currently Moderate Risk	
		White Salmon - Extirpated			
	Umatilla/Walla Walla	Umatilla	Currently Moderate Risk	Currently Moderate Risk	0.64
		Walla-Walla	Currently Low Risk	Currently Moderate Risk	0.98
		Touchet	Currently Low Risk	Currently Moderate Risk	
	John Day	Lower Mainstem	Currently Very Low Risk	Currently Moderate Risk	0.90
		North Fork	Currently Very Low Risk	Currently Low Risk	0.92
		Upper Mainstem	Currently Very Low Risk	Currently Low Risk	0.92
		Middle Fork	Currently Very Low Risk	Currently Low Risk	0.92
		South Fork	Currently Very Low Risk	Currently Low Risk	0.92

1 ICTRT conclusions for MCR steelhead are from draft ICTRT Current Status Summaries (ICTRT 2007d).
2 Average fractions of natural-origin natural spawners are from the ICTRT (2007a).

Table 8.8.2-3. Status of MCR steelhead with respect to extinction risk. Extinction risk is estimated from performance during the "base period" of the 15-20 most recent brood years (approximately 1980-1985 BY through 1998-1999 BY, depending upon population).

			24-Year Extinction Risk											
ESU	MPG	Population	Risk (QET=1)[1]	Risk (QET=1) Lower 95CI	Risk (QET=1) Upper 95CI	Risk (QET=10)[1]	Risk (QET=10) Lower 95CI	Risk (QET=10) Upper 95CI	Risk (QET=30)[1]	Risk (QET=30) Lower 95CI	Risk (QET=30) Upper 95CI	Risk (QET=50)[1]	Risk (QET=50) Lower 95CI	Risk (QET=50) Upper 95CI
Mid Columbia Steelhead	Yakima	Upper Yakima	0.37	0.00	1.00	0.50	0.00	1.00	0.60	0.00	1.00	0.68	0.08	1.00
		Naches	0.06	0.00	0.58	0.18	0.00	0.77	0.27	0.00	0.83	0.34	0.00	0.87
		Toppenish	0.48	0.00	0.58	0.61	0.00	0.73	0.73	0.00	0.92	0.79	0.00	0.97
		Satus	0.00	0.00	0.04	0.00	0.00	0.13	0.00	0.00	0.22	0.00	0.00	0.30
	Eastern Cascades	Deschutes W.	0.00	0.00	0.48	0.00	0.00	0.75	0.00	0.00	0.84	0.01	0.00	0.90
		Deschutes E.	0.42	0.00	1.00	0.48	0.00	1.00	0.51	0.00	1.00	0.53	0.00	1.00
		Klickitat												
		Fifteenmile Cr.	0.00	0.00	0.22	0.00	0.00	0.32	0.00	0.00	0.40	0.00	0.00	0.44
		Rock Cr.												
		White Salmon - Extirpated												
	Umatilla/Walla Walla	Umatilla	0.00	0.00	0.14	0.00	0.00	0.26	0.00	0.00	0.34	0.00	0.00	0.37
		Walla-Walla	0.00	0.00	0.11	0.00	0.00	0.23	0.00	0.00	0.31	0.00	0.00	0.35
		Touchet												
	John Day	Lower Mainstem	0.00	0.00	0.21	0.00	0.00	0.29	0.00	0.00	0.35	0.00	0.00	0.38
		North Fork	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.07
		Upper Mainstem	0.00	0.00	0.36	0.00	0.00	0.43	0.00	0.00	0.61	0.00	0.00	0.67
		Middle Fork	0.00	0.00	0.16	0.00	0.00	0.28	0.00	0.00	0.38	0.00	0.00	0.44
		South Fork	0.00	0.00	0.40	0.00	0.00	0.55	0.01	0.00	0.61	0.03	0.00	0.69

1 Short-term (24-year) extinction risk and 95% confidence limits from Hinrichsen (2008), included as Attachment 1in SCA Aggregate Analysis Appendix. If populations fall to or below the quasi-extinction threshold (QET) four years in a row they are considered extinct in this analysis.

Table 8.8.2-4. Changes in density-independent survival of MCR steelhead ("gaps") necessary for indices of productivity equal to 1.0 and estimates of extinction risk no higher than 5% for MCR steelhead. Survival changes would need to be greater than these estimates for trend or productivity to be greater than 1.0. Estimated "gaps" are based on population performance during the "base period" of approximately the last 20 brood years or spawning years. Factors greater than 1.0 indicate a need for higher survival (e.g., 1.225 indicates that a 22.5% proportional increase in survival is necessary for productivity or trend to equal 1.0); 1.0 indicates no change; and numbers less than 1.0 indicate that additional changes in survival are not necessary for productivity or trend equal to 1.0 and extinction risk to be less than or equal to 5%.

ESU	MPG	Population	Survival Gap For Average R/S=1.0[1]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0 @ HF=0[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 20-yr lambda = 1.0@ HF=1[2]	Upper 95% CI	Lower 95% CI	Survival Gap For 1980-current BRT trend = 1.0[3]	Upper 95% CI	Lower 95% CI	Survival Gap for 24-Yr Ext. Risk <5% (QET=1)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=10)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=30)[4]	Survival Gap for 24-Yr Ext. Risk <5% (QET=50)[4]
Mid Columbia Steelhead	Yakima	Upper Yakima	0.98	1.44	0.66	0.94	3.85	0.23	0.96	4.00	0.23	0.98	1.24	0.49				
		Naches	0.98	1.45	0.66	0.92	3.97	0.21	0.99	4.30	0.23	0.93	1.18	0.48				
		Toppenish	0.69	1.12	0.42	0.68	3.50	0.13	0.73	3.81	0.14	0.69	0.92	0.29				
		Satus	1.16	1.61	0.83	1.11	3.36	0.37	1.21	3.67	0.40	1.12	1.39	0.60				
	Eastern Cascades	Deschutes W.	1.09	1.49	0.80	0.91	2.64	0.32	1.16	3.13	0.43	1.03	1.21	0.50				
		Deschutes E.																
		Klickitat																
		Fifteenmile Cr.	0.85	1.19	0.61	0.88	2.34	0.33	0.88	2.34	0.33	0.88	1.08	0.53				
		Rock Cr.																
		White Salmon - Extirpated																
	Umatilla/Walla Walla	Umatilla	1.06	1.38	0.82	0.86	2.00	0.37	1.07	2.35	0.49	0.98	1.11	0.57				
		Walla-Walla																
		Touchet																
	John Day	Lower Mainstem	0.80	1.32	0.49	0.96	4.61	0.20	1.00	4.67	0.21	1.11	1.35	0.55				
		North Fork	0.85	1.27	0.57	1.00	2.81	0.35	1.02	2.84	0.37	1.05	1.25	0.51				
		Upper Mainstem	0.94	1.40	0.63	1.04	3.24	0.33	1.07	3.30	0.34	1.26	1.49	0.87				
		Middle Fork	0.85	1.23	0.59	0.97	2.79	0.34	1.00	2.84	0.35	1.16	1.37	0.77				
		South Fork	1.01	1.57	0.65	1.05	3.95	0.28	1.08	3.97	0.29	1.26	1.51	0.68				

1 R/S survival gap is calculated as 1.0 ÷ base R/S from Table 8.8.2-1.

2 Lambda survival gap is calculated as (1.0 ÷ base lambda from Table 8.8.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

3 BRT trend survival gap is calculated as (1.0 ÷ base BRT slope from Table 8.8.2-1)^Mean Generation Time. Mean generation time was estimated at 4.5 years for these calculations.

4 Extinction risk survival gap could not be calculated for this species .

Table 8.8.3-1. Proportional changes in average base period survival of MCR steelhead expected from completed actions and current human activities that are likely to continue into the future. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to the base period average); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to the base period average).

			Base-to-Current Adjustment (Divisor)							
ESU	MPG	Population	Hydro[1]	Tributary Habitat[2]	Estuary Habitat[3]	Bird Predation[4]	Marine Mammal Predation[5]	Harvest[6]	Hatcheries[7]	Total[8]
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Naches (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Toppenish (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Satus (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
	Eastern Cascades	Deschutes W. (above TDA)	0.998	1.002	1.003	0.996	1.00	1.041	1.00	1.04
		Deschutes E. (above TDA)	0.998	1.010	1.003	0.996	1.00	1.041	1.00	1.05
		Klickitat (above BON)	0.999	1.040	1.003	0.996	1.00	1.041	1.00	1.08
		Fifteenmile Cr. (above TDA)	0.998	1.001	1.003	0.996	0.78	1.041	1.00	0.81
		Rock Cr. (above JDA)	1.005	1.000	1.003	0.996	1.00	1.041	1.00	1.05
		White Salmon - Extirpated								
	Umatilla/Walla Walla	Umatilla (above JDA)	1.005	1.040	1.003	0.996	1.00	1.041	1.00	1.09
		Walla-Walla (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
		Touchet (above MCN)	1.018	1.040	1.003	0.996	1.00	1.041	1.00	1.10
	John Day	Lower Mainstem (above JDA)	1.005	1.002	1.003	0.996	1.00	1.041	1.00	1.05
		North Fork (above JDA)	1.005	1.003	1.003	0.996	1.00	1.041	1.00	1.05
		Upper Mainstem (above JDA)	1.005	1.002	1.003	0.996	1.00	1.041	1.00	1.05
		Middle Fork (above JDA)	1.005	1.002	1.003	0.996	1.00	1.041	1.00	1.05
		South Fork (above JDA)	1.005	1.007	1.003	0.996	1.00	1.041	1.00	1.05

1 From SCA Hydro Modeling Appendix, Based on differences in average base and current smolt-to-adult survival estimates.
2 From CA Chapter 10, Table 10-7.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Current 2 S/Baseline 2 S" approach, as described in Attachment F-2.
5 From Supplemental Comprehensive Analysis, SCA Marine Mammal Appendix. Fifteenmile Creek is affected because it is a winter-run steelhead population.
6 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
7 Hatchery improvements considered qualitatively
8 Total survival improvement multiplier is the product of the survival improvement multipliers in each previous column.

Table 8.8.5-1. Estimates of percent juvenile steelhead in-river survival rates through the lower Columbia River under the Prospective Actions and in a hypothetical free-flowing reach of equal length (source: Table 5.1 in NMFS 2004a).

Pool Entered	Prospective Actions Lower Columbia Survival		Hypothetical— Free-flowing Reach
	In-river	Rel. Improvement	
McNary	65	12	89
John Day	70	10	91
The Dalles	83	5	96
Bonneville	93	< 1	99

Table 8.8.5-2. Proportional changes in survival of MCR steelhead expected from the Prospective Actions. Factors greater than one result in higher survival (e.g., 1.225 indicates a 22.5% increase in survival, compared to average current survival); 1.0 indicates no change; and numbers less than 1.0 result in lower survival (e.g., 0.996 indicates a 0.4% reduction in survival, compared to current average survival).

			Current-to-Future Adjustment (Divisor)									
ESU	**MPG**	**Population**	**Hydro[1]**	**Tributary Habitat[2] (2007-2017)**	**Estuary Habitat[3]**	**Bird Predation[4]**	**Pike-minnow Predation[5]**	**Kelt Reconditioning[6]**	**Marine Mammal[7]**	**Allowable Harvest8**	**Expected Harvest[8]**	**Hatcheries9**
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Naches (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Toppenish (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Satus (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
	Eastern Cascades	Deschutes W. (above TDA)	1.05	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Deschutes E. (above TDA)	1.05	1.03	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Klickitat (above BON)	1.00	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Fifteenmile Cr. (above TDA)	1.05	1.00	1.06	1.03	1.01	1.00	1.18	0.99	0.99	1.00
		Rock Cr. (above JDA)	1.08	1.00	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		White Salmon - Extirpated										
	Umatilla/Walla Walla	Umatilla (above JDA)	1.08	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Walla-Walla (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Touchet (above MCN)	1.10	1.04	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
	John Day	Lower Mainstem (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		North Fork (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Upper Mainstem (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		Middle Fork (above JDA)	1.08	1.01	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00
		South Fork (above JDA)	1.08	1.02	1.06	1.03	1.01	1.00	1.00	0.99	0.99	1.00

Table 8.8.5-2. Continued.

			Current-to-Future Adjustment (Divisor)					High	Low
ESU	MPG	Population	Non-Hydro With Allowable Harvest[10]	Non-Hydro With Expected Harvest[10]	Total (Allowable Harvest)[11]	Total (Expected Harvest)[11]		Total Base-Current and Current-Future[12]	Total Base-Current and Current-Future[12]
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.14	1.14	1.26	1.26		1.39	1.39
		Naches (above MCN)	1.14	1.14	1.26	1.26		1.39	1.39
		Toppenish (above MCN)	1.14	1.14	1.26	1.26		1.39	1.39
		Satus (above MCN)	1.14	1.14	1.26	1.26		1.39	1.39
	Eastern Cascades	Deschutes W. (above TDA)	1.11	1.11	1.16	1.16		1.21	1.21
		Deschutes E. (above TDA)	1.13	1.13	1.19	1.19		1.25	1.25
		Klickitat (above BON)	1.14	1.14	1.15	1.15		1.24	1.24
		Fifteenmile Cr. (above TDA)	1.30	1.30	1.37	1.37		1.11	1.11
		Rock Cr. (above JDA)	1.10	1.10	1.19	1.19		1.24	1.24
		White Salmon - Extirpated							
	Umatilla/Walla Walla	Umatilla (above JDA)	1.14	1.14	1.24	1.24		1.34	1.34
		Walla-Walla (above MCN)	1.14	1.14	1.26	1.26		1.39	1.39
		Touchet (above MCN)	1.14	1.14	1.26	1.26		1.39	1.39
	John Day	Lower Mainstem (above JDA)	1.11	1.11	1.20	1.20		1.25	1.25
		North Fork (above JDA)	1.11	1.11	1.20	1.20		1.25	1.25
		Upper Mainstem (above JDA)	1.11	1.11	1.20	1.20		1.26	1.26
		Middle Fork (above JDA)	1.11	1.11	1.20	1.20		1.25	1.25
		South Fork (above JDA)	1.12	1.12	1.21	1.21		1.28	1.28

1 From Supplemental Comprehensive Analysis, SCA Hydro Modeling Appendix. Based on differences in average current and future smolt-to-adult survival estimates.
2 From CA Chapter 10, Table 10-9.
3 From CA Appendix D, Attachment D-1, Table 6.
4 From CA Appendix F, Attachment F-2, Table 4. Estimate is based on the "Prospective 2 S/Current 2 S" approach, as described in Attachment F-2.
5 From CA Appendix F, Attachment F-1.
6 It was not possible to quantify survival changes associated with the kelt reconditioning program.
7 From Supplemental Comprehensive Analysis, SCA Marine Mammal Appendix. Fifteenmile Creek is affected because it is a winter-run steelhead population.
8 From SCA Harvest Appendix. Primary source: memorandum from *US v. Oregon* ad hoc technical workgroup.
9No quantitative survival changes have been estimated to result from hatchery Prospective Actions – future effects are qualitative.
10 This multiplier represents the survival changes resulting from non-hydro Prospective Actions. It is calculated as the product of the survival improvement multipliers in each previous column, except for the hydro multipliers.
11 Same as Footnote 8, except it is calculated from all Prospective Actions, including hydro actions.
12 Calculated as the product of the Total Current-to-Future multiplier and the Total Base-to-Current multiplier from Table 8.8.3-1.

Table 8.8.6.1-1. Summary of prospective estimates relevant to the recovery prong of the jeopardy standard for MCR steelhead.

ESU	MPG	Population	20-Yr R/S Recent Climate[1]	20-yr lambda Recent Climate @ HF=0[2]	20-yr lambda Recent Climate @ HF=1[3]	1980-Current BRT Trend Recent Climate[3]	ICTRT MPG Viability Scenario[4]	Recovery Prong Notes for Abundance/Productivity	Recovery Prong Notes for Spatial Structure[5]	Recovery Prong Notes for Diversity[5]
							Need 1 HV and 1 V:			
Mid Columbia Steelhead	Yakima	Upper Yakima (above MCN)	1.42	1.09	1.09	1.39	1 of these 2 populations must be HV or V	All three metrics >1	Currently High Risk (7 of 10 historical MaSAs are not occupied)	Currently High Risk (Introgression with resident O. mykiss and loss of presmolt migration pathways)
		Naches (above MCN)	1.42	1.10	1.08	1.41		All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Toppenish (above MCN)	2.02	1.17	1.15	1.51	Can be 1 of the 2 needed HV or V populations	All three metrics >1	Currently Low Risk	Currently Moderate Risk
		Satus (above MCN)	1.20	1.05	1.03	1.35	"Maintained" Population	All three metrics >1	Currently Low Risk	Currently Moderate Risk
							Need 1 HV and 3 V:			
	Eastern Cascades	Deschutes W. (above TDA)	1.11	1.06	1.01	1.20	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
		Deschutes E. (above TDA)					Must be HV or V	No Data	Currently Low Risk	Currently Moderate Risk
		Klickitat (above BON)					Must be HV or V	No Data	Currently Low Risk	Currently Moderate Risk
		Fifteenmile Cr. (above TDA)	1.30	1.05	1.05	1.15	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Low Risk
		Rock Cr. (above JDA)					"Maintained" Population	No Data	Currently Moderate Risk	Currently Moderate Risk
		White Salmon - Extirpated								
							Need 1 HV and 1 V:			
	Umatilla/Walla Walla	Umatilla (above JDA)	1.26	1.11	1.05	1.35	Must be HV or V	All three metrics >1	Currently Moderate Risk	Currently Moderate Risk
		Walla-Walla (above MCN)					1 of these 2 populations must be HV or V	No Data	Currently Low Risk	Currently Moderate Risk
		Touchet (above MCN)						No Data	Currently Low Risk	Currently Moderate Risk
							Need 1 HV and 2 V:			
	John Day	Lower Mainstem (above JDA)	1.56	1.06	1.05	1.22	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Moderate Risk
		North Fork (above JDA)	1.47	1.05	1.05	1.24	Must be HV or V	All three metrics >1	Currently Very Low Risk	Currently Low Risk
		Upper Mainstem (above JDA)	1.34	1.04	1.04	1.20	1 of these 2 populations must be HV or V	All three metrics >1	Currently Low Risk	Currently Low Risk
		Middle Fork (above JDA)	1.47	1.06	1.05	1.21		All three metrics >1	Currently Low Risk	Currently Low Risk
		South Fork (above JDA)	1.26	1.05	1.04	1.21	"Maintained" Population	All three metrics >1	Currently Very Low Risk	Currently Low Risk

1 Calculated as the base period 20-year R/S productivity from Table 8.8.2-1, multiplied by the total base-to-future survival multiplier in Table 8.8.5-2.
2 Calculated as the base period 20-year mean population growth rate (lambda) from Table 8.8.2-1, multiplied by the total base-to-future survival multiplier in Table 8.8.5-2, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
3 Calculated as the base period 20-year mean BRT abundance trend from Table 8.8.2-1, multiplied by the total base-to-future survival multiplier in Table 8.8.5-2, raised to the power of (1/mean generation time). Mean generation time was estimated to be 4.5 years.
4 From ICTRT (2007c), Attachment 2
5 From Table 8.

Figure 8.8.6-1. Summary of prospective mean R/S estimates for MCR steelhead under the “recent” climate assumption, including 95% confidence limits.

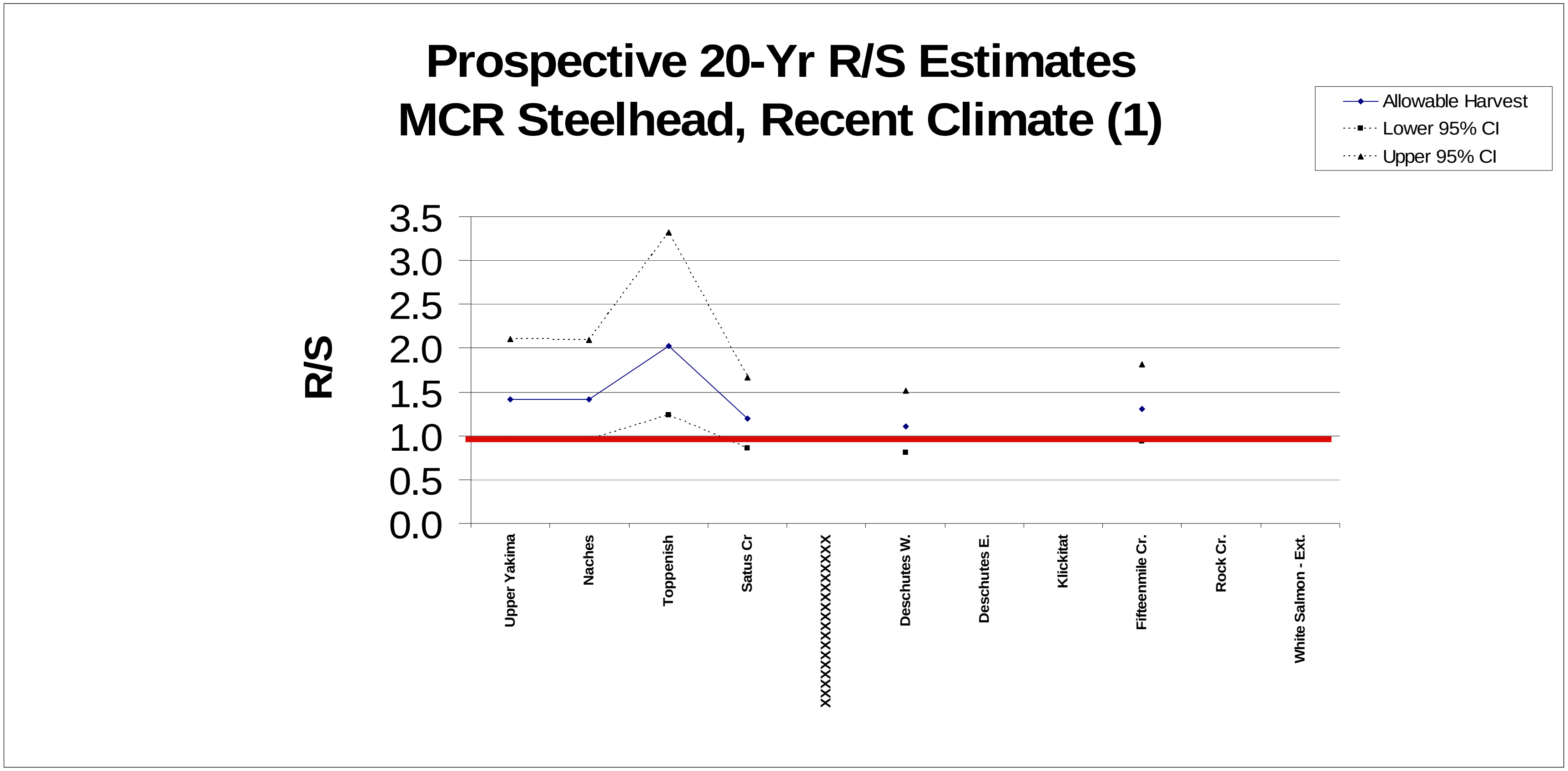


Figure 8.8.6-1. Continued.

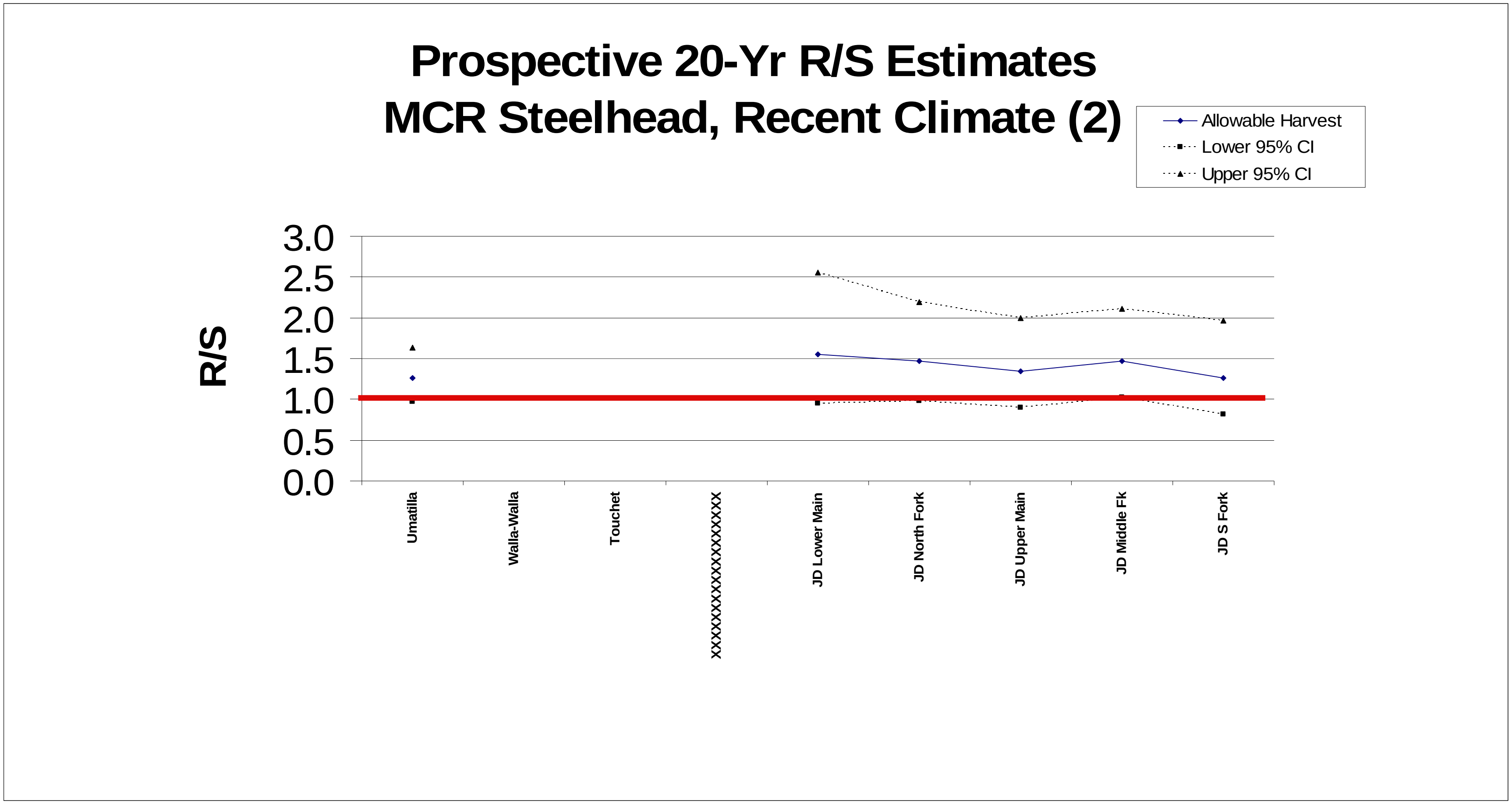


Figure 8.8.6-2. Summary of prospective mean R/S estimates for MCR steelhead under three climate assumptions.

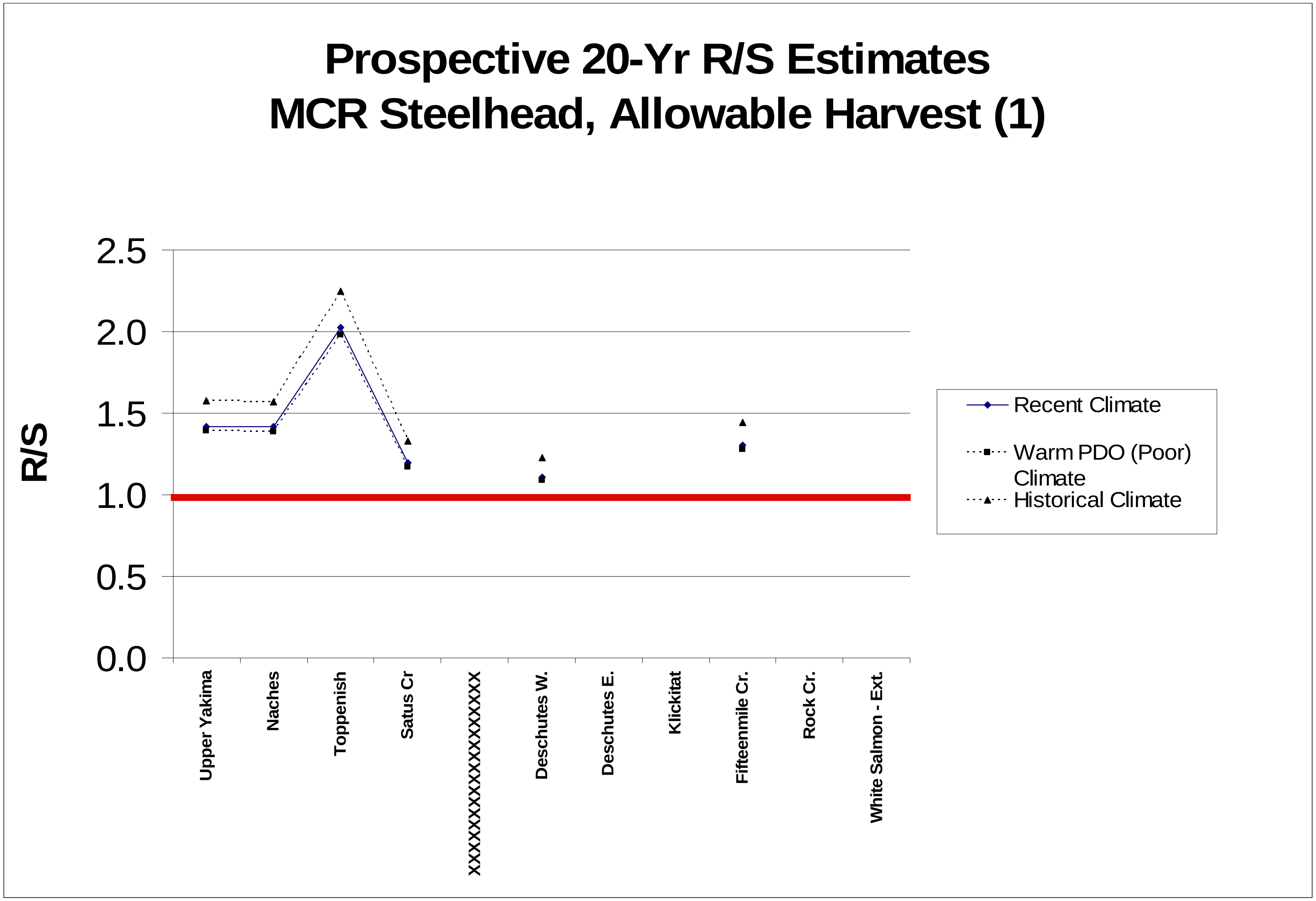
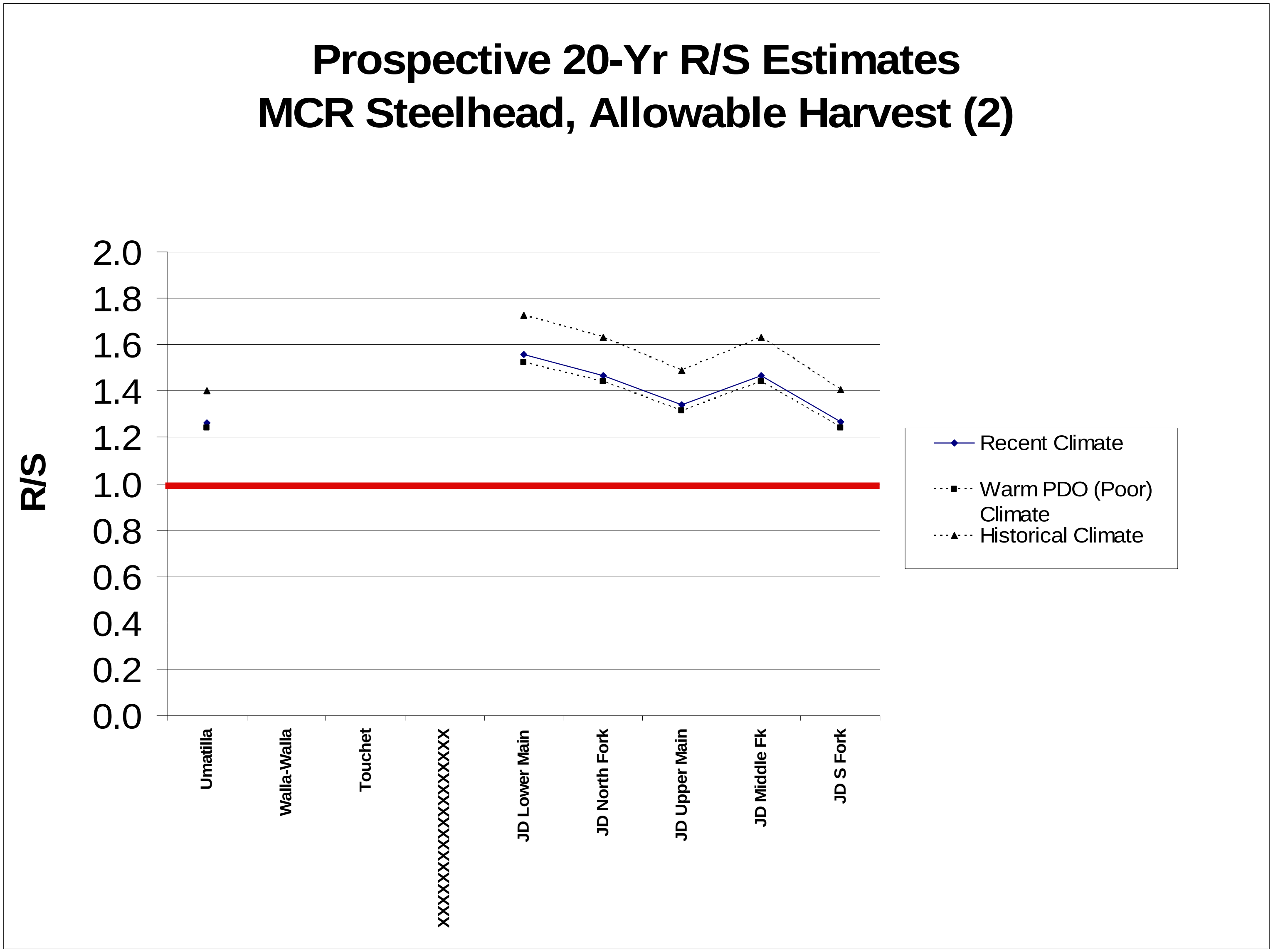


Figure 8.8.6-2. Continued.



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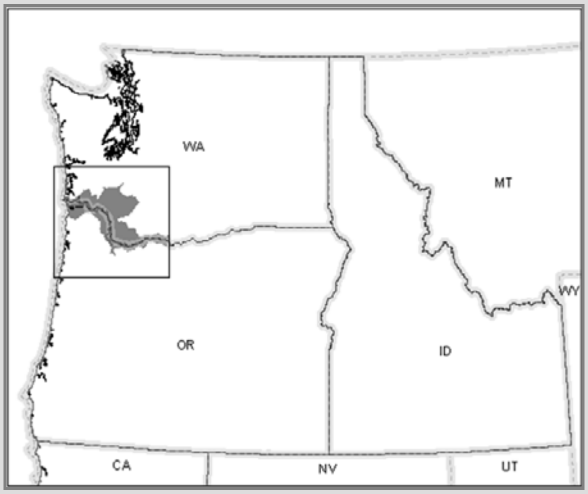
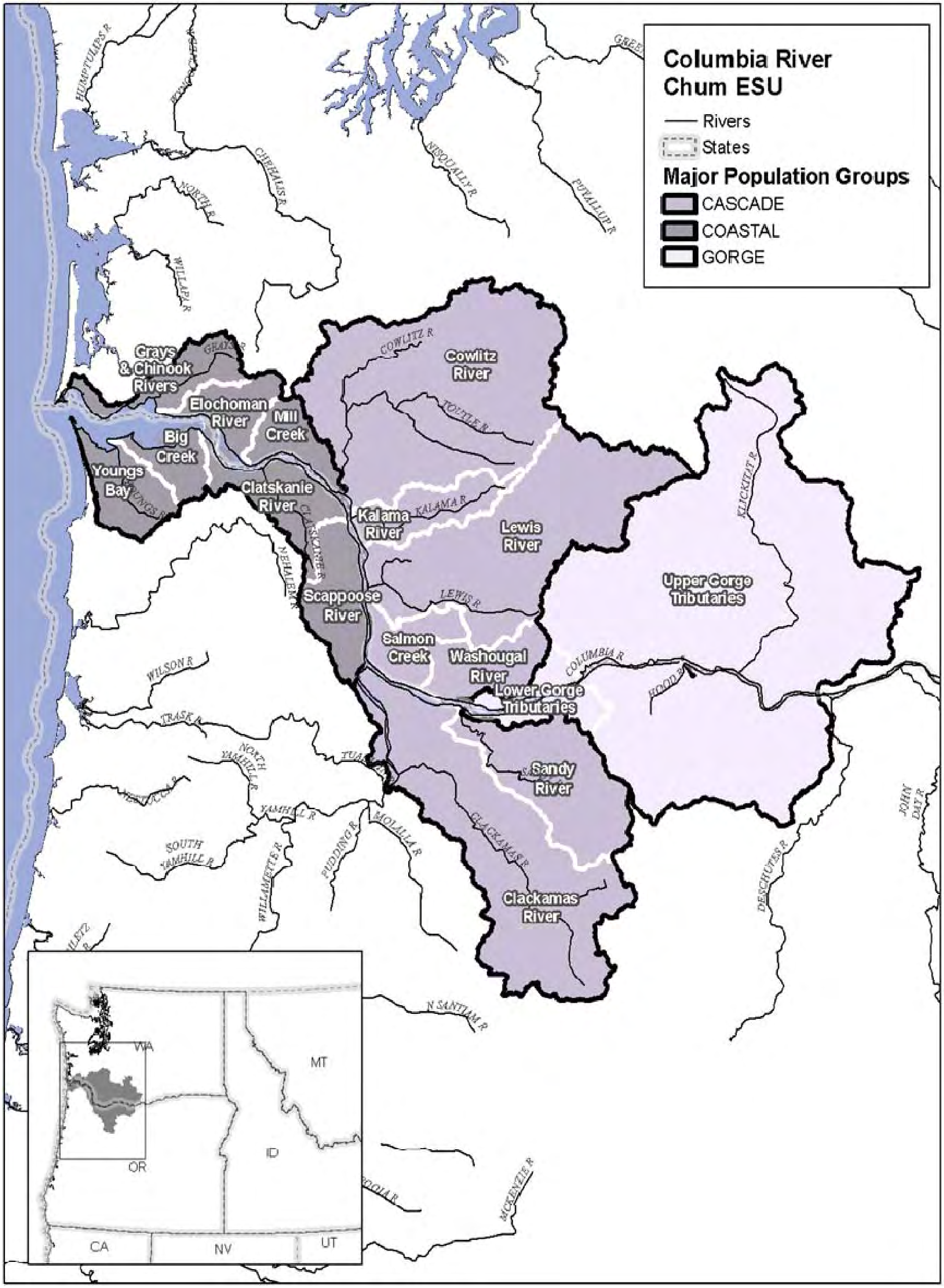
Section 8.9
Columbia River Chum Salmon




Columbia River Chum ESU
Rivers
States
Major Population Groups
CASCADE
COASTAL
GORGE
Grays & Chinook Rivers
Elochoman River
Mill Creek
Big Creek
Youngs Bay
Clatskanie River
Kalama River
Scappoose River
Cowlitz River
Lewis River
Salmon Creek
Washougal River
Lower Gorge Tributaries
Upper Gorge Tributaries
Sandy River
Clackamas River
WA
OR
MT
ID
CA
NV
UT

Section 8.9
Columbia River Chum Salmon

Species Overview

Background

The Columbia River (CR) chum salmon ESU includes all naturally-spawned populations of chum salmon in the Columbia River and its tributaries as well as three artificial propagation programs. There were 16 historical populations in three major population groups in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Significant spawning now occurs for two of the historical populations, meaning that 88% of the historical populations are extirpated or nearly so. Because chum salmon spend only a short time in natal streams before emigration, the loss or impairment of rearing habitat in the Columbia River estuary may have been an important factor in their decline. Another important factor was the inundation of historical spawning areas by Bonneville Reservoir.

Designated critical habitat for this ESU includes all Columbia River estuarine areas and river reaches upstream to the confluence with the White Salmon River and specific stream reaches in a number of subbasins.

Current Status & Recent Trends

Most of the populations in this ESU are extirpated or nearly so. Estimates of abundance and trends are available only for the Grays River and Lower Gorge populations. Abundances for these was low, but trends were relatively stable in the decade beginning 1990. Since then they increased for several years before declining.

Limiting Factors

Human impacts and limiting factors for the Columbia River chum salmon ESU have come from multiple sources, including mainstem and tributary hydropower development and loss or impairment of tributary and estuarine habitat.

Recent Ocean and Mainstem Harvest

Ocean fishing mortality on Columbia River chum salmon is assumed to be zero. Fisheries in the Columbia River are limited to insure that the incidental take of ESA-listed Columbia River chum does not exceed specified rates. Non-Treaty fisheries in the lower Columbia River have been limited to an incidental harvest rate of 5% in recent years. Recent harvest rates have averaged about 1.6%. Columbia River chum are not caught in the treaty Indian fisheries above Bonneville Dam.

8.9.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.9.2.1 Current Rangewide Status of the Species

The Columbia River chum ESU includes 16 historical populations in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Chum salmon return to the Columbia River in late fall (mid-October to December). They primarily spawn in the lower reaches of rivers, digging their redds along the edges of the mainstem and in tributaries or side channels. Some spawning sites are located in areas where geothermally-warmed groundwater or mainstem flow upwells through the gravel.

Chum fry emigrate from March through May shortly after emergence in contrast to other salmonids (e.g., steelhead, coho salmon, and most Chinook salmon), which usually migrate to sea at a larger size after months or years of freshwater rearing. Juvenile chum salmon feed in estuaries to feed before beginning a long-distance oceanic migration. The period of estuarine residence appears to be a critical life history phase and may play a major role in determining the size of the subsequent adult run back to fresh water. Summary data for the ESU are shown in Table 8.9.2.1-1.

Table 8.9.2.1-1. Columbia River chum ESU description and major population groups (MPGs). (Sources: NMFS 2005a; Myers et al. 2006). The designations "-C" and "-G" identify Core and Genetic legacy populations, respectively.[1]

ESU Description	
Threatened	Listed under ESA in 2005
3 major population groups	16 historical populations
Major Population Group	**Population**
Coastal	Grays (C,G), Elochoman (C), Mill Creek, Youngs Bay (C), Big Creek (C), Clatskanie, Scappoose
Cascade	Cowlitz (C),* Kalama, Lewis (C), Salmon Creek, Washougal, Clackamas (C), Sandy
Gorge	Lower Gorge (C,G), Upper Gorge
Hatchery programs included in ESU (3)	Chinook River (Sea Resources Hatchery), Grays River, and Washougal/Duncan Creek
* Myers et al. 2006 stated that "whether [Cowlitz] summer chum salmon constitute a demographically independent population … needs to be studied further." Subsequent genetic analysis (Small et al. 2006) indicated that Cowlitz summer chum are distinct, but population delineations have not yet been revised.	

[1] Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the ESU (WLCTRT 2003).

Human impacts and current limiting factors are primarily related to habitat degradation (Table 8.9.2.1-2). Chum spawning habitat has been substantially limited by the loss of off-channel and side channel habitat and, since 1938, inundation of historically productive areas by Bonneville pool.

Limiting Factors

Summarized below (Table 8.9.2.1-2) are key limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB 2004)]. Oregon is currently engaged in the recovery planning process for Columbia River chum.

Table 8.9.2.1-2. Key limiting factors for Columbia River chum.

Mainstem Hydro	Direct mainstem hydro impacts on the Columbia River chum ESU are most significant for the Upper and Lower Gorge populations. For the Upper Gorge population, some productive historical spawning habitat was inundated by Bonneville pool. FCRPS flow management affects the amount of submerged spawning habitat for the mainstem component of the Lower Gorge population and whether adults can enter (and fry can emerge from) Hardy and Hamilton creeks. Impacts on populations originating in subbasins further downstream (i.e., below the Portland/Vancouver area) are limited to migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.
Predation	Avian predators are assumed to have minimal effect on chum salmon. The significance of fish predation on juvenile chum is unknown.
Harvest	Harvest is limited to indirect fishery mortality. In the 1950s, due to severe population declines, commercial chum salmon fisheries were closed or drastically minimized. Now there are neither recreational nor commercial fisheries in the Columbia River. The number of chum landed as take incidental to the lower river commercial gill net fisheries has been less than 50 fish in each of the last five years.
Hatcheries	Historical hatchery practices do not appear to have influenced chum populations. WDFW's conservation hatcheries are currently an element of chum salmon protection and restoration efforts. Along with other state and Federal hatchery programs throughout the lower Columbia River, these are currently the subject of a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is an important habitat for migrating juveniles from Columbia River chum populations. Alterations in attributes of flow and diking have

	resulted in the loss of emergent marsh, tidal swamp and forested wetlands. These habitats are used extensively by chum juveniles which migrate from their natal areas soon after emergence (Fresh et al. 2005). Estuary limiting factors and recovery actions are addressed in detail as part of a comprehensive regional planning process (NMFS 2006b).
Habitat	Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in the low to moderate elevation habitats most often used by chum. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for chum by reach in all Washington subbasins. Recovery and subbasin plans also identify a suite of beneficial actions for the protection and restoration of tributary subbasin habitats. Similar information is in development for Oregon subbasins.
Ocean & Climate	Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status the ESU to some extent, future trends, especially during the time period relevant to the Prospective Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).

Abundance, Productivity, & Trends

Base status information through 2000 is shown in Table 8.9.2.1-3. Estimates of abundance and trends are available only for the Grays River and Lower Gorge populations. The 10-year trend was negative for the Grays River population and just over 1.0 for the Lower Gorge. After 2000, populations increased for a few years before declining (Keller 2006).

Table 8.9.2.1-3. Abundance, productivity, and trends of Columbia River chum populations. (Sources: NMFS 2005b; McElhany et al. 2007).

Strata	Population	State	Recent Abundance of Natural Spawners			Long-term trend		Median Growth Rate	
			Years[1]	No.[2]	pHOS[3]	Years	Value[4]	Years	λ[5]
Coastal	Grays	W	96-00	331	na	90-00	0.904[6]	90-00	0.807[6]
	Elochoman	W	na	na	na	na	na	na	na
	Mill Creek	W	na	na	na	na	na	na	na
	Youngs Bay	O	na	na	na	na	na	na	na
	Big Creek	O	na	na	na	na	na	na	na
	Clatskanie	O	na	na	na	na	na	na	na
	Scappoose	O	na	na	na	na	na	na	na
Cascade	Cowlitz	W	na	na	na	na	na	na	na
	Kalama	W	na	na	na	na	na	na	na
	Lewis	W	na	na	na	na	na	na	na
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	na	na	na	na	na	na	na
	Clackamas	O	na	na	na	na	na	na	na
	Sandy	O	na	na	na	na	na	na	na
Gorge	Lower Gorge	O/W	96-00	425	N/A	90-00	1.003	90-00	1.00
	Upper Gorge	O/W	na	na	na	na	na	na	na

[1] Years of data for recent means
[2] Geometric mean of total spawners
[3] Average recent proportion of hatchery-origin spawners
[4] Long-term trend of total spawners
[5] Long-term median population growth rate (including both natural- and hatchery-origin spawners)
[6] Hymer 2000 as cited in NMFS 2005b

Extinction Probability/Risk

The 100-year risk of extinction (Table 8.9.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (2004) for use in recovery plan assessments. The rating system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

The risk of extinction is high or very high for all populations except the Washington portion of the Lower Gorge. The Upper Gorge population, and all four of the populations on the Oregon side of the river in the Coastal MPG, are extirpated or nearly so (McElhany et al. 2007).

Table 8.9.2.1-4. Risk of extinction in 100 years; categories for populations of Columbia River chum (sources: Washington's Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strata	Population	State	Extinction Risk Category
Coastal	Grays	W	H
	Elochoman	W	H
	Mill Creek	W	VH
	Youngs Bay	O	VH
	Big Creek	O	VH
	Clatskanie	O	VH
	Scappoose	O	VH
Cascade	Cowlitz	W	VH
	Kalama	W	VH
	Lewis	W	VH
	Salmon	W	VH
	Washougal	W	H
	Clackamas	O	VH
	Sandy	O	VH
Gorge	Lower Gorge	O/W	VH/M
	Upper Gorge	O/W	VH/VH

Spatial Structure

The Columbia River chum ESU consists of three MPGs made up of two to seven historical populations each. In the Coastal MPG, spatial structure is limited by tide gates, dikes, culverts, and hatchery weirs. The filling of Bonneville pool eliminated mainstem and lower tributary habitat for the Upper Gorge population (WLCTRT et al. 2004). Over the past several years, few Columbia River chum salmon have been observed in tributaries between The Dalles and Bonneville dams. Surveys of the White Salmon River in 2002 found one male and one female carcass and the latter had not spawned (Ehlke and Keller 2003). Chum salmon were not observed in any of the upper gorge tributaries, including the White Salmon River, during the 2003 and 2004 spawning ground surveys (Keller 2005a, b). Radio-tracking studies show that a few adult chum tagged at Bonneville Dam were near the confluence of the White Salmon, but did not appear to enter the river and did not stay in the area.

In the Cascade MPG, chum salmon habitat was inundated by Mayfield Lake in the Cowlitz River and Merwin Lake in the North Fork Lewis River. The following measures, which could positively affect the spatial structure of chum populations in the Cascade MPG and thus rangewide status, were included in the new FERC licenses for these two projects:

- Lewis River Hydroelectric Project – chum salmon once ascended the mainstem Lewis River above the current location of Merwin Dam. Because this area is now inundated, PacifiCorps may use its In Lieu fund to repair a landslide upstream of the Lewis River Hatchery which buried chum salmon spawning habitat and fund a partnership with a gravel mining company to create spawning habitat on the East Fork Lewis and/or reconnect and enhance side channels and areas with upwelling to restore spawning habitat in the lower mainstem Lewis (NMFS 2007f)

- Cowlitz River Hydroelectric Project – Tacoma Power will provide minimum flows from Mayfield Dam to protect chum habitat during spawning, incubation, and emergence and will implement gravel augmentation projects in the habitat below the dam (NMFS 2004c)

Diversity

Most Columbia River chum populations have been functionally extirpated or are presently at very low abundance levels. However, in the Cascade MPG, chum sampled from each tributary recently were shown to be the remnants of genetically distinct populations (Small et al. 2006).

Historical hatchery introductions were limited to populations in the Coastal MPG and these were both small in scale and intermittent. As a result, they have not had lasting effects on the diversity of the affected populations. Three recently established artificial propagation programs produce chum salmon at this time; these are conservation programs which use naturally-produced adults for broodstock and release juveniles as fry, boosting egg-to-fry productivity. The current Washougal Hatchery program provides chum salmon for re-introduction into recently restored habitat in Duncan Creek (Washington). This program also provides a safety net for the naturally-spawning population in the mainstem Columbia River below Bonneville Dam during low flow years. The other two programs are designed to augment natural production in the Grays River and to reintroduce chum to the Chinook River. Effects on diversity are expected to be neutral.

8.9.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for CR chum salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the White Salmon River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Cowlitz, Lower Columbia, and Grays/ Elochoman (NMFS 2005b). There are 20 watersheds within the range of this ESU. Three watersheds received a medium rating and 17 received a high rating for their conservation value to the ESU (i.e., for recovery). For more information see Chapter 4. The lower Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor 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. Of the 725 miles of habitat areas eligible for designation, 708 stream miles are designated critical habitat.

In the lower Columbia River and its tributaries, major factors affecting PCEs are altered channel morphology and stability; lost/degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased steam temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004, ODFW 2006b, PCSRF 2006). The status of critical habitat within the action area is discussed in more detail in Section 8.9.3.8.

8.9.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of CR chum salmon. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000b) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.9.2.1-3) will improve.

8.9.3.1 Recent FCRPS Hydro Improvements

Chum salmon have benefited from operations to provide fall and winter tailwater elevations and flows for spawning, incubation, and emergence in habitat just downstream from Bonneville Dam (Lower Gorge population). The flow operation supports spawning, incubation, and emergence and ensures access to Hamilton and Hardy creeks. However, some chum fry have been stranded on shallow water flats on Pierce Island as a result of daily flow fluctuations.

8.9.3.2 Recent Tributary Habitat Improvements

Actions implemented since 2000 range from beneficial changes in land management practices to improving access by replacing culverts and by fish habitat restoration activities at FERC-licensed dams. The latter category includes the removal of Condit Dam in 2009 (NMFS 2006j), a portion of the historical spawning habitat that was inundated by Bonneville pool could be restored over time if sediment released upon the removal of Condit Dam, and natural bedload, deposit in the lower White Salmon River in a way that elevates the stream bottom (NMFS 2006k). However, NOAA Fisheries is uncertain that this action will lead to the restoration of this component of the Upper Gorge population.

As described in Section 8.10.3.2, a comprehensive habitat assessment and restoration plan for the Grays River watershed was conducted by the Pacific Northwest National Laboratory (PNNL) in cooperation with Washington Department of Fish and Wildlife (WDFW) and Pacific States Marine Fisheries Commission (PSMFC) in 2006, focusing on the fall-run Chinook population. Several related projects have been implemented (see attachment to NOAA Fisheries' 2008 Guidance letter to the Pacific Fisheries Management Council PFMC; NMFS 2008i). These include habitat restoration in the upper (reducing excess sediment loads) and lower (reconnecting the river delta-estuarine habitat at Seal Slough, the tidal floodplain at Devils Elbow, estuarine wetlands at Seal Slough, adding large wood to the lower West Fork, reducing temperatures and improving habitat diversity near Grays RM 11.8, and replacing the Nikka tidegate to restore connectivity and increase fish passage) Grays River watersheds. These projects are likely to benefit the Grays River chum salmon population because chum salmon also have a subyearling juvenile life history type and rear in the types of habitats that will be addressed.

8.9.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving wetland and riparian function. These have resulted in an estimated .0.7% survival benefit for Columbia River chum (ocean-type juvenile life history) (Corps et al. 2007a).

8.9.3.4 Recent Predator Management Improvements

Avian Predation
Avian predators are assumed to have little effect on the survival of Columbia River chum salmon.

Piscivorous Fish Predation
The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. Benefits of recent northern pikeminnow management activities to chum salmon are unknown, but could be comparable to those for other salmon species with a subyearling juvenile life history: 2% (Friesen and Ward 1999).

8.9.3.5 Recent Hatchery Management Issues

Hatchery effects have not been identified as a limiting factor for Columbia River chum salmon (LCFRB 2004; ODFW 2006b). NOAA Fisheries described three programs that release chum salmon below Bonneville Dam (Table 8.9.2.1-1) as improving population viability by increasing abundance and spatial distribution (NMFS 2004b), as well as reducing short-term extinction risk. A summary of progress in hatchery reform for lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS (2004b).

8.9.3.6 Recent Harvest Survival Improvements

Columbia River chum salmon are not caught incidentally in tribal fisheries above Bonneville Dam. Colombia River chum are incidentally caught occasionally in non-Indian fall season fisheries below Bonneville. There are no fisheries in the Columbia River that target hatchery or natural-origin chum salmon. The species' later fall return timing is such that they are vulnerable to relatively little potential harvest in fisheries that target Chinook and coho. Colombia River chum rarely take the kinds of sport gear that is used to target other species.

Harvest rates are difficult to estimate since NOAA Fisheries does not have good estimates of total run size. However, the incidental catch of chum amounts to a few tens of fish per year (TAC 2008). The harvest rate in proposed state fisheries in the lower river is estimated to be 1.6% per year and is almost certainly less than 5%.

8.9.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Gorge MPG

Completed consultations include road maintenance, culvert cleaning, treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Upper Gorge); and repairing a creek bank next to a road, parking lot maintenance, and maintenance of a stormwater drainage system along a highway (Lower Gorge).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.9.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration

Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

There projects are likely to affect multiple populations within the ESU. The effects of some on population viability will be positive (treating invasive plants; habitat restoration; tar remediation). Other projects, including road maintenance, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality (habitat restoration with stormwater facilities; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.9.3.8 Status of Critical Habitat under the Environmental Baseline

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century and have degraded the conservation value of designated critical habitat. Factors affecting the conservation value of critical habitat in areas occupied by chum salmon vary from altered channel morphology and stability, loss of habitat diversity, high sediment loads, and altered/reduced streamflow, and elevated temperatures.

Spawning Areas

Chum salmon spawn in the lower and middle mainstem reaches of large streams and at several sites in the mainstem Columbia River between Bonneville Dam and the confluence of the Willamette River. The following are the major factors that have limited the functioning of PCEs and thus the conservation value of spawning habitat (i.e., substrate, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Tributary barriers *[low flows; culverts; dikes; tidegates]*
- Reduced riparian function *[urban and rural development; forest practices; agricultural practices; channel manipulations]*
- Loss of floodplain and side channel connectivity *[urban and rural development; past forest practices; agricultural practices; channel manipulations]*
- Excessive sediment in spawning gravel *[forest practices; agricultural practices]*
- Elevated water temperatures *[water withdrawals; urban and rural development; forest practices; agricultural practices]*

The functioning of mainstem spawning habitat has improved in recent years with operations to provide fall and winter tailwater elevations and flows for spawning, incubation, and emergence in the mainstem just downstream from Bonneville Dam. The flow operation also supports access (i.e., removes a barrier) to spawning habitat in Hamilton and Hardy creeks.

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions that address some of factors limiting PCEs in tributary habitat. These include removing passage barriers, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects will provide immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

As described above, future Federal projects with completed consultations will have neutral or short- or even long-term adverse effects on the functioning of the PCEs safe passage, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Some Federal projects, implemented for restoration purposes, will improve these same PCEs.

Juvenile Rearing Areas & Migration Corridors

Factors that have limited PCEs in juvenile rearing areas and migration corridors (i.e., affecting substrate, water quality, water quantity, cover/shelter, food, riparian vegetation, space, and safe passage) are:

- Entrapment and stranding during emergence from mainstem spawning areas *[power operations at Bonneville Dam]*

- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat *[agriculture and other development in riparian areas; FCRPS and Upper Snake water management*].

Short-term (daily) flow fluctuations at Bonneville Dam sometimes create a barrier (i.e., entrapment on shallow sand flats) for fry moving into the mainstem rearing and migration corridor. Flow management and climate changes together have decreased the delivery of suspended particulate matter and fine sediment to the estuary, and flow management and habitat alterations (dikes and revetments) have restricted the processes that create and maintain habitat diversity. The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of PCEs in the estuary, improving the functioning of cover/shelter, food, and riparian vegetation. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Adult Migration Corridors

Factors that have limited PCEs in the adult migration corridor (i.e., affecting safe passage) are:

- Reduced access to mainstem and tributary spawning areas *[construction of Bonneville Dam for habitat further upstream; FCRPS flow management for the mainstem in the Ives Island area; flood control operations at FERC-licensed dams on the Cowlitz, Lewis, and White Salmon rivers]*

Productive historical spawning areas were located in the lower reaches of tributaries in the upper Gorge. These were inundated when Bonneville pool was filled around 1938. Few adults have passed Bonneville Dam in recent years. Some of those that moved further upstream fall back below the dam.

Hydrosystem flow management operations have been altered since the species was first listed in 1998 to support access to mainstem habitat in the Ives Island area. Entry of adult chum into nearby tributary spawning areas (i.e., Hamilton and Hardy creeks and the constructed spawning channel at Hamilton Springs) depends on mainstem flows, but also on local rainfall during November and December.

Areas for Growth & Development to Adulthood

Although CR chum salmon spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 1993). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.9.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions in the Washougal that will benefit the Lower Gorge population as well as actions that should generally be beneficial throughout the ESU. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.[2] They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for this ESU.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have

[2] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.9.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Some habitat restoration and RM&E actions may have short-term, minor, adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Affects Appendix and in the section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.9.5.1 Effects of Hydro Operations & Configuration Prospective Actions

The overall mainstem hydro strategy will be to provide adequate surface water elevations for chum salmon in redds downstream from Bonneville Dam; ensure that voluntary spill does not result in unsafe TDG levels for fish in shallow water areas; and provide safe passage for adults that migrate past Bonneville Dam. Specifically, the Prospective Actions require that the Action Agencies:

- Provide a tailwater elevation of approximately 11.5 feet at Bonneville Dam beginning in the first week of November (or when chum arrive) and ending by December 31, if reservoir elevations and climate forecasts indicate this operation can be maintained through incubation and emergence

- Through TMT, if water supply is deemed insufficient to provide mainstem spawning or continuous tributary access, provide as appropriate sufficient mainstem flow intermittently to allow fish access to tributary spawning sites if spawning habitat is available in the tributaries

- Make adjustments to tailwater elevation through the TMT process consistent with the size of the spawning population and water supply forecasts

- After completion of spawning, use the TMT process to establish tailwater elevation needed to provide protection for mainstem chum redds through incubation and the end of emergence

- If the emergence period extends beyond April 10th and the decision is made to maintain the tailwater, TMT will discuss the impacts of TDG associated with spill for fish in the gravel (i.e., the start of spring spill could be delayed)

- Revisit chum protection level decision at least monthly through the TMT process to assure it is consistent with the need to provide spring flows for listed Columbia and Snake River stocks

Based on PIT-tag detections for adult fall Chinook, NOAA Fisheries estimates an upstream passage survival rate of 96.9% for adult chum salmon at Bonneville Dam.

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of some flow augmentation water from summer to spring may provide a small benefit to juvenile migrants in the lower Columbia River by slightly reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have shallow water, low velocity habitat, identified as a limiting factor in the estuary (Section 8.9.3.8).

Effects on Species Status

Prospective flow operations will maintain the current abundance, productivity, and spatial structure of the Lower Gorge population. Improvements at Bonneville Dam will increase the passage survival of adult chum salmon that migrate past the project (and of juvenile chum, if any are produced in the upper Gorge).

Effects on Critical Habitat

The flow management operation for mainstem habitat below Bonneville Dam will maintain the current water quantity and quality conditions and substrate supporting spawning, incubation and larval development. Prospective flow operations will also maintain the current access to spawning areas in Hamilton and Hardy creeks.

8.9.5.2 Effects of Tributary Habitat Prospective Actions

Under the Prospective Actions, the FCRPS Action Agencies' will consider funding habitat improvement projects for the historical Columbia River chum salmon population above Bonneville that has been significantly impacted by the FCRPS. Projects will be selected that are consistent with basin-wide criteria for prioritizing projects, including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

Effects on Species Status

Tributary habitat projects, if implemented, will be selected such that they also address limiting factors and thus would also be likely to increase the viability of the local population(s).

Effects on Critical Habitat

If implemented, the potential tributary habitat improvements would address limiting factors, improving the functioning of PCEs in tributary habitat used by the Lower or Upper Gorge populations.

8.9.5.3 Effects of Estuary Habitat Prospective Actions

The FCRPS Action Agencies will carry out 44 estuary habitat projects over the first 3-year period of implementing the RPA (Section 12.3.2.3 in Corps et al. 2007b). The expected survival benefit for CR chum salmon associated with these actions will be less than 2.3%. The RPA requires the implementation of additional projects to obtain specified survival benefits for Interior Columbia Basin Chinook populations, but will also provide survival benefits to Columbia River chum salmon (an estimated 6.7%). Prospective Actions will address limiting factors by protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, reducing noxious weeds, and other actions.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of CR chum salmon.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in rearing areas for subyearling chum salmon. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.9.5.4 Effects of Hatchery Prospective Actions

Under the Prospective Actions, the Action Agencies will continue to fund a hatchery program to reintroduce chum into Duncan Creek. The Washougal Hatchery program was designed to increase the number of naturally spawning chum salmon in Duncan Creek as part of a habitat improvement project. Adults are collected and transported to WDFW's Washougal Hatchery for broodstock to produce juveniles which are outplanted into Duncan Creek. All fish produced by the program are given an otolith mark so that researchers can determine whether using the hatchery program to boost egg-to-fry survival results in increased adult returns.

The Prospective Actions also require that the Action Agencies fund an assessment of habitat potential, the development of reintroduction strategies, implementation of a pilot supplementation projects in selected tributaries below Bonneville Dam.

Under the RPA (Action 39), the FCRPS Action Agencies will adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Species Status

The ongoing Washougal Hatchery program and other prospective reintroduction pilot projects are expected to increase the abundance and productivity, as well as the spatial structure, of the Lower Gorge population.

Effects on Critical Habitat

The effects of prospective hatchery actions on PCEs and the conservation value of critical habitat will be evaluated in subsequent consultations on specific projects.

8.9.5.5 Effects of Harvest Prospective Actions

The 1999-2007, annual non-Indian commercial landings averaged 35 fish (TAC 2008, Table 32). Impacts in the recreational fishery (from non-retention mortalities) are expected to be zero fish in 2008-2017 (TAC 2008). The total impact rates on Columbia River chum for 2008-2017 are expected to average 1.6% (TAC 2008), but the incidental harvest rate is limited to no more than 5.0%. There are no records of chum harvest in tribal fisheries and no impacts are expected in treaty Indian fisheries in 2008-2017 (TAC 2008).

Effects on Species Status

The prospective harvest actions are not expected to affect the abundance or productivity of CR chum salmon.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for CR chum salmon.

8.9.5.6 Effects of Predation Prospective Actions

The prospective increase in incentives in the NPMP could result in an additional 1% survival if benefits are similar to those expected for subyearling Chinook salmon (see Section 8.10.5.6).

Effects on Species Status
Prospective actions that reduce predation on juveniles will support the increased abundance and productivity of CR chum salmon populations.

Effects on Critical Habitat
Continued implementation of the base Northern Pikeminnow Management Program and increased sport fishery reward structure could improve the long-term conservation value of critical habitat by increasing the survival of migrating juvenile salmonids (safe passage PCE) within the migration corridor.

8.9.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS

8.9.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on Columbia River Chum Salmon

This section summarizes the basis for conclusions at the ESU level.

8.9.6.1 Recent Status of the Columbia River Chum Salmon ESU

Columbia River chum salmon is a threatened species. There are only two populations in this ESU with more than a few spawners, the Grays River and Lower Gorge populations in the Coastal and Gorge MPGs, respectively. The construction of Bonneville Dam in the 1930s inundated spawning and early rearing habitat, so that the Upper Gorge population has been extirpated or nearly so. Most historical spawning tributaries below Bonneville are moderately or severely impaired in the lower reaches favored by chum salmon: access is limited by tide gates, dikes, and culverts and floodplains and side channels are no longer connected to the main channel. Flow management and climate changes together have decreased the delivery of suspended particulate matter and fine sediment to the estuary, and flow management and habitat alterations (dikes and revetments) have restricted the processes that create and maintain habitat diversity. Prior to the 1950s, harvest rates were as high as 70%. Large-scale changes in freshwater and marine environments also had substantial effects on salmonid population numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this ESU. The potential for additional risks due to climate change is described in Sections 5.7 and 8.1.3.

In terms of the primary constituent elements of critical habitat, the ability to function in support of the conservation of the species has been limited by the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in tributary spawning and estuary rearing areas. The functioning of mainstem spawning habitat has improved in recent years with operations to provide fall and winter tailwater elevations and flows for spawning, incubation, and emergence in the mainstem just downstream from Bonneville Dam. The flow operation also supports access to spawning habitat in Hamilton and Hardy creeks. However, daily flow fluctuations have sometimes created a barrier (i.e., entrapment on shallow sand flats) for fry moving into the mainstem rearing and migration corridor.

Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands, which may have downstream effects that improve conditions in the lower gradient reaches needed for the conservation of chum salmon. . Federal agencies are implementing numerous projects within the range of CR chum salmon including road and bridge repairs, dredging and dock maintenance, timber sales, and streambank stabilizations. The effects of these projects on population viability will be neutral or they will have short- or even long-term adverse effects.

8.9.6.2 Effects of the FCRPS, Upper Snake, *U.S. v. Oregon* Prospective Actions on the Columbia River Chum Salmon ESU

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the Columbia River, including those populations within the Columbia River chum salmon ESU.[3] In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The Action Agencies' estuary habitat restoration projects will address this objective. Under the Prospective Actions, the Action Agencies will continue to implement the flow operations begun in recent years that provide spawning habitat in the mainstem and access to habitat in the tributaries just below Bonneville Dam and to fund a hatchery program to reintroduce chum into Duncan Creek. The Prospective Actions also require that the Action Agencies fund an assessment of habitat potential, the development of reintroduction strategies, implementation of a pilot supplementation projects in selected tributaries below Bonneville Dam. If projects are implemented, they could compensate for the loss of historical spawning habitat for the Upper Gorge population (inundated by Bonneville Dam) by improving the overall viability of the ESU.

The principal effects of the Prospective Actions on critical habitat will be an increase in the amount and quality of estuarine habitat (for the transitions between fresh- and saltwater and juvenile growth and development before entering the plume).

8.9.6.3 Cumulative Effects Relevant to the Columbia River Chum Salmon ESU

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that

[3] The State of Oregon is in the process of developing a plan for this species. Upon its review, NOAA Fisheries will combine the Washington and Oregon plans into a complete recovery plan for the Lower Columbia River Recovery Domain.

affect instream habitat. These actions will primarily affect conditions within the tributary spawning and rearing areas, including the PCEs of critical habitat needed for successful spawning, incubation, and the growth and development of juvenile chum salmon.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

8.9.6.4 Effects of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Columbia River Chum Salmon ESU

Impacts of the FCRPS and Upper Snake projects on this ESU are most significant for the 2 (out of 16) populations within the ESU that once spawned above or currently spawn just below Bonneville Dam, and are limited relative to impacts from tributary hydropower and tributary habitat. The Upper Gorge population was extirpated the inundation of spawning habitat. The Lower Gorge population will continue to be affected by operations in the Bonneville tailrace, but for populations originating further downstream, only rearing habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington have identified tributary habitat actions that are reasonably certain to occur and that will be generally beneficial throughout the ESU. The State of Washington identified actions in the Washougal that will improve habitat conditions for that potion of the Lower Gorge population. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands, which may have downstream effects that improve conditions in the lower gradient reaches needed for the conservation of chum salmon.

The Action Agencies' prospective hydrosystem operation and estuary habitat improvements, by addressing the influence of their projects, will contribute to the viability of this ESU and thus to its survival with an adequate potential for recovery. Potential tributary habitat projects could further improve viability by compensation for the loss of populations in the Upper Gorge (above Bonneville Dam). The Prospective Action s will not further deteriorate this pre-action condition.

Long term (100 year) extinction risk is high or very high for almost all populations in the ESU. The only exception is the Lower Gorge population, at least on the Washington side of the river. In the short term, the species extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of the Grays River and mainstem Columbia portion of the Lower Gorge population will continue to be preserved by ongoing hatchery actions as a hedge against the short-term risk of extinction.

8.9.6.5 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for the Columbia River Chum Salmon ESU

NOAA Fisheries designated critical habitat for CR chum salmon including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the White Salmon River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Cowlitz, Lower Columbia, and Grays/Elochoman. The environmental baseline within the action area, which includes the Middle Columbia/Hood and Lower Columbia/Sandy subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for CR chum salmon. The major factors currently limiting the conservation value of critical habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, riparian vegetation, and space in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

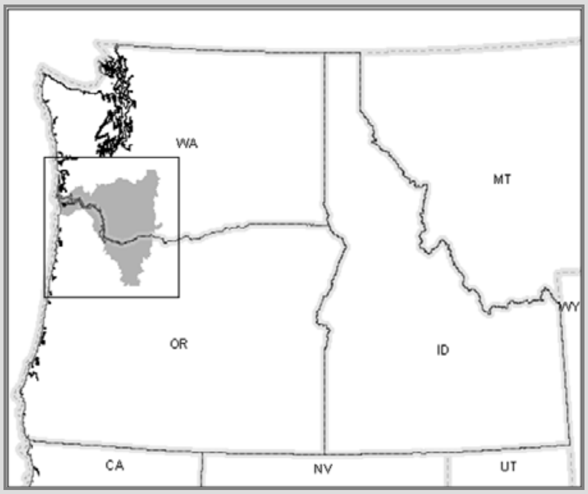
Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions include habitat work in tributaries used for spawning and rearing in the lower Columbia River and estuary, which will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

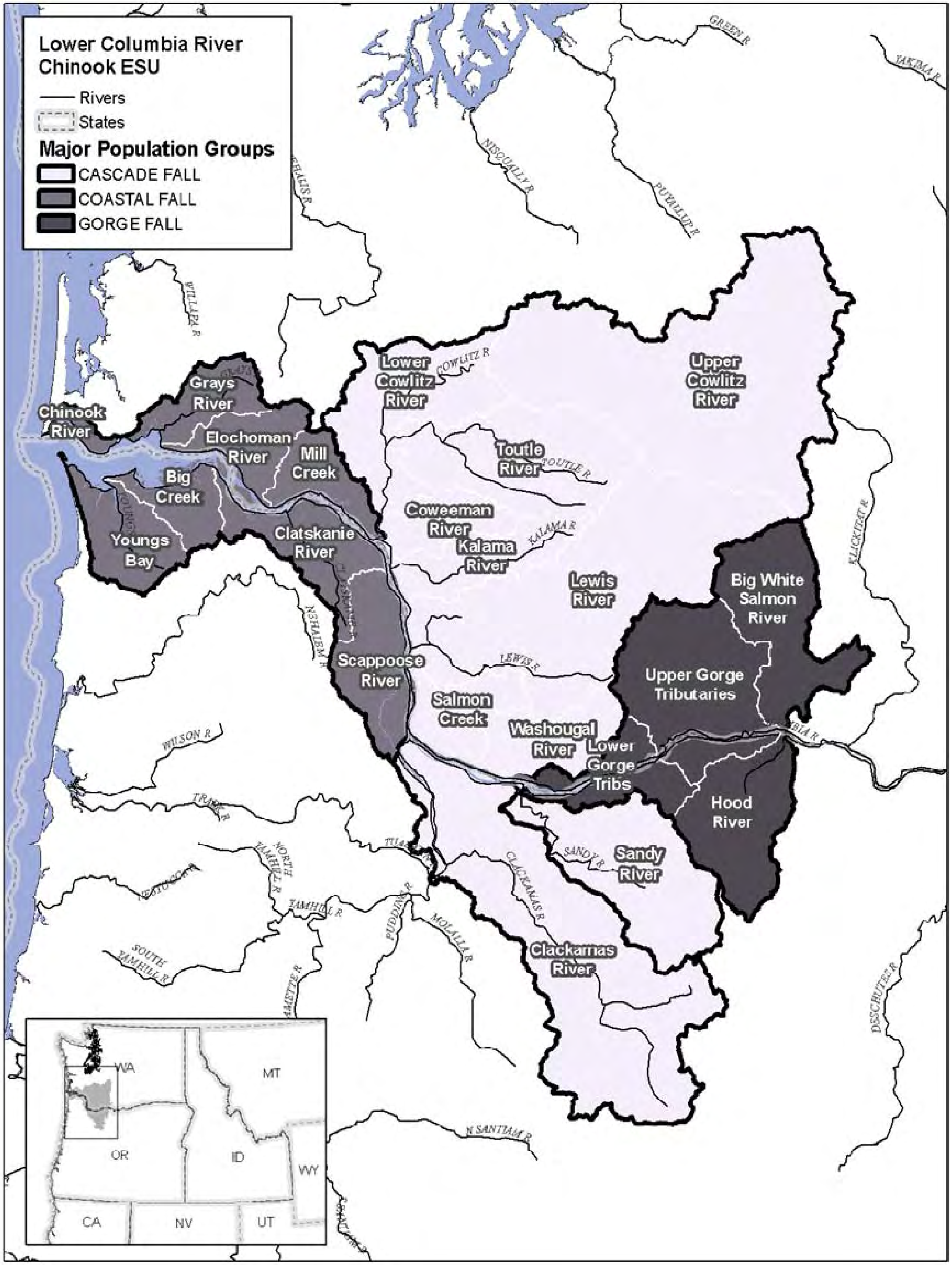
The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs used for spawning, incubation, juvenile growth and development, migration, and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

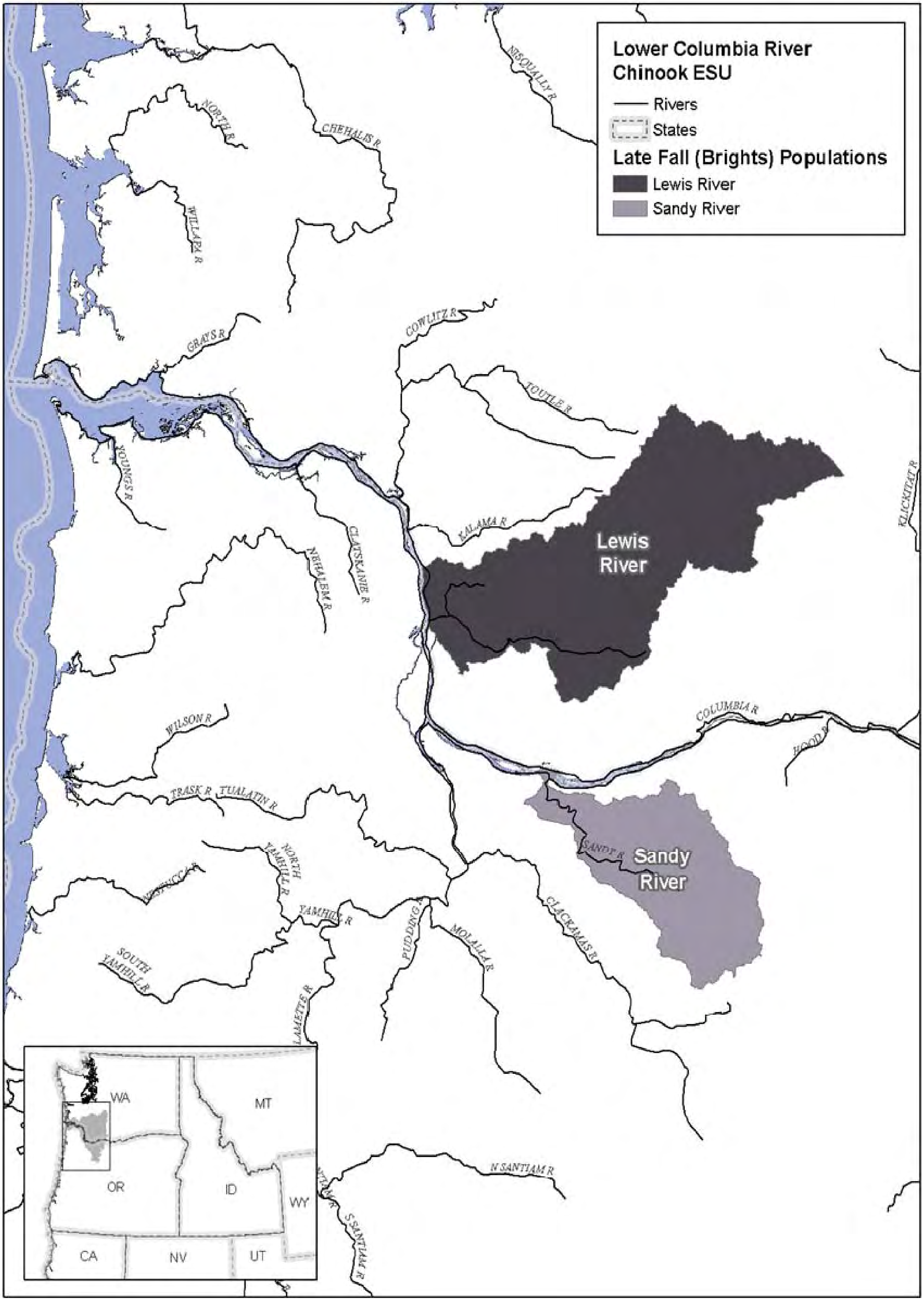
Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the proposed fisheries will not cause deterioration in the pre-action condition for the species, nor reduce the conservation value of this ESU's designated critical habitat. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Columbia River chum salmon ESU nor result in the destruction or adverse modification of designated critical habitat.

Section 8.10
Lower Columbia River Chinook Salmon




Lower Columbia River
Chinook ESU
Rivers
States
Major Population Groups
CASCADE FALL
COASTAL FALL
GORGE FALL
Grays River
Chinook River
Elochoman River
Mill Creek
Big Creek
Youngs Bay
Clatskanie River
Scappoose River
Lower Cowlitz River
Upper Cowlitz River
Toutle River
Coweeman River
Kalama River
Lewis River
Salmon Creek
Washougal River
Lower Gorge Tribs
Upper Gorge Tributaries
Big White Salmon River
Hood River
Sandy River
Clackamas River
WA
MT
OR
ID
WY
CA
NV
UT


Lower Columbia River
Chinook ESU
Rivers
States
Late Fall (Brights) Populations
Lewis River
Sandy River
Lewis River
Sandy River
NISQUALLY R
NORTH R
CHEHALIS R
WILLAPA R
COWLITZ R
GRAYS R
TOUTLE R
YOUNGS R
KALAMA R
CLATSKANIE R
NEHALEM R
KLICKITAT R
COLUMBIA R
HOOD R
WILSON R
TRASK R
TUALATIN R
SANDY R
NORTH YAMHILL R
YAMHILL R
PUDDING R
MOLALLA R
CLACKAMAS R
SOUTH YAMHILL R
N SANTIAM R
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WA
MT
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WY
CA
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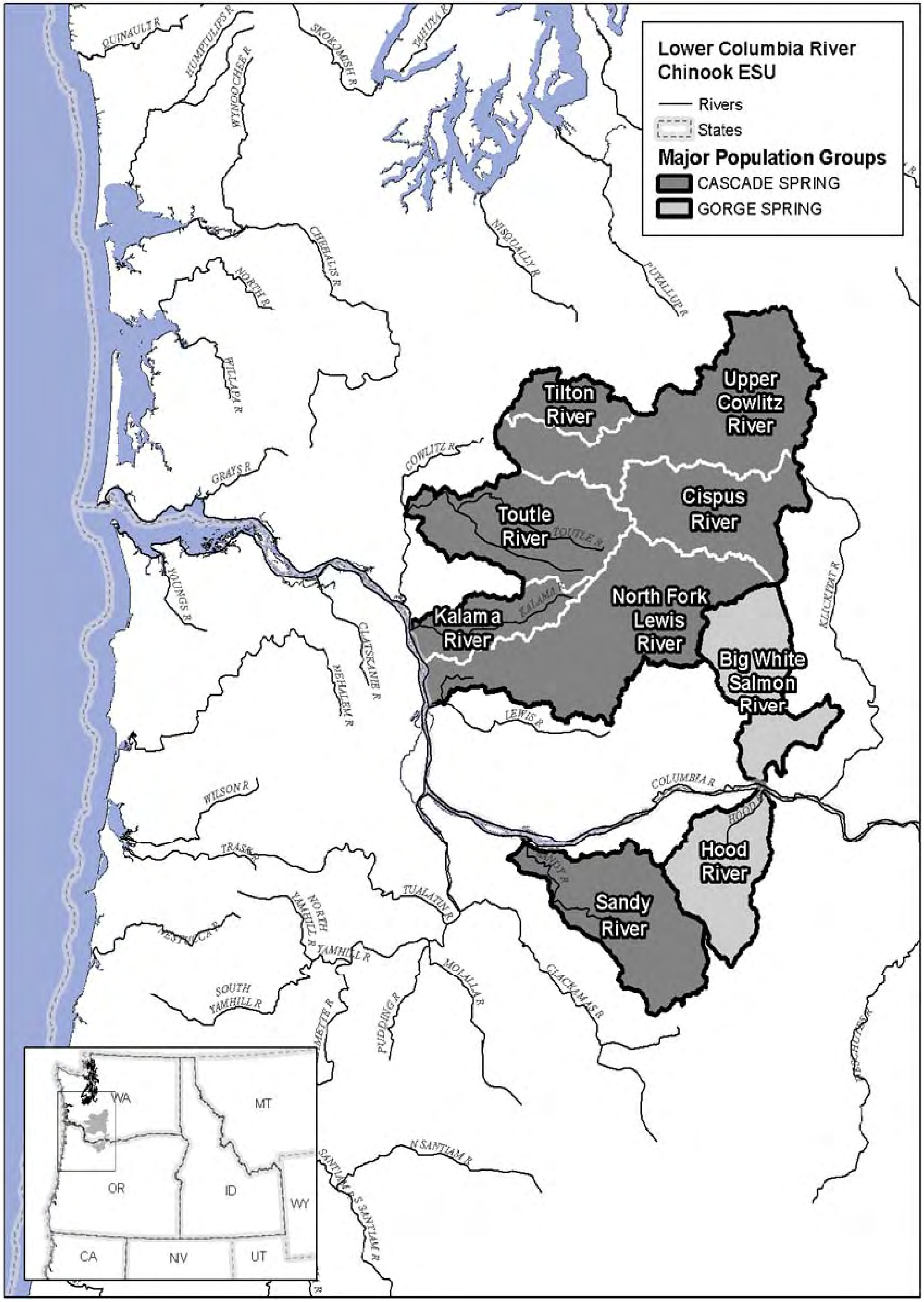
Lower Columbia River Chinook ESU
Rivers
States
Major Population Groups
CASCADE SPRING
GORGE SPRING
Tilton River
Upper Cowlitz River
Cispus River
Toutle River
North Fork Lewis River
Kalama River
Big White Salmon River
Hood River
Sandy River
COLUMBIA R
LEWIS R
COWLITZ R
GRAYS R
YOUNGS R
CLATSKANIE R
NEHALEM R
WILSON R
TRASK R
TUALATIN R
MOLALLA R
CLACKAMAS R
PUDDING R
SOUTH YAMHILL R
N SANTIAM R
KLICKITAT R
NISQUALLY R
PUYALLUP R
CHEHALIS R
NORTH R
WILLAPA R
WYNOOCHEE R
HUMPTULIPS R
QUINAULT R
SKOKOMISH R
WA
MT
OR
ID
WY
CA
NV
UT

Section 8.10
Lower Columbia River Chinook Salmon

Species Overview

Background

The Lower Columbia River (LCR) Chinook salmon ESU includes all naturally spawned populations from the mouth of the Columbia River upstream to and including White Salmon River in Washington and the Hood River in Oregon. Additionally, this ESU includes the Willamette River upstream to Willamette Falls (exclusive of the spring-run Chinook salmon in the Clackamas River), as well as 17 artificial propagation programs. There are six major population groups in this ESU, including 32 historical populations, seven of which are extirpated or nearly so. Lower Columbia River Chinook numbers began to decline by the early 1900s because of habitat degradation and harvest rates and were listed under the ESA as threatened in 1999. The listing was reaffirmed in 2005.

Designated critical habitat for this ESU includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in a number of tributary subbasins.

Current Status & Recent Trends

Many of the populations in this ESU currently have for which data are available have low abundances and many of the long- and short-term trends in abundance are negative, some severely so. Some of the natural runs largely have been replaced by hatchery production.

Limiting Factors

Human impacts and limiting factors for the LCR Chinook include habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and predation. Lower Columbia River Chinook populations began declining in the early 1900s because of habitat changes and harvest rates. FCRPS impacts have been limited, but are most significant for the five populations that spawn in tributaries above Bonneville Dam. These populations are affected by upstream and downstream passage and the inundation of spawning habitat for fall-run Chinook in the lower reaches of the tributaries to the reservoir. For populations originating in tributaries below Bonneville, migration and habitat conditions in the mainstem and estuary have been affected by hydrosystem flow operations. Tributary habitat degradation is pervasive due to development and other land uses, and FERC-licensed hydroelectric projects have blocked some spawning areas. Hatchery production for LCR Chinook has reduced the diversity and productivity of natural populations throughout the ESU. Predators take a significant number of juveniles and adults, particularly from spring-run populations.

Recent Ocean and Mainstem Harvest

Lower Columbia River spring Chinook populations are caught incidentally in ocean fisheries, primarily off the Washington coast and as far north as Alaska, and in spring season fisheries in the Columbia River mainstem and tributaries. In recent years, the total exploitation rates for the Cowlitz spring Chinook population (as a surrogate for all spring Chinook populations of the LCR Chinook ESU) were generally higher prior to the mid 1990s, averaging 50% through 1994. Total exploitation rates have averaged approximately 27% since 1995. The average exploitation rates for non-Treaty fisheries in the Columbia River for these same periods were 27% and 12% respectively.

Lower Columbia River fall-run (tule) Chinook populations are caught in ocean fisheries off the coasts of Oregon, Washington, and British Columbia. Total exploitation rates were generally higher through 1993 (averaging 69%), lower from 1994 to 1999 (averaging 34%), then increasing since 2000 (averaging 49%). From 2002 to 2006 fisheries were managed subject to a 49% exploitation rate limit. Total exploitation rates have been higher in some years but have averaged 49% from 2002 to 2006. The average exploitation rates for non-Treaty fisheries in the Columbia River for these same periods were 16%, 8% and 9% respectively.

Total exploitation rates estimates to the North Fork Lewis bright Chinook population (as a surrogate for all “bright” Chinook populations of the LCR Chinook ESU) were generally higher through 1989 (averaging 56%), declining during the decade of the 1990s (averaging 36%), and increased slightly since 2000 (averaging 38%). The average exploitation rates for non-Treaty fisheries in the Columbia River for these same periods were 25%, 14% and 16% respectively.

8.10.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.10.2.1 Current Rangewide Status of the Species

Lower Columbia River Chinook display three life history types including early fall runs ("tules"), late fall run ("brights") and spring-runs (Table 8.10.2.1-1). Both spring and fall runs have been designated as part of a Lower Columbia River Chinook ESU. This ESU includes populations in tributaries from the ocean to the Big White Salmon River in Washington and Hood River in Oregon. Fall Chinook salmon historically were found throughout the entire range, while spring Chinook salmon historically were only found in the upper portions of basins with snowmelt driven flow regimes (western Cascade Crest and Columbia Gorge tributaries). Late fall Chinook salmon were identified in only two basins in the western Cascade Crest tributaries. In general, late fall Chinook salmon also matured at an older average age than either lower Columbia River spring or fall Chinook salmon, and had a more northerly oceanic distribution. Currently, the abundance of fall Chinook greatly exceeds that of the spring component.

Table 8.10.2.1-1. Life history and population characteristics of Chinook salmon originating in Washington portions of the lower Columbia River.

	Racial Features		
Characteristic	**Spring**	**Tule Fall**	**Late Fall Bright**
Number of extant populations	7 (including 4 that are possibly extinct)	13	1
Life history type	Stream	Ocean	Ocean
River entry timing	March-June	August-September	August-October
Spawn timing	August-September	September-November	November-January
Spawning habitat type	Headwater large tributaries	Mainstem large tributaries	Mainstem large tributaries
Emergence timing	December-January	January-April	March-May
Duration in freshwater	Usually 12-14 months	1-4 months, a few up to 12 months	1-4 months, a few up to 12 months
Rearing habitat	Tributaries and mainstem	Mainstem, tributaries, sloughs, estuary	Mainstem, tributaries, sloughs, estuary
Estuarine use	A few days to weeks	Several weeks up to several months	Several weeks up to several months

	Racial Features		
Characteristic	**Spring**	**Tule Fall**	**Late Fall Bright**
Ocean migration	As far North as Alaska	As far North as Alaska	As far North as Alaska
Age at return	4-5 Years	3-5 Years	3-5 Years
Estimated historical spawners	125,000	140,000	19,000
Recent natural Spawners	800	6,500	9,000
Recent hatchery adults	12,600 (1990-2000)	37,000 (1991-1995)	NA

The Lower Columbia River Chinook salmon ESU is composed of 32 historical populations. The populations are distributed through three ecological zones. The combination of life history types based on run timing, and ecological zones result in six major population groups (referred to as strata by the Willamette-Lower Columbia Technical Recovery Team (WLC TRT) (Table 8.10.2.1-2 and Lower Columbia River Chinook maps). There are 23 (tule) fall- and (bright) late fall-run populations, and nine spring-run populations, some of which existed historically but are now extirpated or nearly so. Also included in the ESU are 17 hatchery programs. Excluded from the ESU are Carson spring Chinook and introduced bright fall Chinook occurring in the Wind and (Big) White Salmon rivers as well as spring Chinook released at terminal fishery areas in Youngs Bay, Blind Slough, and Deep River and in the mainstem Columbia. Populations of spring Chinook in the Willamette, including the Clackamas, are in a different ESU.

Fall Chinook enter freshwater typically in August through October to spawn in large river mainstems and the juvenile life history stage emigrates from freshwater as subyearlings (ocean type). Spring Chinook enter fresh water in March through June to spawn in upstream tributaries and generally emigrate from freshwater as yearlings (stream type). Listed populations of LCR Chinook salmon are stratified by biological, geographical, and ecological considerations into the six major population groups shown in Table 8.10.2.1-2, below.

Table 8.10.2.1-2 LCR Chinook salmon ESU description and major population groups (MPGs) (Sources: NMFS 2005a; Myers et al. 2006). The designations "(C)" and "(G)" identify Core and Genetic Legacy populations, respectively (Appendix B in WLCTRT 2003).[1]

ESU Description	
Threatened	Listed under ESA in 1999; reaffirmed in 2005
6 major population groups	32 historical populations
Major Population Group	**Population**
Cascade Spring	Upper Cowlitz (C,G), Cispus (C), Tilton, Toutle, Kalama, Lewis (C), Sandy (C,G)
Gorge Spring	White Salmon (C), Hood
Coastal Fall	Grays, Elochoman (C), Mill Creek, Youngs Bay, Big Creek (C), Clatskanie, Scappoose
Cascade Fall	Lower Cowlitz (C), Upper Cowlitz, Toutle (C), Coweeman (G), Kalama, Lewis (G), Salmon Creek, Washougal, Clackamas (C), Sandy
Cascade Late Fall	Lewis (C,G), Sandy (C,G)
Gorge Fall	Lower Gorge, Upper Gorge (C,G), White Salmon (C,G), Hood
Hatchery programs included in ESU (17)	Sea Resources Tule Chinook, Big Creek Tule Chinook, Astoria High School (STEP) Tule Chinook, Warrenton High School (STEP) Tule Chinook, Elochoman River Tule Chinook, Cowlitz Tule Chinook Program, North Fork Toutle Tule Chinook, Kalama Tule Chinook, Washougal River Tule Chinook, Spring Creek NFH Tule Chinook, Cowlitz spring Chinook (2 programs), Friends of Cowlitz spring Chinook, Kalama River spring Chinook, Lewis River spring Chinook, Fish First spring Chinook, Sandy River Hatchery (ODFW stock #11)

Limiting Factors

Lower Columbia River Chinook salmon populations began to decline by the early 1900s because of habitat alterations and harvest rates that were unsustainable given these changing habitat conditions. Human impacts and limiting factors come from multiple sources: habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and ecological factors including predation. Tributary habitat has been degraded by extensive development and other types of land use. Fall Chinook spawning and rearing habitat in tributary mainstems has been adversely affected by sedimentation, increased temperatures, and reduced habitat diversity. Spring Chinook access to subbasin headwaters has been restricted or eliminated by the construction of non-Federal dams without fish passage. Five populations (Upper Gorge Fall Run, White Salmon Fall Run, Hood River Fall Run, White Salmon Spring Run, and Hood River Spring Run) are subject to FCRPS impacts involving passage at Bonneville Dam and all populations are affected by habitat alterations in the Columbia River mainstem and estuary. Many naturally-spawning populations have

[1] Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the ESU (WLCTRT 2003).

been subject to the effects of a high incidence of naturally-spawning hatchery fish. The species was subject to harvest rates of 50% or more until recent years. Preservation and recovery of this ESU will require significant efforts by many parties.

Summarized below (Table 8.10.2.1-2) are key limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. Oregon is currently engaged in the recovery planning process for LCR Chinook salmon.

Table 8.10.2.1-2. Key limiting factors for LCR Chinook salmon.

Mainstem Hydro	Direct mainstem hydropower system impacts on LCR Chinook salmon are most significant for the five gorge tributary populations upstream from Bonneville Dam (Upper Gorge Fall Run, White Salmon Fall Run, Hood River Fall Run, White Salmon Spring Run, and Hood River Spring Run). These populations are affected by upstream and downstream passage at Bonneville Dam and spawning habitat in the lower reaches of the tributaries used by the Upper Gorge fall-run population were inundated by Bonneville pool. Federal hydrosystem impacts on populations originating in downstream subbasins are limited to effects on migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.
Predation	Piscivorous birds including Caspian terns and cormorants, fishes including northern pikeminnow, and marine mammals including seals and sea lions take significant numbers of juvenile or adult salmon. Stream-type juveniles, especially yearling smolts from spring-run populations, are vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid water over the channel, which is located near habitat preferred by piscivorous birds (Fresh et al 2005). However, recent research shows that subyearlings from the LCR Chinook ESU are also subject to tern predation, probably because of their long estuarine residence time (Ryan et al. 2006). In addition, spring Chinook are subject to pinniped predation when they return to the estuary as adults (NMFS 2006b). Caspian terns as well as cormorants may be responsible for the mortality of up to 6% of the outmigrating stream-type juveniles in the Columbia River basin [1998 data, from Bonneville Power Administration (BPA 2004) and 2006 data from Roby (2006) as cited in Corps et al. 2007a]. Pikeminnow are significant predators of both yearling and subyearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas, a sport reward fishery to harvest pikeminnow, and the exclusion, hazing, and in some cases, lethal take of marine mammals near Bonneville Dam.
Harvest	LCR Chinook salmon are harvested in the Columbia River and its tributaries and in ocean fisheries off Oregon, Washington, and Canada. Historical harvest

	rates on some populations of Chinook salmon reached 80% or more. Permitted incidental harvest rate limits for fall-run Chinook salmon dropped from 65% just after listing to 42% in 2007. Incidental harvest rates on spring-run fish have been reduced from 50 to 25% (LCFRB 2004).
Hatcheries	Hatchery management practices have reduced the diversity and productivity of natural populations throughout the Columbia River Basin. The long-term domestication of hatchery fish has reduced the productivity of some wild stocks where significant numbers of hatchery fish spawn, especially for tule fall Chinook populations. Large numbers of hatchery fish have also contributed to more intensive mixed stock fisheries, which probably overexploited wild populations already weakened by habitat degradation. For spring Chinook, virtually all production in the Washington portion of the lower Columbia River is of hatchery origin, and Oregon populations of spring Chinook are also subject to significant hatchery influence. State and Federal hatchery programs throughout the lower Columbia River are currently the subject of a series of comprehensive reviews for consistency with the recovery needs of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is a particularly important habitat for migrating salmonids from LCR Chinook populations. Alterations in flow and diking have resulted in the loss of shallow water, low velocity habitats: emergent marshes, tidal swamps, and forested wetlands. These habitats are used extensively by subyearling juveniles. The survival of larger (yearling) juveniles in the ocean can be affected by habitat factors in the estuary such as changes in food availability and the presence of contaminants. Changes in the seasonal hydrograph as a result of water use and reservoir storage throughout the Columbia basin have altered habitat-forming processes including the shape, behavior, size, and composition of the plume compared to historical conditions. Characteristics of the plume are thought to be significant to spring-run yearling migrants during transition to the ocean phase of their lifecycle (Fresh 2004). Estuary limiting factors and recovery actions are addressed in detail in the estuary module of the comprehensive regional planning process (NMFS 2006b).
Habitat	Widespread development and other land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats where fall Chinook salmon spawn and rear. Most of the significant mainstem spawning habitats in large previously-productive systems such as the Cowlitz River have been extensively diked and filled. In addition to cumulative habitat effects, the construction of non-Federal hydropower facilities on Columbia River tributaries has partially or completely

	blocked higher elevation spawning. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for Chinook by reach in all Washington subbasins. Similar information is in development for Oregon subbasins.
Ocean & Climate	Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this ESU to some extent, future trends, especially during the period relevant to the Proposed Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCRFB 2004).

Abundance, Productivity & Trends

The information in Table 8.10.2.1-3 was reported in NOAA Fisheries' most recent status review (Good et al. 2005). Draft status assessments were updated for Oregon populations in a more recent review (McElhany et al. 2007). Some of the natural runs (e.g., the Youngs Bay, Kalama River and Upper and Lower Gorge fall runs, and all of the spring-run populations) have been replaced largely by hatchery production. Quantitative data is only available for about half of the populations

The majority of populations for which data are available have a long-term trend of less than 1.0, indicating the population is in decline. In addition, for most populations there is a high probability that the true trend/growth rate is less than 1.0 (Table 16 in Good et al. 2005). Assuming that the reproductive success of hatchery-origin fish has been equal to that of natural-origin fish, the analysis indicates a negative long-term growth rate for all of the populations except the Coweeman River fall run, which has had very few hatchery-origin spawners. The North Fork Lewis River late fall population is considered the healthiest and is significantly larger than any other population in the ESU. The data used for the analysis shown in Table 8.10.2.1-3 is current only through 2001 for Washington populations and 2004 for Oregon populations. More recent estimates of escapement along with available data for the time series are shown in Tables 8.10.2.1-4 and 8.10.2.1-6 through 8.10.2.1-8.

Table 8.10.2.1-3. Abundance, productivity, and trends of LCR Chinook salmon populations (sources: Good et al. 2005 for Washington and McElhany et al. 2007 for Oregon populations).

Strata	Population	State	Recent Abundance of Natural Spawners			Long-term Trend[b]		Median Growth Rate[c]	
			Years	Geo Mean	pHOS[a]	Years	Value	Years	λ
Cascade Spring	Cowlitz	W	na	na	na	80-01	0.994	na	na
	Cispus	W	2001	1,787	na	na	na	na	na
	Tilton	W	na	na	na	na	na	na	na
	Toutle	W	na	na	na	na	na	na	na
	Kalama	W	97-01	98	na	80-01	0.945	na	na
	NF Lewis	W	97-01	347	na	80-01	0.935	na	na
	Sandy	O	90-04	959	52%	90-04	1.047	90-04	0.834
Gorge Spring	White Salmon	W	na	na	na	na	na	na	na
	Hood	O	94-98	51	na	na	na	na	na
Coastal Fall	Grays	W	97-01	59	38%	64-01	0.965	80-01	0.844
	Elochoman	W	97-01	186	68%	64-01	1.019	80-01	0.800
	Mill	W	97-01	362	47%	80-01	0.965	80-01	0.829
	Youngs Bay	O	na	na	na	na	na	na	na
	Big Creek	O	na	na	na	na	na	na	na
	Clatskanie	O	90-04	41	15%	90-04	1.077	90-04	1.152
	Scappoose	O	na	na	na	na	na	na	na
Cascade Fall	Lower Cowlitz	W	96-01	463	62%	64-00	0.951	80-01	0.682
	Upper Cowlitz	W	na	na	na	na	na	na	na
	Toutle	W	na	na	na	na	na	na	na
	Coweeman	W	97-01	274	0%	64-01	1.046	80-01	1.091
	Kalama	W	97-01	655	67%	64-01	0.994	80-01	0.818
	Lewis	W	97-01	256	0%	80-01	0.981	80-01	0.979
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	97-01	1,130	58%	64-01	1.088	80-01	0.815
	Clackamas	O	98-01	40	na	67-01	0.937	na	na
	Sandy	O	97-01	183	na	na	na	na	na

Strata	Population	State	Recent Abundance of Natural Spawners			Long-term Trend[b]		Median Growth Rate[c]	
			Years	Geo Mean	pHOS[a]	Years	Value	Years	λ
Gorge Fall	Lower Gorge	W/O	na	na	na	na	na	na	na
	Upper Gorge	W/O	97-01	109	13%	64-01	0.935	80-01	0.955
	White Salmon	W	97-01	218	21%	67-01	0.941	80-01	0.945
	Hood River	O	00-04	36	na	na	na	na	na
Cascade Late Fall	NF Lewis	W	97-01	6,818	13%	64-01	0.992	80-01	0.948
	Sandy	O	90-04	2,771	5%	81-04	0.983	81-04	0.997

The LCFRB Recovery Plan described a recovery scenario for Lower Columbia River Chinook. They identified each population's role in recovery as a primary, contributing, or stabilizing populations which generally refer to a desired viability level. The Recovery Plan also suggested viable abundance goals for each population (Table 8.10.2.1-4).

Table 8.10.2.1-4. The ecological zones and populations for the Lower Columbia River Chinook salmon ESU (LCFRB 2004). Primary populations identified for greater than high viability objectives are denoted with an asterisk.

Population/Strata	Status /Goal[1]	Abundance Range		Recent Average (2002-2006)	
		Viable	Potential	Natural-Origin Spawners	% wild
GORGE SPRING					
White Salmon (WA)	C	1,400	2,800	5,237	19
Hood (OR)	P	1,400	2,800		
CASCADE SPRING					
Upper Cowlitz (WA)	P*	2,800	8,100		
Cispus (WA)	P*	1,400	2,300		
Tilton (WA)	S	1,400	2,800		
Toutle (WA)	C	1,400	3,400		
Kalama (WA)	P	1,400	1,400		
NF Lewis (WA)	P	2,200	3,900		
Sandy (OR)	P	2,600	5,200		

Population/Strata	Status /Goal[1]	Abundance Range		Recent Average (2002-2006)	
		Viable	Potential	Natural-Origin Spawners	% wild
CASCADE LATE FALL					
NF Lewis (WA)	P*	6,500	16,600		
Sandy (OR)	P	5,100	10,200		
COAST FALL (Tule)					
Grays/Chinook (WA)	P	1,400	1,400	336	78
Eloch/Skam (WA)	P	1,400	4,500	4,751	31
Mill/Aber/Germ (WA)	C	2,000	3,200	4,063	23
Youngs Bay (OR)	S	1,400	2,800		
Big Creek (OR)	S	1,400	2,800		
Clatskamie (OR)	P	1,400	2,800	179	43
Scapoose (OR)	S	1,400	2,800		
CASCADE FALL (Tule)					
Lower Cowlitz (WA)	C	3,900	33,200		
Upper Cowlitz (WA)	S	1,400	10,800		
Toutle (WA)	S	1,400	14,100		
Coweeman (WA)	P*	3,000	4,100	1,128	82
Kalama (WA)	P	1,300	3,200	12,680	7
EF Lewis/Salmon (WA)	P*	1,900	3,900	597	75
Washougal (WA)	P	5,800	5,800	5,334	39
Clackamas (OR)	C	1,400	2,800		
Sandy (OR)	S	1,400	2,800		
GORGE FALL (Tule)					
Lower Gorge (WA)	C	1,400	2,800		
Upper Gorge (WA)	S	1,400	2,400		
White Salmon (WA)	C	1,600	3,200		
Hood (OR)	S	1,400	2,800		

[1] *Primary populations* are those that would be restored to high or "high+" viability. At least two populations per strata must be at high or better viability to meet recommended TRT criteria. Primary populations typically, but not always, include those of high significance and medium viability. In several instances, populations with low or very low current viability were designated as primary populations in order to achieve viable strata and ESU conditions. In addition, where factors suggest that a greater than high viability level can be achieved, populations have been designated as High+. High+ indicates that the population is targeted to reach a viability level between High and Very High levels as defined by the TRT. *Contributing populations* are those for which some restoration will be needed to achieve a stratum-wide average of medium viability.

Population/Strata	Status /Goal[1]	Abundance Range		Recent Average (2002-2006)	
		Viable	Potential	Natural-Origin Spawners	% wild
Contributing populations might include those of low to medium significance and viability where improvements can be expected to contribute to recovery. *Stabilizing populations* are those that would be maintained at current levels (likely to be low viability). Stabilizing populations might include those where significance is low, feasibility is low, and uncertainty is high.					

WLCTRT (2003) analyzed the number of stream kilometers historically and currently available to salmon populations in the lower Columbia River (Table 8.10.2.1-5). Stream kilometers usable by salmon are determined based on simple gradient cutoffs, as well as on the presence of impassable barriers. This approach overestimates the number of usable stream kilometers, because it does not account for aspects of habitat quality other than gradient. However, the analysis does indicate that the number of kilometers of stream habitat currently accessible is greatly reduced from the historical condition for some populations. Hydroelectric projects in the Cowlitz, Lewis, and White Salmon Rivers have greatly reduced or eliminated access to upstream production areas and therefore extirpated some of the affected populations.

Table 8.10.2.1-5. Current and historically available habitat located below barriers in the Lower Columbia River Chinook salmon ESU (WLCTRT 2003).

Population/Strata	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
GORGE SPRING			
White Salmon (WA)	0	232	0
Hood (OR)	150	150	99
CASCADE SPRING			
Upper Cowlitz (WA)	4	276	1
Cispus (WA)	0	76	0
Tilton (WA)	0	93	0
Toutle (WA)	217	313	69
Kalama (WA)	78	83	94
Lewis (WA)	87	365	24
Sandy (OR)	167	218	77
CASCADE LATE FALL			
NF Lewis (WA)	87	166	52
Sandy (OR)	217	225	96
COAST FALL (Tule)			

Population/Strata	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
Grays/Chinook (WA)	133	133	100
Eloch/Skam (WA)	85	116	74
Mill/Aber/Germ (WA)	117	123	96
Youngs Bay (OR)	178	195	91
Big Creek (OR)	92	129	71
Clatskamie (OR)	159	159	100
Scapoose (OR)	122	157	78
CASCADE FALL (Tule)			
Lower Cowlitz (WA)	418	919	45
Upper Cowlitz (WA)	-	-	-
Toutle (WA)	217	313	69
Coweeman (WA)	61	71	86
Kalama (WA)	78	83	94
Lewis/Salmon (WA)	438	598	73
Washougal (WA)	84	164	51
Clackamas (OR)	568	613	93
Sandy (OR)	227	286	79
GORGE FALL (Tule)			
Lower Gorge (WA)	34	35	99
Upper Gorge (WA)	23	27	84
White Salmon (WA)	0	71	0
Hood (OR)	35	35	100

As briefly addressed above, the return of spring Chinook to the Cowlitz, Kalama, Lewis, and Sandy river populations have all numbered in the thousands in recent years (Table 8.10.2.1-6). The Cowlitz and Lewis populations on the Washington side are managed for hatchery production since most of the historical spawning habitat is inaccessible due to hydro development in the upper basin. A supplementation program is now operated on the Cowlitz River that involves trap and haul of adults and juveniles. A supplementation program is also being developed on the Kalama with fish being passed above the ladder at Kalama Falls. Historically, the Kalama was a relatively small system compared to the other three (Table 8.10.2.1-5). A supplementation program is also being developed for the Lewis River, but the spring Chinook production is still dependent on hatchery production. These systems have all met their respective hatchery escapement goals in recent years, and are expected to do so again in 2008. The existence of the hatchery programs mitigates the risk to these populations. The Cowlitz and Lewis populations would have been extirpated if not for the hatchery programs.

The Sandy River is managed with an integrated hatchery supplementation program that incorporates natural-origin brood stock. There is some spawning in the lower river, but the area upstream from the old Marmot Dam location is preserved for natural-origin production. The return of natural-origin fish to this area (i.e., upstream from the old Marmot Dam site) has averaged almost 1,800 since 2000. This does not account for the additional spawning of natural-origin fish below the dam (prior to its removal). This tentative viable abundance goal for Sandy River spring Chinook is 2,600, although the goal is subject to reconsideration through Oregon's ongoing recovery planning process. The total return of spring Chinook to the Sandy including hatchery fish has averaged more than 7,000 since 2000 (Table 8.10.2.1-6).

Table 8.10.2.1-6. Total annual escapement of Lower Columbia River spring Chinook populations (TAC 2008).

Year or Average	Cowlitz River [a]	Kalama River	Lewis River [a]	Sandy River (Total)	Sandy River (natural-origin fish at Marmot Dam)[b]
1971-1975	11,900	1,100	200	-	
1976-1980	19,680	2,020	2,980	975	
1981-1985	19,960	3,740	4,220	1,940	
1986-1990	10,691	1,877	11,340	2,425	
1991-1995	6,801	1,976	5,870	5,088	
1996	1,787	627	1,730	3,997	
1997	1,877	505	2,196	4,625	
1998	1,055	407	1,611	3,768	
1999	2,069	977	1,753	3,985	
2000	2,199	1,418	2,515	3,641	1,984
2001	1,649	1,784	3,777	5,329	2,445
2002	5,019	2,883	3,554	5,903	1,275
2003	15,890	4,528	5,104	5,600	1,151
2004	16,712	4,573	11,090	12,675	2,698
2005	9,200	3,100	3,400	7,475	1,808
2006	7,000	5,600	7,500	4,812	1,381

Year or Average	Cowlitz River [a]	Kalama River	Lewis River [a]	Sandy River (Total)	Sandy River (natural-origin fish at Marmot Dam)[b]
2007	3,700	7,300	6,700	3,400	790
[a] Includes hatchery escapements, tributary recreational catch, and natural spawning escapement for 1975 to present. The years 1071-73 are based on using he 1975-76 Cowlitz River recreational fishery adult harvest rate [b] TAC (2008)					

There are two bright Chinook populations in the Lower Columbia River Chinook ESU in the Sandy and North Fork Lewis rivers. The Sandy population is currently the less robust. The escapement of natural-origin fish has been variable, but without apparent trend over the last 14 years and has averaged approximately 750 since 2002 (Table 8.10.1.1-7). The viable abundance goal is 5,100 from the LCFRB Recovery Plan, but this is likely high and is being reviewed as Oregon proceeds with its recovery planning process. The North Fork Lewis population is the principal indicator stock. It is a natural-origin population with little or no hatchery influence. The maximum sustained yield escapement goal is 5,700. The viable abundance goal is 6,500. The population has exceeded its escapement goal, often by a wide margin, in most years over the last twenty years or more, although not in 2007. This is consistent with a pattern of low escapements for other far north migrating bright populations including Oregon coastal stocks and upriver brights that return to the Hanford Reach area. This pattern of low escapements for a diverse range of stocks with similar migration pattern and life history suggests that they were all affected by poor ocean conditions.

Table 8.10.2.1-7. Annual escapement of Lower Columbia River bright fall Chinook populations (TAC 2008).

Year	Sandy River	North Fork Lewis
993	1,314	6,429
1994	941	8,439
1995	1,036	9,718
1996	505	12,700
1997	2,001	8,168
1998	773	5,167
1999	447	2,639
2000	84	8,727
2001	824	11,272
2002	1,275	13,284
2003	619	13,433

2004	601	14,165
2005	770	10,197
2006	1,130	10,522
2007	171	3,170

Table 8.10.2.1-8 shows escapements for several of the tule populations including estimates of the proportion of spawners that are natural-origin. The Coweeman, Grays, and East Fork Lewis populations are subject to less hatchery straying. The Cowlitz, Kalama, Washougal, Elochoman, and Mill/Abernathy/Germany populations are more strongly influenced by hatchery fish because of in-basin hatchery programs, or their close proximity to such programs. The natural-origin populations are generally below their viability abundance goals (Table 8.10.2.1-4). The hatchery origin fish are generally at or above their viability goals, but only because of the contribution of hatchery fish.

Table 8.10.2.1-8. Annual escapement for several Lower Columbia River tule Chinook populations (TAC 2008)

Year	Coweeman		Grays		Lewis		Cowlitz		Kalama		Washougal		Elochoman		Ge/Ab/Mi	
	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild
1977	337	1.00	1,009	0.65	1,086		5,837	0.26	6,549	0.50	1,652	0.46	568			
1978	243	1.00	1,806	0.65	1,448		3,192	0.26	3,711	0.50	593	0.46	1,846			
1979	344	1.00	344	0.65	1,304		8,253	0.26	2,731	0.50	2,388	0.46	1,478			
1980	180	1.00	125	0.65	899	1.00	1,793	0.26	5,850	0.50	3,437	0.46	64	0.42	516	0.49
1981	116	1.00	208	0.65	799	1.00	3,213	0.26	1,917	0.50	1,841	0.46	138	0.42	1,367	0.48
1982	149	1.00	272	0.65	646	1.00	2,100	0.26	4,595	0.50	330	0.46	340	0.42	2,750	0.50
1983	122	1.00	825	0.65	598	1.00	2,463	0.26	2,722	0.50	2,677	0.46	1,016	0.42	3,725	0.51
1984	683	1.00	252	0.65	340	1.00	1,737	0.26	3,043	0.50	1,217	0.46	294	0.42	614	0.52
1985	491	0.95	532	0.65	1,029	1.00	3,200	0.26	1,259	0.50	1,983	0.46	464	0.42	1,815	0.53
1986	396	1.00	370	0.65	696	1.00	2,474	0.26	2,601	0.50	1,589	0.46	918	0.42	980	0.49
1987	386	1.00	555	0.65	256	1.00	4,260	0.26	9,651	0.50	3,625	0.46	2,458	0.42	6,168	0.59
1988	1,890	1.00	680	0.65	744	1.00	5,327	0.26	24,549	0.50	3,328	0.46	1,370	0.42	3,133	0.69
1989	2,549	1.00	516	0.65	972	0.78	4,917	0.26	20,495	0.50	4,578	0.46	122	0.42	2,792	0.69
1990	812	1.00	166	0.65	563	1.00	1,833	0.26	2,157	0.50	2,205	0.46	174	0.42	650	0.63
1991	340	1.00	127	0.94	470	1.00	935	0.26	5,152	0.54	3,673	0.47	196	0.09	2,017	0.85
1992	1,247	1.00	109	1.00	335	1.00	1,022	0.26	3,683	0.48	2,399	0.76	190	1.00	839	0.47
1993	890	1.00	27	1.00	164	1.00	1,330	0.06	1,961	0.89	3,924	0.52	288	0.78	885	0.71
1994	1,695	1.00	30	1.00	610	1.00	1,225	0.19	2,190	0.73	3,888	0.70	706	0.98	3,854	0.40

Year	Coweeman		Grays		Lewis		Cowlitz		Kalama		Washougal		Elochoman		Ge/Ab/Mi	
	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild
1995	1,368	1.00	9	1.00	409	1.00	1,370	0.13	3,094	0.69	3,063	0.39	156	0.50	1,395	0.51
1996	2,305	1.00	280	0.48	403	1.00	1,325	0.58	10,676	0.44	2,921	0.17	533	0.66	593	0.54
1997	689	1.00	15	0.64	305	1.00	2,007	0.72	3,548	0.40	4,669	0.12	1,875	0.11	603	0.23
1998	491	1.00	96	0.41	127	1.00	1,665	0.37	4,355	0.69	2,971	0.24	228	0.25	368	0.60
1999	299	1.00	195	0.51	331	1.00	969	0.16	2,655	0.03	3,129	0.68	718	0.25	575	0.69
2000	290	1.00	169	0.96	515	1.00	2,165	0.10	1,420	0.19	2,155	0.70	196	0.62	416	0.58
2001	802	0.73	261	0.64	750	0.70	3,647	0.44	3,714	0.19	3,901	0.43	2,354	0.82	4,024	0.39
2002	877	0.97	107	1.00	1,032	0.77	9,671	0.76	18,952	0.01	6,050	0.47	7,581	0.00	3,343	0.05
2003	1,106	0.89	398	0.72	738	0.98	7,001	0.88	24,782	0.01	3,444	0.39	6,820	0.65	3,810	0.56
2004	1,503	0.91	766	0.90	1,388	0.29	4,621	0.70	6,680	0.10	10,597	0.25	4,796	0.01	6,804	0.02
2005	853	0.60	147	0.66	607	1.00	2,968	0.17	9,272	0.03	2,678	0.41	2,204	0.05	2,083	0.13
2006	561		383		427		2,944		10,386		2,600		317		322	

Extinction Probability/Risk

The LCFRB Recovery Plan provides an overview of the status of populations in the ESU based on TRT recommendations for assessing viability. The risk of extinction category integrates abundance and other viability criteria (Table 8.10.2.1-9). The Recovery Plan also characterizes population status relative to persistence (which combines the abundance and productivity criteria), spatial structure, and diversity, and also habitat characteristics (Table 8.10.2.1-10). This overview for tule populations suggests that risk related to abundance and productivity are higher than those for spatial structure and diversity. Lower scores indicate higher risk. The scores for persistence for most populations range between 1.5 and 2.0. The scores for spatial structure generally range between 3 and 4, and for diversity between 2 and 3, respectively. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 8.10.2.1-9. Risk of extinction (in 100 years) categories for populations of LCR Chinook salmon (sources: Washington's Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strata	Population	State	Extinction Risk Category
Cascade Spring	Cowlitz	W	H
	Cispus	W	H
	Tilton	W	VH
	Toutle	W	VH
	Kalama	W	VH
	NF Lewis	W	VH
	Sandy	O	M
Gorge Spring	White Salmon	W	VH
	Hood	O	VH
Coastal Fall	Grays/Chinook	W	H
	Elochoman/Skamokawa	W	H
	Mill/Abernathy/Germany	W	H
	Youngs Bay	O	VH
	Big Creek	O	VH
	Clatskanie	O	H
	Scappoose	O	VH
Cascade Fall	Lower Cowlitz	W	H
	Upper Cowlitz	W	VH
	Toutle	W	H

Strata	Population	State	Extinction Risk Category
	Coweeman	W	M
	Kalama	W	H
	Lewis	W	M
	Salmon	W	VH
	Washougal	W	H
	Clackamas	O	VH
	Sandy	O	VH
Gorge Fall	Lower Gorge	W/O	H/VH
	Upper Gorge	W/O	H/VH
	White Salmon	W	H
	Hood River	O	VH
Cascade Late Fall	NF Lewis	W	M
	Sandy	O	L

Table 8.10.2.1-10. LCFRB status summaries for Lower Columbia River tule Chinook populations (LCFRB 2004)

Strata	State	Population	Persistence	Spatial Structure	Diversity	Habitat
Coast Fall	WA	Grays	1.5	4	2.5	1.5
	WA	Elochoman	1.5	3	2	2
	WA	Mill/Abern/Ger	1.8	4	2	2
	OR	Youngs Bay				
	OR	Big Creek				
	OR	Clatskanie				
	OR	Scappoose				
Cascade Fall	WA	Lower Cowlitz	1.7	4	2.5	1.5
	WA	Coweeman	2.2	4	3	2
	WA	Toutle	1.6	3	2	1.75
	WA	Upper Cowlitz	1.2	2	2	2

Strata	State	Population	Persistence	Spatial Structure	Diversity	Habitat
	WA	Kalama	1.8	4	2.5	2
	WA	Lewis Salmon	2.2	4	3	2
	WA	Washougal	1.7	4	2	2
	OR	Sandy	1.7	4	2	2
	OR	Clackamas				
Gorge Fall	WA	Lower Gorge	1.8	3	2.5	2.5
	WA	Upper Gorge	1.8	2	2.5	2
	OR	Big White Salmon	1.7	2	2.5	1.5
	OR	Hood				

Notes:
Summaries are taken directly from the LCFRB Recovery Plan (Appendix E). All are on a 4 point scale, with 4 being lowest risk and 0 being highest risk.
Persistence: 0 = extinct or very high risk of extinction (0-40% probability of persistence in 100 years); 1 = Relatively high risk of extinction (40-75% probability of persistence in 100 years); 2 = Moderate risk of extinction (75-95% probability of persistence in 100 years); 3 = Low (negligible) risk of extinction (95-99% probability of persistence in 100 years); 4 = Very low risk of extinction (>99% probability of persistence in 100 years)
Spatial Structure: 0 = Inadequate to support a population at all (e.g., completely blocked); 1 = Adequate to support a population far below viable size (only small portion of historic range accessible); 2 = Adequate to support a moderate, but less than viable, population (majority of historical range accessible but fish are not using it); 3 = Adequate to support a viable population but subcriteria for dynamics or catastrophic risk are not met; 4 = Adequate to support a viable population (all historical areas accessible and used; key use areas broadly distributed among multiple reaches or tributaries)
Diversity: 0 = functionally extirpated or consist primarily of stray hatchery fish; 1 = large fractions of non-local hatchery stocks; substantial shifts in life-history; 2 = Significant hatchery influence or periods of critically low escapement; 3 = Limited hatchery influence with stable life history patterns. No extended intervals of critically low escapements; rapid rebounds from periodic declines in numbers; 4 = Stable life history patterns, minimal hatchery influence, no extended intervals of critically low escapements, rapid rebounds from periodic declines in numbers.
Habitat: 0 = Quality not suitable for salmon production; 1 = Highly impaired; significant natural production may occur only in favorable years; 2 = Moderately impaired; significant degradation in habitat quality associated with reduced population productivity; 3 = Intact habitat. Some degradation but habitat is sufficient to produce significant numbers of fish; 4 = Favorable habitat. Quality is near or at optimums for salmon.

The 100-year risk of extinction is high for almost all populations of fall-run Chinook salmon. Exceptions are:[2]

[2] See WLCTRT (2004)

- Coweeman fall run (moderate)—abundance is low, but the trend has been increasing in recent years; population retains its genetic legacy; good habitat in the upper basin; habitat access only slightly impaired

- Lewis fall run (moderate)—abundance is low and trend is slightly negative; population retains its genetic legacy; habitat capacity has been limited by urbanization in the Salmon Creek and lower North and East Forks of the Lewis River and by passage impediments at the FERC-licensed hydroelectric project

- Lewis late-fall run (moderate)—long term high abundance levels (thousands of fish) with little hatchery contribution; long-term trend is slightly negative, although this may be expected for a population that is routinely exceeding its escapement goal; population retains its genetic legacy; habitat capacity has been limited by flow management operations at the FERC-licensed hydroelectric project, but these are addressed in new license (NMFS 2007f).

- Sandy late-fall run (low)—abundance has varied from several hundred to a few thousand in recent years; run has not been supplemented with hatchery fish and there is little chance of introgression from the fall-run programs in neighboring basins due to differences in run and spawn timing; most of the historical production area has remained accessible

Almost all of the spring-run populations of LCR Chinook are at very high risk of extinction. These have been excluded from much of their historical habitat above FERC-licensed dams. The exception is the Sandy River spring-run population, for which the risk of extinction is moderate. Large areas of productive high quality habitat have remained accessible in this watershed, particularly in the forested upper basin where production areas are distributed among several tributaries that drain Mt. Hood (McElhany et al. 2007).

Spatial Structure

The LCR Chinook salmon ESU consists of six MPGs made up of two to nine populations each. Currently, the spatial structures of populations in the Coastal and Cascade Fall Run MPGs are similar to their respective historical conditions. The following FERC-licensed projects soon will either be removed or become passable, allowing the affected populations to re-occupy historical habitat:

- Bull Run Hydroelectric Project, Little Sandy dam (Marmot dam removed in 2007) – removal by 2008 (NMFS 2003d) will improve access to the upper Sandy watershed for spring-run Chinook salmon (designated a Core and Genetic Legacy population by the McElhany et al. (2003))

- Lewis River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2007f), a first step toward restoring the spring run (Core)

- Cowlitz River Hydroelectric Project - upstream and downstream passage facilities will be developed (NMFS 2004c), allowing restoration in the Cispus Spring Run (Core), Tilton Spring Run, and Upper Cowlitz Spring (Core and Genetic Legacy) and Fall Run population.

In contrast, spatial structure within the Upper Gorge Fall Run population is substantially limited by habitat inundation under Bonneville Pool and spatial structure within the Upper Gorge and Cascade Spring Run MPGs is limited by tributary barriers to migration. Historical tributary barriers include Condit Dam, built on the White Salmon River in the early 20th century, and injury and delay at the inadequate passage facilities, plus adverse effects on downstream habitat, at Powerdale Dam on the Hood River. However, (inefficient) passage was restored at Powerdale some years ago, which along with Condit Dam has been decommissioned and is scheduled for removal (Section 8.10.3.2).

Diversity

The diversity of the Coastal, Cascade and Gorge Fall Run major population groups (i.e., all except the Late Fall Run Chinook MPG) has been eroded by large hatchery influences, and periodically by low effective population sizes. In contrast, hatchery programs for spring Chinook salmon are preserving the genetic legacy of populations that were extirpated from blocked areas.

8.10.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for LCR Chinook salmon includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Lower Columbia, Grays/Elochoman, Clackamas, and Lower Willamette (NMFS 2005b). There are 48 watersheds within the range of this ESU. Four watersheds received a low rating, 13 received a medium rating, and 31 received a high rating for their conservation value (i.e., for recovery). For more information, see Chapter 4. The lower Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor 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. Of the 1,655 miles of habitat eligible for designation, 1,311 miles of stream are designated critical habitat.

In the lower Columbia River and its tributaries, major factors affecting PCEs are altered channel morphology and stability; lost degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased stream temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004, ODFW 2006b, PCSRF 2006). The status of critical habitat within the action area is discussed in more detail in Section 8.10.3.8.

8.10.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of LCR Chinook salmon. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000b) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.10.2.1-3) will improve. The most significant actions involve reduced harvest rates for fall and spring Chinook in fresh water and ocean fisheries, which have significantly increased escapement to the spawning grounds.

8.10.3.1 Recent FCRPS Hydro Improvements

Corps et al. (2007b) estimated that hydropower configuration and operational improvements implemented in 2000 to 2006 have resulted in an 11.3% increase in survival for yearling juvenile LCR Chinook salmon from populations that pass Bonneville Dam. Improvements during this period included the installation of a corner collector at Powerhouse II (PH2) and the partial installation of minimum gap runners at Powerhouse 1 (PH1) and of structures that improve fish guidance efficiency (FGE) at PH2. Spill operations have been improved and Powerhouse 2 is used as the first priority powerhouse for power production because bypass survival is higher than at PH1 and drawing water toward PH2 moves fish toward the corner collector. The bypass system screen was removed from PH1 because tests showed that turbine survival was higher than through the bypass system at that location.

8.10.3.2 Recent Tributary Habitat Improvements

Actions implemented since 2000 range from beneficial changes in land management practices to improving passage by replacing culverts and by reintroducing fish into areas above FERC-licensed dams. The latter category includes two projects in tributaries above Bonneville Dam (i.e., within the action area for this consultation):

- Condit – removal in 2009 (NMFS 2006j) will support the restoration of the spring- and fall-run Chinook populations in the White Salmon River (both were designated Core populations by the WLC TRT (2003))

- Powerdale – removal by 2012 (NMFS 2005o) will support the restoration of the spring- and fall-run populations in the Hood River

Both removals will greatly increase the abundance and productivity of the affected populations by increasing the amount of habitat available for spawning and rearing. Although there is some uncertainty regarding whether the affected populations will become reestablished, NOAA Fisheries has determined that these are the correct next steps toward their restoration.

The Grays River is designated as a priority population for the restoration of the Coastal Fall MPG. It is used as one of the indicator populations for harvest management purposes and was identified by the Lower Columbia Tule Chinook Working Group (2008) as the weakest. A comprehensive habitat assessment and restoration plan was conducted by the Pacific Northwest National Laboratory (PNNL) in cooperation with Washington Department of Fish and Wildlife (WDFW) and Pacific States Marine Fisheries Commission (PSMFC) for the Grays River in 2006. Several related projects have been implemented (see attachment to NOAA Fisheries' 2008 Guidance letter to the Pacific Fisheries Management Council PFMC; NMFS 2008i). These include habitat restoration in the upper (reducing excess sediment loads) and lower (reconnecting the river delta-estuarine habitat at Seal Slough, the tidal floodplain at Devils Elbow, estuarine wetlands at Seal Slough, adding large wood to the lower West Fork, reducing temperatures and improving habitat diversity near Grays RM 11.8, and replacing the Nikka tidegate to restore connectivity and increase fish passage) Grays River watersheds.

8.10.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function. These have resulted in an estimated 0.7% survival benefit for fall-run Chinook populations with an ocean-type juvenile life history (Corps et al. 2007b). The estimated survival benefit for spring-run Chinook (stream-type juvenile life history) is 0.3%.

8.10.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the Columbia River estuary was reduced from a total of 13,790,000 smolts to 8,210,000 smolts after relocation from Rice to East Sand Island in 1999. Yearling Chinook are generally considered vulnerable to these predators based on PIT-tag data from upriver stocks (Ryan et al. 2006). However, these authors also determined that predation rates for subyearling fall Chinook from populations in the Lower Columbia River ESU were higher than for subyearlings from upriver locations (possibly due to their longer residence time in the estuary), indicating that recent reductions in tern predation have benefited lower Columbia fall Chinook populations as well as those with a yearling life history.

Piscivorous Fish Predation

Since its commencement in 1990, the Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality. The recent improvement in lifecycle survival attributed to the NPMP is estimated to be 2% for both yearling and subyearling juvenile salmonids (Friesen and Ward 1999; Corps et al. 2007b).

Marine Mammal Predation

In recent years, sea lion predation of adult spring-run Chinook in the Bonneville tailrace has increased from 0%, or sufficiently low that it was rarely observed, to about 8.5% (SCA Marine Mammal Appendix). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the survival of adult spring-run Chinook by 5.5%., so that the continuing negative impact will be approximately 3.0%.

8.10.3.5 Recent Hatchery Management Issues

The presence of naturally spawning hatchery-origin Chinook salmon has been identified as a limiting factor for the viability of this species (LCFRB 2004; ODFW 2006b). Of the 20 programs that release Chinook salmon below Bonneville Dam, NOAA Fisheries has identified only one program (Cowlitz Spring Chinook) as improving population viability by increasing spatial distribution (NMFS 2004b). Fifteen programs were identified as reducing short-term extinction risk, helping to preserve genetic resources important to ESU survival and recovery.[3] A summary of progress in hatchery reform for Lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS (2004b).

Most salmonids returning to the region are primarily derived from hatchery fish. In 1987, for example, 70% of the spring Chinook salmon, 80% of the summer Chinook salmon, 50% of the fall Chinook salmon, and 70% of the steelhead returning to the Columbia River Basin originated in hatcheries (CBFWA 1991). Hatcheries have traditionally focused on compensating for impacts to fisheries and it is only recently that risks posed by hatchery programs to natural population viability have been demonstrated.

NOAA Fisheries identified four primary ways hatcheries may harm wild-run salmon and steelhead: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects (NMFS 2000b). In many areas, hatchery fish provide increased fishing opportunities. However, when natural-origin fish mix with hatchery stocks in these areas, naturally produced fish can be overharvested. Moreover, when migrating adult hatchery and natural-origin fish blend in the spawning grounds, the health of the natural-origin fish and the habitat's ability to support them can be overestimated. This potential overestimate exists because the hatchery fish mask the surveyors' ability to discern actual natural-origin run status, thus resulting in harvest objectives that were too high to sustain the naturally produced populations.

[3] The buffer against extinction is probably short term because dependence on hatchery intervention can lead to increased risk over time (ICTRT 2007a).

Over the last several years, the role hatcheries play in the Columbia Basin has been expanded from simple production to supporting species recovery. The evaluation of hatchery programs and implementation of hatchery reform in the lower Columbia River is occurring through several processes, including: (1) the Lower Columbia River Recovery and Fish and Wildlife Subbasin Plan; (2) Hatchery Genetic and Management Plan development for ESA compliance; (3) FERC-related plans on the Cowlitz and Lewis Rivers; and, (4) the federally mandated Artificial Production Review and Evaluation. More recently a National Environmental Policy Act (NEPA) review of all Mitchell Act funded hatchery facilities was initiated which will include many of those producing Lower Columbia River Chinook. Washington's Lower Columbia River recovery plan identifies strategies and measures to support recovery of naturally-spawning fish. The plan also includes associated research and monitoring elements designed to clarify interactions between natural and hatchery fish and quantify the effects artificial propagation has on natural fish. The objective is to rehabilitate depleted populations and provide for harvest, while minimizing impacts to wild fish. For more detail on the use of hatcheries in recovery strategies, see the Lower River Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2004).

The states of Oregon and Washington and other fisheries co-managers are currently engaged in a substantial review of hatchery management practices through the Hatchery Scientific Review Group (HSRG). The HSRG was established and funded by Congress to provide an independent review of current hatchery programs in the Columbia River Basin. The HSRG has largely completed their work on LCR tule populations and provided their recommendations. A general conclusion is that the current production programs are not consistent with practices that reduce impacts on naturally-spawning populations, and will have to be modified to reduce adverse effects on key natural populations identified in the Interim Recovery Plan, (i.e., necessary for broad sense recovery). The adverse effects are caused by hatchery-origin adults spawning with natural-origin fish or competing with natural-origin fish for spawning sites.

Early in 2007 NOAA Fisheries expressed the need to change current hatchery programs and anticipated that new direction for those programs would be given soon (NMFS 2007g). NOAA Fisheries followed with a letter to the states of Oregon and Washington in November 2007 that again highlighted the immediate need for decisions about hatchery programs (NMFS 2007h). In response and through their own initiative, the states have embraced the recommendations of the HSRG and have now initiated a comprehensive program of hatchery and associated harvest reforms (WDFW and ODFW 2008). The program is designed specifically to achieve HSRG objectives related to controlling the number of hatchery-origin fish on the spawning grounds and in the hatchery broodstock. The program will require mass marking of released hatchery fish, changing hatchery release strategies, reducing hatchery production at some facilities, and building a system of weirs and improved collection facilities to control the straying of hatchery fish. The program will also require development and implementation of more mark-selective fisheries and increasing the productivity of river basins through habitat management actions (i.e., see Section 8.10.3.2 for habitat projects in the Grays River). Overall, the program represents a comprehensive and integrated approach to recovery that will be advanced by substantive reforms in hatchery practices.

8.10.3.6 Recent Harvest Survival Improvements

Lower Columbia River Chinook are caught in both ocean and in-river fisheries. As discussed in Section 8.10.5.5, LCR tule Chinook in particular are managed subject to a total exploitation rate limit for the combined ocean and in-river fisheries. The necessary sharing between ocean and in-river fisheries is implemented by coordination and the close association between Pacific Fishery Management Council fisheries and the 2008 *U.S. v. Oregon* Agreement and related biological opinions.

Each year, fisheries in the Columbia River will be managed, after accounting for anticipated ocean harvest, so as not to exceed the total exploitation rate limit. In 2008, the total exploitation rate limit is 41%. From 2002 to 2006, the limit was 49%. The exploitation rate limit was reduced to 42% in 2007. NOAA Fisheries' guidance to the Council for 2008 was that Council fisheries should be managed such that the total exploitation rate on Lower Columbia River Chinook tule populations, from all fisheries does not exceed 41%. For 2009 and thereafter, NOAA Fisheries will set a total exploitation rate limit for tule Chinook through their annual guidance letter to the Council. NOAA Fisheries is required to provide such guidance by the Council's Salmon FMP. Fisheries subject to the 2008 *U.S. v. Oregon* Agreement that are part of the set of Prospective Actions must be managed subject to the overall exploitation rate limit as proposed in 2008 and as they have been since 1999.

NOAA Fisheries recently completed a section 7 consultation of the effects of PFMC and Fraser Panel fisheries on Lower Columbia River Chinook. NOAA Fisheries concluded that fisheries managed subject to a total exploitation rate of 41% would not jeopardize the listed species (NMFS 2008e). The PFMC opinion provides the substantive foundation for the review of the management strategy for LCR Chinook.

Tables 8.10.3.6-1, -2, and -3 provide estimates of harvest impacts and their distribution across fisheries for spring, bright, and tule populations in the Lower Columbia River Chinook ESU. Table 8.10.3.6-1 provides estimates of harvest impacts to spring-run populations. Exploitation rates were generally higher prior to the mid 1990s, averaging 50%. Spring-run Chinook stocks in the Columbia River, including Upper Willamette River spring Chinook decreased significantly in the mid 1990s, which led to a significant reduction in harvest, particularly in-river. The abundance of these stocks was gradually restored, reaching another peak by the early part of the 2000s. Fishery impacts increased in response to higher abundance; but by 1999, both Upper Willamette River Chinook and Lower Columbia River Chinook ESUs had been listed under the ESA. As a consequence, fishery managers implemented mass-marking programs for hatchery-origin fish and phased in mark-selective fisheries. Beginning in 1995, total exploitation rates averaged approximately 27%, although actual exploitation rates on unmarked natural-origin fish were lower as a consequence of the implementation of mark-selective fisheries in-river. Those estimates were not immediately available. Fishery impacts reported under the heading of the Columbia River include those that occur in tributary sport fisheries. Tributary sport fisheries are not included in fisheries covered by the 2008 Agreement. Oregon and Washington manage their tributary sport fisheries separately subject to provisions of Fishery

Management and Evaluation Plans (FMEPs). These FMEPs were considered for ESA purposes under limit #4 of the 4(d) Rule (NMFS 2000c).

Table 8.10.3.6-1. Total adult equivalent exploitation rates for the Cowlitz spring Chinook population (as an example of exploitation rates for LCR spring Chinook) (Simmons 2008).

Year	Total Exploitation Rate	Ocean					Columbia River	
		Southeast Alaska	Canada		Southern US		Non-Indian	Indian
			WCVI	Other Canada	PFMC	PgtSd	Exp Rate	Exp Rate
1980	52%	2%	5%	4%	17%	0%	24%	0%
1981	48%	3%	5%	4%	17%	0%	20%	0%
1982	55%	2%	5%	3%	15%	0%	30%	0%
1983	57%	2%	9%	5%	9%	0%	32%	0%
1984	54%	2%	11%	5%	4%	0%	31%	0%
1985	43%	1%	5%	3%	8%	0%	25%	0%
1986	52%	1%	5%	3%	12%	0%	31%	0%
1987	45%	1%	5%	3%	11%	0%	25%	0%
1988	49%	1%	5%	2%	16%	0%	26%	0%
1989	50%	1%	3%	3%	19%	0%	25%	0%
1990	57%	1%	5%	2%	23%	0%	26%	0%
1991	54%	1%	4%	3%	14%	0%	32%	0%
1992	46%	1%	5%	3%	19%	0%	19%	0%
1993	48%	1%	5%	3%	15%	0%	25%	0%
1994	45%	1%	4%	3%	3%	0%	35%	0%
1995	10%	1%	2%	1%	4%	0%	1%	0%
1996	11%	1%	0%	0%	7%	0%	2%	0%
1997	16%	1%	1%	2%	5%	0%	7%	0%
1998	12%	1%	0%	2%	9%	0%	0%	0%
1999	38%	1%	1%	1%	15%	0%	20%	0%
2000	38%	1%	3%	1%	9%	0%	25%	0%
2001	21%	1%	2%	1%	7%	0%	10%	0%
2002	43%	1%	2%	2%	13%	0%	24%	0%
2003	34%	1%	3%	2%	13%	0%	16%	0%
2004	31%	1%	3%	2%	13%	0%	11%	0%

Year	Total Exploitation Rate	Ocean					Columbia River	
		Southeast Alaska	Canada		Southern US		Non-Indian	Indian
			WCVI	Other Canada	PFMC	PgtSd	Exp Rate	Exp Rate
2005	36%	1%	4%	2%	17%	0%	11%	0%
2006	34%	1%	4%	3%	16%	0%	11%	0%

Table 8.10.3.6-2 provides estimates of harvest estimates to the North Fork Lewis bright Chinook population. Exploitation rates were generally higher through 1989 (averaging 56%), declining during the decade of the 1990s (averaging 36%), and increased slightly since 2000 (averaging 38%).

Table 8.10.3.6-2. Total adult equivalent exploitation rate for the North Fork Lewis bright Chinook population (Simmons 2008)

Year	Total exploitation rate	Ocean					Columbia River	
		Southeast Alaska	Canada		Southern US		Non-Indian Exp Rate	Indian Exp Rate
			WCVI	Other Canada	PFMC	PgtSd		
1979	64%	9%	8%	6%	9%	2%	29%	0%
1980	68%	11%	8%	7%	8%	2%	33%	0%
1981	39%	11%	6%	6%	6%	2%	7%	0%
1982	43%	9%	6%	6%	8%	2%	12%	0%
1983	42%	10%	11%	6%	4%	3%	8%	0%
1984	58%	10%	15%	7%	2%	2%	22%	0%
1985	54%	6%	7%	6%	5%	3%	27%	0%
1986	64%	5%	8%	6%	6%	4%	35%	0%
1987	65%	5%	8%	5%	5%	3%	39%	0%
1988	68%	6%	10%	5%	7%	3%	38%	0%
1989	44%	7%	3%	4%	4%	1%	24%	0%
1990	38%	8%	6%	4%	7%	2%	12%	0%
1991	57%	7%	5%	5%	5%	2%	33%	0%
1992	57%	7%	9%	6%	7%	3%	25%	0%
1993	51%	7%	6%	4%	7%	3%	25%	0%
1994	38%	7%	11%	9%	1%	3%	7%	0%
1995	36%	7%	3%	2%	1%	1%	22%	0%
1996	16%	7%	0%	0%	2%	2%	3%	0%
1997	25%	11%	2%	3%	2%	2%	7%	0%

Year	Total exploitation rate	Ocean					Columbia River	
		Southeast Alaska	Canada		Southern US		Non-Indian Exp Rate	Indian Exp Rate
			WCVI	Other Canada	PFMC	PgtSd		
1998	23%	11%	0%	2%	1%	1%	8%	0%
1999	19%	6%	1%	2%	7%	2%	0%	0%
2000	24%	6%	5%	1%	5%	2%	5%	0%
2001	31%	7%	4%	1%	6%	3%	11%	0%
2002	41%	9%	3%	3%	7%	3%	15%	0%
2003	50%	11%	3%	4%	5%	2%	24%	0%
2004	40%	9%	2%	2%	3%	1%	22%	0%
2005	50%	8%	6%	5%	8%	3%	20%	0%
2006	32%	10%	2%	3%	3%	1%	13%	0%

Table 8.10.3.6-3 provides estimates of harvest impacts for tule Chinook populations based on an aggregate of coded wire tag indicator stocks. Exploitation rates were generally higher through 1993 (averaging 69%), lower through 1999 (averaging 34%), then increasing since 2000 (averaging 49%). From 2002 to 2006 fisheries were managed subject to a 49% exploitation rate limit. Total exploitation rates have been higher in some years but have averaged 49% from 2002 to 2006 (Table 8.10.3.6-3).

Table 8.10.3.6-3. Total adult equivalent exploitation rates for LCR tule populations (Simmons 2008).

Year	Ocean					Columbia River	
	Total Exp. Rate	SEAK Exp. Rate	Canada Exp. Rate	PFMC Exp. Rate	Pgt Snd Exp. Rate	Non-Treaty Exp. Rate	Treaty Exp. Rate
1983	69%	4%	34%	21%	3%	7%	0%
1984	70%	4%	40%	6%	3%	16%	1%
1985	66%	4%	35%	16%	3%	9%	0%
1986	82%	3%	38%	15%	4%	22%	0%
1987	82%	2%	27%	20%	4%	28%	0%
1988	81%	3%	25%	15%	2%	36%	0%
1989	59%	4%	19%	10%	3%	23%	0%
1990	60%	4%	26%	19%	3%	9%	0%
1991	63%	3%	28%	15%	4%	12%	0%
1992	65%	3%	31%	21%	4%	8%	0%

Year	Ocean					Columbia River	
	Total Exp. Rate	SEAK Exp. Rate	Canada Exp. Rate	PFMC Exp. Rate	Pgt Snd Exp. Rate	Non-Treaty Exp. Rate	Treaty Exp. Rate
1993	61%	3%	27%	18%	3%	9%	0%
1994	33%	4%	26%	2%	1%	0%	0%
1995	36%	4%	21%	6%	2%	3%	1%
1996	26%	3%	4%	7%	1%	9%	0%
1997	35%	5%	12%	7%	2%	10%	0%
1998	33%	4%	13%	6%	0%	9%	0%
1999	42%	3%	10%	13%	0%	15%	0%
2000	48%	4%	23%	9%	0%	13%	0%
2001	51%	2%	29%	12%	0%	7%	0%
2002	51%	3%	24%	14%	0%	9%	0%
2003	47%	4%	21%	10%	0%	12%	0%
2004	45%	4%	25%	9%	0%	7%	0%
2005	51%	4%	28%	11%	0%	7%	0%
2006	51%	4%	28%	12%	0%	7%	0%

8.10.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations and their designated critical habitat.

Gorge Fall MPG

Completed consultations include repairing a creek bank next to a road, parking lot maintenance, and maintenance of a stormwater drainage system along a highway (Lower Gorge); road maintenance and culvert cleaning (Upper Gorge); treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Hood population). The USFS implemented two habitat restoration projects: improve 5 acres of riparian through thinning and improve 49 acres of riparian and one mile of stream by adding large woody debris (Hood population).

Gorge Spring MPG

Completed consultations include invasive plant treatment, a grazing allotment, and vegetation management in a transmission line right-of-way (Hood). The USFS implemented two habitat restoration projects: improve 5 acres riparian through thinning and improve 49 acres riparian and one mile of stream by adding large woody debris (Hood population).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.10.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the ESU. The effects of some on population viability will be positive (treating invasive plants; adding large woody debris; tar remediation). Other projects, including road maintenance, grazing allotments, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on water quality (adding large woody debris; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.10.3.8 Status of Critical Habitat under the Environmental Baseline

Factors described in Section 8.10.2, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century and have degraded the conservation value of designated critical habitat. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. Tributary habitat conditions vary widely among the various drainages occupied by LCR Chinook salmon. Factors affecting the conservation value of critical habitat vary from lack of adequate pool/riffle channel structure, high summer water temperatures, low flows, poor overwintering conditions due to loss of connection to the floodplain, and high sediment loads.

Spawning & Rearing Areas

The following are the major factors that have limited the functioning of primary constituent elements and thus the conservation value of tributary habitat used for spawning and both tributary and estuarine habitat used for rearing (i.e., spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Tributary barriers *[culverts; dams; water withdrawals]*
- Reduced riparian function *[urban and rural development; forest practices; agricultural practices; channel manipulations]*
- Loss of wetland and side channel connectivity *[urban and rural development; past forest practices; agricultural practices; channel manipulations]*
- Excessive sediment in spawning gravel *[forest practices; agricultural practices]*
- Elevated water temperatures *[water withdrawals; urban and rural development; forest practices; agricultural practices]*

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions that address these limiting factors. These include removing passage barriers, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. The dam removal actions at FERC-licensed hydroelectric projects in the White Salmon and Hood rivers (Section 8.10.3.2) are addressing most of the key limiting factors in those watersheds. Some projects will provide immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

As described above, future Federal projects with completed consultations will have neutral or short- or even long-term adverse effects on the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Some Federal projects, implemented for restoration purposes, will improve these same PCEs.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile and adult passage mortality *[hydropower projects in the mainstem lower Snake and Columbia rivers]*
- Pinniped predation on spring-run adults (Gorge Spring MPG) due to habitat changes in the lower river *[existence and operation of Bonneville Dam]* and increasing numbers of pinnipeds.
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators *[Caspian terns and double-crested cormorants]*
- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat *[agriculture and other development in riparian areas; FCRPS and Upper Snake water management]*

The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of these PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at Bonneville Dam has improved with the addition of the Bonneville PH2 corner collector. Reductions in piscivorous fish predation have increased the survival of both yearling and subyearling life history types in the estuary.

NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult spring-run Chinook in the tailrace of Bonneville Dam (NMFS 2008d).This action is expected to increase the survival of spring-run adults by 5.5%; reducing the continuing impact to approximately 3.0%.

The safe passage of both yearling and subyearling LCR Chinook salmon through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown during that same period. For populations with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. For populations with subyearling smolts, restoration projects in the estuary are improving the functioning of cover/shelter, food, and riparian vegetation required by this type of juvenile migrant. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although LCR Chinook spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.10.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions that will benefit the White Salmon and Hood spring-run and the Upper Gorge, White Salmon and Hood fall-run populations as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.[4] They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for this ESU.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these

[4] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for may of its projects.

factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.10.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Flow augmentation from the Upper Snake Project (NMFS 2008b) will continue to provide benefits through 2034. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.10.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Benefits of Bonneville passage improvements affect only the six populations in the Gorge Fall and Spring Run MPGs. Prospective Actions include completing the installation of minimum gap runners at Bonneville PH1 and the FGE improvements at PH2 and improvements to sluiceway fish guidance system (efficiency and conveyance) at PH1. Collectively these modifications are expected to increase the survival of yearling (spring) and subyearling (fall) Chinook salmon that pass through Bonneville Dam (Upper Gorge Fall Run, White Salmon Fall Run, Hood River Fall Run, and Hood River Spring Run populations) by <1%. Spillway survival improvements during this time period are expected to increase the passage survival through Bonneville Dam of yearling (spring) Chinook salmon by an additional 0.5% and of subyearling (fall) Chinook salmon by an additional 3.9%.

As a result of this ten-year program of improvements, an estimated 95.5% of the yearling Chinook that migrate past Bonneville Dam will survive.[5] A portion of the 4.5 % mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling Chinook would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion on Remand, NOAA Fisheries estimated that 98% of the yearling Chinook would survive migration through a free-flowing reach of equal length (see Table 5.1 in NMFS 2004a). Therefore, approximately 35% (1.6%/4.5%) of the expected mortality experienced by in-river migrating yearling Chinook is probably due to natural factors.

[5] NOAA Fisheries has not estimated the in-river survival of subyearling Chinook salmon.

The direct survival rate of adult Chinook at Bonneville Dam is already quite high. Based on PIT-tag detections of SR spring/summer and fall Chinook at Bonneville and later redetected at upstream dams, NOAA Fisheries estimates upstream passage survival rates of 98.6 and 96.9% for adult spring–and fall–run Chinook, respectively (i.e., relevant to the Gorge MPGs).[6]

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of much of the flow augmentation water from summer to spring will provide a small benefit to juvenile migrants in the lower Columbia River by reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.10.3.3).

Effects on Species Status

Prospective passage improvements at Bonneville Dam will support increased abundance and productivity of the upper Gorge populations, thereby improving the overall spatial structure of the ESU.

Effects on Critical Habitat

Improvements at Bonneville Dam will increase the functioning of the PCE of safe passage in the juvenile and adult migration corridors.

8.10.5.2 Effects of Tributary Habitat Prospective Actions

The Prospective Actions include funding for habitat improvements in the Hood River that will benefit the spring Chinook population in that watershed (Table 6 of Attachment B.2.2-2 in Corps et al. 2007b). The project, which will complement the effects on habitat of removing Powerdale Dam, includes actions to increase instream habitat complexity, restore and protect riparian vegetation, provide access and safe passage, and to acquire instream flow.

The Prospective Actions also include the Action Agencies' consideration of funding for habitat improvement projects for any of the LCR Chinook populations above Bonneville that have been significantly impacted by the FCRPS. Projects are to be selected that are consistent with basin-wide criteria for prioritizing projects (e.g., address limiting factors), including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

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[6] This estimate is adjusted to account for estimated harvest and straying rates of adults within the FCRPS migration corridor, but otherwise captures all other sources of mortality including those resulting from the existence and operation of the FCRPS and other potential sources, including natural mortality (i.e., that would occur without human influence).

Effects on Species Status

Prospective improvements in tributary habitat in the Hood River will support the increased abundance, productivity, and spatial structure of the spring-run population of LCR Chinook. Habitat projects in other tributaries, if implemented, will be selected such that they also address limiting factors and thus would increase the viability of the local population(s).

Effects on Critical Habitat

Prospective habitat improvements in the Hood River will improve the functioning of PCEs for spawning and rearing (spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space). Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale and some, such as the removal of barriers, will improve conditions at the watershed scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

8.10.5.3 Effects of Estuary Habitat Prospective Actions

The FCRPS Action Agencies will carry out approximately 44 estuary habitat projects over the first 3-year period of implementing the RPA (Section 12.3.2.3 in Corps et al. 2007b). The estimated survival benefit for fall-run LCR Chinook salmon associated with these specific actions will be less than 2.3%. The estimated benefit for spring-run Chinook is 1.4%.

The RPA requires the implementation of additional projects to obtain specified survival benefits for Interior Columbia Basin Chinook populations, but will also provide benefits to those from the lower Columbia River. The estimated survival benefit for fall-run LCR Chinook salmon is 6.7%. The estimated survival benefit for spring-run Chinook is less than 4.3%. Prospective Actions will address limiting factors by protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reducing of noxious weeds, and other actions.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of spring- and fall-run populations of LCR Chinook.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in the migration corridor for yearling Chinook migrants and in rearing areas for subyearling Chinook. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). The positive effects on the functioning of PCEs and the conservation value of critical habitat will be long-term.

8.10.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Under the RPA (Action 39), the FCRPS Action Agencies will continue funding hatcheries as well as adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.10.5.5 Effects of Harvest Prospective Actions

Lower Columbia River spring Chinook populations are caught in non-Treaty spring season fisheries in the Columbia River below Bonneville Dam, and in tributary fisheries targeting hatchery-origin fish. The tributary fisheries are not part of the Prospective Action, but have been considered separately for ESA compliance through the 4(d) Rule (NMFS 2000c). There are no specific harvest rate constraints in the 2008 Agreement that apply to LCR spring Chinook. However, management constraints for upriver spring Chinook stocks from the Snake and Upper Columbia ESUs (see Sections 8.3 and 8.6 of this document) that are part of the Agreement substantially limit impacts to natural-origin spring Chinook from the LCR populations. Non-treaty fisheries in the lower Columbia are subject to harvest rate limits under the 2008 Agreement on natural-origin upriver spring Chinook populations that range from 0.5 to 2.7%, depending on run size (see Section 8.3 of this document). Impacts to natural-origin LCR spring Chinook populations, subject to the 2008 Agreement, will be similar to those allowed for upriver spring Chinook. As described above, the spring populations are managed to meet escapement goals for hatchery programs being used for reintroductions and supplementation. Mark selective fisheries are used below Bonneville Dam during the spring season to limit impacts to natural-origin fish. Due to the collective conservation restrictions for several other Chinook populations, hatchery escapement goals have been met exceeded in recent years. NOAA Fisheries expects that escapement goals will be met in 2008 and for the duration of the Agreement.

There are two extant natural-origin bright populations in the LCR Chinook ESU. Bright populations are caught in non-Treaty fall season fisheries in the Columbia River below Bonneville Dam. No specific harvest rate constraints in the 2008 Agreement apply directly to LCR bright Chinook, but fall season fisheries are constrained by limits set on Snake River fall Chinook, Lower Columbia River coho, and summer steelhead. The North Lewis River stock is used as a harvest indicator for ocean and in-river fisheries. The escapement goal used for management purposes for the North Lewis River population is 5,700 based on estimates of maximum sustained yield. The escapement was below goal in 2007 and the forecast for 2008 is for another low return, but escapements have otherwise exceeded the goal by a wide margin in every year but one since 1980. The escapement shortfall in 2007 is consistent with a pattern of low escapements for other far north migrating stocks in the region and can likely be attributed to poor ocean conditions. Given the long history of healthy returns, NOAA Fisheries does not anticipate the need to take specific management actions to protect the bright component of the Lower Columbia River Chinook ESU in 2008 or for the duration of the Agreement. NOAA Fisheries does expect that the states of Washington and Oregon will continue to take appropriate actions through their usual authorities, to ensure that the escapement goal continues to be met. NOAA Fisheries will monitor escapements for the bright populations, and trends for other far north migrating stocks, and take more specific action in the future if necessary.

The majority of harvest impacts to Lower Columbia River tule Chinook populations occur in ocean fisheries (Table 8.10.3.8-3). Since 2002 about 70% of harvest impacts have occurred in the ocean. In the Columbia River, tule populations are caught primarily in non-treaty fall season fisheries below Bonneville Dam. There are no specific harvest constraints in the 2008 U.S. v. Oregon Agreement that apply to Lower Columbia River tule Chinook. Non-treaty fall season fisheries are constrained by limits to Snake River fall Chinook, Lower Columbia River coho, and summer steelhead. NOAA Fisheries has, nonetheless, considered it necessary to define additional constraints for Lower Columbia River tule populations and has done so through its annual guidance letter to the Council (see for example Lohn and McInnis 2008).

For the last several years, NOAA Fisheries has limited Council and in-river fisheries by specifying a total exploitation rate limit. From 2002 to 2006, the limit was 49%. The exploitation rate limit was reduced to 42% in 2007. NOAA Fisheries' guidance to the Council for 2008 was that Council fisheries should be managed such that the total exploitation rate on Lower Columbia River Chinook tule populations, from all fisheries does not exceed 41%. For 2009 and thereafter, NOAA Fisheries will set a total exploitation rate limit for tule Chinook through their annual guidance letter to the Council. NOAA Fisheries is required to provide such guidance by the Council's Salmon FMP. Fisheries subject to the 2008 *U.S. v. Oregon* Agreement that are part of the set of Prospective Actions must be managed subject to the overall exploitation rate limit as proposed in 2008 and have been since 1999.

NOAA Fisheries recently completed a section 7 consultation of the effects of PFMC and Fraser Panel fisheries on Lower Columbia River Chinook. NOAA Fisheries concluded that fisheries managed subject to a total exploitation rate of 41% would not jeopardize the listed species (NMFS 2008e). The

PFMC opinion provides the substantive foundation for the review of the management strategy for LCR Chinook.

The anticipated exploitation rate on Lower Columbia River tule Chinook in Council fisheries is 9.8% (Table 8.10.5.5-1). The exploitation rate in Puget Sound fisheries, which included Fraser Panel fisheries, is 0.2%. Some additional harvest occurs in marine fisheries in the environmental baseline in ocean fisheries outside the Council area. The combined exploitation rate from all marine fisheries is 28.7%. The anticipated exploitation rate from all marine and freshwater fisheries in 2008 is 35.8%, and thus well below the 41% limit.

Table 8.10.5.5-1. Expected exploitation rates on Lower Columbia River tule Chinook in 2008 marine area fisheries (PFMC 2008).

Southeast Alaska	**2.1**
British Columbia	**16.4**
Puget Sound	**0.3**
PFMC	**9.8**
Total	**28.7**

Managers responsible for in-river fisheries took NOAA Fisheries' guidance (NMFS 2008i), along with the biological opinion on the Council fisheries (NMFS 2008e), into account when planning the 2008 in-river fishery. The prospective exploitation rate for tule Chinook in the in-river fisheries in 2008 is 7.1%, and thus, when combined with the anticipated exploitation rate from marine area fisheries, complies with the overall limit of 41%. The distribution of fishery impacts between ocean and in-river fisheries, and among in-river fisheries, may be adjusted in-season so long as the total exploitation rate does not exceed 41% in 2008. Managers responsible for in-river fisheries propose to use NOAA Fisheries' guidance, along with the yearly biological opinion on the Council fisheries, into account when planning the 2009-17 in-river fishery seasons.

Effects on Species Status

Prospective improvements in harvest effects support the increased abundance and productivity of spring- and fall-run populations of Lower Columbia River chinook. Harvest levels have been considered in detail in the recent biological opinion for PFMC and Fraser Panel fisheries (NMFS 2008). NOAA Fisheries concluded in that opinion that the proposed total exploitation limit is consistent with the expectation the species' survival and recovery.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for LCR Chinook salmon.

8.10.5.6 Effects of Predation Prospective Actions

Avian predation
The survival of yearling Chinook will increase 2.1% and that of subyearlings will increase at least 0.7% with the reduced Caspian tern nesting habitat in the estuary and the subsequent relocation of most of the terns to sites outside the Columbia River basin (RPA Action 45). Continued implementation and improvement of avian deterrence at Bonneville Dam (RPA Action 48) is also likely to increase juvenile Chinook survival.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous fish predation
The prospective continued increase in incentives in the NPMP (RPA Action 43) will result in an additional 1% survival during the period 2008 to 2018.

Effects on Species Status
Prospective improvements in predation will support the increased abundance and productivity of spring- and fall-run populations of LCR Chinook.

Effects on Critical Habitat
Prospective improvements in predation will improve the functioning of the PCE of safe passage in the migration corridor for yearling Chinook migrants and in rearing areas for subyearling Chinook.

8.10.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRP"S.

8.10.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on Lower Columbia River Chinook Salmon & Critical Habitat

This section summarizes the basis for conclusions at the ESU level and for the rangewide status of critical habitat.

8.10.6.1 Recent Status of the Lower Columbia River Chinook Salmon ESU

Lower Columbia River Chinook salmon is a threatened species. Many of the populations in this ESU currently have low abundance and many of the long-term trends in abundance for individual populations are negative, some severely so. Some of the natural runs (especially the spring Chinook populations in the Cascade and Gorge MPGs) have been replaced largely by hatchery production. The construction of Bonneville Dam in the 1930s inundated spawning and rearing habitat and impeded juvenile and adult migration, significantly limiting the viability of the Gorge Spring and Fall Run MPGs. Flow management and climate changes together have decreased the delivery of suspended particulate matter and fine sediment to the estuary, and flow management and habitat alterations (dikes and revetments) have restricted the processes that create and maintain habitat diversity. These factors have affected populations in the Cascade Fall, Late Fall, and Spring Run and Coastal Fall Run MPGs as well as those above Bonneville Dam. The viability of natural-origin populations has been limited by hatchery practices and by harvest rates that were once as high as 80%. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this ESU. The potential for additional risks due to climate change is described in Section 5.7 and 8.13.

In terms of the primary constituent elements of critical habitat, the ability to support the conservation of the species has been limited by barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development. In the Lewis, Cowlitz, White Salmon, Sandy, and Hood River watersheds, these problems are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.10.3.2). The functioning of mainstem habitat as a juvenile rearing and migration corridor has improved in recent years with habitat restoration projects in the estuary and with the development of the corner collector at Bonneville PH2, respectively. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands within the range of LCR Chinook salmon (Section 8.10.3.7). Some future Federal actions with completed section 7 consultations will restore access to blocked habitat, increase channel complexity, and restore riparian condition. Examples are the removal of Condit Dam on the White Salmon and Powerdale on the Hood River. Many actions will have neutral or short- or even long-term negative effects on habitat conditions, but all were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat.

8.10.6.2 Effects of FCRPS, Upper Snake, & *U.S. v. Oregon* Prospective Actions on Lower Columbia River Chinook & Critical Habitat

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the lower Columbia River, including those populations within the LCR Chinook salmon ESU.[7] In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The FCRPS Action Agencies' estuary habitat restoration projects and relocation of most of the Caspian terns to sites outside the Columbia basin will increase the survival of juvenile Chinook. Implementation of habitat improvement projects in the Hood River watershed will address the loss of historical spawning habitat for that fall-run population, which was inundated by Bonneville pool. Actions that will further improve the viability of the Gorge populations include the continued increase in the northern pikeminnow reward fishery, and continued and improved avian

[7] The State of Oregon is in the process of developing a plan for this species. Upon its review, NOAA Fisheries will combine the Washington and Oregon plans into a complete recovery plan for the Lower Columbia River Recovery Domain.

deterrence at Bonneville Dam, and prospective juvenile and adult passage improvements at Bonneville Dam.

The principal effects of the Prospective Actions on critical habitat will be increases in passage survival at Bonneville Dam and in the estuary with the relocation of Caspian terns (juvenile and adult migration corridors free of obstructions); an increase in the amount and quality of estuarine habitat (for the transitions between fresh- and saltwater, juvenile growth and development before entering the plume, and the final development of adults before they migrate to upstream spawning areas); and an improvement in the functioning of PCEs for spawning, incubation, and rearing for the spring-run Chinook population in the Hood River.

8.10.6.3 Cumulative Effects Relevant to Lower Columbia River Chinook & Critical Habitat

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. These actions will improve the functioning of the PCEs of critical habitat needed for successful spawning, incubation, and the growth and development of juvenile Chinook.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

8.10.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Lower Columbia River Chinook ESU

Impacts of the FCRPS and Upper Snake projects are most significant for the 5 (out of 32) populations that spawn above Bonneville Dam and are limited relative to those from tributary hydropower; tributary habitat; harvest; hatcheries; and predation by birds, fish, and marine mammals. These populations are affected by upstream and downstream passage and, for the fall-run populations, by inundation of spawning habitat. For populations originating in tributaries below Bonneville, only migration and habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydro projects.

The states of Oregon and Washington have identified tributary habitat actions that are reasonably certain to occur and that will benefit the White Salmon and Hood spring-run and the Upper Gorge, White Salmon, and Hood fall-run populations, as well as actions that should be generally beneficial throughout the ESU. Habitat blockages in the Lewis, Cowlitz, Sandy, and Hood watersheds are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.10.3.2). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2 and other improvements. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement of habitat conditions on state forest lands within the range of Lower Columbia River Chinook (Section 8.10.3.7).

NOAA Fisheries considered the effects of harvest on the various life-history types and component populations of the LCR Chinook ESU. LCR spring Chinook populations are managed to meet hatchery escapement goals and to maintain the genetic legacy of populations and support supplementation efforts. Fisheries are managed generally to meet the escapement goals of the North Fork Lewis River “bright” population. This population was below goal in 2007, but has otherwise been well above its escapement goal in the past. The LCR tule Chinook populations are affected by ocean and inriver fisheries. Tule Chinook are managed subject to a total exploitation rate limit for all fisheries. In 2008 the total exploitation rate limit was set by NOAA Fisheries at 41% through its yearly guidance to PFMC. A portion of the total exploitation rate is allocated by the States through PFMC-related processes to the inriver fisheries which are managed subject to U.S. v Oregon.

The effect of this management strategy was recently reviewed through a section 7 consultation on PFMC and Fraser Panel fisheries (NNFS 2008e). NOAA Fisheries concluded that the proposed total exploitation rate was not likely to jeopardize the LCR Chinook salmon ESU. The underlying analysis assumed that the total exploitation rate in 2009 and thereafter would be no more than 41%, but NOAA Fisheries indicated that further reductions in harvest may be forth coming as a consequence of ongoing review and subsequent ESA section 7 consultations. Future total exploitation rates will be set through NOAA Fisheries’ yearly guidance to Council and related consultations. Inriver fisheries will necessarily be managed subject to that guidance.

The FCRPS Action Agencies’ prospective passage improvements at Bonneville Dam, estuary habitat improvements, and predator management improvements will contribute to the viability of this ESU by addressing the influence of their projects, contributing to its survival with an adequate potential for recovery. The prospective habitat work in the Hood River and potential funding for tributary projects for the populations above Bonneville is expected to support the restoration of specific populations within the ESU. The Prospective Actions will not further deteriorate the pre-action condition. Long term (100-year) extinction risk is high or very high for almost all populations in this ESU. Exceptions are the Lewis River fall- and late fall- and the Sandy late fall- and spring-run populations. In the short term, the species’ extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of the nearly extirpated spring-run Chinook populations will continue to be preserved by ongoing hatchery actions as a hedge against short-term risk of extinction.

8.10.6.5 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for Lower Columbia River Chinook

NOAA Fisheries designated critical habitat for LCR Chinook salmon including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Lower Columbia, Grays/Elochoman, Clackamas, and Lower Willamette. The environmental baseline within the action area, which includes the Middle Columbia/Hood and Lower Columbia/Sandy subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for LCR Chinook. The major factors currently limiting the conservation value of critical habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

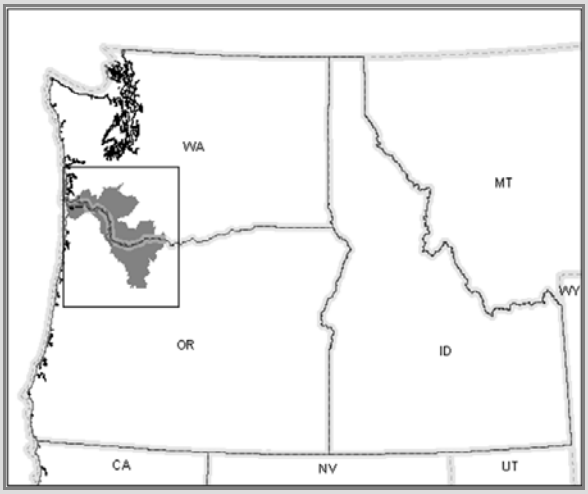
Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat Chinook in the tailrace of Bonneville Dam will do the same for spring-run adults. Habitat work in tributaries used for spawning and rearing in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

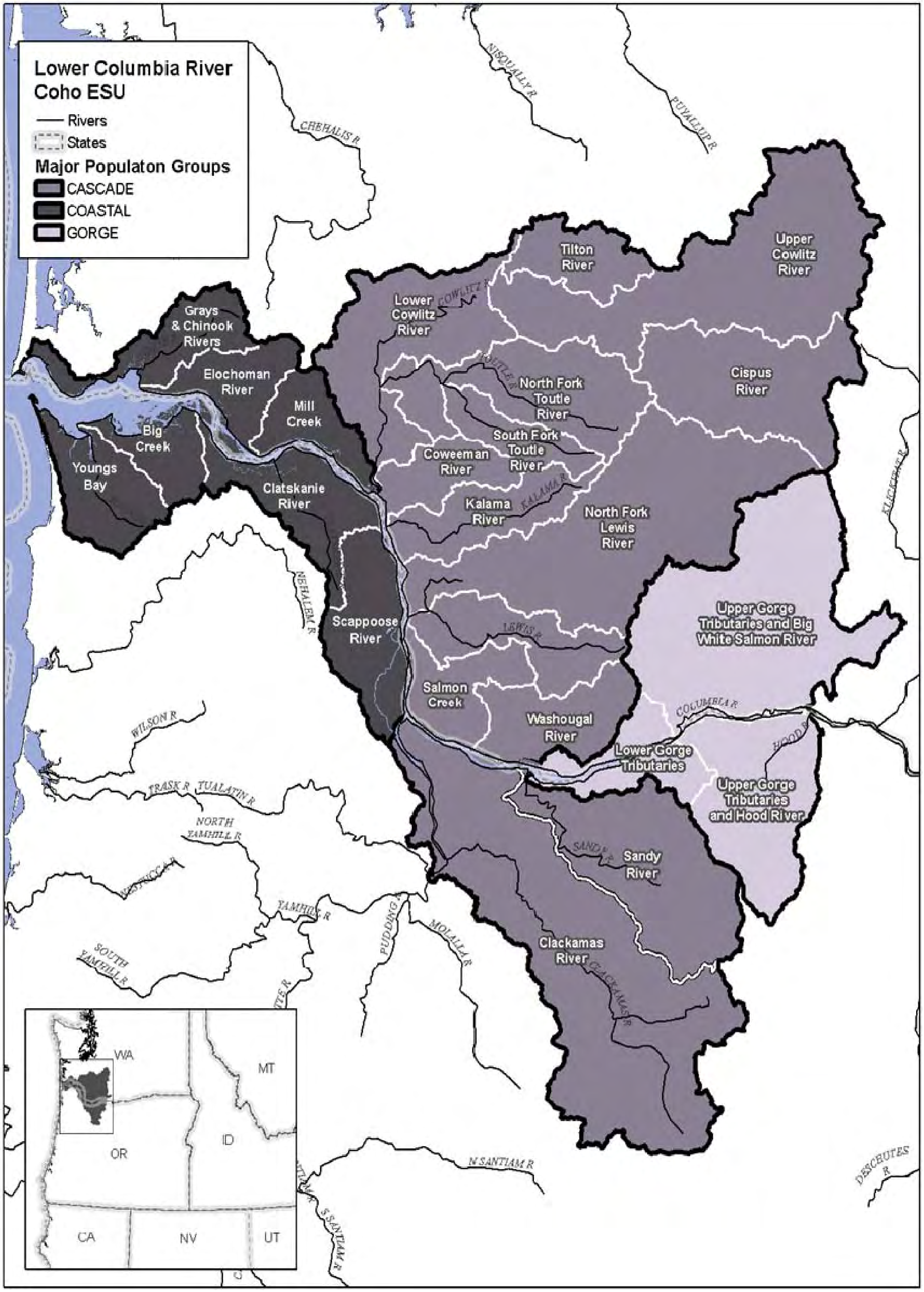
The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs used for spawning, incubation, juvenile growth and development, migration, and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the proposed fisheries will not cause deterioration in the pre-action condition for the species, nor reduce the conservation value of this ESU's designated critical habitat. NOAA Fisheries therefore concludes that the fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Lower Columbia River Chinook salmon ESU nor result in the destruction or adverse modification of designated critical habitat.

Section 8.11
Lower Columbia River Coho Salmon




Lower Columbia River
Coho ESU
Rivers
States
Major Populaton Groups
CASCADE
COASTAL
GORGE
Grays & Chinook Rivers
Elochoman River
Mill Creek
Big Creek
Youngs Bay
Clatskanie River
Scappoose River
Lower Cowlitz River
Tilton River
Upper Cowlitz River
Cispus River
North Fork Toutle River
South Fork Toutle River
Coweeman River
Kalama River
North Fork Lewis River
Salmon Creek
Washougal River
Upper Gorge Tributaries and Big White Salmon River
Lower Gorge Tributaries
Upper Gorge Tributaries and Hood River
Sandy River
Clackamas River
CHEHALIS R
NISQUALLY R
PUYALLUP R
COWLITZ R
TOUTLE R
KALAMA R
LEWIS R
COLUMBIA R
HOOD R
SANDY R
CLACKAMAS R
KLICKITAT R
NEHALEM R
WILSON R
TRASK R
TUALATIN R
NORTH YAMHILL R
YAMHILL R
SOUTH YAMHILL R
PUDDING R
MOLALLA R
N SANTIAM R
S SANTIAM R
DESCHUTES R
WA
MT
OR
ID
CA
NV
UT

Section 8.11
Lower Columbia River Coho Salmon

Species Overview

Background

The Lower Columbia River (LCR) coho salmon ESU includes all naturally spawned coho populations in stream and tributaries to the Columbia River in Washington and Oregon, from the mouth of the Columbia up to and including the White Salmon and Hood rivers, and includes the Willamette to Willamette Falls, Oregon, as well as 25 artificial propagation programs. The ESU includes 24 historical populations in three major population groups. The Lower Columbia River coho salmon ESU was listed as threatened under the ESA in 2005.

NOAA Fisheries has not yet designated critical habitat for this ESU.

Current Status & Recent Trends

Data on the status of natural-origin Lower Columbia River coho salmon are very limited. Most populations have low or very low numbers. Most of the natural runs largely have been replaced by hatchery production.

Limiting Factors

Human impacts and limiting factors for the Lower Columbia River coho salmon include habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and predation. Lower Columbia River coho populations have been in decline for the last 70 years. FCRPS impacts have been limited, but most significant for the two populations that spawn in tributaries above Bonneville Dam. These populations are affected by upstream and downstream passage and, for Oregon populations, by inundation of some historical habitat by Bonneville pool. For populations originating in tributaries below Bonneville, migration and habitat conditions in the mainstem and estuary have been affected by hydrosystem flow operations. Tributary habitat degradation is pervasive due to development and other land uses, and FERC-licensed hydroelectric projects have blocked some spawning areas. Coho populations in the lower Columbia River have been heavily influenced by extensive hatchery releases. While those releases represent a threat to the genetic, ecological, and behavioral diversity of the ESU, some of the hatchery stocks at present also protect a significant portion of the ESU's remaining genetic resources.

Recent Ocean and Mainstem Harvest

Lower Columbia River coho are caught in ocean fisheries and non-Treaty fisheries in the mainstem Columbia River below Bonneville Dam. Previously, Oregon Coast Natural coho were used as a surrogate for estimating ocean fisheries impacts to Lower Columbia River coho. In 2006, largely as a consequence of increased attention resulting from its listing, the methods for assessing harvest in ocean fisheries were changed so that these were more specific to natural-origin Lower Columbia River coho.

Until 1993 the exploitation rates in salmon fisheries on Lower Columbia River coho have been very high, contributing to their decline. The combined ocean and in-river exploitation rates for Lower Columbia River coho averaged 91% through 1983, averaged 68% from 1984-1993, and decreased to an average of 17% from 1994-2007. In 2006 and 2007 ocean and inriver fisheries were managed using an abundance-based harvest rate schedule that depends on brood-year escapement and marine survival. Based on the year-specific circumstances, total exploitation rates were limited to 15% and 20%, respectively. NOAA Fisheries will continue to seek to develop harvest schedules that are consistent with information being developed by the Willamette Lower Columbia Technical Recovery Team and through ongoing hatchery reform and recovery planning efforts.

8.11.2 Current Rangewide Status

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.11.2.1 Current Rangewide Status of the Species

The Lower Columbia River coho salmon ESU includes 24 historical populations in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Although run time variation is inherent to coho life history, the ESU includes two distinct runs: early returning (Type S) and late returning (Type N). Type S coho salmon generally migrate south of the Columbia once they reach the ocean, returning to fresh water in mid-August and to the spawning tributaries in early September. Spawning peaks from mid-October to early November. Type N coho have a northern distribution in the ocean, return to the Columbia River from late September through December and enter the tributaries from October through January. Most Type N spawning occurs from November through January, but some spawning occurs in February and as late as March (LCFRB 2004). Summary data for the ESU are shown in Table 8.11.2.1-1.

Table 8.11.2.1-1. Lower Columbia River coho ESU description and major population groups (MPGs). (Sources: NMFS 2005a; Myers et al. 2006)

ESU Description	
Threatened	Listed under ESA in 2005
3 major population groups	24 historical populations
Major Population Group	**Population**
Coast	Grays, Elochoman, Mill Creek, Youngs Bay, Big Creek, Clatskanie, Scappoose Creek
Cascade	Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon Creek, Washougal, Clackamas, Sandy
Gorge	Lower Gorge, Washington Upper Gorge and (Big)White Salmon River, Oregon Upper Gorge and Hood River
Hatchery programs included in ESU (25)	Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Lewis River Type-N Coho Program,

ESU Description	
	Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Washougal River Type-N Coho Program, Eagle Creek NFH, Sandy Hatchery, and the Bonneville/ Cascade/Oxbow complex coho hatchery programs.

Human impacts and current limiting factors for this ESU come from multiple sources: habitat degradation, habitat blockage by FERC-licensed dams in several subbasins, harvest, hatchery effects, ecological factors including predation, and Bonneville Dam passage for some populations (see Table 8.11.2.1-2).

Limiting Factors

Summarized below (Table 8.11.2.1-2) are key limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. Oregon is currently engaged in the recovery planning process for Lower Columbia River coho.

Table 8.11.2.1-2. Key limiting factors for Lower Columbia River coho.

Mainstem Hydro	Direct mainstem hydro impacts on lower Columbia River ESUs are most significant for the two gorge tributary populations upstream from Bonneville Dam (WA Upper Gorge and [Big] White Salmon River; OR Upper Gorge and Hood River). These populations are affected by upstream and downstream passage at Bonneville Dam and by inundation of historical habitat at the lower ends of the smaller tributaries by the reservoir (WLCTRT 2004, McElhany et al. 2007). On the Oregon side of the gorge, the tributary streams are especially short and end at impassable waterfalls. Federal hydrosystem impacts on populations originating in downstream subbasins are limited to effects on migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.
Predation	Piscivorous birds including Caspian terns and cormorants, and fishes including northern pikeminnow, take significant number of juvenile salmon. As stream-type juveniles, coho are probably vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid channel areas located near habitat preferred by piscivorous birds (Fresh et al 2005). PIT-tagged coho smolts (originating above Bonneville Dam) were second only to steelhead in predation rates at the East Sand Island colony in 2007 (Roby et al. 2008). Pikeminnow are significant predators of yearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas and a sport reward fishery to control numbers of pikeminnow.
Harvest	Lower Columbia River coho are harvested in the ocean and in Columbia

	River and tributary freshwater fisheries of Oregon and Washington. Incidental take of coho salmon prior to the 1990s fluctuated from approximately 60 to 90%, but has been reduced since listing to 15 to 25% (LCFRB 2004). The exploitation of hatchery coho has remained approximately 50% through the use of selective fisheries.
Hatcheries	Coho hatchery programs in the lower Columbia have been tasked to compensate for impacts of fisheries. Important genetic resources can reside in hatcheries and 25 hatchery programs are included in the LCR coho ESU (NMFS 2005a). However, hatchery programs in the LCR have not operated specifically to conserve LCR coho, and these programs threaten the viability of natural populations. The long-term domestication of hatchery fish has eroded the fitness of these fish in the wild and has reduced the productivity of wild stocks where significant numbers of hatchery fish spawn with wild fish. Large numbers of hatchery fish have also contributed to more intensive mixed stock fisheries, which probably overexploited wild populations weakened by habitat degradation. Most LCR coho populations have been heavily influenced by hatchery production over the years. State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is an important habitat for migrating juveniles from LCR coho populations. Due to a short residence time in the estuary, stream-type juveniles such as coho have limited mortality associated with a scarcity of habitat, changes in food availability, and the presence of contaminants. However, they are particularly vulnerable to bird predation in the estuary (see above). Coho are likely to be affected by flow and sediment delivery changes in the plume, although mechanisms have not been determined (Casillas 1999). Estuary limiting factors and recovery actions are addressed in detail in a comprehensive regional planning process (NMFS 2006b).
Habitat	Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for coho by reach in all Washington subbasins. Similar information is in development for Oregon subbasins.

Ocean & Climate	Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this ESU to some extent, future trends, especially during the period relevant to the Proposed Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).

Abundance, Productivity, and Trends

Data on the status of LCR coho salmon are very limited. As indicated in Table 8.11.2.1-3, population-specific abundance estimates are available for only five populations and trend estimates for only two. Base status information was reported in NOAA Fisheries' most recent status review (Good et al. 2005). Draft status assessments were updated for Oregon populations in a more recent review (McElhany et al. 2007). In many cases, populations have low current abundance and natural runs have been extensively replaced by hatchery production. Time series are not available for Washington coho populations.

Table 8.11.2.1-3. Abundance, productivity, and trends of LCR coho populations. (Sources: Good et al. 2005 and Myers et al. 2006)

Strata	Population	St.	Recent Abundance of Natural Spawners			Long-term trend		Median Growth Rate	
			Years[1]	No.[2]	pHOS[3]	Years	Value[4]	Years	λ[5]
Coast	Grays	W	na	na	na	na	na	na	na
	Elochoman	W	na	na	na	na	na	na	na
	Mill Creek	W	na	na	na	na	na	na	na
	Youngs Bay & Big Creek	O	2002	4,473	91%	na	na	na	na
	Clatskanie	O	na	na	na	na	na	na	na
	Scappoose	O	2002	458	0%	na	na	na	na
Cascade	Lower Cowlitz	W	na	na	na	na	na	na	na
	Coweeman	W	na	na	na	na	na	na	na
	SF Toutle	W	na	na	na	na	na	na	na
	NF Toutle	W	na	na	na	na	na	na	na

Strata	Population	St.	Recent Abundance of Natural Spawners			Long-term trend		Median Growth Rate	
			Years[1]	No.[2]	pHOS[3]	Years	Value[4]	Years	λ[5]
	Upper Cowlitz	W	na	na	na	na	na	na	na
	Cispus	W	na	na	na	na	na	na	na
	Tilton	W	na	na	na	na	na	na	na
	Kalama	W	na	na	na	na	na	na	na
	NF Lewis	W	na	na	na	na	na	na	na
	EF Lewis	W	na	na	na	na	na	na	na
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	na	na	na	na	na	na	na
	Clackamas	O	90-05	482	25%	90-05	1.029	90-05	1.01
	Sandy	O	90-05	482	17%	90-05	1.029	90-05	1.01
Gorge	Lower Gorge Tribs & White Salmon	O/W	na	na	na	na	na	na	na
	Upper Gorge Tribs & Hood River	O/W	2000	1,317[6]	>65[7]	na	na	na	na

Note:
Myers et al. (2006) identified Youngs Bay and Big Creek as demographically independent populations in the Coast MPG and described the following three populations in the Gorge MPG: Lower Gorge, Washington Upper Gorge and White Salmon, Oregon Upper Gorge and Hood River.
[1] Years of data for recent means
[2] Geometric mean of total spawners
[3] Average recent proportion of hatchery-origin spawners
[4] Long-term trend of total spawners
[5] Long-term median population growth rate (including both natural- and hatchery-origin spawners)
[6] Number of natural spawners for Hood River combined with Upper Gorge – Oregon, only
[7] Contains an unknown (i.e., unmarked) additional fraction of hatchery-origin coho from upstream releases

Steel and Sheer (2003) as cited in WLCTRT 2003 analyzed the number of stream kilometers historically and currently available to salmon populations in the lower Columbia River (Table 8.11.2.1-4). Stream kilometers usable by salmon are determined based on simple gradient cutoffs and on the presence of impassable barriers. This approach overestimates the number of usable stream kilometers, because it does not account for aspects of habitat quality other than gradient. However, the analysis does indicate that the number of kilometers of stream habitat currently accessible is greatly reduced from the historical condition for some populations. Hydroelectric projects in the Cowlitz, North Fork Lewis, and White Salmon rivers have greatly reduced or eliminated access to upstream production areas and therefore extirpated some of the affected populations.

Table 8.11.2.1-4. Current and historically available habitat located below barriers in the Lower Columbia River coho salmon ESU.

Population	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
Youngs Bay	178	195	91
Grays River	133	133	100
Big Creek	92	129	71
Elochoman River	85	116	74
Clatskanie River	159	159	100
Mill, Germany, Abernathy Creeks	117	123	96
Scappoose Creek	122	157	78
Cispus River	0	76	0
Tilton River	0	93	0
Upper Cowlitz River	4	276	1
Lower Cowlitz River	418	919	45
North Fork Toutle River	209	330	63
South Fork Toutle River	82	92	89
Coweeman River	61	71	86
Kalama River	78	83	94
North Fork Lewis River	115	525	22
East Fork Lewis River	239	315	76
Clackamas River	568	613	93
Salmon Creek	222	252	88
Sandy River	227	286	79
Washougal River	84	164	51
Lower Gorge Tributaries	34	35	99
Upper Gorge Tributaries	23	27	84
White Salmon River	0	71	0

Population	Potential Current Habitat (km)	Potential Historical Habitat (km)	Current/ Historical Habitat Ratio (%)
Hood River	35	35	100
Total	3,286	5,272	62

The abundance of coho returning to the Lower Columbia River from 2001 to 2007 ranged from 318,600 to more than 1,108,300, with most of the abundance comprised of hatchery fish (PFMC 2008). At present, the Lower Columbia River coho hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short-term but is of uncertain contribution in the long term (NMFS 2004d).

Natural-origin fish are defined as those whose parents spawned in the wild, while hatchery-origin fish are defined as those whose parents were spawned in a hatchery. There is still significant coho production in the Clackamas and Sandy rivers. Good et al. (2005) reports that there appeared to be little natural production from other populations (References for abundance time series and related data are in Appendix C.5.2 in Good et al. (2005). More recent information indicates that there may have been more spawning and natural-origin production than previously thought.

Recent information from the WLC TRT describing methods used to assess species status and preliminary reports from application of these methods is contained in a review draft report on viability criteria (WLCTRT 2006). An additional review draft report related to the status of the Oregon populations of the Lower Columbia River coho salmon ESU has recently been released (June 2007) for public comment (McElhany et al. 2007).

Oregon Populations

Clackamas

Presently, the Clackamas River population above the North Fork Dam is one of only two populations in the ESU for which natural production trends can be estimated. The portion of the population above the dam has a relatively low fraction of hatchery-origin spawners, while they dominate the area below the dam. A 2002 stratified random survey by ODFW estimated a total of 2,402 coho spawning in the Clackamas River below North Fork Dam (WLCTRT 2003). The survey estimated that 78% of the fish observed were of hatchery origin. Counts at North Fork Dam in 2002 indicate a total of 998 coho went above the dam and 12% of those were of hatchery origin. Also, 100% of coho sampled in Clear Creek (a lower Clackamas River tributary) were of natural origin (Brown et al. 2003, cited Good et al. 2005).

The number of adult coho salmon returns to the North Fork Dam is shown in Figure 8.11.2.1-1 and Table 8.11.2.1-5. Prior to 1973, hatchery-origin adults and juveniles were released above North Fork Dam, and the time series from 1957-1972 contains an unknown fraction of hatchery-origin spawners.

The adult return of coho to the North Fork Dam has been highly variable over the last 50 years, but without an apparent trend.

Figure 8.11.2.1-1. Clackamas North Fork Dam counts of adult (3-year-old) coho salmon, 1957–2007 (TAC 2008).

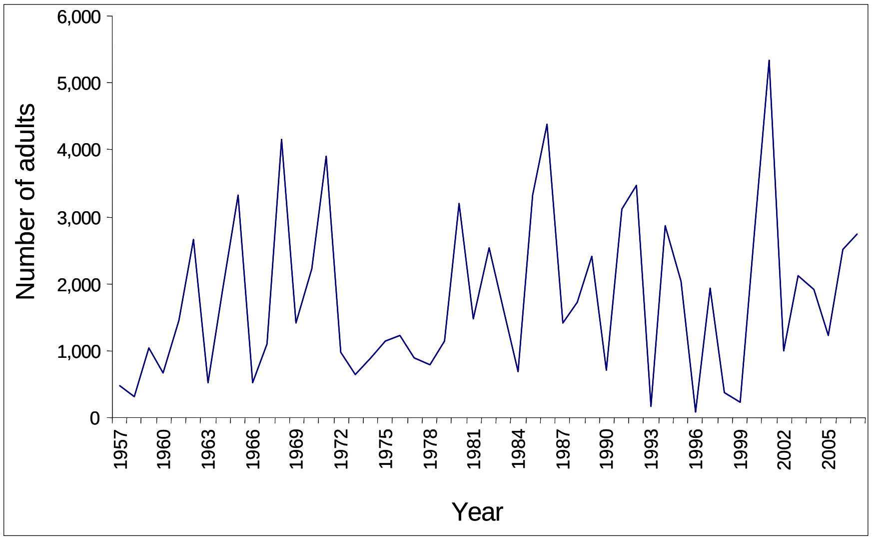


Table 8.11.2.1-5. Abundance of wild Clackamas coho, 1957-2007 (TAC 2008). 2007 data are only through December 31 and are preliminary. The run will not be complete until March 2008 (TAC 2008).

Year	Adult count	Jack count	Total count
1957	484	114	598
1958	309	213	522
1959	1,046	284	1,330
1960	670	1,515	2,185
1961	1,449	740	2,189
1962	2,665	454	3,119
1963	513	1,366	1,879
1964	1,879	597	2,476
1965	3,312	625	3,937
1966	527	250	777
1967	1,096	402	1,498
1968	4,154	542	4,696
1969	1,420	434	1,854
1970	2,220	531	2,751

Year	Adult count	Jack count	Total count
1971	3,912	183	4,095
1972	978	116	1,094
1973	644	96	740
1974	901	36	937
1975	1,133	56	1,189
1976	1,215	19	1,234
1977	893	49	942
1978	790	57	847
1979	1,138	47	1,185
1980	3,192	50	3,242
1981	1,469	112	1,581
1982	2,543	405	2,948
1983	1,599	78	1,677
1984	683	83	766
1985	3,314	592	3,906
1986	4,373	214	4,587
1987	1,402	318	1,720
1988	1,714	210	1,924
1989	2,413	231	2,644
1990	709	162	871
1991	3,123	317	3,440
1992	3,476	210	3,686
1993	168	31	199
1994	2,873	54	2,927
1995	2,036	69	2,105
1996	88	1	89
1997	1,935	37	1,972
1998	367	15	382
1999	238	61	299
2000	2,833	146	2,979
2001	5,344	184	5,528
2002	998	139	1,137

Year	Adult count	Jack count	Total count
2003	2,117	194	2,311
2004	1,915	124	2,039
2005	1,168	152	1,320
2006	2,505	176	2,681
2007	2,739	57	2,796

Since almost all Lower Columbia River coho females and most males spawn at 3 years of age, a strong cohort structure is produced. Figure 8.11.2.1-2 shows returns from the three adult cohorts on the Clackamas. Figure 8.11.2.1-2 also shows a pattern that is highly variable, but without an obvious or significant trend for the respective cohorts with the possible exception of cohort "C."

Estimates of smolt out-migration measured at North Fork Dam on the Clackamas also indicate variable, but generally stable production. There was a recent period in the late 1990s where smolt production was reduced followed by higher counts in the first half of this decade (Figure 8.11.2.1-3).

Sandy

The Sandy River population above Marmot Dam is the only other population in the Lower Columbia River coho salmon ESU for which natural production trends can be estimated. The portion of the Sandy River population above Marmot Dam has almost no hatchery-origin spawners, while they dominate the area below the dam (Good et al. 2005). The number of adult coho salmon passing above Marmot Dam is shown in Figure 8.11.2.1-4 and Table 8.11.2.1-6. The abundance of Sandy River coho declined substantially through much of the decade of the 1990s. Returns over the last two brood cycles since 2000 have been substantially higher (Figure 8.11.2.1-4).

Figure 8.11.2.1-2. Clackamas North Fork Dam counts of adult (3-year-old) coho salmon by cohort, 1957-2002. Cohort A, cohort B and cohort C (TAC 2008).

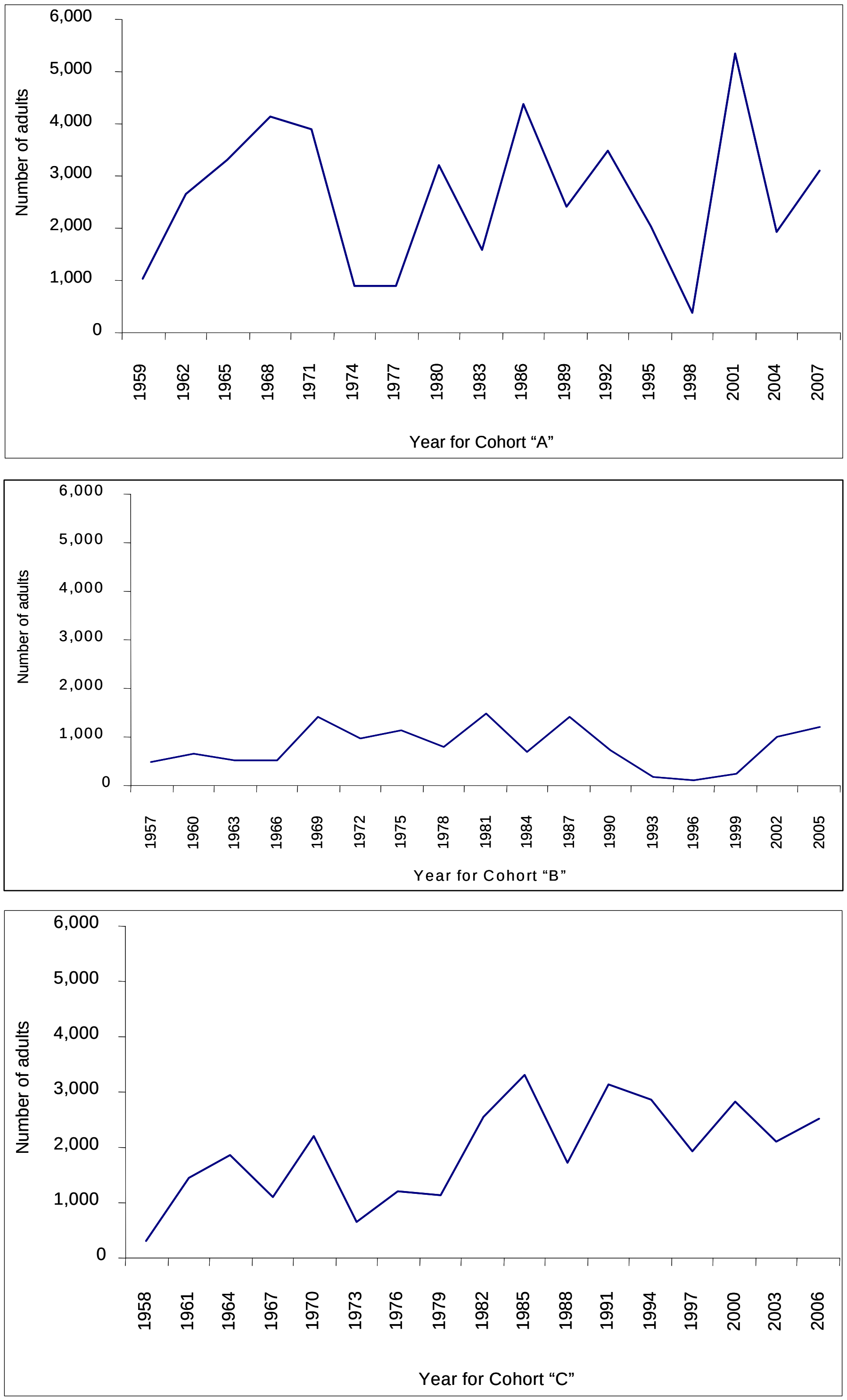


Figure 8.11.2.1-3 Total outmigrating juvenile coho passing Clackamas North Fork Dam (TAC 2008)

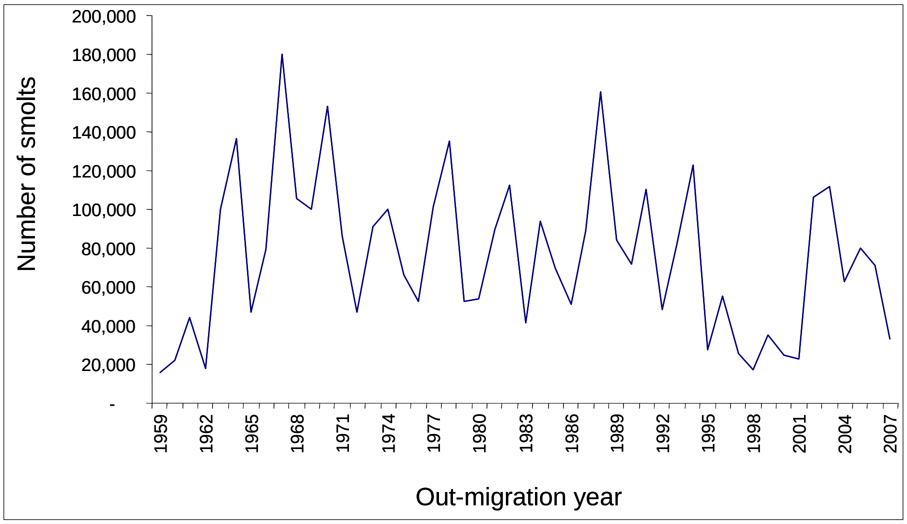


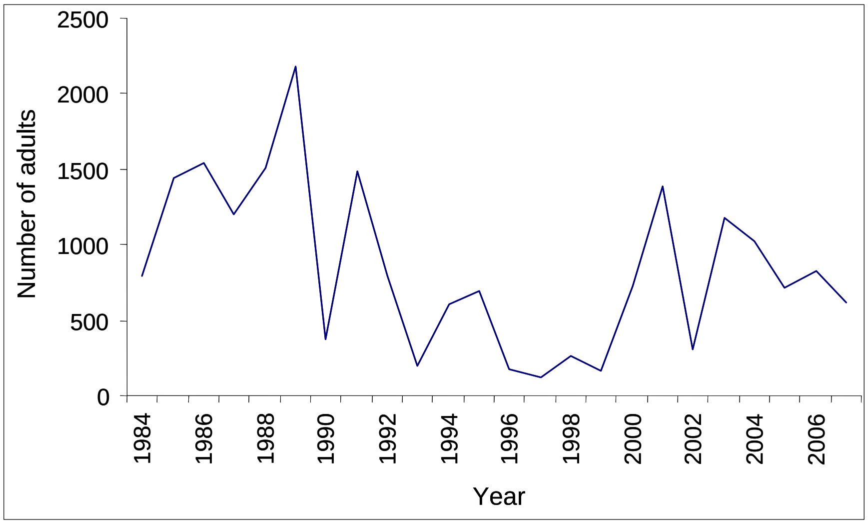
Table 8.11.2.1-6. Abundance of wild Sandy coho, 1957-2006. No data are available for some years. (TAC 2008).

Year	Adult count	Jack count	Total count
1957			264
1958			330
1959			68
1960			1670
1961			1733
1962			1458
1963			2199
1964			1126
1965			1018
1966	162	67	229
1967	386	283	669
1968	841	440	1281
1969	411	305	716
1970			
1971			
1972			
1973			

Year	Adult count	Jack count	Total count
1974			
1975			
1976			
1977			283
1978			426
1979			682
1980			635
1981			620
1982	722	20	742
1983	26	34	60
1984	798	8	806
1985	1445	27	1472
1986	1546	48	1594
1987	1205	198	1403
1988	1506	84	1590
1989	2182	113	2295
1990	376	80	456
1991	1491	1	1492
1992	790	55	845
1993	193	27	220
1994	601	47	648
1995	697	19	716
1996	181	0	181
1997	116	0	116
1998	261	0	261
1999	162	19	181
2000	730	12	742
2001	1388	8	1396
2002	310	1	311
2003	1173	26	1199
2004	1025	7	1032
2005	717	28	745

Year	Adult count	Jack count	Total count
2006	822	13	835
2007	617	0	617

Figure 8.11.2.1-4. Count of adult coho salmon at the Marmot Dam on the Sandy River. Almost all spawners above Marmot Dam are natural origin (TAC 2008).



Other Oregon Populations

ODFW recently initiated an effort to obtain abundance estimates for more Lower Columbia River coho populations using a random stratified sampling protocol (i.e., similar to that used to estimate abundance of Oregon Coastal coho salmon). Results from this survey are presented in Table 8.11.2.1-7. Information related to the proportion of these fish that are of hatchery origin is limited or completely unavailable. Estimates of percent hatchery in 2002 for the Scappoose, Clatskanie, Upper Gorge tributaries, and Youngs Bay and Big Creek are 0%, 60%, 65%, and 91%, respectively. These surveys suggest that hatchery-origin spawners dominate Lower Columbia River ESU coho populations in Oregon, but there are appear to be pockets of natural production.

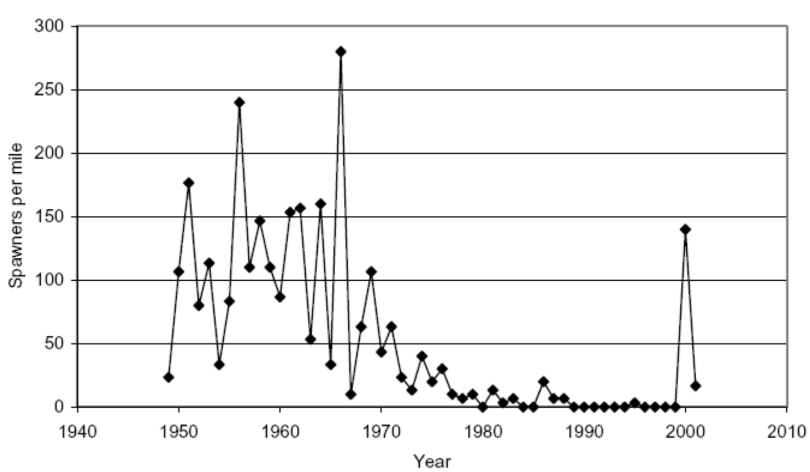
Prior to these recent intensive surveys, ODFW conducted coho salmon spawner surveys in the lower Columbia River. These surveys were combined to obtain spawners-per-mile information at the scale of the population units (Figures 8.11.2.1-4a-d) (Good et al. 2005). In many years over the last two decades, these surveys have reported no natural-origin coho salmon spawners. Based on the spawners-per-mile survey data, previous assessments have concluded that coho salmon in these populations are extinct or nearly so (ODFW 1999, Good et al. 2005). The estimates of a few hundred spawners in each of the Oregon-side populations in the recent years suggests that these areas have been recolonized or that prior spawning surveys missed fish that were nonetheless present.

Table 8.11.2.1-7. Recent abundance of wild coho in other Oregon population areas (TAC 2008).

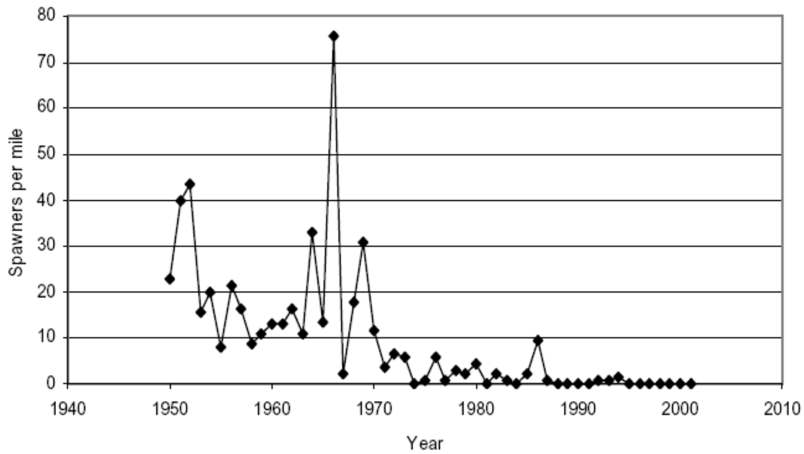
Year	Astoria Area		Clatskanie	Scappoose[1]	Gorge and Hood	
	Youngs Bay	Big Creek[1]			Lower Gorge	Hood[1]
1999	0		0	23	22	
2000	285		66	55	19	
2001	171		131	375	40	
2002	364	125	520	453	338	147
2003	45	190	357	317	NA	41
2004	128	124	758	719	NA	126
2005	77	240	348	336	263	1,262
2006	NA	252	747	689	226	373
2007	NA	216	357	333	NA	352

[1] Counts in Big Creek, Scappoose and Hood are a combination of weir/dam counts and spawning ground counts. Dam counts at the weirs/dams are of unmarked fish; spawning ground counts are wild fish based on mark and scale data.

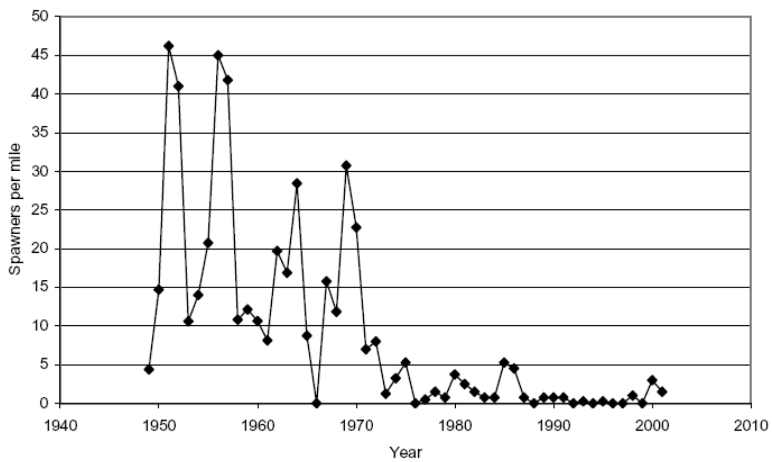
Figures 8.11.2.1-4a. Youngs Bay coho salmon spawners per mile, 1949–2001.



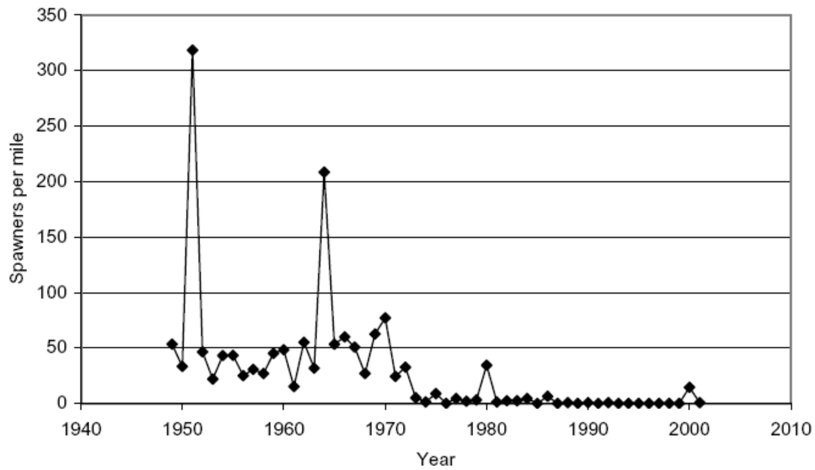
Figures 8.11.2.1-4b. Big Creek coho salmon spawners per mile, 1949–2001.



Figures 8.11.2.1-4c. Clatskanie River coho salmon spawners per mile, 1949–2001.



Figures 8.11.2.1-4d. Scappoose River spawners per mile, 1949–2001.



Abundance estimates for Oregon populations of the Lower Columbia River coho ESU can be compared to available abundance criteria. The WLC TRT defines a reproductive failure threshold (RFT) and quasi-extinction threshold (QET) (WLCTRT 2006). At very low abundance, populations may experience a decrease in reproductive success because of factors such as the inability to find mates, random demographic effects (the variation in individual reproduction become important), changes in predator-prey interactions, and other "Allee" effects. The reproductive failure threshold (RFT) is used to define an abundance below which no recruitment is assumed to occur.

The Interim Regional Lower Columbia Salmon Recovery Plan provides preliminary estimates of minimum abundance levels associated with viable status (LCFRB 2004). Table 8.11.2.1-8 lists the RFT/QET and viability abundance levels for Oregon population of the Lower Columbia River coho salmon ESU.

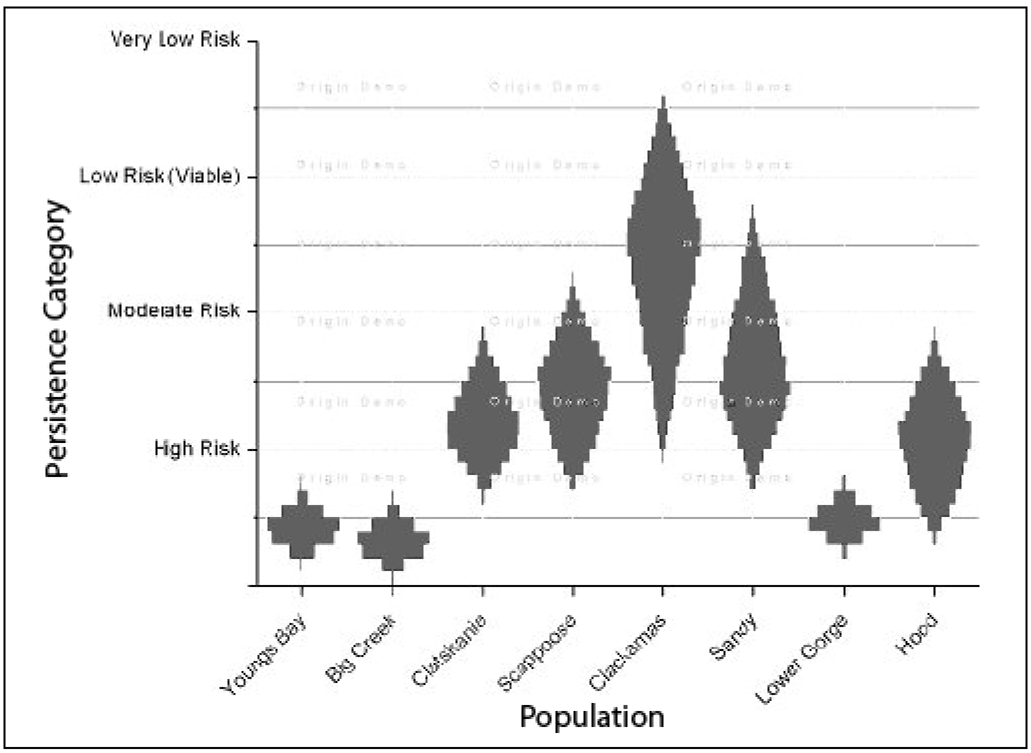
Table 8.11.2.1-8. RFT/QET and Minimum Viability Abundance Thresholds for Oregon population of the Lower Columbia River coho salmon ESU.

Population	RFT/QET WLCTRT (2006)	Minimum Viability Abundance LCFRB (2004)
Clackamas	200	600
Sandy	300	600
Big Creek	100	600
Youngs Bay	100	600
Clatskanie	200	600
Scappoose	200	600
Lower Gorge Tributaries	100	600
Hood River	200	600

In recent years at least, all the Oregon populations have been above the RFT/QET levels. The Clackamas has been well above the minimum viability abundance level; the Sandy has been above the viability abundance level at least in recent years.

The WLC TRT and ODFW recently reviewed the status of the Oregon population of the Lower Columbia River coho salmon ESU (WLCTRT 2006). They evaluated information related to measures of abundance, productivity, spatial structure and diversity criteria. The methods used are discussed in the draft report in some detail (WLCTRT 2006). The report provides an overall summary of population status for the Oregon population of the Lower Columbia River coho salmon ESU (Figure 8.11.2.1-5). The results generally indicate that many of the populations are currently at high risk with none being in a desirable low risk status.

Figure 8.11.2.1-5. Overall summary of population status for Oregon LCR coho populations.



Washington Populations

Hatchery production also dominates the Washington populations of Lower Columbia River coho; the majority of spawners believed to be hatchery strays. There are no estimates of spawner abundance for these populations, but WDFW began trapping outmigrating juvenile coho several years ago, and these data indicate that natural production (albeit of hatchery-origin fish) is occurring in several areas (Table 8.11.2.1-9).

There is no direct way to determine whether these populations would be naturally self-sustaining in the absence of hatchery-origin spawners. WDFW suggests that juvenile outmigrant production seen in the monitored streams is typical of other Washington Lower Columbia River ESU streams and that a substantial number of natural-origin spawners may return to the lower Columbia River each year, but are not observed because there is no monitoring for coho on the Washington side.

Table 8.11.2.1-9. Estimates of natural coho salmon juvenile outmigrants from Washington Lower Columbia River streams (TAC 2008).

Out-migrant Year	Cedar Creek	Mill Creek	Abernathy Creek	Germany Creek	East Fork Lewis River	Cowlitz Falls Dam	Mayfield Dam
1997						3,700	700
1998	38,400					110,000	16,700
1999	28,000					15,100	9,700
2000	20,300				4,514-9,028	106,900	23,500
2001	24,200	6,300	6,500	8,200		334,700	82,200
2002	35,000	8,200	5,400	4,300		166,800	11,900
2003	36,700	10,500	9,600	6,200		403,600	38,900
2004	37,000	5,700	6,400	5,100		396,200	36,100
2005	58,300	11,400	9,000	4,900		766,100	40,900
2006	46,000	6,700	4,400	2,300		370,000	33,600
2007	29,300	7,000	3,300	2,300		277,400	34,200

Estimates are based on expansions from smolt traps, not total census. Cedar Creek is a tributary of the North Fork Lewis River population. Mill, Germany and Abernathy Creeks are combined into a single population unit for TRT analysis. The Cowlitz River above Cowlitz Falls is partitioned into three independent populations (Upper Cowlitz, Cispus, and Tilton Rivers). The East Fork Lewis River estimate shows a range based on uncertainties about trap efficiency.

The Washington Department of Fish and Wildlife used the estimates of smolt production from monitored streams to estimate the total smolt production from the Washington portion of the Lower Columbia River coho salmon ESU in 2007 (Volkhardt et al. 2008). The estimate of total natural-origin smolt production in 2007 was 476,100 (Table 8.11.2.1-10).

Table 8.11.2.1-10. Estimated smolt production from streams with hatcheries, streams without hatcheries, minimum abundance from monitored streams, and predicted smolt abundance for the Washington-side of the LCR ESU (Volkhardt et al. 2008).

Node	Smolt Abundance			Smolt Density (smolts/sq. mile)		
	5.00%	Median	95.00%	5.00%	Median	95.00%
Unmonitored H_streams	193,700	200,100	206,800	233	241	249
Unmonitored W_streams	79,460	82,520	85,810	128	133	138
Monitored Streams	191,200	193,400	195,800			
Natural-origin Smolt Prediction	467,900	476,100	484,900			

These smolt production estimates, in combination with estimates of marine survival, were used to develop estimates of adult returns of natural-origin Lower Columbia River coho of 9,500 to the Washington side of the ESU (PFMC 2008). This was combined with estimates of 3,900 natural-origin Lower Columbia River coho to the Oregon side of the ESU, for a total of 13,400 natural-origin adults returning in 2008 (PFMC 2008).

This natural-origin production includes a mix of fish from streams that have a substantial amount of hatchery-origin strays and others where hatchery straying is believed to be relatively limited. Information gathered over the last several years suggests there is more coho production on both the Washington and Oregon-side streams than previously believed and that coho production in the ESU is not limited to that which occurs in the Clackamas and Sandy rivers

The populations above Cowlitz Falls on the Cowlitz River (Upper Cowlitz, Cispus, and Tilton Rivers) are also suitable for natural coho production (Table 8.11.2.1-9). However, these populations are not currently considered self-sustaining. Three dams block anadromous passage to the upper Cowlitz River. Currently, adult coho salmon (some of hatchery origin) are collected below the lower dam (Mayfield Dam) and trucked to the area above the upper dam (Cowlitz Falls Dam). There has been no appreciable downstream passage through the dams, so juvenile outmigrants were collected at Cowlitz Falls Dam and trucked below Mayfield Dam. The collection efficiency of outmigrating juveniles was 40–60% and spawners could replace themselves. Thus, hatchery production (in addition to the trap-and-haul operation) has maintained the populations. The new FERC license for the project requires the development of new passage facilities. Hatchery programs will be reformed, but production will continue (see “Spatial Structure,” (below).

Preliminary viability and recovery goals have been established by WLC TRT (2004) and Lower Columbia Fish Recovery Board (LCRFB) and are presented in Table 8.11.2.1-10. The method used to establish recovery goals is described in LCFRB (2004). It should be noted that the viability goal assumes no hatchery fish presence, and average ocean conditions. Due to resource constraints, the recovery goals for coho salmon made assumptions that the spatial distribution of coho was the same as that of steelhead, which probably under-estimates the actual coho salmon distribution. WDFW and LCFRB are currently developing more specific information to be included in the recovery plan for the Lower Columbia River coho. The coho viability goals for abundance therefore should be considered preliminary.

Table 8.11.2.1-11. The ecological zones (strata) and populations for the Lower Columbia River coho salmon ESU(LCFRB 2004). Primary (P), contributing (C), and stabilizing (S) population designations for the recovery scenario. Respective target viabilities are high or better, medium, and no lower than current levels. Primary populations identified for greater than high viability objectives are denoted with an '*'.

Population/Strata	Status/Goal [1]	Abundance Range		Viability	
		Viable	Potential	Current	Goal
COASTAL					
Grays /Chinook (WA)	P	600	4,600	Low	High
Mill, Germany, Abernathy (WA)	C	600	3,700	Low	Med
Elochoman/Skamokawa (WA	P	600	7,000	Low	High
Youngs Bay (OR))	S	600	1,200	na	Low
Big Creek (OR)	P	600	1,200	na	High
Clatskanie (OR)	S	600	1,200	na	Low
Scappoose (OR)	P	600	1,200	na	High
CASCADE					
Upper Cowlitz (WA)	P	600	28,800	V Low	Med
Lower Cowlitz (WA)	C	600	19,100	Low	High
Cispus (WA)	C	600	6,600	V Low	Med
Tilton (WA)	C	600	4,000	V Low	Low
South Fork Toutle (WA)	P	600	32,900	Low	High
North Fork Toutle (WA)	P	600	1,200	Low	High
Coweeman (WA)	P	600	7,600	Low	High
Kalama (WA)	C	600	1,300	Low	Med
North Fork Lewis (WA)	C	600	5,900	Low	High
East Fork Lewis (WA)	P	600	4,100	Low	High
Salmon Creek (WA)	S	600	5,700	V Low	V Low
Washougal (WA)	C	600	4,200	Low	Med

Population/Strata	Status/Goal [1]	Abundance Range		Viability	
		Viable	Potential	Current	Goal
Sandy (OR)	P*	600	1,200	na	High+
Clackamas (OR)	P*	600	1,200	na	High+
GORGE					
Lower Gorge Tributaries (WA)	P	600	1,200	Low	High
Upper Gorge Tributaries (WA)	P	600	1,100	Low	High
White Salmon (WA)	C	600	1,200	V Low	Low
Hood River (OR)	C	600	1,200	na	Med

[1] **Primary populations** are those that would be restored to high or "high+" viability. At least two populations per strata must be at high or better viability to meet recommended TRT criteria. Primary populations typically, but not always, include those of high significance and medium viability. In several instances, populations with low or very low current viability were designated as primary populations in order to achieve viable strata and ESU conditions. In addition, where factors suggest that a greater than high viability level can be achieved, populations have been designated as High+. High+ indicates that the population is targeted to reach a viability level between High and Very High levels as defined by the TRT.
Contributing populations are those for which some restoration will be needed to achieve a stratum-wide average of medium viability. Contributing populations might include those of low to medium significance and viability where improvements can be expected to contribute to recovery.
Stabilizing populations are those that would be maintained at current levels (likely to be low viability). Stabilizing populations might include those where significance is low, feasibility is low, and uncertainty is high.

Extinction Probability/Risk

The 100-year risk of extinction (8.11.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (WLCTRT 2004) for use in recovery plan assessments. The rating system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 8.11.2.1-12. Risk of extinction in 100 years categories for populations of LCR coho (sources: Washington's Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strata	Population	State	Extinction Risk Category
Coast	Grays	W	H
	Elochoman	W	H
	Mill Creek	W	H
	Youngs Bay	O	VH

Strata	Population	State	Extinction Risk Category
	Big Creek	O	VH
	Clatskanie	O	H
	Scappoose	O	H
Cascade	Lower Cowlitz	W	H
	Coweeman	W	H
	SF Toutle	W	H
	NF Toutle	W	H
	Upper Cowlitz	W	VH
	Cispus	W	VH
	Tilton	W	VH
	Kalama	W	H
	NF Lewis	W	H
	EF Lewis	W	H
	Salmon	W	VH
	Washougal	W	H
	Clackamas	O	L
	Sandy	O	H
Gorge	Lower Gorge	O/W	VH/H
	WA Upper Gorge and White Salmon River	W	VH
	OR Upper Gorge and Hood River	O	VH

Spatial Structure

The LCR coho ESU consists of three MPGs made up of three to 14 populations each. Spatial structure has been substantially reduced by the loss of access to the upper portions of some basins due to tributary hydro development. Examples are the complete barrier at Condit Dam on the (Big) White Salmon River and delay and injury associated with inadequate passage facilities at Powerdale Dam on the Hood River (FERC-licensed hydropower projects; see Section 8.11.3.2, Environmental Baseline, Tributary Habitat for effects of their scheduled removals). Key coho production areas in the Cowlitz and North Fork Lewis River have been taken out of production due to utility projects. In addition, inundation of historical habitat when Bonneville pool was filled diminished the spatial structure of the Gorge population spawning in the smaller tributary streams above Bonneville Dam.

The following FERC-licensed projects, which although not in the action area do affect rangewide status, will either be removed or become passable, allowing the affected populations to re-occupy historical habitat:

- Bull Run (Little Sandy dam.) – removal by 2008 (NMFS 2003d) will improve passage for the coho population into the upper Sandy watershed (Marmot dam was removed in 2007.)

- Lewis River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2007f), a first step toward restoring the North Fork Lewis River coho population

- Cowlitz River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2004c), supporting restoration of the Cowlitz, Cispus, and Tilton coho populations

The Federal Energy Regulatory Commission's (FERC) licenses for the Lewis and Cowlitz river hydroelectric projects require their respective owners/operators to operate hatchery programs. PacifiCorps and Cowlitz PUD operate a hatchery program to support a naturally-spawning, harvestable population of coho salmon throughout its historical range in the North Fork Lewis basin. Tacoma Power operates a conservation hatchery program that is supplementing natural origin and adult coho from naturally spawning hatchery fish now returning to the upper Cowlitz Basin. The North Fork Lewis program is in its very early stages and it is too early to conclude that it will increase overall abundance as well as the spatial structure coho in the Lewis Basin.

Diversity

The diversity of populations in all three MPGs has been eroded by large hatchery influences and periodically, low effective population sizes.

The genetic legacy of the Lewis and Cowlitz River coho populations is preserved in ongoing hatchery programs.

8.11.2.2 Current Rangewide Status of Critical Habitat

NOAA Fisheries has not yet designated critical habitat for this ESU.

8.11.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed *environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.*

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of LCR coho salmon. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend in Table 8.11.2.1-3 will improve.

8.11.3.1 Recent FCRPS Hydro Improvements

Corps et al. (2007a) estimated that hydropower configuration and operational improvements implemented in 2000 to 2006 have resulted in an 11.3% increase in survival for yearling Lower Columbia River coho that pass Bonneville Dam. Improvements during this period included the installation of a corner collector at Powerhouse II (PH2) and the partial installation of minimum gap runners at Powerhouse 1 (PH1) and of structures that improve fish guidance efficiency (FGE) at PH2. Spill operations have been improved and Powerhouse 2 is used as the first priority for power production because bypass survival is higher than at PH1 and drawing water toward PH2 moves fish toward the corner collector. The bypass system screen was removed from PH1 because tests showed that turbine survival was higher than through the bypass system at that location.

8.11.3.2 Recent Tributary Habitat Improvements

Actions implemented since 2000 range from beneficial changes in land management practices to improving passage by replacing culverts and by reintroducing fish into areas above FERC-licensed dams. The latter category includes two projects in the tributaries above Bonneville Dam (i.e., within the action area for this consultation):

- Condit – removal in 2009 (NMFS 2006j) will support the restoration of the White Salmon River portion of the WA Upper Gorge coho population
- Powerdale – removal by 2012 (NMFS 2005o) will support the restoration of the Hood River portion of the OR Upper Gorge coho population

Both removals will greatly increase the abundance and productivity of the affected populations by increasing the amount of habitat available for spawning and rearing. Although there is some uncertainty regarding whether the affected populations will become reestablished, NOAA Fisheries has determined that these are the correct next steps toward their restoration.

8.11.3.3 Recent Estuary Habitat Improvements

The FCRPS Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function. These have resulted in an estimated 0.3% survival benefit for LCR coho (stream-type juvenile life history).

8.11.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the Columbia River estuary was reduced from 13,790,000 smolts to 8,210,000 smolts after relocation from Rice to East Sand Island in 1999. The double-crested cormorant colony has grown during the same period.

Piscivorous Fish Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. The recent improvement in lifecycle survival attributed to the NPMP is estimated at 2% for yearling juvenile salmonids (Friesen and Ward 1999).

8.11.3.5 Recent Hatchery Management Issues

The presence of naturally spawning hatchery-origin coho salmon has been identified as a limiting factor for the viability of this species (LCFRB 2004; ODFW 2006b). Of the 29 programs that release coho salmon below Bonneville Dam, NOAA Fisheries identified only four programs as improving population viability by increasing spatial distribution (NMFS 2004b). Twenty-two were identified as reducing short-term extinction risk, helping to preserve genetic resources important to ESU survival and recovery.[1] A summary of progress in hatchery reform for Lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS 2004b.

Most salmonids returning to the region are primarily derived from hatchery fish. The production of hatchery fish, among other factors, has contributed to the 90% reduction in natural-origin coho salmon runs in the lower Columbia River over the past 30 years (Flagg et al. 1995).

NOAA Fisheries identified four primary ways hatcheries may harm wild-run salmon and steelhead: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects (NMFS 2000b). In many areas, hatchery fish provide increased fishing opportunities. However, when natural-origin fish mix with hatchery stocks in these areas, naturally produced fish can be overharvested. Moreover, when migrating adult hatchery and natural-origin fish blend in the spawning grounds, the health of the natural-origin fish and the habitat's ability to support them can be overestimated. This potential overestimate exists because the hatchery fish mask the surveyors' ability to discern actual natural-origin run status, thus resulting in harvest objectives that were too high to sustain the naturally produced populations.

Over the last several years, the role hatcheries play in the Columbia Basin has been expanded from simple production to supporting species recovery. The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia River is occurring through several processes, including: (1) the Lower Columbia River Recovery and Fish and Wildlife Subbasin Plan; (2) Hatchery Genetic and Management Plan development for ESA compliance; (3) FERC-related plans on

[1] The buffer against extinction is probably short term because dependence on hatchery intervention can lead to increased risk over time (ICTRT 2007a).

the Cowlitz and Lewis Rivers; and, (4) the federally mandated Artificial Production Review and Evaluation. More recently a National Environmental Policy Act (NEPA) review of all Mitchell Act funded hatchery facilities was initiated which will include many of those producing Lower Columbia River coho. Washington's Lower Columbia River Recovery Plan identifies strategies and measures to support recovery of naturally-spawning fish. The plan also includes associated research and monitoring elements designed to clarify interactions between natural and hatchery fish and quantify the effects artificial propagation has on natural fish. The objective is to rehabilitate depleted populations and provide for harvest, while minimizing impacts to wild fish. For more detail on the use of hatcheries in recovery strategies, see the Lower River Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2004).

The states of Oregon and Washington and other co-managers are currently engaged in a substantial review of hatchery management practices through the Hatchery Scientific Review Group (HSRG). The HSRG was established and funded by Congress to provide an independent review of current hatchery programs in the Columbia River Basin. The HSRG has largely completed their work on Lower Columbia River coho populations and provided their recommendations ([HSRG 2007). A general conclusion from the information generated by the HSRG is that the current production programs are not consistent with practices that reduce impacts on naturally-spawning populations, and will have to be modified to reduce the adverse effects of hatchery fish on key natural populations identified in the Interim Recovery Plan, as necessary for broad sense recovery of the ESU. The adverse effects are caused in part by excess hatchery adults returning to natural spawning grounds.

Early in 2007 NOAA Fisheries expressed the need to change current hatchery programs and anticipated that decisions regarding the direction for those programs would be made soon (NMFS 2007g). NOAA Fisheries followed with a letter to the states of Oregon and Washington in November 2007 that again highlighted the immediate need for decisions about hatchery programs (NMFS 2007h). In response and through their own initiative, the states have embraced the recommendations of the HSRG and have now initiated a comprehensive program of hatchery and associated harvest reform (WDFW and ODFW 2008). The program is designed specifically to achieve HSRG objectives related to controlling the relative abundance of hatchery fish on the spawning grounds and in the hatchery broodstock. The program will require mass marking of released hatchery fish, changing hatchery release strategies, reducing hatchery production at some facilities, and building a system of weirs and improved collection facilities to control the straying of hatchery fish. The program will also require development and implementation of more mark selective fisheries and increasing the productivity of river basins through habitat management actions. Overall, the program represents a comprehensive and integrated approach to recovery that will be advanced by substantive reforms in hatchery practices.

Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

8.11.3.6 Recent Harvest Survival Improvements

Lower Columbia River coho are caught in both ocean and in-river fisheries. As discussed in Section 8.11.5.5, LCR coho are managed subject to a total exploitation rate limit for the combined ocean and in-river fisheries. The necessary sharing between ocean and in-river fisheries is implemented by coordination and the close association between Pacific Fishery Management Council fisheries and the 2008 *U.S. v. Oregon* Agreement and related biological opinions.

Each year, fisheries in the Columbia River will be managed, after accounting for anticipated ocean harvest, so as not to exceed the total exploitation rate limit. In 2008, the total exploitation rate limit is 8% based on the year specific circumstances. For 2009 and thereafter, NOAA Fisheries will set a total exploitation rate limit for LCR coho through their annual guidance letter to the Council. NOAA Fisheries is required to provide such guidance by the Council's Salmon FMP. Fisheries subject to the 2008 *U.S. v. Oregon* Agreement that are part of the set of Prospective Actions must be managed subject to the overall exploitation rate limit as proposed in 2008 and as they have been since 1999.

NOAA Fisheries recently completed a section 7 consultation of the effects of PFMC and Fraser Panel fisheries on Lower Columbia River Chinook. NOAA Fisheries concluded that fisheries managed in 2008 subject to a total exploitation rate of 8% would not jeopardize the listed species (NMFS 2008e). The PFMC opinion provides the substantive foundation for the review of the management strategy for LCR coho.

Table 8.11.3.6-1 includes the available information on exploitation rates of Lower Columbia River coho in ocean and freshwater fisheries. Previously, Oregon Coast Natural coho were used as a surrogate for estimating ocean fisheries impacts to Lower Columbia River coho. In 2006, largely as a consequence of increased attention resulting from its listing, the methods for assessing harvest in ocean fisheries were changed so that these were more specific to Lower Columbia River coho.

Until 1993 the exploitation rates in salmon fisheries on Lower Columbia River coho have been very high, contributing to their decline (Table 8.11.3.6-1). The combined ocean and inriver exploitation rates for Lower Columbia River coho averaged 91% through 1983, averaged 69% from 1984-1993, and decreased to an average of 16.7% from 1994-2007.

Table 8.11.3.6-1. Estimated Ocean (all marine area fisheries) and Inriver Exploitation Rates on Lower Columbia River Natural Coho, 1970-2007 (TAC 2008).

Year	Ocean Exploitation Rate	Inriver Exploitation Rate	Total Exploitation Rate
1970	65.2%	28.4%	93.6%
1971	82.5%	9.9%	92.4%
1972	84.3%	8.6%	92.9%
1973	81.9%	11.2%	93.1%

Year	Ocean Exploitation Rate	Inriver Exploitation Rate	Total Exploitation Rate
1974	83.5%	9.2%	92.7%
1975	81.4%	10.1%	91.5%
1976	89.9%	5.5%	95.4%
1977	88.8%	5.3%	94.1%
1978	82.5%	7.9%	90.4%
1979	79.4%	9.5%	88.9%
1980	73.1%	24.5%	97.6%
1981	81.1%	6.8%	87.9%
1982	61.6%	20.8%	82.4%
1983	78.7%	3.9%	82.6%
1984	31.9%	27.0%	58.9%
1985	43.2%	22.3%	65.5%
1986	33.5%	39.7%	73.2%
1987	59.5%	19.4%	78.9%
1988	56.4%	20.3%	76.7%
1989	55.3%	22.7%	78.0%
1990	68.9%	7.5%	76.4%
1991	45.4%	19.1%	64.5%
1992	50.9%	8.7%	59.6%
1993	42.3%	10.5%	52.8%
1994	7.0%	3.5%	10.5%
1995	12.0%	0.3%	12.3%
1996	8.0%	4.4%	12.4%
1997	12.0%	1.6%	13.6%
1998	8.0%	0.2%	8.2%
1999	9.0%	18.5%	27.5%
2000	7.0%	17.5%	24.5%
2001	7.0%	6.4%	13.4%
2002	12.0%	2.1%	14.1%
2003	14.0%	8.9%	22.9%

Year	Ocean Exploitation Rate	Inriver Exploitation Rate	Total Exploitation Rate
2004	15.0%	9.3%	24.3%
2005	11.0%	6.5%	17.5%
2006	6.8%	6.5%	13.3%
2007	11.9%	6.7%	18.6%

8.10.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations.

Gorge MPG

Completed consultations include road maintenance (Washington Upper Gorge and White Salmon); repairing a creek bank next to a road, parking lot maintenance, and maintenance of a stormwater drainage system along a highway (Lower Gorge), culvert cleaning, treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Oregon Upper Gorge and Hood populations). The USFS implemented two habitat restoration projects: improve 5 acres of riparian through thinning and improve 49 acres of riparian and one mile of stream by adding large woody debris (Hood population).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.11.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the ESU. The effects of some on population viability will be positive (treating invasive plants; adding large woody debris; tar remediation). Other projects, including road maintenance, grazing allotments, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

8.11.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions that will benefit the Oregon Upper Gorge and Hood River, Washington Upper Gorge and White Salmon, and Washougal populations, as well as actions that should be generally beneficial throughout the ESU. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.[2] They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve the conditions for this ESU. It is not possible to quantify the extent of these positive effects, however.

[2] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.11.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Releasing a portion of the flow augmentation water from the Upper Snake Project in May (NMFS 2008b) will provide minor benefits through 2034. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.11.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Benefits of Bonneville passage improvements affect only the two populations in the Gorge MPG. Prospective Actions include completing the installation of minimum gap runners at Bonneville PH1 and the FGE improvements at PH2 and improvements to sluiceway fish guidance system (efficiency and conveyance) at PH1. Collectively these modifications are expected to increase the survival of yearling coho that pass through Bonneville Dam (i.e., from the 1) Washington Upper Gorge and White Salmon and 2) Oregon Upper Gorge and Hood River) by 1%. Spillway survival improvements during this time period are expected to increase the passage survival through Bonneville Dam of yearling coho salmon by an additional 0.5%.

As a result of this ten-year program of improvements, an estimated 95.5% of the yearling coho that migrate past Bonneville Dam will survive. A portion of the 4.5% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that yearling coho would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion, NOAA Fisheries estimated that the survival of yearling LCR coho in a hypothetical unimpounded Columbia River would be 95% (Table 5.1 in NMFS 2004a). Therefore, approximately 57.8% (2.6%/4.5%)[3] of the expected mortality experienced by in-river migrating juvenile coho is probably due to natural factors.

Based on PIT-tag detections of SR fall Chinook at Bonneville and redetected at upstream dams, NOAA Fisheries estimates an upstream passage survival rate of 96.9% for adult coho salmon that pass Bonneville Dam (i.e., relevant to the Gorge MPG).

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of some flow augmentation water from summer to spring may provide a small benefit to juvenile migrants in the lower Columbia River by slightly reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat in the lower Columbia River below Bonneville Dam.

8.11.5.2 Effects of Tributary Habitat Prospective Actions

The Prospective Actions include funding for habitat improvements in the Hood River that will benefit the coho population in that watershed (Table 6 in Attachment B.2.2-2; Corps et al. 2007b). The project, which will complement the effects on habitat of removing Powerdale Dam, includes actions to increase instream habitat complexity, restore and protect riparian vegetation, provide access and safe passage, and to acquire instream flow and thus is likely to increase the abundance, productivity, and spatial structure of the Hood River coho salmon population. Adverse effects to habitat during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008h). The positive effects of these projects on habitat (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long-term.

The Prospective Actions also include the Action Agencies' consideration of funding for habitat improvement projects for any of the Lower Columbia River coho populations above Bonneville that have been significantly impacted by the FCRPS. Projects are to be selected that are consistent with basin-wide criteria for prioritizing projects (e.g., address limiting factors), including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is

[3] LCR coho salmon are found in the Klickitat River about 56 km upstream of Bonneville Dam.

uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

8.11.5.3 Effects of Estuary Prospective Actions

The Action Agencies will carry out approximately 44 estuary habitat projects over the first 3-year period of implementing the RPA. The estimated survival benefit for yearling coho associated with these specific actions will be 1.4%.

The RPA requires Action Agencies will implement projects that achieve an additional survival benefit for LCR coho salmon of 4.3% during the period 2010 to 2018. Prospective Actions will include protection and restoration of riparian areas, the protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

8.11.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Under the RPA (Action 39), the FCRPS Action Agencies will continue funding hatcheries as well as adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to hatchery-specific ESA § 7(a)(2) consultation, implementation of hatchery reform principles will: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are fixed and natural productivity increases. These benefits, however, are not relied upon for this consultation and are pending completion of future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.11.5.5 Effects of Harvest Prospective Actions

Under the Prospective Action the harvest of Lower Columbia River coho will vary from year-to-year using the ocean portion of Oregon's harvest matrix (Table 8.11.5.5-1) (NMFS 2008i). Lower Columbia River coho are caught in non-Treaty fall season fisheries in the Columbia River below Bonneville Dam. The states propose to manage Columbia River salmon fisheries each year during 2008 through 2017 with an associated total exploitation rate (ER) on Lower Columbia River natural-origin coho equivalent to the remainder of the ocean portion of Oregon's harvest matrix after ocean fisheries are accounted for. The total ER for each year will be determined using the ocean portion of Oregon's harvest matrix (Table 8.11.5.5-1), which will be described in NMFS's yearly guidance letter to PFMC. For 2008, NMFS guidance to PFMC is to manage fisheries with a total ER for natural-origin Lower Columbia River coho of 8% and the expected preseason exploitation rate for inriver fisheries is 2.1% (NMFS 2008e). The ER for natural-origin Lower Columbia River coho ESU in 2008 through 2017 will be estimated as a combined ER for early and late stocks for ocean and inriver fisheries.

Table 8.11.5.5-1. Harvest management matrix for Lower Columbia River coho salmon showing maximum allowable Ocean fishery mortality rate.

Parental Escapement [1]		**Marine Survival Index (based on return of jacks per hatchery smolt)**			
		Critical (<0.0008)	**Low (< 0.0015)**	**Medium (< 0.0040)**	**High (> 0.0040)**
High	> 0.75 full seeding	< 8.0%	< 15.0%	< 30.0%	< 45.0%
Medium	0.75 to 0.50 full seeding	< 8.0%	< 15.0%	< 20.0%	< 38.0%
Low	0.50 to 0.20 full seeding	< 8.0%	< 15.0%	< 15.0%	< 25.0%
Very Low	0.20 to 0.10 of full seeding	< 8.0%	< 11.0%	< 11.0%	< 11.0%
Critical	< 0.10 of full seeding	0 – 8.0%	0 – 8.0%	0 – 8.0%	0 – 8.0%

[1] Full Seeding: Clackamas River = 3,800, Sandy River = 1,340

The ER is estimated as the sum of total mortalities divided by the total ocean abundance. The ER for natural-origin Lower Columbia River coho is assumed to be equivalent to the ER for unmarked coho. The total ocean abundance of Columbia River unmarked coho is provided by the ocean FRAM model. The FRAM model estimates the exploitation rate for all ocean fisheries and for the Buoy 10 sport fishery. For Columbia River fisheries upstream of Tongue Point, the ER is estimated separately for the mainstem sport fishery, SAFE commercial fisheries and mainstem commercial fisheries.
The states of Oregon and Washington have developed two preseason models: one to allocate in-river impact rates among fisheries and one to monitor harvest to maintain the total ER at or below the allowable combine ER for unmarked coho each year. The preseason model used in fishery planning to estimate catch per statistical week in mainstem and SAFE fisheries uses average harvest rates from historical data. The preseason model will be used to structure coho seasons each year and to allocate coho catch among in-river fisheries while remaining within the prescribed yearly ER limit for unmarked fish.

Effects on Hatchery-Origin coho
Although proposed fisheries are being managed primarily to meet ER limits for natural-origin fish, the status of hatchery-origin fish and associated hatchery programs provide secondary consideration. For the time being, achieving hatchery escapement goals, particularly for programs used for supplementation or conservation purposes is desirable.

Lower Columbia River coho hatchery program management requires that these programs are self-sustaining, restricting the practice of using production from other programs to back-fill shortfalls in production goals (NMFS 2004b). This has not been a concern with the abundant returns in recent years. This is particularly the case for those programs involved in supplementation or re-introduction of natural production. Fishery management plans in 2008 also incorporate conservative expectations of coho abundance in order to maximize the prospect of meeting hatchery escapement goals (Table 8.11.5.5-2).

Table 8.11.5.5-2. Lower Columbia River coho hatchery programs, escapement goals and escapement, by program for the last 10 years. Shaded areas/Italic type highlights programs that are used, at least in part, to support supplementation or reintroduction activities. Numbers in bold indicate years in which the escapement goal was not met for that program.

Facility		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Big Creek	***Goal***	*828*	*828*	*700*	*700*	*700*	*700*	*525*	*700*	*700*	*700*
	Escapement	*1,949*	*1,684*	*4,034*	*10,047*	*8,365*	*7,946*	*3,545*	*6,555*	*6,175*	*3,938*
Bonneville	**Goal**	8,751	8,751	6,000	6,000	5,143	6,074	6,074	6,074	6,000	6,000
	Escapement	6,076	4,512	18,116	45,163	25,888	36,318	24,438	25,609	38,001	33,954
Sandy	***Goal***	*1,382*	*1,382*	*1,300*	*1,300*	*1,207*	*1,000*	*1,000*	*1,200*	*1,300*	*1,300*
	Escapement	*5,476*	***1,013***	*12,506*	*20,454*	*6,979*	*8,921*	*16,126*	*10,015*	*8,507*	*7,555*
Grays R.	**Goal**	861	1,362	1,246	1,341	1,341	1,341	1,341	1,341	600	600
	Escapement	**62**	**710**	12,910	6,483	**600**	**683**	1,676	4,838	835	969
Elochoman early	**Goal**	669	876	510	823	823	823	823	823	420	420
	Escapement	**19**	2,131	6,851	11,729	7,953	7,738	5,124	2,784	2,652	2,113
Elochoman late	**Goal**	496	788	788	997	997	997	776	450	450	450
	Escapement	567	2,693	4,536	7,401	4,161	2,800	1,024	761	**324**	979
Cowlitz	***Goal***	*7,483*	*7,438*	*7,483*	*5,740*	*4,715*	*3,000*	*3,000*	*4,200*	*2,700*	*2,700*
	Escapement	*18,378*	*40,321*	*50,395*	*75,744*	*82,876*	*31,165*	*44,622*	*33,655*	*54,283*	*37,111*
Toutle	***Goal***	*1,250*	*1,250*	*1,480*	*1,168*	*1,168*	*1,168*	*1,168*	*1,168*	*700*	*700*
	Escapement	6,506	12,508	28,774	15,730	18,828	30,207	25,462	8,055	6,523	17,680
Kalama Complex early	**Goal**	477	638	700	460	460	460	460	460	350	350
	Escapement	4,274	6,726	4,289	15,680	4,774	4,697	1,487	1,694	3,354	5,130
Kalama Complex late	**Goal**	1,405	1,310	1,533	671	671	671	671	671	300	300
	Escapement	**282**	1,095	10,110	15,522	4,351	3,198	3,156	1,233	5,344	1,768
Lewis Complex early	**Goal**	2,713	2,937	1,526	1,583	1,583	1,583	1,583	1,583	1,583	900
	Escapement	6,882	17,466	17,037	38,656	17,316	37,904	21,853	19,686	18,451	17,163
Lewis	***Goal***	*2,517*	*2,517*	*4,954*	*5,968*	*4,756*	*5,000*	*5,000*	*3,257*	*2,000*	*2,000*

Facility		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Complex late	***Escapement***	*16,130*	*17,717*	*23,199*	*60,812*	*6,170*	*20,803*	*10,750*	*16,164*	*18,071*	*15,818*
Washougal late	**Goal**	4,565	4,906	742	748	748	748	748	748	2,450	2,450
	Escapement	**1,605**	**2,581**	5,597	18,457	19,282	6,085	4,023	3,277	11,016	5,175
Eagle Creek	**Goal**	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300
	Escapement	12,612	11,779	33,106	30,146	6,285	4,812	7,776	8,921	14,153	11,128

All hatcheries have exceeded their broodstock goals in at least 5 of the most recent 10 years (1998-2007). The five programs marked for supplementation or re-introduction met their goals in all of the last 10 years, except for the Sandy River program, which met the goal in 8 of the last 10 years (Table 8.11.5.5-3). Based on the preseason run size and expected ocean and in-river fisheries, the expected hatchery escapement are: 57,800 early coho to Washington hatcheries compared to the escapement goal of 3,000; 95,500 early coho to Oregon hatcheries compared to the escapement goal of 11,300; and 32,300 late coho to Washington hatcheries compared to the escapement goal of 24,400 (TAC 2008). As a consequence, there is a high likelihood that all hatchery broodstock needs will be met as they have in recent years.

Effects on Species Status

Prospective improvements in harvest effects support the increased abundance, productivity, diversity, and spatial structure of spring- and fall-run populations of LCR coho. Harvest levels have been considered in detail in the recent biological opinion for PFMC and Fraser Panel fisheries (NMFS 2008e). NOAA Fisheries concluded in that opinion that the proposed total exploitation limit is consistent with the expectation the species' survival and recovery.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for LCR coho.

8.11.5.6 Effects of Predation Prospective Actions

Prospective Actions that reduce predation on juvenile coho will support the increased survival and therefore abundance and productivity of LCR coho salmon.

Avian predation

The survival of yearling coho will increase 7.8% with the relocation of most of the Caspian terns to sites outside the Columbia River basin, management of cormorant predation at East Sand Island, and improved avian deterrence at Bonneville Dam.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous fish predation

The Prospective Action to continue the increase in incentives in the NPMP will result in an additional 1% survival.

8.11.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.11.6 Aggregate Effect of the Environmental Baseline, Prospective Actions & Cumulative Effects on Lower Columbia River Coho Salmon

This section summarizes the basis for conclusions at the ESU level.

8.11.6.1 Recent Status of the Lower Columbia River Coho ESU

Lower Columbia River coho salmon is a threatened species. Although there is little quantitative information, it is likely that many of the populations in this ESU have low abundance. Long-term trends and lambda for the Clackamas and Sandy River populations are just over 1.0. The Youngs Bay and Big Creek populations are sustained by hatchery production. The viability of the species has been limited by habitat degradation, habitat blockage by FERC-licensed dams in several subbasins, harvest, hatchery effects, and ecological factors including predation as well as the effects of the existence and operation of the FCRPS and Upper Snake projects. The historical role of the FCRPS and Reclamation projects was the loss of habitat for the Oregon Upper Gorge and Hood River population under Bonneville pool and passage delay and mortality at Bonneville Dam for the two populations in the Gorge MPG. Coho smolts are vulnerable to bird predation in the estuary. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this ESU. The potential for additional risks due to climate change is described in Section 5.7 and 8.1.3.

8.11.6.2 Effects of the FCRPS, Upper Snake & *U.S. v. Oregon* Prospective Actions on the Lower Columbia River Coho ESU

In the LCFRB's recovery plan,[4] one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume." The Action Agencies' estuary habitat restoration projects and relocation of Caspian terns to reduce predation on juvenile coho will address this objective. Implementation of habitat improvement projects in the Hood watershed will address limiting factors that remain after the FERC-licensed dam is removed. The potential funding for additional habitat projects could address the loss of historical spawning habitat for the Oregon Upper Gorge and Hood River and the Upper Gorge Washington and White Salmon populations, including some habitat that was inundated by Bonneville pool. Actions that will further improve the viability of the Gorge populations include the continued increase in the northern pikeminnow reward fishery, and continued and improved avian deterrence at Bonneville Dam, and prospective juvenile passage improvements at Bonneville Dam.

Some adverse impacts from hatchery practices will continue, and allowable harvest rates will vary according to the year-specific guidance letter from NMFS to Council. In 2009 and thereafter, the Council is required to manage fisheries subject to the ocean portion of the Oregon harvest matrix (Table 8.11.5.1.5-1**)**. Exploitation rates are therefore likely to vary based on year specific circumstances.

The effect of this management strategy was recently reviewed through a section 7 consultation on PFMC and Fraser Panel fisheries (NMFS 2008e). NOAA Fisheries concluded that managing fisheries subject to the ocean portion of the Oregon harvest matrix was not likely to jeopardize the Lower Columbia River coho salmon ESU. The underlying analysis assumed that the total exploitation rate in 2009 and thereafter would be no more than to the ocean portion of the Oregon harvest matrix. Inriver fisheries will necessarily be managed subject to that guidance.

8.11.6.3 Cumulative Effects Relevant to the Lower Columbia River Coho ESU

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. These actions will improve the functioning of habitat needed for successful spawning, incubation, and the growth and development of juvenile coho.

[4] The LCFRB recovery plan addresses Lower Columbia River coho salmon, but because this species was not listed under the ESA at the time NOAA Fisheries evaluated the plan, the agency did not approve the LCFRB's plan as an interim regional recovery plan for the Washington portion of the Lower Columbia River coho ESU. The LCFRB is updating the coho portion of its plan, and Oregon is developing a recovery plan for the Oregon portion of the ESU. NOAA Fisheries will review and evaluate these plan elements for adequacy as the ESA recovery plan for LCR coho salmon.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia River and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

8.11.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Lower Columbia River Coho ESU

Impacts of the FCRPS and Upper Snake projects on this ESU are most significant for the two (out of 24) populations that spawn above Bonneville Dam and are limited relative to those from tributary hydropower, tributary habitat, harvest, hatcheries, and predation by birds and fish. These populations are affected by upstream and downstream passage and, for the Oregon Upper Gorge and Hood River population, by inundation of spawning habitat. For populations originating in tributaries below Bonneville, only migration and habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington identified tributary habitat actions that are reasonably certain to occur and that will benefit the Oregon Upper Gorge and Hood River, Washington Upper Gorge and White Salmon, and Washougal populations, as well as actions that should be generally beneficial throughout the ESU. Habitat blockages in the Lewis, Cowlitz, Sandy, and Hood watersheds are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.11.3.2). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2 and other improvements. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement of habitat conditions on state forest lands within the range of Lower Columbia River coho (Section 8.11.3.7).

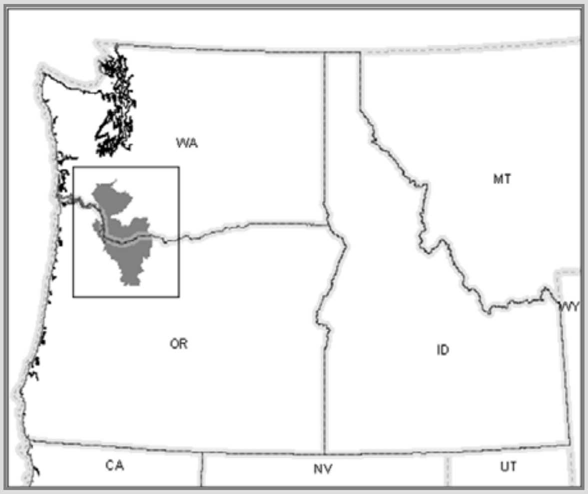
The FCRPS Action Agencies' prospective passage improvements at Bonneville Dam, estuary habitat improvements, and predator management improvements will contribute to the viability of this ESU and thus to its survival with an adequate potential for recovery. The Action Agencies' prospective habitat work in the Hood River and additional potential funding for tributary projects for the populations above Bonneville, plus actions at FERC-licensed dams in the Cowlitz, Lewis, White Salmon, Hood, and Sandy subbasins are expected to support the restoration of specific populations within the ESU. The Prospective Actions will not further deteriorate the pre-action condition.

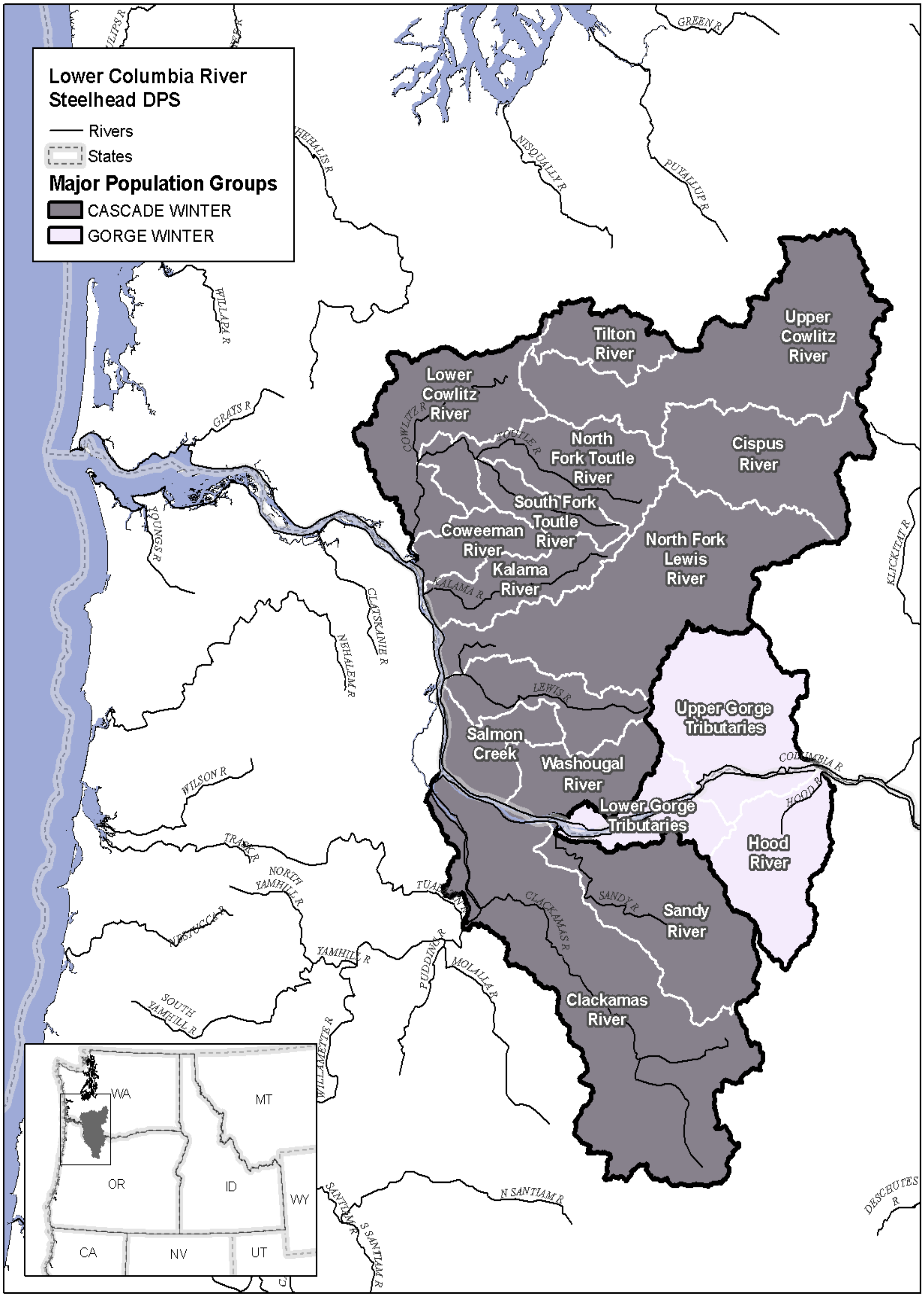
Long term (100 year) extinction risk is high or very high for almost all populations in this ESU. The only exception is the Clackamas population. In the short term, the species' extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of the Lewis and Cowlitz River coho populations will continue to be preserved by ongoing hatchery actions as a hedge against short-term risk of extinction.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the proposed fisheries will not cause deterioration in the pre-action condition for the species. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Lower Columbia River coho salmon ESU.

Section 8.12
Lower Columbia River Steelhead




Lower Columbia River
Steelhead DPS
Rivers
States
Major Population Groups
CASCADE WINTER
GORGE WINTER
Tilton River
Upper Cowlitz River
Lower Cowlitz River
North Fork Toutle River
Cispus River
South Fork Toutle River
Coweeman River
Kalama River
North Fork Lewis River
Upper Gorge Tributaries
Salmon Creek
Washougal River
Lower Gorge Tributaries
Hood River
Sandy River
Clackamas River
WA
MT
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ID
WY
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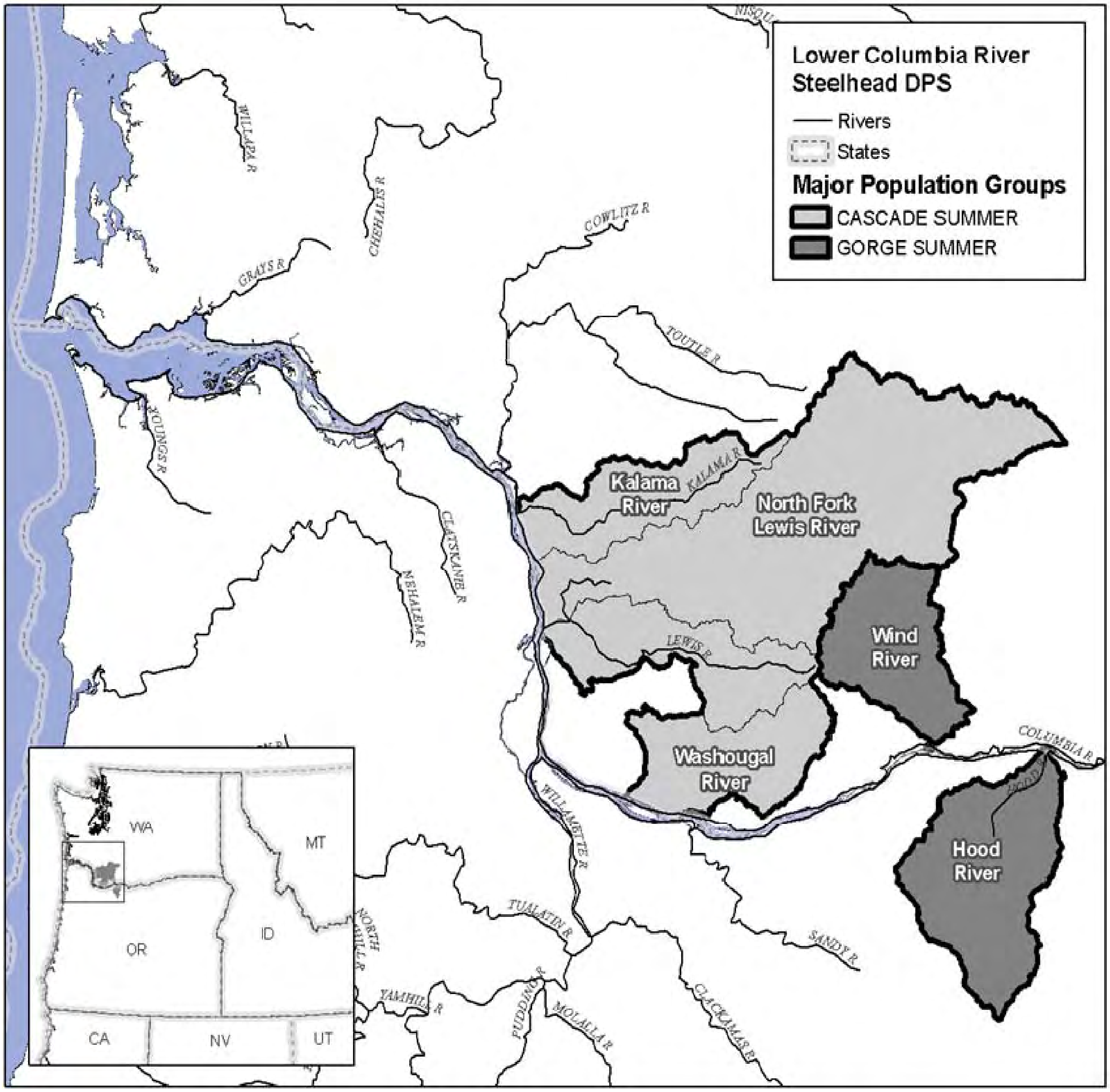
UT


Lower Columbia River
Steelhead DPS
Rivers
States
Major Population Groups
CASCADE SUMMER
GORGE SUMMER
Kalama River
North Fork Lewis River
Wind River
Washougal River
Hood River
WILLAPA R
CHEHALIS R
COWLITZ R
GRAYS R
TOUTLE R
KALAMA R
YOUNGS R
CLATSKANIE R
NEHALEM R
LEWIS R
COLUMBIA R
WILLAMETTE R
TUALATIN R
SANDY R
YAMHILL R
PUDDING R
MOLALLA R
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WA
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Section 8.12
Lower Columbia River Steelhead

Species Overview

Background

The Lower Columbia River steelhead DPS includes 23 historical anadromous populations in four major population groups. This DPS includes both summer- and winter-run types. the Lower Columbia River steelhead DPS was listed as threatened under the ESA in 1998, reaffirmed in 2006.

Designated critical habitat for LCR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers as well as specific stream reaches in a number of tributary subbasins.

Current Status & Recent Trends

Many of the populations comprising this DPS are small and many of the long- and short-term trends in abundance of individual populations are negative, some severely so. In addition, for most populations the probability is high that the trend in natural-origin spawners is less than one. A number of the populations have a substantial fraction of hatchery-origin spawners. Exceptions are the Kalama, North and South Fork Toutle, and East Fork Lewis winter-run populations, which have few hatchery fish spawning in natural spawning areas. These populations have relatively low recent abundance estimates; the largest is the Kalama River with 726 spawners.

Limiting Factors

Human impacts and limiting factors include habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and ecological factors including predation. Tributary habitat has been degraded by extensive development and other effects of changing land use. This has adversely affected stream temperatures and reduced the habitat diversity needed for steelhead spawning, incubation, and rearing. Steelhead access to tributary headwaters has been restricted or blocked by FERC-licensed dams built without passage facilities or facilities that were inadequate and have caused injury and delay. Four populations (Wind summer-run, Hood summer-run, Upper Gorge winter-run, and Hood winter-run) are subject to FCRPS impacts involving passage at Bonneville Dam and all populations are affected by habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this DPS will require significant efforts by many parties.

Recent Ocean and Mainstem Harvest

The Lower Columbia River steelhead DPS includes both winter and summer-run populations. Ocean fishing mortality on LCR steelhead is assumed to be zero. In recent years, non-Treaty mainstem winter and spring season fisheries have been managed subject to a 2% harvest rate limit on natural-origin winter steelhead. Treaty Indian fisheries only affect those populations above Bonneville Dam. LCR winter steelhead are not caught in non-Treaty summer or fall season fisheries. The harvest rate in non-Treaty fisheries has been limited to a maximum of 2%.

8.12.2 Current Rangewide Status

With this first step of the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

8.12.2.1 Current Rangewide Status of the Species

Lower Columbia River steelhead is a threatened species composed of 23 historical anadromous populations in four major population groups (called strata by the Willamette-Lower Columbia Technical Recovery Team (WLC TRT) (Table 8.12.2.1-1 and Lower Columbia River Steelhead Map).

Table 8.12.2.1-1. Lower Columbia River steelhead DPS description and major population groups (MPGs) (Sources: NMFS 2006a; Myers et al. 2006). The designations "(C)" and "(G)" identify Core and Genetic Legacy populations, respectively (Appendix B in WLCTRT 2003).[1]

DPS Description	
Threatened	Listed under ESA in 1999; reaffirmed in 2006
4 major population groups	23 historical populations
Major Population Group	**Population**
Cascade Summer	Kalama (C), NF Lewis, EF Lewis (G), Washougal (C,G)
Gorge Summer	Wind (C), Hood
Cascade Winter	Lower Cowlitz, Coweeman, NF Toutle (C), SF Toutle, Coweeman, Upper Cowlitz (C,G), Lower Cowlitz, Cispus (C), Tilton, Kalama, NF Lewis (C), EF Lewis, Salmon Creek, Washougal, Clackamas (C), Sandy (C)
Gorge Winter	Lower Gorge, Upper Gorge, Hood (C,G)
Hatchery programs included in DPS (10)	Cowlitz Trout Hatchery (in the Cispus, Upper Cowlitz, Lower Cowlitz, and Tilton Rivers), Kalama River Wild (winter- and summer-run), Clackamas Hatchery, Sandy Hatchery, and Hood River (winter- and summer-run) steelhead hatchery programs

This DPS includes both summer and winter type steelhead. Summer steelhead return to freshwater from May to November, entering the Columbia River in a sexually immature condition and requiring several months in fresh water before spawning. Winter steelhead enter fresh water from November to April. They are close to sexual maturation and spawn shortly after arrival in their natal streams.

[1] Core populations are defined as those that, historically, represented a substantial portion of the species abundance. Genetic legacy populations are defined as those that have had minimal influence from nonendemic fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the DPS (WLCTRT 2003).

Where both races spawn in the same stream, summer steelhead tend to spawn at higher elevations than the winter forms. Juveniles rear in fresh water (stream type life history).

Limiting Factors

Human impacts and limiting factors come from multiple sources: habitat degradation (including tributary hydropower development), hatchery effects, fishery management and harvest decisions, and ecological factors including predation. Tributary habitat has been degraded by extensive development and other effects of changing land use. This has adversely affected stream temperatures and reduced the habitat diversity needed for steelhead spawning, incubation, and rearing. Steelhead access to tributary headwaters has been restricted or blocked by FERC-licensed dams built without passage facilities or facilities that were inadequate and have caused injury and delay. Four populations (Wind summer-run, Hood summer-run, Upper Gorge winter-run, and Hood winter-run) are subject to FCRPS impacts involving passage at Bonneville Dam and all populations are affected by habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this DPS will require significant efforts by many parties.

Summarized below (Table 8.12.2.1-2) are key limiting factors for this DPS and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. Oregon is currently engaged in the recovery planning process for LCR steelhead.

Table 8.12.2.1-2. Key limiting factors for LCR steelhead.

Mainstem Hydro	Direct mainstem hydropower system impacts on LCR steelhead are most significant for the four gorge tributary populations upstream from Bonneville Dam (Wind River Summer Run, Hood River Summer Run, Upper Gorge Winter Run, and Hood River Winter Run). These populations are affected by upstream and downstream passage at Bonneville Dam and in the case of the Upper Gorge winter steelhead population, by the inundation of historical habitat under the reservoir (WLCTRT 2004). Impacts on populations originating in subbasins below Bonneville Dam are limited to effects on migration and habitat conditions in the lower Columbia River (below Bonneville Dam) including the estuary.
Predation	Piscivorous birds including Caspian terns and cormorants, fishes including northern pikeminnow, and marine mammals including seals and sea lions take significant numbers of juvenile or adult winter steelhead. Stream-type juveniles, especially steelhead smolts, are vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid water over the channel, which is located near habitat preferred by piscivorous birds (Fresh et al 2005). Steelhead are also subject to pinniped predation when they return to the estuary as adults (NMFS 2006b). Caspian terns as well as cormorants may be responsible for the mortality of up to 6% of the outmigrating stream-

	type juveniles in the Columbia River basin (Corps et al. 2007a). Pikeminnow are significant predators of both juvenile and subjuvenile juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation include redistribution of avian predator nesting areas, a sport reward fishery to harvest pikeminnow, and the exclusion and hazing of marine mammals near Bonneville Dam.
Harvest	Harvest includes direct and indirect fishery mortality. Lower Columbia River steelhead are harvested in Columbia River and tributary freshwater fisheries of Oregon and Washington. Fishery impacts on wild LCR steelhead have been limited to less than 10% since the implementation of mark-selective fisheries during the 1980s.
Hatcheries	The long-term domestication of hatchery fish has eroded the fitness of these fish in the wild and has reduced the productivity of wild stocks where significant numbers of hatchery fish spawn with wild fish. Until selective fisheries were instituted in the early 1990s, large numbers of hatchery fish contributed to intensive mixed stock fisheries, overexploiting wild populations already weakened by habitat degradation. State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is an important habitat for migrating juveniles from LCR steelhead populations. Due to a short residence time in the estuary, stream-type juveniles such as steelhead have limited mortality associated with a scarcity of habitat, changes in food availability, and the presence of contaminants. However, they are particularly vulnerable to bird and pinniped predation in the estuary (Fresh et al. 2005). Furthermore, steelhead are believed to be affected by flow and sediment delivery changes in the plume (Casillas 1999). Estuary limiting factors and recovery actions are addressed in detail in a comprehensive regional planning process (NMFS 2006b).
Habitat	Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats. Winter steelhead populations have been blocked from higher elevation spawning habitats by construction of FERC-licensed hydropower facilities. Major hydro projects in the Cowlitz and Lewis basins have blocked access to approximately 80% of the historical steelhead spawning and rearing habitat within both basins (LCFRB 2004). In addition to cumulative habitat effects, the construction of non-Federal hydropower

	facilities on Columbia River tributaries has partially or completely blocked higher elevation spawning. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for steelhead by reach in all Washington subbasins. Similar information is in development for Oregon subbasins.
Ocean & Climate	Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average. Although climate change will affect the future status of this DPS to some extent, future trends, especially during the time period relevant to the Prospective Actions, are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).

Abundance, Productivity & Trends

The information in Table 8.12.2.1-3 was reported in NOAA Fisheries' most recent status review (Good et al. 2005). Draft status assessments were updated for Oregon populations in a more recent review (McElhany et al. 2007). Long-term averages were used where available, although some of the time series are relatively recent. Many of the populations comprising this DPS are small and many of the long- and short-term trends in abundance of individual populations are negative, some severely so. In addition, for most populations the probability is high that the true trend/growth rate is less than one (Table 43 in Good et al. 2005). A number of the populations have a substantial fraction of hatchery-origin spawners. Exceptions are the Kalama, North and South Fork Toutle, and East Fork Lewis winter-run populations, which have few hatchery fish spawning in natural spawning areas. These populations have relatively low recent mean abundance estimates; the largest is the Kalama River with a geomean of 726 spawners.

Table 8.12.2.1-3. Abundance, productivity, and trends of LCR steelhead populations (Sources: Good et al. 2005 for Washington and McElhany et al. 2007 for Oregon populations).

Strata	Population	State	Recent Abundance of Natural Spawners			Long-term Trend[b]		Median Growth Rate[c]	
			Years	Geo. Mean	pHOS[a]	Years	Value	Years	λ
Cascade Summer	Kalama	W	99-03	474	32%	77-03	0.928	77-03	0.712
	NF Lewis	W	na	na	na	na	na	na	na
	EF Lewis	W	99-03	434	25%	na	na	na	na
	Washougal	W	99-03	264	8%	86-03	0.991	86-03	0.996
Gorge Summer	Wind	W	99-03	472	5%	na	na	na	na
	Hood	O	93-05	195	11.4%	93-05	0.995	93-05	0.811
Cascade Winter	Lower Cowlitz	W	na	na	na	na	na	na	na
	Coweeman	W	98-02	466	50%	87-02	0.916	87-02	0.782
	SF Toutle	W	98-02	504	2%	84-02	0.917	84-02	0.933
	NF Toutle	W	98-02	196	0%	89-02	1.135	89-02	1.062
	Upper Cowlitz	W	na	na	na	na	na	na	na
	Cispus	W	na	na	na	na	na	na	na
	Tilton	W	2002	2,787	73%	na	na	na	na
	Kalama	W	98-02	726	0%	77-02	0.998	77-02	0.916
	NF Lewis	W	na	na	na	na	na	na	na
	EF Lewis	W	na	na	na	na	na	na	na
	Salmon	W	na	na	na	na	na	na	na
	Washougal	W	98-02	323	0%	na	na	na	na
	Clackamas	O	90-05	1168	16.2%	90-05	1.03	90-05	0.976
	Sandy	O	90-05	1040	11%	90-05	0.95	90-05	0.923
Gorge Winter	Lower Gorge	W	na	na	na	na	na	na	na
	Upper Gorge	W	na	na	na	na	na	na	na
	Hood River	O	96-00	756	52%	na	na	na	na

Extinction Probability/Risk

The risk of extinction over 100 years (Table 8.12.2.1-4) was derived qualitatively, based on risk categories and criteria identified by the WLC TRT (2004) for use in recovery plan assessments. The rating system categorized extinction risk probabilities as very low (<1%), low (1 to 5%), medium (5 to 25%), high (26 to 60%), and very high (>60%) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

The 100-year risk of extinction is high or very high for most populations of LCR steelhead. Exceptions are:

- Wind summer run (moderate)—abundance is low; hatchery fish contribute to a small portion of escapement and genetic analyses indicate that introgression has been limited; habitat access only slightly impaired

- South Fork Toutle winter run (moderate)—abundance is moderate; hatchery fish contribute to a small portion of escapement; much of the upper basin is recovering from the effects of the Mt. St. Helens eruption; much of the historical range is accessible

- Kalama winter run (moderate)—abundance is moderate; hatchery fish contribute to a small portion of escapement; much of the historical range is accessible

- Clackamas winter run (low)—average abundance is near 1,000 fish; hatchery fish contribute to escapement but the broodstock is largely native in origin; upstream and downstream passage through the North Fork Dam may be partially blocked or delayed—lower elevation habitat is degraded, but headwater areas appear to be in good condition

- Hood winter run (moderate)—abundance is moderate; hatchery fish contribute about half of the run; the hatchery stock was reestablished in 1991 using what are presumed to be native fish, although there may have been some introgression, especially from naturally-produced Big Creek fish; blockages are limited to a few headwater reaches that were not significant historical production areas; lower elevation habitat is degraded

Table 8.12.2.1-4. Risk of extinction categories for populations of LCR steelhead (sources: Washington's Lower Columbia Fish Recovery Board plan [LCFRB 2004] and McElhany et al. [2007] for Oregon populations).

Strata	Population	State	Extinction Risk Category
Cascade Summer	Kalama	W	H
	NF Lewis	W	VH
	EF Lewis	W	H
	Washougal	W	H
Gorge Summer	Wind	W	M
	Hood	O	VH
Cascade Winter	Lower Cowlitz	W	H

Strata	Population	State	Extinction Risk Category
	Coweeman	W	H
	NF Toutle	W	H
	SF Toutle	W	M
	Upper Cowlitz	W	H
	Cispus	W	H
	Tilton	W	VH
	Kalama	W	M
	NF Lewis	W	H
	EF Lewis	W	H
	Salmon	W	H
	Washougal	W	H
	Clackamas	O	L
	Sandy	O	H
Gorge Winter	Lower Gorge	W/O	H/H
	Upper Gorge	W/O	H/M
	Hood	O	M

Spatial Structure

Spatial structure has been substantially reduced by the loss of access to the upper portions of some basins due to tributary hydro development. For example, since the early 20th century the spatial structure of the summer- and winter-run populations in the Hood River has been limited by delay and injury at the inadequate trap-and-haul facility at Powerdale Dam (see Section 8.12.3, Environmental Baseline, for information about the scheduled removal of this FERC-licensed hydropower project). The following FERC-licensed projects affecting rangewide status soon will either be removed or become passable, allowing the affected populations to re-occupy historical habitat:

- Bull Run (Marmot Dam) – removal by 2008 (NMFS 2003d) will improve passage (i.e., eliminate delay and injury) for the winter-run steelhead population (designated a Core population by the WLC TRT (2003)) into the upper Sandy River watershed

- Lewis River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2007f), a first step toward restoring the North Fork Lewis winter-run steelhead population

- Cowlitz River Hydroelectric Project – upstream and downstream passage facilities will be developed (NMFS 2004c), supporting the restoration of the Upper Cowlitz, Tilton, and Cispus winter-run steelhead populations

The FERC licenses for the Lewis and Cowlitz River hydroelectric projects require their respective owners/operators to operate hatchery programs. PacifiCorps and Cowlitz PUD operate a hatchery program to support a naturally-spawning, harvestable population of steelhead throughout its historical range in the North Fork Lewis basin. Tacoma Power is planning to operate a conservation hatchery that will produce steelhead for reintroduction into the upper Cowlitz basin. Combined with the new passage facilities at each project, the hatchery programs are expected to increase the number of natural spawners as well as the spatial structure of their respective populations.

Diversity

Before the early 1990s, the diversity of some populations was likely eroded by large hatchery influences. Periodically, many populations have been vulnerable to genetic drift and other effects on diversity associated with low effective population sizes. At present, the role for most steelhead hatchery programs in the lower Columbia River is to compensate for impacts to fisheries. Operations at these hatcheries are designed to minimize competition with and predation upon natural-origin fish by managing the size of juveniles at release and by locating release points below spawning and rearing areas. Adult hatchery fish should not spawn naturally to avoid impacts to population diversity. Some hatchery programs (e.g., the Skamania hatchery program in Washington) outplant non-local steelhead into various areas and attempt to isolate adult returns and prevent them from spawning with natural fish. There is little information available to determine how effective these programs are at avoiding impacts to population diversity.

The genetic legacy of several populations (Hood River summer – and winter – run and the Cowlitz, Sandy, and Clackamas late winter – run populations) is preserved in ongoing hatchery programs.

8.12.2.2 Current Rangewide Status of Critical Habitat

Designated critical habitat for LCR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette (NMFS 2005b). There are 32 watersheds within the range of this DPS. Two watersheds received a low rating, 11 received a medium rating, and 29 received a high rating of conservation value to the DPS (for more information, see Chapter 4). The lower Columbia River rearing/migration corridor is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 2,673 miles of habitat eligible for designation, 2,324 miles of stream are designated critical habitat.

In the lower Columbia River and its tributaries, major factors affecting PCEs are altered channel morphology and stability; lost/degraded floodplain connectivity; loss of habitat diversity; excessive sediment; degraded water quality; increased stream temperatures; reduced stream flow; and reduced access to spawning and rearing areas (LCFRB 2004; ODFW 2006; PCSRF 2006). The status of critical habitat within the action area is discussed in more detail in Section 8.12.3.8.

8.12.3 Environmental Baseline

The following section evaluates the environmental baseline as the effects of past and ongoing human and natural factors within the action area. It includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities that will have occurred contemporaneously with this consultation. The effects of unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultations are also part of the environmental baseline. For a detailed environmental baseline analysis pertinent to all species please see Chapter 5, Environmental Baseline, of the SCA.

Both Federal and non-Federal parties have implemented a variety of actions that have improved the status of LCR steelhead. Actions that have been implemented since the environmental baseline was described in the 2000 FCRPS Biological Opinion (NMFS 2000b) are discussed in the following sections. To the extent that their benefits continue into the future (and other factors are unchanged), estimates of population growth rate and trend developed by the WLC TRT (Table 8.12.2.1-3) will improve.

8.12.3.1 Recent FCRPS Hydro Improvements

Corps et al. (2007) estimated that hydropower configuration and operational improvements implemented at Bonneville Dam between 2000 and 2006 have resulted in an increase in survival for juvenile LCR steelhead that pass Bonneville Dam, although it was unable to quantify the improvement. Actions during this period included the installation of a corner collector at Powerhouse II (PH2) and the partial installation of minimum gap runners (MGR) at Powerhouse I (PHI) and structures that improved Fish Guidance Efficiency (FGE) at PH2. Spill operations have improved and PH2 is given the first priority for powerhouse operations because bypass survival is higher than at PH1 and drawing water toward PH2 moves fish toward the corner collector. The juvenile bypass system screen was removed from PH1 because testing showed that survival through the turbines was higher than through the bypass system.

8.12.3.2 Recent Tributary Habitat Improvements

Actions since 2000 have ranged from beneficial land management practices through improvement in access due to culvert replacement through improved fish passage into areas above FERC-licensed dams. The latter category refers to the upcoming removal of Powerdale Dam on the Hood River above Bonneville (i.e., within the action area for this consultation) by 2012 (NMFS 2005o). This action is expected to support the restoration of the summer-and winter-run steelhead populations. Hood River winter steelhead were designated a Core and Genetic Legacy (and Hood River summer steelhead a Core) population by the WLCTRT (2003). Although there is some uncertainty that these populations will become reestablished, NOAA Fisheries has determined that this is the correct next step toward their restoration.[2]

8.12.3.3 Recent Estuary Habitat Improvements

The Action Agencies have implemented 21 estuary habitat projects, removing passage barriers and improving riparian and wetland function. These have resulted in an estimate 0.3% survival benefit for LCR steelhead (stream-type juvenile life history).

8.12.3.4 Recent Predator Management Improvements

Avian Predation

Caspian tern predation in the estuary was reduced from a total of 13,790,000 smolts to 8,201,000 smolts after relocation from Rice to East Sand Island in 1999. The double-crested cormorant colony has grown during the same period. Juvenile steelhead are highly vulnerable to these predators based on PIT-tag data from the upriver stocks (Ryan et al. 2006).

Piscivorous Fish Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has reduced predation-related juvenile salmonid mortality since it began in 1990. The recent improvement in lifecycle survival attributed to the NPMP is estimated at 2% for larger juvenile salmonids (Friesen and Ward 1999).

Marine Mammal Predation

In recent years, sea lion predation of adult winter steelhead (Gorge Winter Run MPG) in the Bonneville tailrace has increase from 0%, or sufficiently low that it was rarely observed, to a mortality rate of about 21.8% (SCA Marine Mammal Appendix). NOAA Fisheries has completed section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on winter-run steelhead in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the relative survival of winter-run steelhead by 18.2%, so that the continuing negative impact will be approximately 7.6%.

8.12.3.5 Recent Hatchery Management Issues

The presence of naturally spawning hatchery-origin steelhead has been identified as a limiting factor for the viability of this species (LCFRB 2004; ODFW 2006b). Of the 25 programs that release steelhead below Bonneville Dam, NOAA Fisheries identified only one program as improving population viability by increasing spatial distribution (NMFS 2004b). Four were identified as reducing short-term extinction risk, helping to preserve genetic resources important to DPS survival

[2] The steelhead population in the (Big) White Salmon River is part of the Mid-Columbia River DPS. Thus, removal of Condit Dam will not affect the status of the Lower Columbia River steelhead DPS.

and recovery.[3] A summary of progress in hatchery reform for Lower Columbia programs that release fish above Bonneville Dam is reported in Table 2 of NMFS 2004 b

8.12.3.6 Recent Harvest Survival Improvements

Fisheries in the mainstem Columbia River are currently managed subject to the terms of the *U.S. v. Oregon* Interim Management Agreement for 2005-2007 in a manner that ensures a limited incidental take of ESA-listed LCR steelhead. In recent years, non-Indian mainstem fisheries have been managed subject to a 2% harvest rate limit on winter steelhead, including the winter populations of the LCR steelhead DPS. The yearly incidental take of winter-run steelhead populations in non-Indian fisheries has averaged 1.9% and has ranged from 0.2-9.3% since 2001 (Table 8.12.3.6-1). The non-Indian harvest rate in 2002 was an anomaly and corrective actions were taken to avoid harvest rates over 2%. The yearly incidental take of winter-run steelhead populations in non-Indian fisheries, excluding 2002, has averaged 0.7% since 2001. The yearly incidental catch of winter-run steelhead populations in tribal fisheries, which is limited to winter populations above Bonneville Dam, has averaged 2.2% and has ranged from 0.8-5.8% since 2001 (Table 8.12.3.6-2).

Table 8.12.3.6-1. Non-Indian harvest rates for winter-run steelhead expressed as a proportion of the total winter-run steelhead run size (TAC 2008, Table 16).

Year	Non-Indian
2001	0.6%
2002	9.3%
2003	1.0%
2004	0.9%
2005	0.6%
2006	0.2%
2007	0.6%
Average 2001-2007	1.91%

Table 8.12.3.6-2. Treaty Indian harvest rates for winter-run steelhead expressed as a proportion of the unmarked winter-run steelhead counts at Bonneville Dam in the winter season (TAC 2008).

Year	Treaty Indian
2001	3.40%

[3] The buffer against extinction is probably short term because dependence on hatchery intervention can lead to increased risk over time (ICTRT 2007a).

Year	Treaty Indian
2002	0.30%
2003	5.80%
2004	0.80%
2005	0.80%
2006	1.80%
2007	2.30%
Average 2001-2007	2.17%

In recent years, non-Indian mainstem winter, spring and summer season fisheries have been managed subject to a 2% harvest rate limit on summer steelhead, including summer steelhead populations of the LCR steelhead DPS. Treaty fisheries are managed for a range of expected impacts on the summer-run component of the LCR steelhead DPS. Actual harvest impacts on summer steelhead populations of the LCR steelhead DPS associated with non-Indian fisheries have generally been lower than the 2% limit; recent actual harvest rates have ranged from 0.2 to 0.5% (Table 8.12.3.6-3). Recent harvest rates on summer steelhead populations of the LCR steelhead DPS associated with Treaty fisheries have ranged from 4.1-12.3% (Table 8.12.3.6-3). The harvest rates in Table 8.12.3.6-3 for Treaty and non-Indian fisheries are not additive. Harvest impacts to the summer-run populations of the LCR steelhead DPS associated with Treaty fisheries in Table 8.12.3.6-3 is the same as for A-run summer steelhead. However, impacts to the summer-run populations of the LCR steelhead DPS would be less than for the other A-run DPS' because its upstream boundary is within the Bonneville Pool and much tribal fishing occurs upstream of this boundary. For the purposes of this analysis however, the harvest impacts on summer steelhead populations of the LCR steelhead DPS associated with Treaty fisheries have ranged from 4.1-12.4% (Table 8.12.3.6-3).

Table 8.12.3.6-3. Treaty Indian and non-Indian harvest rates for summer-run populations of the LCR steelhead DPS (Treaty and non-Indian harvest rates are not additive because these are calculated using a different denominator).

Year	Treaty *	Non-Indian**
1998	12.4%	
1999	7.4%	0.5%
2000	5.1%	0.4%
2001	6.0%	0.3%
2002	4.6%	0.4%

Year	Treaty *	Non-Indian**
2003	5.4%	0.4%
2004	7.0%	0.2%
2005	6.0%	0.3%
2006	6.0%	0.3%
2007	4.1%	0.3%
* TAC 2008 ** TAC 2008		

8.12.3.7 Future Effects of Federal Actions with Completed Consultations

NOAA Fisheries searched its Public Consultation Tracking System Database (PCTS) for Federal actions occurring in the action area that had completed Section 7 consultations between December 1, 2004 and August 31, 2007 (i.e., updating this portion of the environmental baseline description in the 2004 FCRPS Biological Opinion) that have affected the status of the populations.

Gorge Summer MPG

Completed consultations include removal of Hemlock Dam, a road maintenance project, and a project to clean culverts and a stream channel (Wind) and treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Hood population). The USFS consulted on habitat restoration projects: improve 2 miles of riparian by removing noxious weeds and planting native vegetation (Wind) and improve 5 acres riparian through thinning and 49 acres riparian and 1 mile of stream by adding large wood (Hood population).

Gorge Winter MPG

Completed consultations include repairing a creek bank next to a road, parking lot maintenance at Oneonta Gorge, and stormwater drainage maintenance along the Columbia River Highway (Lower Gorge) and treating invasive plants, a grazing allotment, and vegetation management along a transmission line right-of-way (Hood population). The USFS consulted on habitat restoration projects: improve 2 miles of riparian by removing noxious weeds and planting native vegetation (Upper Gorge) and improve 5 acres riparian through thinning and 49 acres riparian and 1 mile of stream by adding large wood (Hood population).

Projects Affecting Multiple MPGs/Populations

NOAA Fisheries (NMFS 2006k) completed consultation on issuance of a 50-year incidental take permit to the State of Washington for its Washington State Forest Practices Habitat Conservation Plan (HCP). The HCP will lead to a gradual improvement in habitat conditions on state forest lands within the action area, removing barriers to migration, restoring hydrologic processes, increasing the number of large trees in riparian zones (a source of shade and LWD), improving streambank integrity, and reducing fine sediment inputs.

Federal agencies completed consultation on a large number of projects affecting habitat in the lower Columbia River including maintenance dredging and boat ramp/dock repairs, tar remediation at Tongue Point, bridge and road repairs, an embankment and riprap repair, and several habitat restoration projects that included stormwater facilities and programs. A total of five wave energy projects have been proposed for the Oregon coast and one for the Washington coast. NOAA Fisheries has completed consultation on one project, in Makah Bay on the Olympic Peninsula in Washington (NMFS 2007k).

NOAA Fisheries' Habitat Restoration Programs with Completed Consultations

NOAA Fisheries funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho as Cumulative Effects actually received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007l), the Restoration Center Programs (NMFS 2004g), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000e). The objectives of these programs are described below, but to avoid "double counting," NOAA Fisheries considered the projects submitted by the states (see Chapter 17 in Corps et al. 2007a) as Cumulative Effects (Section 8.12.4).

Pacific Coastal Salmon Recovery Fund

Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho and Alaska, and the Pacific Coastal and Columbia River tribes receive Congressional PCSRF appropriations from NOAA Fisheries Service each year. The fund supplements existing state, tribal and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NOAA Fisheries has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho and Alaska, and with three tribal commissions on behalf of 28 Indian tribes; Northwest Indian Fisheries Commission, Klamath River Inter-Tribal Fish & Water Commission, Columbia River Inter-Tribal Fish Commission. These MOUs establish criteria and processes for funding priority PCSRF projects. The PCSRF has made significant progress in achieving program goals, as indicated in Reports to Congress, workshops and independent reviews.

NOAA Restoration Center Programs

NOAA Fisheries has consulted with itself on the activities of the NOAA Restoration Center in the Pacific Northwest. These include participation in the Damage Assessment and Restoration Program (DARP), Community-based Restoration Program (CRP), and Restoration Research Program. As part of the DARP, the RC participates in pursuing natural resource damage claims and uses the money collected to initiate restoration efforts. The CRP is a financial and technical assistance program which helps communities to implement habitat restoration projects. Projects are selected for funding in a competitive process based on their ecological benefits, technical merit, level of community involvement, and cost-effectiveness. National and regional partners and local organizations contribute matching funds, technical assistance, land, volunteer support or other in-kind services to help citizens carry out restoration.

Mitchell Act-funded Irrigation Diversion Screening Programs

Through annual cooperative agreements, NOAA Fisheries funds three states agencies to operate, maintain, and construct fish screening facilities at irrigation diversions and to operate and maintain adult fishways. The agreements are with Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife. The program also funds research, monitoring, evaluation, and maintenance of existing fishway structures, primarily those associated with diversions.

Summary

Effects on Species Status

These projects are likely to affect multiple populations within the DPS. The effects of some on population viability will be positive (removal of Hemlock Dam; removing invasive weeds and planting native vegetation; adding large woody debris; tar remediation). Other projects, including road maintenance, grazing allotments, dock and boat launch construction, maintenance dredging, and embankment repair, will have neutral or short- or even long-term adverse effects. All of these projects have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy.

Effects on Critical Habitat

Some of the future federal projects will have positive effects on safe passage/access (removing Hemlock Dam), water quality (adding large woody debris; tar remediation). The other types of projects will have neutral or short- or even long-term adverse effects on safe passage and water quality. All of these actions have undergone section 7 consultation and were found to meet the ESA standards for avoiding any adverse modification of critical habitat.

8.12.3.8 Status of Critical Habitat under the Environmental Baseline

Factors described in Section 8.12.2, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century and have degraded the conservation value of designated critical habitat. Salmon habitat has been altered through activities such as urban development, logging, grazing, power generation, and agriculture. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. Tributary habitat conditions vary widely among the various drainages occupied by LCR steelhead. Factors affecting the conservation value of critical habitat vary from lack of adequate pool/riffle channel structure, high summer water temperatures, low flows, poor overwintering conditions due to loss of connection to the floodplain, and high sediment loads.

Spawning & Rearing Areas

The following are the major factors that have limited the functioning of primary constituent elements and thus the conservation value of tributary habitat used for spawning and both tributary and estuarine habitat used for rearing (i.e., spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Tributary barriers *[culverts; dams; water withdrawals]*
- Reduced riparian function *[urban and rural development; forest practices; agricultural practices; channel manipulations]*
- Loss of wetland and side channel connectivity *[urban and rural development; past forest practices; agricultural practices; channel manipulations]*
- Excessive sediment in spawning gravel *[forest practices; agricultural practices]*
- Elevated water temperatures *[water withdrawals; urban and rural development; forest practices; agricultural practices]*

In recent years, the Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions that address these limiting factors. These include removing passage barriers, improving channel complexity, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. The dam removal action at the FERC-licensed hydroelectric project in the Hood River (Section 8.12.3.2) is addressing most of the key limiting factors in that watershed. Some projects will provide immediate benefits and some will result in long-term benefits with survival improvements accruing into the future.

As described above, future Federal projects with completed consultations will have neutral or short- or even long-term adverse effects on the functioning of the PCEs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Some Federal projects, implemented for restoration purposes, will improve these same PCEs.

Juvenile & Adult Migration Corridors

Factors that have limited the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile and adult passage mortality [*hydropower projects in the mainstem lower Snake and Columbia rivers*]

- Pinniped predation on winter-run adults (Gorge Winter MPG) due to habitat changes in the lower river [*existence and operation of Bonneville Dam*] and increasing numbers of pinnipeds.

- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators *[Caspian terns and double-crested cormorants]*

- In the lower Columbia River and estuary—diking and reduced peak spring flows have eliminated much of the shallow water, low velocity habitat *[agriculture and other development in riparian areas; FCRPS and Upper Snake water management]*

The FCRPS Action Agencies and other Federal and non-Federal entities have taken actions in recent years to improve the functioning of these PCEs. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids at Bonneville Dam has improved with the addition of the Bonneville PH2 corner collector. Reductions in piscivorous fish predation have increased the survival of juvenile steelhead in the estuary.

NOAA Fisheries has completed Section 7 consultation on granting permits to the states of Oregon, Washington, and Idaho, under section 120 of the Marine Mammal Protection Act, for the lethal removal of certain individually identified California sea lions that prey on adult winter-run steelhead in the tailrace of Bonneville Dam (NMFS 2008d). This action is expected to increase the survival of winter-run adults so that the continuing impact is reduced to approximately 7.6%.

The safe passage of juvenile LCR steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The double-crested cormorant colony has grown during that period. Projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately RM 40) have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 5.3.1.3 in Corps et al. 2007a).

Areas for Growth & Development to Adulthood

Although LCR steelhead spend part of their first year in the ocean in the Columbia River plume, NOAA Fisheries designated critical habitat no farther west than the estuary (i.e., a line connecting the westward ends of the river mouth jetties; NMFS 2005b). Therefore, the effects of the Prospective Actions on PCEs in these areas were not considered further in this consultation.

8.12.4 Cumulative Effects

Cumulative effects includes state, tribal, local, and private activities that are reasonably certain to occur within the action area and likely to affect the species. Their effects are considered qualitatively in this analysis.

As part of the Biological Opinion Collaboration process, the states of Oregon and Washington provided information on various ongoing and future or expected projects that NOAA Fisheries determined are reasonably certain to occur and will affect recovery efforts in the lower Columbia basin (see lists of projects in Chapter 17 in Corps et al. 2007a). These include tributary habitat actions that will benefit the Wind and Hood summer-run and the Upper Gorge and Hood winter-run populations, as well as actions that should be generally beneficial throughout the DPS. Generally, all of these actions are either completed, ongoing, or reasonably certain to occur.[4] They address protection and/or restoration of existing or degraded fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include growth management programs (planning and regulation), a variety of stream and riparian habitat projects, watershed planning and implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, and hydraulic project permitting. Responsible entities include cities, counties, and various state agencies. Many of these actions will have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of salmon and steelhead populations and the functioning of PCEs in designated critical habitat. Therefore these activities are likely to have cumulative effects that will significantly improve conditions for this DPS.

Some types of human activities that contribute to cumulative effects are expected to have adverse impacts on populations and PCEs, many of which are activities that have occurred in the recent past and have been an effect of the environmental baseline. These can also be considered reasonably certain to occur in the future because they are currently ongoing or occurred frequently in the recent past, especially if authorizations or permits have not yet expired. Within the freshwater portion of the action area for the Prospective Actions, non-federal actions are likely to include urban development and other land use practices. In coastal waters within the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, and fishing permits. Private activities are likely to be continuing commercial and sport fisheries and resource extraction, all of which can contaminate local or larger areas of the coastal ocean with hydrocarbon-based materials. Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments (or in the case of contaminants, safeguards). Therefore, although NOAA Fisheries finds it likely that the cumulative effects of these activities will have

[4] The State of Oregon identified potential constraints (e.g., funding, staffing, landowner cooperation) for many of its projects.

adverse effects commensurate to those of similar past activities, it is not possible to quantify these effects.

8.12.5 Effects of the Prospective Actions

Continued operation of the FCRPS and Upper Snake projects, as well as the harvest action, will have continuing adverse effects that are described in this section. However, the Prospective Actions will ensure that these adverse effects are reduced from past levels. The Prospective Actions also include habitat improvement and predator reduction actions that are expected to be beneficial. Releasing a portion of the flow augmentation water from the Upper Snake Project in May (NMFS 2008b) will provide some minor benefits through 2034. Some habitat restoration and RM&E actions may have short-term, minor adverse effects, but these will be more than balanced by short- and long-term beneficial effects.

Continued funding of hatcheries by FCRPS Action Agencies will have both adverse and beneficial effects, as described in the SCA Hatchery Effects Appendix and in this section. The Prospective Actions will ensure continuation of the beneficial effects and will reduce any threats and adverse impacts posed by existing hatchery practices.

8.12.5.1 Effects of Hydro Operations & Configuration Prospective Actions

Benefits of Bonneville passage improvements affect only the five populations in the Gorge Summer and Winter Run MPGs. Prospective Actions include completing the installation of minimum gap runners at Bonneville PH1 and the FGE improvements at PH2 and improvements to sluiceway fish guidance system (efficiency and conveyance) at PH1. Collectively these modifications are expected to increase the survival of juvenile steelhead that pass through Bonneville Dam by 1%. Spillway survival improvements during this time period are expected to increase juvenile passage survival through Bonneville Dam by an additional 2.8%.

As a result of this ten-year program of improvements, an estimated 90.8% of the juvenile steelhead that migrate past Bonneville Dam will survive. A portion of the 9.2% mortality indicated by the juvenile survival metric (i.e., 1 – survival) is due to mortality that juvenile steelhead would experience in a free-flowing reach. In the 2004 FCRPS Biological Opinion on Remand, NOAA Fisheries estimated that 99% of the juvenile steelhead would survive migration through a free-flowing reach of equal length (see Table 5.1 in NMFS 2004a). Therefore, approximately 10% (0.9%/9.2%) of the expected mortality experienced by migrating LCR steelhead from above Bonneville Dam is probably due to natural factors.

The direct survival rate of adult steelhead at Bonneville Dam is already quite high. Based on PIT-tag detections at Bonneville and later at The Dalles Dam, NOAA Fisheries estimates an upstream passage survival rate of 98.5% for adult LCR steelhead (i.e., relevant to the Gorge MPGs).[5] The Action

[5] This estimate is adjusted to account for estimated harvest and straying rates of adults within the FCRPS migration corridor, but otherwise captures all other sources of mortality including those resulting from the existence and

Agencies will evaluate the use of the second powerhouse corner collector as a potential means to provide a safer downstream passage route for kelts from March 1 to April 9 (prior to spill).

Under the Prospective Actions, flows from the upper Snake basin will continue to be reduced during spring compared to an unregulated system. However, shifting the delivery of some of the flow augmentation water from summer to spring may provide a small benefit to juvenile migrants in the lower Columbia River by slightly reducing travel time, susceptibility to predators, and stress, as described above. Increasing spring flows will also address conditions that have altered channel margin habitat, identified as a limiting factor in the lower Columbia River below Bonneville Dam (Section 8.12.3.3).

Effects on Species Status

Prospective passage improvements at Bonneville Dam will support increased abundance and productivity of the Gorge populations, thereby improving the overall spatial structure of the DPS.

Effects on Critical Habitat

Improvements at Bonneville Dam will increase the functioning of the PCE of safe passage in the juvenile and adult migration corridors.

8.12.5.2 Effects of Tributary Habitat Prospective Actions

The Prospective Actions include funding for habitat improvements in the Hood River that will benefit the summer and winter steelhead populations in that watershed (Table 6 of Attachment B.2.2-2 in Corps et al. 2007b). The project, which will complement the effects on habitat of removing Powerdale Dam, includes actions to increase instream habitat complexity, restore and protect riparian vegetation, provide access and safe passage, and to acquire instream flow. A second project, removal of Hemlock Dam in Trout Creek (a tributary to the Wind River), will provide access to historical habitat for the Wind River summer-run and Upper Gorge winter-run populations in that watershed.

The Prospective Actions also include the Action Agencies' consideration of funding for habitat improvement projects for any of the LCR steelhead populations above Bonneville that have been significantly impacted by the FCRPS. Projects are to be selected that are consistent with basin-wide criteria for prioritizing projects (e.g., address limiting factors), including those derived from recovery and subbasin plans. However, the type and distribution of these potential projects is uncertain, in part because the RPA only commits the Action Agencies to achieving specific survival improvements for species in the Interior Columbia Basin.

Effects on Species Status

Prospective improvements in tributary habitat in the Hood and Wind rivers will support the increased abundance, productivity, and spatial structure of the summer and winter-run populations in those

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operation of the FCRPS and other potential sources, including natural mortality (i.e., that would occur without human influence).

watersheds. Habitat projects in other tributaries, if implemented, will be selected such that they also address limiting factors and thus would also increase the viability of the local population(s).

Effects on Critical Habitat

Prospective habitat improvements in the Hood and Wind rivers will improve the functioning of PCEs for spawning and rearing (spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space). Restoration actions in designated critical habitat will have long-term beneficial effects at the project scale and some, such as the removal of barriers, will improve conditions at the watershed scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short time (no more than a few weeks and typically less). Examples include sediment plumes, localized and brief contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008 III). The positive effects of these projects on the functioning of PCEs (e.g., restored access, improved water quality and hydraulic processes, restored riparian vegetation, enhanced channel structure) will be long term.

8.12.5.3 Effects of Estuary Prospective Actions

The FCRPS Action Agencies will carry out approximately 44 estuary habitat projects over the first 3-year period of implementing the RPA (Section 12.3.2.3 in Corps et al. 2007b). The estimated survival benefit for juvenile steelhead is 1.4%.

The RPA requires the implementation of additional projects to obtain specified survival benefits for Interior Columbia Basin steelhead populations, but will also provide benefits to those from the lower Columbia River. The estimated survival benefit for juvenile steelhead is 4.3%. Prospective Actions will address limiting factors by protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reducing of noxious weeds, and other actions.

Effects on Species Status

Prospective improvements in estuarine habitat will support the increased abundance, productivity, diversity, and spatial structure of summer- and winter-run populations of LCR steelhead.

Effects on Critical Habitat

Prospective estuarine habitat improvements will improve the functioning of the PCEs of water quality and safe passage in the migration corridor for juvenile steelhead migrants. Projects that improve estuarine habitat will have long-term beneficial effects at the project scale. Adverse effects to PCEs during construction are expected to be minor, occur only at the project scale, and persist for a short-time (no more than a few weeks and typically less). The positive effects on the functioning of PCEs and the conservation value of critical habitat will be long-term.

8.12.5.4 Effects of Hatchery Prospective Actions

Effects on Species Status

Under the RPA (Action 39), the FCRPS Action Agencies will continue funding hatcheries as well as adopt programmatic criteria for funding decisions on hatchery mitigation programs for the FCRPS that incorporate BMPs. NOAA Fisheries will consult on the operation of existing or new programs when Hatchery and Genetic Management Plans are updated by hatchery operators with the Action Agencies as cooperating agencies. For the lower Columbia, new HGMPs must be submitted to NOAA Fisheries and ESA consultations initiated by July 2009 and consultations must be completed by January 2010. Subject to subsequent hatchery specific ESA § 7(a)(2) consultation, implementation of BMPs in NOAA Fisheries approved HGMPs are expected to: 1) integrate hatchery mitigation and conservation objectives, 2) preserve genetic resources, and 3) accelerate trends toward recovery as limiting factors and threats are addressed and natural productivity increases. These benefits, however, are not relied upon for this consultation pending completion of the future consultations.

Effects on Critical Habitat

NOAA Fisheries will analyze the effects of the hatchery actions on critical habitat designated for this species in subsequent consultations on site-specific actions.

8.12.5.5 Effects of Harvest Prospective Actions

Prospective non-Indian fisheries will be managed subject to 2% harvest rate limits on natural-origin steelhead from the Lower Columbia River. However, the expected incidental harvest impacts on the winter-run and summer-run components of the LCR Steelhead DPS associated with proposed non-Indian fisheries (TAC 2008; Table 29a) are expected to be less than ESA-prescribed limits (TAC 2008; Table 29). The incidental catch of winter-run steelhead in non-Indian fisheries has averaged 1.9% since 1999 (Table 8.12.3.6-1). The yearly incidental catch of summer-run steelhead in non-Indian fisheries has averaged 0.3% since 1999 (Table 8.12.3.6-3). Harvest rates associated with non-Indian fisheries are not expected to change over the course of this Agreement (TAC 2008).

There are no specific incidental harvest rate limits for tribal fisheries on the LCR steelhead DPS (TAC 2008; Table 29). The expected incidental harvest impacts on the winter-run and summer-run components of the LCR Steelhead DPS associated with prospective tribal fisheries is the same as the range observed in recent years (TAC 2008; Table 29a). The harvest rate for tribal fisheries on the winter-run populations of the LCR steelhead DPS from 2001 to 2007 averaged 2.2% and ranged from 0.8% to 5.8% (Table 8.12.3.6-2). The harvest for tribal fisheries on the summer-run populations of the LCR steelhead DPS are considered the same as for A-run summer steelhead in general. However, harvest impacts to the summer-run populations of the LCR steelhead DPS are in reality less than for A-run as a whole because the upstream boundary of LCR steelhead DPS is within the Bonneville Pool and much tribal fishing impacting A-run fish occurs upstream of this boundary. However, for the purposes of this analysis, the incidental harvest rates on summer steelhead populations of the LCR steelhead DPS associated with Treaty fisheries have ranged from 4.1-12.4% (Table 8.12.3.6-3). Incidental harvest rates for winter-run and summer-run associated with prospective tribal fisheries are not expected to change over the course of this Agreement (TAC 2008).

Effects on Species Status

Prospective harvest effects will be less than or equal to recent harvest effects and thus are expected to support the increased abundance and productivity of winter-run populations of Lower Columbia River steelhead.

Effects on Critical Habitat

The effects of harvest activities in the Prospective Actions on PCEs occur from boats or along the river banks, mostly in the mainstem Columbia River. The gear that are used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear minimally disturb streambank vegetation or channel substrate. Effects on water quality are likely to be minor; these will be due to garbage or hazardous materials spilled from fishing boats or left on the banks. By removing adults that would otherwise return to spawning areas, harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas, although this has not been identified as a limiting factor for LCR steelhead.

8.12.5.6 Effects of Predation Prospective Actions

Avian predation

The survival of juvenile steelhead will increase 3.4% with the reduced Caspian tern nesting habitat in the estuary and the subsequent relocation of most of the terns to sites outside the Columbia River basin (RPA Action 45). Continued implementation and improvement of avian deterrence at Bonneville Dam (RPA Action 48) is also likely to increase juvenile steelhead survival.

The RPA (Action 46) requires that the Action Agencies develop a cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of actions, if warranted, in the estuary.

Piscivorous fish predation

The prospective continued increase in incentives in the NPMP will result in an additional 1% survival during the period 2008 to 2018 (RPA Action 43).

Effects on Species Status

Prospective improvements in predation will support the increased abundance and productivity of summer- and winter-run populations of LCR steelhead.

Effects on Critical Habitat

Prospective improvements in predation will improve the functioning of the PCE of safe passage in the migration corridor for juvenile steelhead migrants.

8.12.5.7 Effects of Research & Monitoring Prospective Actions

Please see Section 8.1.4 of the SCA. Monitoring for this species will be commensurate with the effects of the FCRPS.

8.12.6 Aggregate Effects of the Environmental Baseline, Prospective Actions & Cumulative Effects on Lower Columbia River Steelhead DPS

This section summarizes the basis for conclusions at the DPS level.

8.12.6.1 Recent Status of the Lower Columbia River Steelhead DPS

Lower Columbia steelhead is a threatened species. Many of the populations in this DPS currently have low abundance and many of the long-term trends in abundance for individual populations are negative, some severely so. The historical role of the FCRPS and Upper Snake projects in limiting viability was the loss of historical habitat for the Upper Gorge Winter Run population under Bonneville pool and passage delay and mortality at Bonneville Dam for two populations of summer and two of winter steelhead. Stream-type juveniles, especially steelhead smolts, are vulnerable to bird predation in the estuary and adult winter-run steelhead are subject to pinniped predation at Bonneville Dam. The long-term domestication of hatchery fish eroded the fitness of these populations in the wild. Until selective fisheries were instituted in the early 1990s, intensive mixed-stock fisheries overexploited wild steelhead populations already weakened by habitat degradation. Large-scale changes in freshwater and marine environments have also had substantial effects on salmonid population numbers. Ocean conditions that affect the productivity of all Pacific Northwest salmonids appear to have contributed to the decline of many of the stocks in this DPS. The potential for additional risks due to climate change is described in Sections 5.7 and 8.1.3.

In terms of the primary constituent elements of critical habitat, the ability to function in support of the conservation of the species has been limited by barriers to some tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary areas used for spawning, incubation, and larval growth and development. In the Lewis, Cowlitz, Sandy, and Hood River watersheds, these problems will be addressed by actions taken at FERC-licensed hydroelectric projects (Sections 8.12.2.1 and 8.12.3.2). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2. Implementation of the State of Washington's Forest Practices Habitat Conservation Plan will lead to a gradual improvement in habitat conditions on state forest lands within the range of LCR steelhead (Section 8.12.3.2). Some future Federal actions with completed Section 7 consultations will restore access to blocked habitat, increase channel complexity, and restore riparian condition. Examples are the removal of Hemlock Dam in the Wind River subbasin and Powerdale on the Hood River. Many actions will have neutral or short- or even long-term negative effects on habitat conditions, but all were found to meet the ESA standards for avoiding jeopardy and for avoiding any adverse modification of critical habitat.

8.12.6.2 Effects of the FCRPS, Upper Snake & *U.S. v. Oregon* Prospective Actions on the Lower Columbia River Steelhead DPS

NOAA Fisheries has adopted the LCFRB's (2004) recovery plan as its interim recovery plan for the Washington side of the lower Columbia River, including those populations within the LCR steelhead DPS.[6] In the LCFRB's recovery plan, one of the elements considered likely to yield the greatest benefit is to "(p)rotect and enhance existing juvenile rearing habitat in the lower Columbia River, estuary, and plume," (2004). The Action Agencies' estuary habitat restoration projects and relocation of most of the Caspian terns to sites outside the Columbia basin will increase the survival of juvenile steelhead. Juvenile steelhead will also experience an estimated 2.8% increase in passage survival at Bonneville Dam. Implementation of habitat improvement projects in the Hood and Wind River watersheds will address the loss of historical spawning habitat for the Upper Gorge Winter Run population that was inundated by Bonneville pool. Actions that will further improve the viability of the Gorge populations include the continued increase in the northern pikeminnow reward fishery, continued and improved avian deterrence at Bonneville Dam, and prospective juvenile and adult passage improvements at Bonneville Dam. Harvest rates will be less than or equal to those in recent years.

The principal effects of the Prospective Actions on critical habitat will be the increase in juvenile passage survival at Bonneville Dam and in the estuary with the relocation of Caspian terns (juvenile and adult migration corridors free of obstructions); an increase in the amount and quality of estuarine habitat for the transitions between fresh- and saltwater, juvenile growth and development before entering the plume, and the final development of adults before they migrate to upstream spawning areas; an improvement in the functioning of PCEs for spawning, incubation, and rearing in the Hood and Sandy rivers; and an increase in the amount of spawning and rearing habitat (space) in the Lewis and Cowlitz watersheds.

8.12.6.3 Cumulative Effects Relevant to the Lower Columbia River Steelhead DPS

Habitat-related actions and programs that the states of Oregon and Washington have determined are reasonably certain to occur are expected to address the protection and/or restoration of fish habitat, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect instream habitat. These actions will primarily affect conditions within the tributary spawning and rearing areas, including the PCEs of critical habitat needed for successful spawning, incubation, and the growth and development of juvenile steelhead.

Other types of non-Federal activities, especially those that have occurred frequently in the past, are likely to have adverse effects on the species and its critical habitat. Within the action area for this consultation (the mainstem lower Columbia and tributary areas above Bonneville Dam), these are likely to include urban development and other land use practices.

[6] The State of Oregon is in the process of developing a plan for this species. Upon its review, NOAA Fisheries will combine the Washington and Oregon plans into a complete recovery plan for the Lower Columbia River Recovery Domain.

8.12.6.4 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on the Lower Columbia River Steelhead DPS

Impacts of the FCRPS and Upper Snake projects are most significant for the 4 (out of 23) populations within the DPS that spawn above Bonneville Dam and are limited relative to impacts from tributary hydropower, tributary habitat, hatcheries, and predation by birds, fish, and marine mammals. These populations are affected by upstream and downstream passage and, for the Upper Gorge winter-run population, by inundation of spawning habitat. For populations originating in tributaries below Bonneville, only migration and habitat conditions in the mainstem and estuary are affected by the existence and operation of the hydrosystem.

The states of Oregon and Washington identified tributary habitat actions that are reasonably certain to occur and that will benefit the Wind and Hood summer-run and the upper Gorge and Hood winter-run populations, as well as actions that should be generally beneficial throughout the DPS. Habitat blockages in the Lewis, Cowlitz, Sandy, and Hood subbasins are being addressed by actions taken at FERC-licensed hydroelectric projects (Section 8.12.2.1). The functioning of mainstem habitat as a juvenile migration corridor has improved in recent years with the development of the corner collector at Bonneville PH2 and other improvements. Implementation of the State of Washington’s Forest Practices Habitat Conservation Plan will lead to a gradual improvement of habitat conditions on state forest lands within the range of Lower Columbia River steelhead (Section 8.12.3.7).

NOAA Fisheries considered the effects of harvest on the various life-history types and component populations of the LCR steelhead DPS. Prospective non-Indian fisheries will be managed subject to 2% harvest rate limits on winter and summer natural-origin steelhead populations from the LCR steelhead DPS. There are no specific harvest rate limits for tribal fisheries on LCR steelhead DPS. However, the prospective harvest rates associated with tribal fisheries in the Columbia River over the course of the 2008-2017 *U.S. v. Oregon* Management Agreement are expected to be similar to those observed in recent years. The expected harvest rate for tribal fisheries on winter-run populations of the LCR steelhead DPS is the same as the 2.2% harvest rate average observed from 2001 to 2007 (Table 8.12.3.6-2). The expected harvest rate for tribal fisheries on summer-run populations of the LCR steelhead DPS is the same as the 6.4% harvest rate average observed from 2001 to 2007 (Table 8.12.3.6-3).

The Action Agencies’ prospective passage improvements at Bonneville Dam, estuary habitat improvements, and predator management improvements will contribute to the viability of this DPS by addressing the influence of their projects, contributing to its survival with an adequate potential for recovery. The Action Agencies’ prospective habitat projects in the Hood and Wind rivers and additional potential funding of tributary projects above Bonneville are expected to support the restoration of specific populations within the DPS. The Prospective Actions will not further deteriorate the pre-action condition.

The full scope of needed improvements in tributary habitat will be outlined in the final recovery plan for the lower Columbia River, but this plan is not complete. Some adverse impacts from hatchery practices will continue, and harvest rates may be as high as 10% unless reduced as a result of ongoing reviews and subsequent section 7 consultations.

Long term (100 year) extinction risk is high or very high for almost all populations in this DPS. Exceptions are the Wind summer- and South Fork Toutle, Kalama, Clackamas, and Hood winter-run populations. In the short term, the species' extinction risk is expected to be reduced through implementation of the actions described above. In particular, the genetic legacy of several populations (Hood River summer- and winter- and the Cowlitz, Sandy, and Clackamas late-winter populations) will continue to be preserved by ongoing hatchery actions as a hedge against the short-term risk of extinction.

8.12.6.5 Effect of the Aggregate Environmental Baseline, Prospective Actions & Cumulative Effects on PCEs of Critical Habitat for the Lower Columbia River Steelhead DPS

NOAA Fisheries designated critical habitat for LCR steelhead including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood River as well as specific stream reaches in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette. The environmental baseline within the action area, which encompasses the Middle Columbia/Hood, Lower Columbia/Sandy, and Lower Columbia/Clatskanie subbasins, has improved over the last decade but does not yet fully support the conservation value of designated critical habitat for LCR steelhead. The major factors currently limiting the conservation value of critical habitat are barriers in many tributary spawning and rearing areas and the impairment of PCEs such as water quality and quantity, substrate, forage, and natural cover in some tributary and estuarine areas used for spawning, incubation, and larval growth and development.

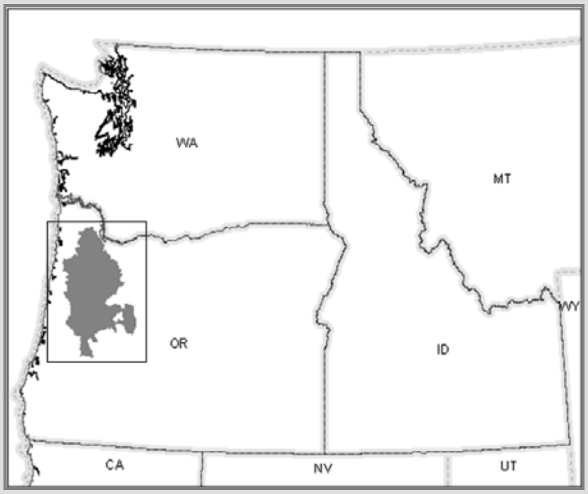
Although some current and historical effects of the existence and operation of the hydrosystem and tributary and estuarine land use will continue into the future, critical habitat will retain at least its current ability for PCEs to become functionally established and to serve its conservation role for the species in the near- and long-term. Prospective Actions will substantially improve the functioning of many of the PCEs; for example, reducing predation by Caspian terns, cormorants, and northern pikeminnows will further improve safe passage for juveniles and the removal of sea lions known to eat steelhead in the tailrace of Bonneville Dam will do the same for winter-run adults. Habitat work in tributaries used for spawning and rearing in the lower Columbia River and estuary will improve the functioning of water quality, natural cover/shelter, forage, riparian vegetation, space, and safe passage, restoring the conservation value of critical habitat at the project scale and sometimes in larger areas where benefits proliferate downstream. There are likely to be short-term, negative effects on some PCEs at the project scale during construction, but the positive effects will be long term. In addition, a number of actions in tributary and estuarine areas will proactively address the effects of climate change. These various improvements are sufficiently certain to occur and to be relied upon for this determination. They are either required by NOAA Fisheries' RPA for the FCRPS or otherwise the product of regional agreement and Action Agency commitment (Upper Snake actions are supported by the SRBA agreement and harvest by the 2008 *U.S. v. Oregon* Agreement).

The aggregate effect of the environmental baseline, Prospective Actions, and cumulative effects will be an improvement in the functioning of PCEs used for spawning, incubation, juvenile growth and development, migration, and juvenile and adult transitions between fresh and salt water. Considering the ongoing and future effects of the environmental baseline and cumulative effects, the Prospective Actions will be adequate to ensure that they will not reduce the ability of critical habitat to serve its conservation role for this species.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the proposed fisheries will not cause deterioration in the pre-action condition for the species, nor reduce the conservation value of this DPS' designated critical habitat. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Lower Columbia River steelhead DPS nor result in the destruction or adverse modification of designated critical habitat.

Section 8.13
Upper Willamette River Chinook Salmon



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Section 8.13
Upper Willamette River Chinook Salmon

As discussed in Section 1.3 of this Opinion, the effect of freshwater fisheries on UWR Chinook, including those being proposed under the 2008 *U.S. v. Oregon* Agreement, were considered previously through an ESA evaluation, pursuant Section 4(d), of an FMEP from the state of Oregon. Because NOAA Fisheries has previously determined that Section 9 take prohibitions do not apply to the proposed fisheries, the effects of the fishing activities under the 2008 *U.S. v. Oregon* Agreement on UWR Chinook were not considered further in this Biological Opinion.

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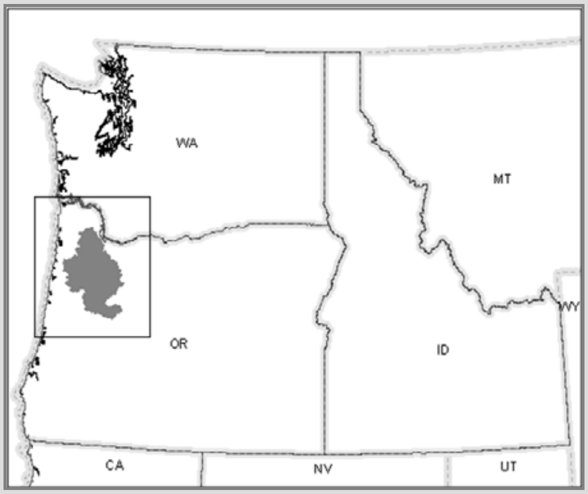
Section 8.14
Upper Willamette River Steelhead



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Section 8.14
Upper Willamette River Steelhead

As discussed in Section 1.3 of this Opinion, the effect of freshwater fisheries on UWR steelhead, including those being proposed under the 2008 *U.S. v. Oregon* Agreement, were considered previously through an ESA evaluation, pursuant Section 4(d), of an FMEP from the state of Oregon. Because NOAA Fisheries has previously determined that Section 9 take prohibitions do not apply to the proposed fisheries, the effects of the fishing activities under the 2008 *U.S. v. Oregon* Agreement on UWR steelhead were not considered further in this Biological Opinion.

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Chapter 9
Southern Resident Killer Whales

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Chapter 9
Southern Resident Killer Whales

9.1 Current Rangewide Status

The Southern Resident killer whale DPS consists of three pods, identified as J, K, and L pods. In this section, the status of the Southern Resident killer whales throughout their range is summarized. Although the entire Southern Resident DPS has potential to occur in the coastal waters at any time during the year, occurrence is more likely during November to May when Southern Residents are only occasionally found in the inland waters of Washington State. The information on the rangewide status of the species is generally representative of the status of the species in coastal waters. The final recovery plan for Southern Residents was issued in January 2008 (NMFS 2008j). This section summarizes information taken largely from the recovery plan, as well as new data that became available more recently. For more detailed information about this population, please refer to the Final Recovery Plan for Southern Resident Killer Whales, which can be found on the internet at www.nwr.noaa.gov.

9.1.1 Status and Trends

Although there is little information available regarding the historical abundance of Southern Resident killer whales, two methods have been used to estimate a historical population size of 140 to 200. The minimum estimate (~140) is the number of whales killed or removed for public display in the 1960s and 1970s added to the remaining population at the time of the captures. The maximum estimate (~200) is based on a recent genetic analysis of microsatellite DNA (NMFS 2003e).

At present, the Southern Resident population has declined to essentially the same size that was estimated during the early 1960s, when it was considered as likely depleted (Olesiuk et al. 1990) (Figure 9.1-1). Since censuses began in 1974, J and K pods have steadily increased their sizes. However, the population suffered approximately a 20% decline from 1996-2001, largely driven by declines in L pod. There have been recent increases in the population from 2002-2006 indicating that L pod's decline may have ended, however such a conclusion is premature. The 2007 census counted 87 Southern Resident killer whales, 25 in J pod, 19 in K pod and 43 in L pod.

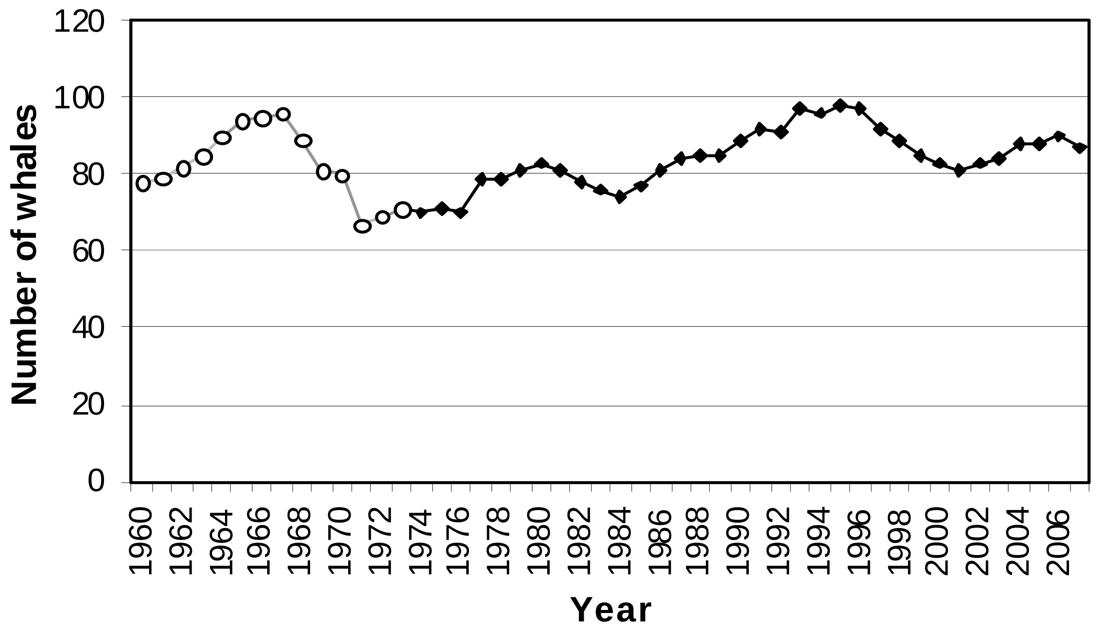

Figure 9.1-1. Population size and trend of Southern Resident killer whales, 1960-2007. Data from 1960-1973 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990). Data from 1974-2007 (diamonds, black line) were obtained through photo-identification surveys of the three pods (J, K, and L) in this community and were provided by the Center for Whale Research (unpubl. data) and NMFS (2008j). Data for these years represent the number of whales present at the end of each calendar year except for 2007, when data extend only through October.

9.1.2 Listing status

The Southern Resident killer whale Distinct Population Segment (DPS) was listed as endangered under the ESA on November 18, 2005 (NMFS 2005d). The final rule included information on the population decline in the 1990s and identified several potential factors that may have caused the decline or may be limiting recovery. These are: quantity and quality of prey, toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. The rule also identified oil spills as a potential risk factor for this species. Southern Residents are designated as “depleted” and “strategic” under the Marine Mammal Protection Act (MMPA) (NMFS 2003e). Critical habitat for the Southern Resident killer whale DPS was proposed on June 15, 2006 (NMFS 2006l) and the final designation of critical habitat was published November 29, 2006 (NMFS 2006c). Critical habitat includes approximately 2,560 square miles of inland waters in three specific areas: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Southern Resident critical habitat does not occur in the coastal waters, and is therefore not considered further in this consultation.

9.1.3 Range and Distribution

Southern Residents are found throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia (Figure 9.1-2).

Figure 9.1-2. Geographic Range (light shading) of the Southern Resident Killer Whale Population. Reprinted from Wiles (2004).

Southern Residents are highly mobile and can travel up to 86 miles (160 km) in a single day (Erickson 1978, Baird 2000). To date, there is no evidence that Southern Residents travel further than 50 km offshore (Ford et al. 2005). Although the entire Southern Resident DPS has potential to occur in coastal waters at any time during the year, occurrence is more likely during November to May.

Southern Residents spend the majority of their time from late spring to early autumn in inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound) (Bigg 1982, Ford et al. 2000, Krahn et al. 2002) (Figure 9.1-3). Typically, J, K and L pods arrive in May or June and spend most of their time in the core area of Georgia Basin and Puget Sound until departing in October. K and L pods also make frequent trips to the outer coasts of Washington and southern Vancouver Island during this time, which generally last a few days (Ford et al. 2000).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976				J,K								
1977												
1978			J,K									
1979											J,K	
1980												
1981				J,K								
1982						J,K				J,K		
1983										J,K	J,K	
1984						J,K						
1985						J,K						
1986					J,K							
1987										J,K	J,K	J,K
1988					J,K							
1989			J,K							J,K	J,K	J,K
1990												
1991					J,K					J,K		
1992												
1993					J,K							
1994										J,L		
1995												
1996										J,K	J,K	
1997										J,L	J,L	J,K
1998											J,K	
1999												
2000												
2001												
2002			J,K,L?									
2003												J,K
2004					J,L	J,L						J,K
2005		J?			J,L							
2006	J?											
2007	none					J,L						

Only J Pod present		Two pods present, as indicated		J, K, and L pods present		Data not available	

Figure 9.1-3. Monthly occurrence of the three Southern Resident killer whale pods (J, K, and L) in the inland waters of Washington and British Columbia, 1976-2005. This geographic area is defined as the region east of Race Rocks at the southern end of Vancouver Island and Port Angeles on the Olympic Peninsula. Pods were recorded as present during a month if they were sighted on at least one day (Hanson 2008).

Late summer and early fall movements of Southern Residents in the Georgia Basin have remained fairly consistent since the early 1970s, with strong site fidelity shown to the region as a whole. However, presence in inland waters in the fall has increased in recent years (NMFS 2008j). It is uncertain whether potential variability in sighting effort over time has contributed to this trend. During early autumn, Southern Residents, and J pod in particular, expand their routine movements into Puget Sound, likely to take advantage of chum and Chinook salmon runs (Osborne 1999). During late fall, winter, and early spring, the ranges and movements of the Southern Residents are less well known.

Sightings through the Strait of Juan de Fuca in late fall suggest that activity shifts to the outer coasts of Vancouver Island and Washington (Krahn et al. 2002).

The Southern Residents were formerly thought to range southward along the coast to about Grays Harbor (Bigg et al. 1990) or the mouth of the Columbia River (Ford et al. 2000). However, recent sightings of members of K and L pods in Oregon (in 1999 and 2000) and California (in 2000, 2003, 2005, 2006 and 2008) have considerably extended the southern limit of their known range (NMFS 2008j). There have been 40 verified sightings or strandings of J, K or L pods along the outer coast from 1975 to present with most made from January to May. These include 16 records off Vancouver Island and the Queen Charlottes, 11 off Washington, four off Oregon, and nine off central California. Most records have occurred since 1996, but this is more likely because of increased viewing effort along the coast for this time of year. Sightings in Monterey Bay, California coincided with large runs of salmon, with feeding witnessed in 2000 (Black et al. 2001). L pod was also seen feeding on unidentified salmon off Westport, Washington, in March 2004 during the spring Chinook run in the Columbia River (M. B. Hanson, personal observation, as cited in Krahn et al. 2004).

9.1.4 Life history

Southern Resident killer whales are a long lived species, with late onset of sexual maturity (review in NMFS 2008j). Females produce a low number of surviving calves over the course of their reproductive life span (5.4 surviving calves over 25 years) (Olesiuk et al. 1990, Bain 1990). Mothers and offspring maintain highly stable social bonds throughout their lives, which is the basis for the matrilineal social structure in the Southern Resident population (Bigg et al. 1990, Baird 2000, Ford et al. 2000). Groups of related matrilines form pods. Three pods – J, K, and L, make up the Southern Resident community. Clans are composed of pods with similar vocal dialects and all three pods of the Southern Residents are part of J clan.

Southern Resident killer whales are known to consume 22 species of fish and one species of squid (Scheffer and Slipp 1948, Ford et al. 1998, 2000, Ford and Ellis 2006, Saulitis et al. 2000). A long-term study of resident killer whale diet identified salmon as their preferred prey (97 percent of prey consumed during spring, summer and fall) (Ford and Ellis 2006). Feeding records for Southern Residents suggest that diet resembles that of the Northern Residents, with a strong preference for Chinook salmon (78 percent of identified prey) during late spring to fall (Hanson et al. 2005, Ford and Ellis 2006). Chum salmon (11 percent) are also taken in significant amounts, especially in autumn. Other species eaten include coho (5 percent), steelhead (*O. mykiss*, 2 percent), sockeye (*O. nerka*, 1 percent), and non salmonids (e.g., Pacific herring and quillback rockfish [*Sebastes maliger*] 3 percent combined). Chinook were preferred despite the much lower abundance of Chinook in the study area in comparison to other salmonids (such as sockeye), presumably because of the species' large size, high fat and energy content, and year-round occurrence in the area. Killer whales also captured older (i.e., larger) than average Chinook (Ford and Ellis 2006).

Researchers are expanding the sample size for Southern Residents and collecting additional fecal samples for analysis to address the potential biases of scale sampling. In inland waters from May to September, Southern Residents' diet consists of approximately 88% Chinook (Hanson et al. 2007a). These studies also confirmed a shift to chum salmon in fall. Little is known about the winter and early spring diet of Southern Residents. Early results from genetic analysis of fecal and prey samples indicate that Southern Residents consume Fraser River-origin Chinook, as well as salmon from Puget Sound, Washington and Oregon coasts, the Columbia River, and Central Valley California (Hanson et al. 2007b). As further data are analyzed, they will provide information on which specific runs of salmon the whales are consuming in certain locations and seasons.

There are no fecal or prey samples or direct observations of predation events (where the prey was identified to the species) when the whales are in coastal waters. Although less is known about diet preferences of Southern Residents off the Pacific coast, it is likely that salmon are also important during late fall and winter when Southern Residents more predictably occur in coastal waters. Chemical analyses support the importance of salmon in the year round diet of Southern Residents (Krahn et al. 2002, 2007). Krahn et al. (2002), examined the ratios of DDT (and its metabolites) to various PCB compounds in the whales, and concluded that the whales feed primarily on salmon throughout the year rather than other fish species. Krahn et al. (2007) analyzed stable isotopes from tissue samples collected in 1996 and 2004/2006. Carbon and nitrogen stable isotopes indicated that J and L pods consumed prey from similar trophic levels in 2004/2006 and showed no evidence of a large shift in the trophic level of prey consumed by L pod between 1996 and 2004/2006.

Researchers have estimated the energy requirements of killer whales and caloric values for salmon to calculate the number of fish needed per day. Salmon differ significantly in size across species and runs, and prey preference among salmon would affect annual consumption rates. Fewer salmon per day would be required from a larger preferred prey species such as Chinook salmon. NOAA Fisheries provides an estimate of the biological requirements of Southern Residents using the best available information on metabolic needs of the Southern Resident population and the caloric content of salmon (NMFS 2008k).

9.2 Environmental Baseline

Because the entire listed entity is found in the coastal waters during some portion of the year, the status of the species in this area is the same as the range-wide status of the species, described above. The following discussion summarizes the conditions in coastal waters that are known to affect the likelihood that Southern Resident killer whales will survive and recover in the wild. The small size of the population increases the level of concern about any risks to Southern Resident killer whales (NMFS 2008j).

Natural Mortality

Seasonal mortality rates among Southern and Northern Resident whales are believed to be highest during the winter and early spring, based on the numbers of animals missing from pods returning to inland waters each spring. Olesiuk et al. (2005) identified high neonate mortality that occurred outside of the summer field research seasons. At least 12 newborn calves (9 in southern community and 3 in northern community) were seen outside the summer field season and disappeared by the next field season. Additionally, stranding rates are higher in winter and spring for all killer whale eco-types in Washington and Oregon (Norman et al. 2004). Southern Resident strandings in coastal waters include three separate events (1995 and 1996 off of Northern Vancouver Island and the Queen Charlotte Islands, and 2002 offshore of Long Beach, Washington State), and the causes of death are unknown (NMFS 2008j).

In recent years, sighting reports indicate anecdotal evidence of thin killer whales returning to inland waters in the spring. For example, in March 2006 a thin female from the Southern Resident population (L54) with a nursing calf was sighted off Westport, WA. The sighting report indicated she had lost so much blubber that her ribs were showing under the skin (Cascadia Research 2008).

Prey Availability

Salmon, particularly Chinook salmon, are the preferred prey of Southern Resident killer whales in inland waters of Washington State during spring, summer and early fall. Chemical analyses support the importance of salmon in the year round diet of Southern Residents. Based on the best available information, Southern Residents may equally prefer Chinook salmon in inland and coastal waters. This analysis therefore focuses on effects of the Prospective Actions on Chinook abundance in coastal waters. Focusing on Chinook provides a conservative estimate of potential effects of the Prospective Action on Southern Residents within coastal waters. The total abundance of all salmon and other potential prey species is difficult to quantify, but is orders of magnitude larger than the total abundance of Chinook in coastal waters.

When prey abundance is low, killer whales may spend more time and energy foraging than when prey abundance is high, with the potential for fitness consequences including reduced reproductive rates and higher mortality rates. Ford and Ellis (2006) correlated coastwide reduction in Chinook abundance (Alaska, British Columbia, and Washington) with decreased survival of resident whales (Northern and Southern Residents), but changes in killer whale abundance have not been linked to changes in salmon stock groups.

The availability of prey to Southern Resident killer whales is affected by a number of natural and human actions. Details regarding baseline conditions of those Chinook salmon in the Columbia River basin that are listed under the Endangered Species Act are described in Chapters 8.2 (Snake River fall Chinook), 8.3 (Snake River spring/summer Chinook), 8.6 (Upper Columbia River spring Chinook), 8.10 (Lower Columbia River Chinook), and 8.13 (Upper Willamette River Chinook) sections of the SCA. The baseline also includes Chinook ESUs that are not ESA-listed, notably the typically abundant Hanford Reach fall Chinook ESU and the Mid-Columbia spring Chinook ESU. Adult salmon are also affected by fisheries harvest in fresh and marine waters. In addition, climate effects from Pacific decadal oscillation and El Nino/Southern oscillation conditions and events cause changes in ocean productivity which can affect natural mortality of salmon, as described in more detail in Chapter 5 (5.7 Large-scale Environmental Variation). Predation in the ocean also contributes to natural mortality of salmon. Salmonids are prey for pelagic fishes, birds, and marine mammals.

Based on the best available information regarding diet composition for Southern Residents killer whales (which suggests that Chinook salmon are their preferred prey), their metabolic needs, and the caloric content of salmon, NOAA Fisheries estimates that the Southern Resident population (based on 2007 population size and structure) could need approximately 221,000 Chinook on an annual basis in coastal waters of their range (NMFS 2008k). Based on estimates derived from fisheries catch and escapement data over the past decade, there may be approximately 3.5 million adult Chinook salmon available in the coastal range of Southern Residents (NMFS 2008k). This estimate includes estimated annual reductions in prey availability from fisheries harvest in coastal waters. However, this estimate is likely to vary on an annual basis due to a combination of factors including ocean conditions and harvest management decisions (implementing the regulations for ocean salmon fisheries include ESA section 7 consultation).

Another factor that could affect the number of salmon required is the size of individual Chinook. NOAA Fisheries is not able to assess the potential differences in biomass of individual Chinook available to Southern Residents, and thus relies on abundance estimates as a proxy measure (as in past consultation, i.e., NMFS 2006m). Southern Resident killer whales consume both natural and hatchery salmon (DFO unpubl. data). There is no information available suggesting that Southern Residents would be affected differently by consuming natural or hatchery salmon (i.e., no known differences in size, energy content, contaminant level, or behavior or location in the ocean).

Prey Quality

Contaminants enter fresh and marine waters and sediments from numerous sources, but are typically concentrated near populated areas of high human activity and industrialization. As discussed in the Status of the Species section above, recent studies have documented high concentrations of PCBs, DDTs, and PBDEs in killer whales (Ross et al. 2000, Ylitalo et al. 2001, Reijnders and Aguilar 2002, Krahn et al. 2004). Harmful contaminants are stored in blubber; however, organochlorines can be released from the blubber and become redistributed to other tissues increasing risk of immune or reproductive effects during weight loss from reductions in prey (Krahn et al. 2002).

As top predators, when killer whales consume contaminated prey they accumulate the contaminants in their blubber. When prey is scarce, killer whales metabolize their blubber and the contaminants are mobilized. In addition, nursing females transmit large quantities of contaminants to their offspring. Chinook salmon contain higher levels of some contaminants (i.e., PCBs) than other salmon species (O'Neill et al. 2005). Only limited information is available for contaminant levels of Chinook along the west coast (i.e., higher PCB and PBDE levels may distinguish Puget Sound-origin stocks, whereas higher DDT-signature may distinguish California origin stocks; Krahn et al. 2007). Adult Chinook that originate from the Columbia River may accumulate contaminants through development and growth in the freshwater and marine environment, and become a source of contaminant loading if consumed by Southern Residents.

Vessel Activities and Sound

Commercial shipping, ferry operations, military vessels and recreational vessels occur in the coastal range of Southern Residents; however, the density of traffic is lower in the coastal compared to inland waters of Washington State and British Columbia. Several studies in the inland waters of Washington State and British Columbia have linked interactions of vessels and Northern and Southern Resident killer whales with short-term behavioral changes (Kruse 1991; Williams et al. 2002a, b; Foote et al. 2004, Bain et al. 2006). Although the potential impacts from vessels and the sounds they generate are poorly understood, these activities may affect foraging efficiency, communication, and/or energy expenditure through their physical presence, increased underwater sound level, or both. Collisions of killer whales with vessels are rare, but remain a potential source of serious injury and mortality. There are no known incidents of Southern Resident collisions with vessels in coastal waters, however, very few stranded killer whales are recovered and there are stretches of unpopulated coastline where stranded whales would not be reported.

Vessel sounds in coastal waters are most likely from large ships, tankers and tugs. Most sound generated by large vessels is a source of low frequency (5 to 500 Hz) human-generated sound in the world's oceans (NRC 2003). While ships generate some broadband noise in the hearing range of whales, the majority of energy is below their peak hearing sensitivity. Such vessels do not target whales, move at relatively slow speed and are likely detected and avoided by Southern Residents. It is difficult to precisely quantify or estimate the magnitude of the risks posed by commercial whale watching and recreational vessels in coastal waters; however, weather conditions in the Pacific Ocean in winter limit these activities. The risk to Southern Residents is less in coastal waters than within the inland waters of Washington State and British Columbia, where traffic levels are higher and a greater proportion of traffic may target whales (whale watching and recreational vessels).

Non-Vessel Sound

Anthropogenic (human-generated) sound in coastal waters within the range of Southern Residents is generated by other sources besides vessels, including oil and gas exploration, construction activities, and military operations. Natural sounds in the marine environment include wind, waves, surf noise, precipitation, thunder, and biological noise from other marine species. The intensity and persistence of certain sounds (both natural and anthropogenic) in the vicinity of marine mammals vary by time and location and have the potential to interfere with important biological functions (e.g., hearing, echolocation, communication).

Sound from in-water construction activities could potentially occur through permits issued by the Army Corps of Engineers under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act of 1899 and by the State of Washington under its Hydraulic Project Approval (HPA) program. Several consultations on federal projects in the coastal range of Southern Residents have been conducted and conservation measures have been included to minimize or eliminate potential effects to marine mammals. Sound, such as sonar generated by military vessels also has the potential to disturb killer whales in coastal waters.

Oil spills

Oil spills have occurred in the coastal range of Southern Residents in the past, and there is potential for spills in the future. Oil can be discharged into the marine environment in any number of ways, including shipping accidents, refineries and associated production facilities, and pipelines. Despite many improvements in spill prevention since the late 1980s, much of the region inhabited by Southern Residents remains at risk from serious spills because of the heavy volume of shipping traffic and proximity to petroleum refining centers in inland waters. Numerous oil tankers transit through the coastal range of Southern Residents throughout the year. The magnitude of the risks posed by oil discharges in this area is difficult to precisely quantify or estimate.

The long-term effects of repeated ingestion of sub-lethal quantities of petroleum hydrocarbons on killer whales are not well understood. In marine mammals, acute exposure to petroleum products can cause changes in behavior and reduced activity, inflammation of the mucous membranes, lung congestion, pneumonia, liver disorders, and neurological damage (Wursig 1990 and Geraci 1990). In addition, oil spills have the potential to adversely impact habitat and prey populations, and, therefore, may adversely affect Southern Residents by reducing food availability.

Scientific Research

Most of the scientific research conducted on Southern Resident killer whales occurs in inland waters of Washington State and British Columbia. In general, the primary objective of this research is population monitoring or data gathering for behavioral and ecological studies. In 2006, NOAA Fisheries issued scientific research permits to seven investigators who intend to study Southern Resident killer whales. Research activities are typically conducted between May and October in inland waters. However, some permits include authorization to conduct research in coastal waters.

In the biological opinion NOAA Fisheries prepared to assess the impact of issuing the permits, we determined that the effects of these disturbances on Southern Residents were likely to adversely affect, but not jeopardize the continued existence of, the Southern Resident killer whales (NMFS 2006n). The annual authorized takes by harassment of Southern Residents under these permits totaled 1,935 non-invasive takes (e.g., surveys and photo-identification); 70 takes from biopsying, tagging, or breath sampling; and 820 takes due to unintentional harassment, although actual anticipated takes are substantially lower. While most of the authorized takes would occur in inland waters, a small portion of this disturbance is part of the baseline in the coastal range of Southern Residents.

Activities Outside U.S. Jurisdiction

The Southern Resident killer whales are highly migratory and may transit in and out of the waters of the United States and the high seas. NOAA Fisheries does not presently have information to assess the impact on Southern Residents of scientific research or boating activities within Canadian jurisdictional waters. NOAA Fisheries included information on Canadian fisheries within the coastal range of Southern Residents using the same methods to quantify U.S. fisheries in this area (NMFS 2008k).

Summary of the Environmental Baseline

Southern Resident killer whales are exposed to a wide variety of past and present state, federal or private actions and other human activities in their coastal range as well as federal projects in this area that have already undergone formal section 7 consultation, and state or private actions that are contemporaneous with this consultation. All of the following activities discussed in the above section are likely to have some level of impact on Southern Residents when they are in coastal waters of their range.

Reductions in food availability, increased exposure to pollutants, and human disturbance have all been identified as potential threats to killer whales in Washington and British Columbia (Ford and Ellis 1999, 2005; Ford et al. 2000; Baird 2001; Krahn et al. 2002, 2004; Taylor 2004, Wiles 2004). Researchers are unsure about which threats are most significant to the Southern Resident population. Although the three primary factors are identified as prey availability, environmental contaminants, and vessel effects and sound, none have been directly linked to or identified as the cause of the recent decline of the Southern Resident killer whales (Krahn et al. 2002). There is limited information on how these factors or additional unknown factors may be affecting Southern Resident killer whales when in coastal waters in winter. For reasons discussed earlier, it is possible that two or more of these factors may act together to harm the whales. The small size of the population increases the level of concern about all of these risks (NMFS 2008j).

9.3 Effects of the Prospective Actions on Southern Resident Killer Whales

The potential effects of the Prospective Actions on Southern Resident killer whales relate to prey availability. Contamination (prey quality) is not an issue because the effects of the Prospective Actions do not include the introduction of contaminants into freshwater. Chapter 2 of the SCA defines the federal actions aggregated in the SCA, or Prospective Actions, which include:

- Operation and configuration of the Federal Columbia River Power System (FCRPS) as described in the 2007 FCRPS Biological Assessment (Corps et al. 2007b) and the mainstem effects of 11 Reclamation irrigation projects (Corps et al. 2007b, Appendix B-1-7), as modified by NOAA Fisheries' RPA for the FCRPS (described in Chapter 4 of the FCRPS Biological Opinion (NMFS 2008a).

- Operation and Maintenance of 12 Irrigation Projects in the Upper Snake (described in Reclamation's 2007 Upper Snake Biological Assessment (USBR 2007).

- NOAA Fisheries' § 10(a)(1)(A) Transportation Permit issued as part of NOAA Fisheries' FCRPS Opinion.

- NOAA Fisheries' participation in the 2008-2017 *U.S. v. Oregon* Management Agreement (hereafter, "2008 *U.S. v. Oregon* Agreement") concerning particular Columbia River fisheries related activities as described in Chapter 2 of NOAA Fisheries' Biological Opinion for that Agreement.

- Federal Action Agencies' funding of all FCRPS mitigation hatchery programs.

Most of the direct effects of the Prospective Actions occur within the freshwater system and plume of the Columbia River; effects experienced by Southern Residents in the coastal area are indirect. The Prospective Actions may affect the abundance of killer whale prey in the ocean. Changes in prey abundance would affect the entire population of Southern Resident killer whales. The best available information indicates that salmon are the preferred prey of killer whales year round, including in coastal waters (Status of the Species), and that Chinook are the preferred salmon species. Prey abundance is a concern for killer whales both in the near and long term. To survive in the near term, killer whales require regular supplies of adult Chinook prey in the ocean, and to recover over the longer term, killer whales require abundant Chinook stocks coast-wide, likely including stocks from the Columbia River (Status of the Species). This analysis considers the short-term (less than ten years) and long-term (ten years and longer) effects of the Prospective Actions described above.

9.3.1 Effects of Hydro and Associated Actions on Southern Resident Killer Whales

Short-Term Effects

The hydro and associated actions combined include operation and configuration of the FCRPS, federal water management in the Upper Snake, and federal actions to improve habitat, reduce predation and fund hatcheries. Included in the hatchery funding is a commitment to review and reform (as needed) future hatchery operations. No details are proposed regarding hatchery reform, and NOAA Fisheries expects that future hatchery production, including reforms, will be subject to additional future consultation when detailed actions are proposed. In the interim, the Prospective Action is to continue funding hatchery operations at current levels.

Effects of Artificial Production

The Prospective Actions include continued funding for artificial propagation of Chinook salmon, which produces killer whale prey. Action agency (BPA, Corps and Reclamation) funding accounts for approximately 50 percent of the Chinook smolts released above Bonneville Dam (Jones 2008). This analysis also assumes that current levels of funding and production will continue over the short term.

For returns prior to 2007, the proportion of hatchery-origin Chinook passing Bonneville Dam ranged between 50 and 80 percent for individual stocks of Chinook from the Columbia River (PCSRF 2007). Since 2000, Chinook hatchery returns to Bonneville Dam represented approximately 70 percent of the total Chinook run, on average (Turner 2008). If the Prospective Actions produce approximately 50% of all returning hatchery Chinook above Bonneville Dam, and all hatchery Chinook combined represent approximately 70% of the Chinook returns at Bonneville, approximately 35% of the total annual return of Chinook above Bonneville Dam can be attributed to the Prospective Actions.

Effects of Hydrosystem Operations

The operation and configuration of the FCRPS causes mortality of migrating juvenile Chinook, which in turn results in fewer adult Chinook in the ocean and reduced prey availability, compared to an absence of dam-related juvenile mortality. For purposes of determining whether the Chinook prey base for killer whales is adversely affected by the proposed action, it is not necessary to precisely quantify the mortality resulting from the hydrosystem operations (as distinguished from other causes), so long as it can be reasonably concluded that the decrease in the prey base for killer whales resulting from hydrosystem operations is less than the increase in the prey base resulting from the hatchery programs funded by the action agencies.

The effect of the hatchery programs is to increase by 35% the number of Columbia and Snake River Chinook originating above Bonneville Dam and available to the killer whales. In order for any decrease caused by the hydrosystem to exceed this increase, the hydrosystem would have to cause a 35% or greater reduction in the total number of Columbia and Snake River Chinook available to killer whales. For the reasons discussed below, it is unlikely that the hydrosystem results in a 35% or greater reduction in the killer whale prey base.

Many factors cause mortality to juvenile salmon as they migrate to the ocean. Natural mortality occurs from predators, competition for food, and disease. Human actions unrelated to the hydrosystem, such as the diking and filling of wetlands, road construction and maintenance, and introduction of pollutants can increase mortality in that part of the migration corridor that is within the hydrosystem. And the "bare existence" of the dams, as well as the operation of the dams, also causes juvenile mortality.

Although we have relatively good estimates of the overall level of mortality experienced by juvenile Chinook as they move through the hydrosystem, available information does not enable us to partition the overall level of mortality among the various potential causes. Attempts to allocate mortality have not been notably successful. Most recently, in *National Wildlife Federation v. NMFS*, CV 01-640-RE (D. OR. May 26, 2005) the Court rejected NOAA Fisheries' attempt to partition the sources of mortality. The Court directed the federal agencies to focus instead on the actions needed to bring ESA-listed salmon to recovery. Thus, the analysis in other parts of this opinion does not attempt to estimate how many fewer ESA-listed salmon are present as a result of the operating the hydrosystem.

To assure that the effects of the hydro operations in the Prospective Action on the killer whale prey base will not outweigh the benefits to that prey base resulting from the hatchery programs funded as part of that action, NOAA Fisheries compared the percent increase in adult Chinook from the hatchery actions to the total mortality rate for juvenile Chinook passing through the hydrosystem, regardless of cause. This comparison is a very conservative approach since only a portion of these mortalities are, in fact, the result of the hydro operations being consulted upon.

As further described in other portions of this biological opinion dealing with ESA-listed salmon (SCA, Hydro Modeling Appendix), the estimated average survival for spring/summer Chinook passing through the area of the hydrosystem under the proposed action varies from about 67% (for both in-river migrating and transported juveniles from Lower Granite to Bonneville Dams, assuming a "D" value of 0.709) to more than 95% (passing 1 dam). More than 85% of adult spring/summer Chinook returning to the Columbia and Snake Rivers come from fish that pass 4 dams or fewer dams, which have a survival rate of 73 to over 95%. Thus, for spring/summer Chinook, the total mortality, regardless of cause, is less than 35% (That is, the total survival through the hydrosystem is greater than 65%).

Spring/summer Chinook primarily spawn and rear in tributaries and enter the Snake and Columbia Rivers as yearling smolts that use the area of the hydrosystem primarily as a migratory corridor. Thus, the high level of natural mortality that occurs to all salmon in the egg-to-smolt stage has already taken place before the spring Chinook enter the hydrosystem. For fall Chinook, the reverse is true.

Fall Chinook spawn and rear principally in the mainstem of the Snake and Columbia Rivers. Regardless of whether they originate in the wild or from a hatchery, fall Chinook move through the system primarily as smaller, sub-yearling fish. Due to their size, such fish are more vulnerable to predation and other natural mortalities. This loss is exacerbated by the increased time that sub-yearlings spend rearing in shallow-water habitat as they move through the migratory corridor. Many of these losses would occur regardless of whether the fall Chinook were migrating through a hydrosystem or in a natural river.

Since fall Chinook losses from natural causes are considerably greater than the spring/summer Chinook losses during the downstream migration, it is no surprise that the estimated survival rates for fall Chinook passing through the hydrosystem are considerably lower than those for spring/summer Chinook, but combined these rates exceed 65%. The survival rate[1] for those passing through 8 dams is approximately 33%; for 4 dams survival is about 54%; and for 1 dam survival is approximately 85%.[2] Less than 3% of the fall Chinook adults originate from locations that are above more than 8 dams. About 29% (primarily the Hanford Reach run) pass through 4 dams, and about 68% of the fall Chinook adults (primarily hatchery production) originate above only 1 dam. When the survival rate is weighted based on the percentage of the fall Chinook found in each group, the overall weighted average survival of fall Chinook passing through the hydrosystem is approximately 74% [(3%*33%)+(29%*54%)+(68%*85%)].

Because the overall losses occurring within the area of the hydrosystem to both spring/summer and fall Chinook are less than 35%, the hatchery production contained in

[1] The implementation of the Prospective Actions should substantially improve the survival of migrating fall Chinook salmon. However, NOAA Fisheries does not attempt to estimate quantitative improvements for fall Chinook salmon from these actions due to complications arising from the expression of multiple life-history strategies.

[2] Juvenile fall Chinook survival estimates are calculated based on per km survival estimates from McNary tailrace to John Day tailrace (1999 – 2002 migrations, June 19 to July 23 releases) using information presented in Williams et al. 2005 (Table 39). The average of these data is 76.7% over a 123 km reach, or a survival rate of nearly 0.998 / km. The entire FCRPS reach is about 512 km, the Bonneville to McNary reach is about 287 km, and Bonneville dam and reservoir is about 73 km in length.

the Prospective Actions more than mitigates for losses to the killer whale prey base, regardless of the source of loss.

The above assessment does not take into account the increased productivity and survival due to habitat and predator programs, which, if included, would show a further increase in the prey base for killer whales. Additionally, there are more hatchery and natural Chinook salmon available to Southern Resident killer whales from Columbia River stocks than is apparent from returns to Bonneville Dam. Recent estimates of ocean abundance (estimated by extrapolation from fisheries catch data) indicate approximately 1,000,000 adult Chinook originate from Columbia River stocks (NMFS 2008k, CTC 2007, ODFW and WDFW 2007). Although there is large annual variability in adult Chinook returns to the mouth of the Columbia River, returns from 1980 to 2007 indicate a slight positive trend, with average abundance of approximately 800,000 Chinook (Corps et al. 2008a).

Long-Term Effects

Salmon analyses presented in the SCA indicate that Prospective Actions including actions that affect the operation of the hydrosystem, tributary and estuary habitat, harvest, predation (tern, pike minnow and marine mammal), hatcheries, and RM&E overall have positively affected and will continue to positively affect the survival and recovery of the listed entities of salmon and steelhead. These analyses consider whether a sufficient number of populations within specific Major Population Groups (MPGs) will survive (i.e., low 24-year extinction risk) and trend toward recovery (i.e., improved average returns-per-spawner, median population growth rate, and abundance trend) to indicate that a specific MPG trends toward recovery (more details available in SCA, Chapter 7).

As discussed in SCA Section 8.1.5 (Effects of Hatchery Programs), while hatchery Prospective Actions (the Action Agencies' obligation to fund hatcheries) are important steps to reducing risk and assuring the long-term viability of these ESUs, at present the hatchery reform process is underway and it is not possible to quantify results or expect that benefits of these reforms are "reasonably certain to occur," and therefore was not part of the basis for conclusions. The Prospective Actions include implementation of hatchery reform (described in RPA 39) pending completion of separate ESA consultations (target completion dates: November 2009 to June 2010; SCA Section 5.5.1). Thus, hatchery effects from the Prospective Actions were assumed as constant from present until future adoption of hatchery reforms as the result of these separate consultations.

Over the long term, the abundance of Columbia River Chinook, and thus of Southern Resident killer whale prey, may be affected by climate change. The Prospective Actions include monitoring of climate effects on salmonids and mechanisms to synthesize, update, and modify implementation to respond to new information regarding the effects of climate change on listed salmonids (SCA Section 7.1.2.1).

The analysis in the SCA concludes that listed Chinook ESUs, and all other listed salmonid ESUs/DPSs in the Columbia River Basin, are expected to survive with an adequate potential for recovery, and the Prospective Actions are not likely to jeopardize the continued existence of these ESUs. Additionally, the Prospective Actions will not adversely modify the designated critical habitat of these and all other listed ESUs/DPSs addressed, and critical habitat is expected to remain functional (or retain the ability to become functional) to serve the intended conservation role in the near and long term. These conclusions were derived after reviewing the effects of the Prospective Actions, the effects of the environmental baseline, and any cumulative effects presented in the salmon analyses. The long-term recovery of listed Columbia River salmon is a benefit for Southern Resident killer whales in the long term.

The potential harmful effects of artificial production on long-term fitness of salmon populations are discussed in the SCA Appendix, Hatchery Effects Report. Specifically, hatcheries can negatively affect population viability by reducing abundance, productivity, spatial distribution and/or diversity of natural-origin fish (described in McElhany et al. 2000). Table 3 of the SCA Appendix, Hatchery Effects Report, identified risks or threats to population viability for Chinook ESUs, including isolated hatchery practices or non-indigenous hatchery broodstock and/or the influence of strays, in combination with a high proportion of hatchery fish in the population can increase the risks to productivity and diversity. The Prospective Actions contemplate future hatchery reforms intended to address harmful effects of hatchery production on the long-term fitness of the naturally spawning fish. Detailed information is not presently available to evaluate long-term effects of a continuation of current hatchery production on Chinook availability, or of reforms to hatchery operations. Thus, an analysis of long-term effects of the hatchery funding contemplated in the Prospective Actions is not possible at this time and will be considered in separate future consultations when detailed information is available.

9.3.2 Effects of Harvest Actions on Southern Resident Killer Whales

Prospective Actions include the 2008 *U.S. v. Oregon* Agreement, which includes some take of hatchery- and natural-origin Chinook salmon. The terminal fisheries do not directly affect Southern Residents, as the fisheries occur after the fish have returned to the river and are no longer available to the whales in the ocean.

Short-Term Effects

Since the majority of fish available for in-river harvest are hatchery fish, the majority of salmon caught will be hatchery salmon. Although the harvest action is constrained by take limitations on natural-origin salmon, some are incidentally caught. Even with the proposed harvest levels on Chinook, most hatchery programs are expected to meet or exceed escapement goals (SCA Chapter 8), and thus will continue to operate at full production with no effect on the future availability of hatchery Chinook in the ocean. In-river harvest of natural-origin fish reduces the number of adults returning to the spawning grounds, and consequently could reduce the number of offspring in the following generation. Such a reduction could in turn reduce the number of adult Chinook available as prey to killer whales in the ocean.

Spring and fall run Chinook are likely to be affected differently by the prospective harvest actions because of differences in their life histories. Spawning habitat for natural-origin Snake River fall Chinook is fully seeded, and Upper River Brights are above escapement goals. Spawning habitat for fall stocks below Bonneville dam, with few exceptions, is also fully seeded, because of stray hatchery fish. Thus harvest of fall run Chinook is not expected to result in a decrease in the number of offspring in the subsequent generation. In contrast, spring returns of natural-origin Chinook, particularly for upriver stocks, tend to be under-seeded. The prospective harvest action manages take of natural-origin upriver Chinook using a sliding scale, and can result in take levels from 5.5 to 17 percent of natural-origin Chinook. Generally, the level of take can be characterized as 10 percent natural-origin from these ESUs. This analysis makes the conservative assumption that in some cases available spawning habitat will be under-seeded, and that a further reduction may occur as a result of the harvest of natural-origin Chinook. That reduction would be proportional to the allowable harvest rate.

Overall, Chinook returns are approximately 30 percent natural-origin fish (70 percent hatchery), whereas upriver spring Chinook are approximately 12 and 32 percent natural-origin for runs returning to spawn above Priest Rapids Dam on the Columbia River and to the Snake River, respectively (average return, 2003 to 2007). On average, the return of natural-origin Chinook to the mouth of the Columbia River from these stocks combined is approximately 30,000 (average return, 2003 to 2007). The 10 percent take that can be expected from the harvest action is therefore approximately 3,000 natural-origin Chinook.

A conservative assumption is that spawner-to-spawner rates are on the order of one-to-one. Given this assumption, the annual return to the river mouth would be 3,000 additional Chinook had there been no fishing. Approximately 3,000 Chinook represents less than 1 percent of the Chinook stocks available to Southern Residents in the ocean that originate from the Columbia River (~1,000,000 Chinook; NMFS 2008k, CTC 2007, ODFW and WDFW 2007) or that return to the mouth of the Columbia River annually (~800,000 Chinook; Corps et al. 2008a).

Long-Term Effects

Over the long term, reductions in naturally spawning spring Chinook could compound. This could reduce Chinook available for killer whale prey in the year in which the reduction was realized and over the long term if it increased the extinction risk of the listed Chinook stocks. As discussed above, the SCA concludes that the combination of

Prospective Actions in all areas is likely to ensure the survival, and maintain the long-term potential for recovery, of the listed Chinook ESUs.

9.4 Cumulative Effects

Cumulative effects are those effects of future tribal, state, local or private activities, not involving Federal activities, reasonably certain to occur within the action area (50 CFR 402.02). For the purpose of the Southern Resident killer whale analysis, this area is the coastal range of the species. Future Federal actions will be reviewed through separate section 7 consultation processes.

Future tribal, state and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives and fishing permits. Activities are primarily those conducted under state, tribal or federal government management. These actions may include changes in ocean policy and increases and decreases in the types of activities that currently occur, including changes in the types of fishing activities, resource extraction, or designation of marine protected areas, any of which could impact listed species or their habitat. Government actions are subject to political, legislative and fiscal uncertainties. These realities, added to the geographic scope, which encompasses several government entities exercising various authorities, and the changing economies of the region, make analysis of cumulative effects speculative. A Final Recovery Plan for Southern Resident Killer Whales was published January 24, 2008 (NMFS 2008l). Although state, tribal and local governments have developed plans and initiatives to benefit marine fish species, ESA listed salmon, and the listed Southern Residents, they must be applied and sustained in a comprehensive way before NOAA Fisheries can consider them “reasonably certain to occur” in its analysis of cumulative effects. Details regarding cumulative effects of Chinook salmon in the Columbia River are described in Chapter 8 sections of the SCA for each ESU affected.

Private activities are primarily associated with commercial and sport fisheries, construction, and marine pollution. These potential factors are ongoing and expected to continue in the future, and the level of their impact is uncertain. For these reasons, it is not possible to predict beyond what is included in SCA Chapter 8 whether future non-Federal actions will lead to an increase or decrease in prey available to Southern Resident killer whales, or have other effects on their survival and recovery.

Conclusion

Harvest under *U.S. v. Oregon* will result in the harvest of both hatchery and naturally spawning Chinook. The harvest of hatchery fish, which account for the majority of adult Chinook returning to the Columbia River, is managed to meet hatchery escapement goals and does allow for adequate broodstock escapement for most hatchery programs. As a result, the number of adults returning to hatcheries is sufficient to ensure that the production of hatchery fish in subsequent years will not be reduced as a result of harvest.

In contrast, not all naturally spawning Chinook escape at levels that allow the natural spawning habitat to be fully seeded. Thus, there is likely to be some reduction of Chinook available as killer whale prey in the ocean in subsequent years as a result of the harvest of returning adults. Assuming a one-to-one relationship between the reduction of adults for broodstock and their adult progeny in the ocean, NOAA Fisheries estimates that the *U.S. v. Oregon* harvest actions could reduce the killer whale prey base by as many as 3,000 Chinook annually.

This level of potential annual reduction is less than 1 percent of the Columbia River Chinook contribution to the whales' prey resources. In the short term, the annual reduction of available prey is small in magnitude, and not likely to appreciably diminish the likelihood of the Southern Resident's survival and recovery by affecting their numbers, reproduction, or distribution.

Although annual effects of harvest are relatively small, these effects could compound over subsequent generations. Over the long term, NOAA Fisheries' analysis (SCA Chapter 8) concludes that the combination of Prospective Actions in all areas is likely to ensure the survival, and maintain the long-term potential for recovery, of the listed Chinook ESUs. NOAA Fisheries therefore concludes that over the long term the harvest action proposed under *U.S. v. Oregon* is not likely to appreciably diminish the likelihood of the Southern Resident's survival and recovery by affecting their numbers, reproduction, or distribution.

NOAA Fisheries has reviewed the current status of the endangered population of Southern Resident killer whales and the environmental baseline, the short-and long-term effects of the Proposed Action, and the cumulative effects. Based on this review, and the considerations discussed above, it is NOAA Fisheries' biological opinion that the *U.S. v. Oregon* harvest action is likely to reduce the number of Chinook available in the ocean as killer whale prey by a small amount, but this small reduction is not likely to jeopardize the continued existence of Southern Resident killer whales.

Chapter 10
Green Sturgeon of the Southern DPS

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Chapter 10
Green Sturgeon of the Southern DPS

10.1 Status of the Species

With this first step in the analysis, NOAA Fisheries accounts for the principal life history characteristics of each affected listed species. The starting point for this step is with the scientific analysis of species' status which forms the basis for the listing of the species as endangered or threatened.

10.1.1 Listing

Upon completion of a status review, NOAA Fisheries determined that green sturgeon comprise two DPSs that qualify as species under ESA: 1) a northern DPS, consisting of populations in coastal systems from the Eel River, California northward, that was determined to not warrant listing; and 2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River (Adams et al. 2002). The southern distinct population segment (DPS) of green sturgeon was listed as threatened under the ESA by NOAA Fisheries on April 7, 2006 (NMFS 2006d). Take prohibitions via section 4(d) of the ESA have not yet been promulgated, nor has critical habitat yet been designated for the southern DPS, although both actions are expected to occur in 2008.

10.1.2 Life history

Green sturgeon are the most marine-oriented of the North American sturgeon species. Juveniles of this species are able to enter estuarine waters after only one year in freshwater. During this time, they are believed to feed on benthic invertebrates, although little is known about rearing habitats and feeding requirements. Green sturgeon are known to range in nearshore marine waters from Mexico to the Bering Sea, and are commonly observed in bays and estuaries along the west coast of North America, including the Columbia River (NMFS 2008m). McLain (2006) noted that Southern DPS green sturgeon were first determined to occur in Oregon and Washington waters in the late 1950s when tagged San Pablo Bay green sturgeon were recovered in the Columbia River estuary. The proportion of the Southern relative to Northern DPS is high (~ 67-82%, or 121 fish, of 155 fish sampled) (Israel and May 2007). Aggregations of adults occupy the lower Columbia River and estuary, up to the Bonneville Dam, primarily during summer months (WDFW and ODFW 2002, Moser and Lindley 2007). Beamis and Kynard (1997) suggested that green sturgeon move into estuaries of non-natal rivers to feed. Information from fisheries-dependent sampling suggests that green sturgeon only occupy large estuaries during the summer and early fall in the northwestern United States. Green sturgeon are known to enter Washington estuaries during summer (Moser and Lindley 2007). There is no evidence of spawning in the Lower Columbia. Green sturgeon in the Lower Columbia River are most likely feeding, but, to date, all stomachs examined (n>50) have been empty (Rien as cited in Grimaldo and Zeug 2001).

10.1.3 Status/Population Trend

Quality data on current population sizes and trends for green sturgeon is non-existent. Lacking any empirical abundance information, Beamesderfer et al. (2007) recently attempted to characterize the relative size of the Sacramento-San Joaquin green sturgeon population (Southern DPS) by comparison with the Klamath River population (Northern DPS). Using Klamath River tribal fishery harvest rate data and assuming adults represent 10% of the population at equilibrium, they roughly estimate the Klamath population at 19,000 fish with an annual recruitment of 1,800 age-1 fish. Given the relative abundance of the two stocks in the Columbia River estuary based on genetic samples, they speculate abundance of the Sacramento population may equal, or exceed the Klamath population estimate. Collectively, Beamesderfer et al. (2007) estimate abundances of the various green sturgeon populations may be larger than previously thought due to seasonal high abundances in the Columbia River, Willapa Bay, and Grays River estuaries and other coastal tributaries, historical high harvest in different areas at different times, and a significant portion of each population likely remains in the ocean at any given time.

10.1.4 Key Limiting Factors for Green Sturgeon

The principal factor in the decline of the Southern DPS is the reduction of the spawning habitat to a limited section of the Sacramento River (NMFS 2006d). The potential for catastrophic events to affect such a limited spawning area increases the risk of the green sturgeon's extirpation. Insufficient freshwater flow rates in spawning areas, contaminants (e.g., pesticides), bycatch of green sturgeon in fisheries, potential poaching (e.g., for caviar), entrainment of juveniles by water projects, influence of exotic species, small population size, impassable migration barriers, and elevated water temperatures in the spawning and rearing habitat likely also pose threats to this species (NMFS 2006d).

10.1.5 Harvest Effects

In the past, take of green sturgeon may have occurred from direct harvest in sport and commercial fisheries and from catch and release mortality in commercial fisheries. In the more recent years, the take of green sturgeon in the Columbia River was incidental to fisheries directed at white sturgeon. The numerous management actions implemented by the states of Oregon and Washington since 1994 to control white sturgeon harvest also reduced harvest of green sturgeon, including a reduction of impacts to the listed Southern DPS. The reduced catch of green sturgeon in recent years is believed to be the result of these collective management actions by the states resulting in lower catch, and is not considered indicative of lower abundance of the stock (TAC 2008).

Incidental take of green sturgeon primarily occurs during the early-fall (August) and late-fall (September-November) seasons, concurrent with peak abundance of green sturgeon in the lower Columbia River. Sturgeon angler effort and catch in the estuary increased steadily during the 1990s and peaked in 1998 when anglers made 86,400 trips and caught 30,300 white sturgeon, or 73% of the total catch below Bonneville Dam (TAC 2008). Since 1989, all fisheries affecting lower Columbia River white sturgeon have been managed for Optimum Sustainable Yield (OSY) to provide sustainable broodstock recruitment and ensure the overall health of the white sturgeon population. Beginning in 1996, the states formally adopted a three-year Joint State management agreement based on OSY to guide Columbia River sturgeon fisheries and management decisions. Although the majority of the tenets within the current Joint State sturgeon management agreement focus on white sturgeon, a few objectives specific to benefit green sturgeon management were also included. Beginning July 7, 2006, and in response to the ESA listing of the Southern DPS, retention of green sturgeon in the commercial fisheries was disallowed (TAC 2008). Beginning in January 2007, the states changed the regulations in the recreational fishery to also disallow retention of green sturgeon (TAC 2008). The delay in the implementation of non-retention requirements in the recreational fishery were related to the prescribed process for changing sport regulations and the need for a concurrent public education process.

Harvest of green sturgeon has declined from an average of 1,388 fish annually during 1991-2000 to 154 fish per year since 2001 due to changes in regulations and season structure (Table 10.1-1). During 1996-2006, an average of 61 green sturgeon were harvested in the recreational fishery (Table 10.1-1). During 1996-2006, anglers released an average of 7 green sturgeon annually (2.7 sub-legal, 3.1 legal, and 1.3 over legal-sized) (TAC 2008). With the listing of the Southern green sturgeon DPS, the states took additional emergency action to disallow retention of green sturgeon during commercial fisheries beginning in July 2006, when the ESA listing became effective. During the remainder of 2006, the states started a public awareness and education process so that the sport fishing community would be better able to recognize the differences between white and green sturgeon. The states also disallowed retention of green sturgeon in the recreational fishery starting in 2007 (TAC 2008).

Table 10.1-1. Lower Columbia River Green Sturgeon Catch, 1991-2007 (TAC 2008)

Green Sturgeon						
Year	Sport	Commercial				
		Winter	Summer	Early Fall	Late Fall	Total
1991	22	4	--	2	3,180	3,208
1992	73	10	--	1,750	400	2,233
1993	15	1	--	--	2,220	2,236
1994	132	1	--	--	240	373
1995	21	--	--	--	390	411
1996	63	1	--	--	610	674
1997	41	2	--	1,474	138	1,655
1998	73	0	--	743	151	967
1999	93	2	--	508	279	882
2000	32	0	--	568	636	1,236
2001	50	4	--	338	--	392
2002	51	7	--	--	156	214
2003	52	1	--	11	27	91
2004	29	1	--	6	51	87
2005	119	0	38	32	21	210
2006	70	16	0	--	--	86
2007	7	0	0	0	0	0

10.2 Effects of the Prospective Actions

10.2.1 Effect of Prospective Harvest

Prospective take of green sturgeon would occur only from catch-and-release mortalities in non-Indian recreational and commercial fisheries because retention of green sturgeon is no longer allowed in any fishery. Prospective fishing regulations in Washington and Oregon for commercial and recreational fisheries would prohibit retention of green sturgeon. However, there may be a minor level of green sturgeon retained in recreational fisheries due to misidentification by anglers. In 2007, seven green sturgeon were kept by recreational anglers (TAC 2008). This number is expected to decline through 2017, as anglers learn to identify green sturgeon accurately. TAC (2008) estimates catch-and-release mortality rates for sturgeon in recreational and commercial fisheries as 2.6% and 5.2%, respectively.

The estimated total green sturgeon handle in recreational fisheries has been 65 fish (58 kept and 7 released) annually. Of the handled fish, about 80% (52 fish) of these are believed to be from the ESA-listed Southern DPS based on current genetics data (Israel and May 2007). The total expected take of ESA-listed green sturgeon in recreational fisheries is estimated to be 7-10 fish misidentified by anglers and kept, and one killed fish as a result of catch-and-release mortality (42-45 fish released * 0.026=1 mortality)

Similarly, it is estimated that a total of 339 green sturgeon will be handled annually in commercial fisheries in the Columbia River, of which about 80% (271) would be from the Southern DPS (TAC 2008). Of those released, an estimated 5.2% (14 fish) may die as a result of catch-and-release mortality. Commercial fishers do not generally misidentify green sturgeon. Therefore, the total annual take of Southern DPS green sturgeon associated with future lower Columbia River commercial fisheries is estimated to be about 14 fish per year (TAC 2008).

Green sturgeon are not known to occur upstream of Bonneville Dam and would not be impacted by treaty Indian fisheries (TAC 2008).

10.2.2 Hydrosystem Effects

- Green sturgeon only encounter the effects of the FCRPS between Bonneville Dam and the Columbia River plume, including the Columbia River estuary.

- Adults are known to be found in this portion of the action area only during late summer and fall. At this time, operation of the FCRPS has a small effect on streamflow (e.g. flows are decreased about 15 kcfs (9%) in August and are increased 5 kcfs or about 5% in September. Such minor flow effects would have unmeasurable effects on benthic fish species such as green sturgeon.

- Larger effects of the FCRPS in the occupied portion of the action area, such as changes in the habitat characteristics of the Columbia River estuary, are unlikely to have substantial effects on green sturgeon because adult green sturgeon tend to use deepwater habitats. No spawning or juvenile rearing is known to occur in the Columbia basin.

- Green sturgeon are bottom (benthic) feeders and are not known to rely on salmonids as a prey base.

Conclusion

After reviewing the effects of the Columbia River fisheries managed pursuant to the 2008 *U.S. v Oregon* Agreement, the environmental baseline, and any cumulative effects, NOAA Fisheries determines that the proposed fisheries will not cause deterioration in the pre-action condition for the species. NOAA Fisheries therefore concludes that fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are not likely to jeopardize the continued existence of the Southern DPS of green sturgeon.

Chapter 11

Reinitiation of Consultation

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Chapter 11
Reinitiation of Consultation

As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; (4) a new species is listed or critical habitat designated that may be affected by the identified action.

NOAA Fisheries finds the management constraints contained in this biological opinion necessary for the conservation of the affected listed species. In arriving at these management constraints, NOAA Fisheries has been mindful of affected treaty rights and its Federal trust obligations. NOAA Fisheries will reconsider the management constraints in this biological opinion that affect treaty rights in the event new information indicates such reconsideration is warranted.

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Chapter 12

Conservation Recommendations

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Chapter 12
Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NOAA Fisheries believes the following conservation recommendations should be implemented:

1. Recent information from analysis of PIT-tag data suggests that there is a difference between fish returning to the upper Columbia and Snake rivers in mortality rates of adult steelhead and spring Chinook during upstream passage. The reasons for this difference are unknown, but could be significant and should be resolved. A careful analysis of the existing PIT-tag data will contribute to our understanding of the problem and should be undertaken immediately. The results of that analysis are likely to lead to suggestions for further research or analysis and should be followed to the degree necessary to resolve uncertainties related to this apparent difference in upstream passage mortality.

2. Estimates of stock-specific harvest rates are sometimes limited by our ability to distinguish between stock components in mixed stock fisheries. This is a particular problem for steelhead which have a complex life history and protracted run timing. It is also true for Lower Columbia River coho which have early and late timing run components that overlap in space and time. Efforts should be made to resolve these uncertainties and provide more accurate stock specific harvest rates. For steelhead information could be improved by implementing a PIT-tagging program that systematically tagged representative steelhead stocks. For coho improvements would result from marking of hatchery coho destined for areas above Bonneville Dam. These and other measures designed to improve stock composition estimates should be evaluated and implemented.

3. Mortality from harvest occurs as a result of catch and retention, but also occurs when fish are caught and released, and when fish contact fishing gear but or not otherwise landed. Estimates of all forms of non-retention mortality are often based on limited information. Research should be directed at improving estimates of non-retention harvest mortality. Available estimates of non-retention mortality should be used when quantifying the overall affect of harvest.

4. Estimates of harvest mortality rely on a complex network of sampling and monitoring programs for various non-Treaty and treaty-Indian fisheries. The monitoring programs are managed primarily by state and tribal parties who regulate the fisheries. The managers should conduct a comprehensive review of their monitoring programs to insure that they are sufficient to provide information needed and are cost effective.

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Chapter 13

Incidental Take Statement

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Chapter 13
Incidental Take Statement

13.1 Introduction

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. *Take* is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. *Harm* is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. *Harass* is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. *Incidental take* is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary; they must be undertaken by the Action Agency. In this manner, they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Action Agencies have a continuing duty to regulate the activity covered in this incidental take statement. If the Action Agencies (1) fail to assume and implement the terms and conditions or (2) fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the agencies must report the progress of the action and its impact on the species to NOAA Fisheries as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

An incidental take statement specifies the amount of incidental take of endangered or threatened species associated with the action. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

13.2 Amount or Extent of Incidental Take Anticipated

NOA Fisheries anticipates that take of the ESA listed species will occur as a result of proposed fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement. The incidental take occurs as a result of catch and retention, or mortalities resulting from catch and release, or mortalities resulting from encounter with fishing gear, as a consequence of fishing activity. In some cases, fisheries are managed subject to specific *incidental take limits* for an ESU, DPS, or specified stock component. These may be fixed, as is the case with incidental take limits for steelhead in non-Treaty fisheries, or may vary from year-to-year depending on application of an abundance-based harvest rate schedule, as is the case with Snake River Spring/summer Chinook and Snake River fall Chinook, for example. For other ESUs, DPSs, or stock components there are no specified limits. Instead, NOAA Fisheries characterizes the *expected incidental take* that will occur associated with the proposed fisheries as a range based on observations from recent years. In some cases, the expected incidental take is less than the specified incidental take limit for a stock component due to conservative management. The incidental take limits and expected incidental take levels are expressed in terms of harvest rates unless indicated otherwise and are shown in Tables 13.2-1 and Table 13.2-2.

Table 13.2-1. Incidental take limits of listed salmonids for non-Treaty and treaty-Indian fisheries under the 2008 *U.S. v. Oregon* Agreement expressed in terms of harvest rates unless otherwise indicated.

ESUs	Take Limits (%)	Treaty Indian (%)	Non-Indian (%)
Snake River Fall Chinook Salmon	21.5-45.0 [1]	20.0-30.0	1.5-15.0
Snake River Spring/Summer Chinook Salmon	5.5 - 17.0[2]	5.0-14.3[2]	0.5-2.7
Lower Columbia River Chinook Salmon			
Spring Component	Managed For Hatchery Escapement Goals	0	[3]
Tule Component (LRH stock)	41% Exploitation Rate[4]	0	41% exploitation rate [4]
Bright Component (LRW stock)	Managed For Escapement Goal	0	5,700 goal
Willamette River Spring Chinook Salmon	15.0	0	15
Snake River Basin Steelhead			
A-Run Component	4.0[5]	[6]	4.0
B-Run Component	15-22[7]	13-20[7]	2.0[7]
Lower Columbia River Steelhead			
Winter component	2.0	[6]	2.0
Summer component	4.0[5]	[6]	4.0
Upper Willamette River Steelhead	2.0[5]	0	2.0

ESUs	Take Limits (%)	Treaty Indian (%)	Non-Indian (%)
Middle Columbia River Steelhead			
Winter component	2.0	[6]	2.0
Summer component	4.0[5]	[6]	4.0
Upper Columbia River Spring Chinook Salmon	5.5 - 17.0[2]	5.0-14.3[2]	0.5-2.7
Columbia River Chum Salmon	5.0	0	5.0
Upper Columbia River Steelhead			
Natural-origin Component	4.0[5]	[6]	4.0
Hatchery Component	[8]	[8]	[8]
Snake River Sockeye Salmon	6.0-8.0[1]	5.0-7.0	1.0
Lower Columbia Coho Salmon	8.0-45%[9]	0	8.0-45%[9]
Research, Monitoring and Evaluation	0.1-0.5[10]		

Footnotes:

1. Allowable take depends on run size.
2. Impacts in treaty fisheries on listed wild fish can be up to 0.8% higher than the river mouth runsize harvest rates (indicated in table above) due to the potential for changes in the proportion wild between the river mouth and Bonneville Dam.
3. Managed for hatchery escapement goals.
4. Total exploitation rate limit including ocean and inriver fisheries in 2008. Fisheries in 2009-2017 will be managed consistent with NMFS guidance to PFMC.
5. Applies to non-Indian fisheries only. 2% in winter/spring/summer seasons and 2% in fall season.
6. There is no specific harvest rate limit proposed for treaty fisheries on winter steelhead above Bonneville or on A-run summer steelhead.
7. For fall fisheries only.
8. There is no take prohibition on ad-clipped hatchery fish even if they part of a listed group.
9. Coho fisheries in 2008 will be managed for a combined ocean and in-river exploitation rate of 8%. Fisheries in 2009-2017 will be managed consistent with NMFS guidance to PFMC, based on the ocean portion of Oregon's harvest matrix.
10. Includes research, monitoring and evaluation that is currently in place. For Chinook and coho ESU's, the range is 0.1-0.5% per ESU. For Steelhead DPS' or Snake River sockeye ESU the range is 0.1-0.3% per DPS.

Table13.2-2. Expected incidental take of listed salmonids for non-Treaty and treaty Indian fisheries under the 2008 *U.S. v. Oregon* Agreement expressed in terms of harvest rates unless otherwise indicated.

ESUs	Total Expected Take (%)	Treaty Indian (%)	Non-Indian (%)
Snake River Fall Chinook Salmon	17.9-32.2 [1]	11.6-23.0[1]	5.9-9.0[1]
Snake River Spring/Summer Chinook Salmon	7.0 - 14.6[2]	5.8-12.5[2]	1.2-2.1[2]
Lower Columbia River Chinook Salmon			
Spring Component	0.2-2.0	0	0.2-2.0
Tule Component (LRH stock)	7.7-14.9[3]	0	7.7-14.9[3]
Bright Component (LRW stock)	6.0-18.8 [3]	0	6.0-18.8 [3]
Upper Willamette River Spring Chinook Salmon	5.0-11.0[4]	0	5.0-11.0[4]
Snake River Basin Steelhead			
A-Run Component	na[5]	4.1-12.4[6]	0.9-1.7
B-Run Component	14-21.8[7]	13-20[7]	1.0-1.8[7]
Lower Columbia River Steelhead			
Winter component	na[5]	<1.4-6.9[8,9]	0.2-1.0 [3]
Summer component	na[5]	<4.1-12.4[6,8]	0.2-0.4 [3]
Upper Willamette River Steelhead	na[5]	0	0.2-1.0 [3]
Middle Columbia River Steelhead			
Winter component	na[5]	1.4-6.9[9]	0.2-1.0 [3]
Summer component	na[5]	4.1-12.4[6]	0.9-1.7
Upper Columbia River Spring Chinook Salmon	7.0-14.6[2]	5.8-12.5[2]	1.2-2.1[2]
Columbia River Chum Salmon	1.6	0	1.6
Upper Columbia River Steelhead			
Natural-origin Component	na[5]	4.1-12.4[6]	0.9-1.7
Hatchery Component	na[5]	3.8-9.2[10]	7.6-11.2
Snake River Sockeye Salmon	2.8-7.1[10]	2.8-6.1[10]	0.0-1.0[10]
Lower Columbia Coho Salmon	13.3-24.3[11]	0	13.3-24.3[11]
Research, Monitoring, and Evaluation	0.1-0.5 [12]		

Notes:

- Fisheries are normally managed in season with buffers and other conservative management measures that typically result in impacts being less than allowed ESA limits.
- Allowed take for spring Chinook, fall Chinook, B-steelhead, sockeye, and coho varies by run size.
- Ranges represent recent year averages.
- Steelhead harvest rates assume equal harvest rates on any DPS present in fishery.

Footnotes:

1. Range based on 1999-2007 average under fixed harvest rate schedule. Expected impacts may increase under new abundance based management.
2. Range based on 2001-2007 average for treaty and non-treaty fisheries. Treaty spring Chinook harvest impacts on listed fish can be higher than river mouth run size harvest rates, because of changing hatchery/wild proportions between the river mouth and Bonneville Dam. Future expected impacts may be higher if run sizes indicate use of upper end of harvest rate schedule.
3. Range based on 2003-2007 harvest rates for in-river fisheries.
4. Range of harvest rate for Columbia River mainstem fisheries only.
5. Steelhead impacts are not additive, because of different methods of calculating harvest rates.
6. Range based on 1998-2007 treaty mainstem harvest rates. Tributary impacts not included.
7. Range based on 1998-2007 fisheries.
8. Range based on 1998-2007 treaty mainstem harvest rates. Tributary impacts not included.
9. Expected impact for above Bonneville portion of ESU only. Impacts on entire ESU will be lower Winter season harvest rates are based on catch in Bonneville Pool divided by Bonneville Dam count of winter steelhead. Tributary impacts not included.
10. Range based on 1998-2007 fisheries.
11. Range based on 2003-2007 fisheries.
12. Includes research, monitoring and evaluation that is currently in place. For Chinook and coho ESU's, the range is 0.1-0.5% for each ESU. For Steelhead DPS' and sockeye and chum ESU's the range is 0.1-0.3% for each DPS.

13.2.1 Chinook Salmon

Snake River Fall Chinook

Fisheries affecting Snake River fall Chinook will be managed using the agreed abundance-based harvest rate schedule (Table 8.2.5.5-1). The incidental take limit for Snake River fall Chinook salmon will therefore vary annually depending on the year specific estimates of run size. The maximum allowable harvest rates in non-Treaty and treaty-Indian fisheries are 15% and 30%, respectively. In most years, the maximum allowable harvest rates will be less. The distribution of harvest mortality between non-Treaty and treaty-Indian fisheries may vary so long as the total harvest rate does not exceed the year specific maximum.

Snake River Spring/Summer Chinook & Upper Columbia River Chinook

Fisheries affecting Snake River spring/summer Chinook and Upper Columbia River Chinook will be managed using the agreed to abundance based harvest rate schedule (Table 8.3.5.5-1). The incidental take limit for Snake River spring/summer Chinook and Upper Columbia River Chinook salmon will therefore vary annually depending on the year specific estimates of run size. The maximum allowable harvest rates in non-Treaty and treaty-Indian fisheries are 2.7% and 14.3%, respectively. In most years, the maximum allowable harvest rates will be less. The distribution of harvest mortality between non-Treaty and treaty-Indian fisheries may vary so long as the total harvest rate does not exceed the year specific maximum.

Lower Columbia River Chinook

The spring component of the Lower Columbia River ESU is being managed to achieve hatchery escapement goals. The expected incidental take in non-Indian fisheries on the spring component of the Lower Columbia River ESU ranges from 0.2 to 2.0%. The bright component of the Lower Columbia River ESU is being managed to achieve the escapement goal for the North Fork Lewis population. The expected incidental take in the non-Indian fisheries on the bright component of the Lower Columbia River ESU ranges from 6.0 to 18.8%. Harvest on the tule component of the Lower Columbia River ESU is subject to an incidental take limit, expressed as a total exploitation rate limit for all ocean and in-river fisheries combined. That limit will be specified annually through NOAA Fisheries' guidance letter to the PFMC. Each year, fisheries in the Columbia River will be managed, after accounting for anticipated ocean harvest, so as not to exceed the total exploitation rate limit. In 2008, the total exploitation rate limit is 41%. For comparison, the expected total exploitation rate from all fisheries is 35.8%. After accounting for anticipated harvest in ocean fisheries, the associated exploitation rate for in-river fisheries is 7.1%. The distribution of harvest between ocean and in-river fisheries may vary from year-to-year and inseason so long as the total exploitation rate does not exceed the year specific total. Tribal fisheries are not expected to affect Lower Columbia River Chinook. The expected harvest rate in treaty-Indian fisheries on Lower Columbia River Chinook is zero.

13.2.2 Columbia River Chum Salmon

The incidental take limit on Columbia River chum from the proposed non-Treaty fishery is limited to 5%, with an expected incidental take of 1.6%. No take of Columbia River chum is expected in treaty-Indian fisheries.

13.2.3 Lower Columbia Coho Salmon

Fisheries affecting Lower Columbia River coho will be managed subject to an incidental take limit, expressed as a total exploitation rate, that will be defined annually using the harvest matrix that is based on brood year escapement and marine survival (Table 8.11.5.5-1). The exploitation rate limit will apply to all Council area (under the jurisdiction of the PFMC) and in-river fisheries. Each year, fisheries in the Columbia River will be managed, after accounting for anticipated ocean harvest, so as not to exceed the specified limit. In 2008, the total exploitation rate limit is 8%. The expected exploitation rate in Council area fisheries in 2008 is 5.9%. After accounting for anticipated harvest in ocean fisheries, the associated exploitation rate limit for in-river fisheries in 2008 is 2.1%. The distribution of harvest between ocean and in-river fisheries may vary from year-to-year and inseason so long as the total exploitation rate does not exceed the year specific total. No take of Lower Columbia River coho is expected in treaty-Indian fisheries.

13.2.4 Snake River Sockeye

The non-Treaty and treaty-Indian fisheries will be managed subject to an incidental take limit that will be defined annually using the abundance-based harvest rate schedule (Table 8.4.5.6-1). The harvest rate limit on Snake River sockeye in non-Treaty fisheries is 1%. The harvest rate limit on Snake River sockeye in treaty-Indian fisheries is either 5% or 7%, depending on the year specific circumstances.

13.2.5 Steelhead

The incidental take limit for non-Treaty fisheries for the aggregate of winter run populations returning to the Lower Columbia River and Middle Columbia River steelhead DPSs is 2%.

Non-Treaty winter, spring, and summer season fisheries are also subject to a 2% incidental take limit on natural-origin summer run steelhead, from all DPSs. Non-Indian fisheries in the fall season are subject to an additional harvest rate limit on summer run steelhead of 2%. The harvest limit on summer steelhead in non-Indian fisheries is therefore 4% per year, for all DPSs.

The expected incidental take for treaty-Indian fisheries on the winter component of the Lower Columbia River steelhead DPS located above Bonneville Dam, and the winter component of the Middle Columbia River steelhead DPS, ranges from 1.4% to 6.9%.

The expected incidental take for treaty-Indian fisheries on the summer component of the Lower Columbia River steelhead DPS located above Bonneville Dam and the summer component of the Middle Columbia River steelhead DPS ranges from 4.6% to 12.9%.

The expected incidental take for treaty-Indian fisheries on Upper Columbia River steelhead and Snake River A-run steelhead ranges from 4.1% to 12.4% and are assumed to be equal.

Treaty-Indian fisheries affecting Snake River B-run steelhead will be managed using the agreed abundance-based harvest rate schedule (Table 8.5.5.5-2). The incidental take limit for Snake River B-run steelhead will therefore vary annually between 13% and 20% depending on the year specific estimates of run size.

The 2008 *U.S. v. Oregon* Agreement includes proposed treaty-Indian fisheries in several tributaries between Bonneville and McNary dams that may take listed steelhead. The take in each tributary is specific to that population and not the DPS in general. In the Chapter 5 of the SCA, the Environmental Baseline, Table 5.6.1-6 lists the fisheries by tributary, the number of natural-origin fish harvested by fishery and the affected DPS (TAC 2008). The expected incidental take in the tributary fisheries, expressed as the average catch of natural-origin fish, is equivalent to what is presented in Table 5.6.1-6 of the SCA Chapter 5.

13.2.6 Green Sturgeon

Green sturgeon are caught in non-Treaty commercial and recreational fisheries below Bonneville Dam. Retention of green sturgeon is not allowed in either fishery. Take therefore occurs in the form of catch, handling, and subsequent release. The mortality of released fish is low. The total expected lethal take of ESA-listed green sturgeon in sport fisheries is estimated to be 7-10 fish misidentified by anglers and kept, one fish from release mortalities (42-45 fish released). The total expected annual take of Southern DPS green sturgeon associated with prospective *U.S v. Oregon* non-Indian commercial fisheries is estimated to be 14 fish. There is no expected take of Southern DPS green sturgeon in prospective treaty Indian fisheries.

13.2.7 Southern Resident killer whales

NOAA Fisheries is not including an incidental take authorization for Southern Resident killer whales at this time because the incidental take of marine mammals has not been authorized under section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments. Following issuance of such regulations or authorizations, NOAA Fisheries may amend this biological opinion to include an incidental take statement for Southern Resident killer whales, as appropriate.

13.2.8 Research, Monitoring & Evaluation

During this consultation, NOAA Fisheries also considered the expected incidental take that may occur associated with specified research, monitoring, and evaluation activities. The activities include sturgeon stock assessment work, and test fishing done for research, monitoring, and evaluation purposes. Mortality associated with these activities will be kept to a minimum, but are subject collectively to annual incidental take limits. For Chinook and coho ESUs the incidental take is expected to range between 0.1% and 0.5%, but is subject to a limit of 0.5%. For sockeye and chum ESUs, and steelhead DPSs, the incidental take is expected to range between 0.1% and 0.3%, but is subject to a limit of 0.3%.

13.3 Effect of the Take

In this Biological Opinion, NOAA Fisheries has determined that the level of take anticipated is not likely to jeopardize the continued existence of ESA-listed salmonid species or green sturgeon or result in the destruction or adverse modification of designated critical habitat.

13.4 Reasonable & Prudent Measures

NOAA Fisheries concludes that the following reasonable and prudent measures are necessary and appropriate to minimize the impacts to listed species from fisheries considered in this Biological Opinion.

1. In-season management actions taken during the course of fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement shall be consistent with the level of take specified in the Incidental Take Statement. NOAA Fisheries shall consult with the states and tribes to account for the catch of ESA-listed salmon, steelhead, and green sturgeon in the action area as these occur through the season. NOAA Fisheries will track the results of these monitoring activities, and in particular, any anticipated or actual increases in the incidental take from those expected preseason.

2. Harvest impacts on listed species shall be monitored using the best available measures. Although NOAA Fisheries is the federal agency responsible for seeing that this reasonable and prudent measure is carried out, in practical terms, it is the states and tribes that conduct monitoring of catch and non-retention impacts.

3. The abundance of Snake River fall Chinook at the river mouth is used as an indicator for determining the allowable year specific harvest rates. The allowable harvest therefore depends on preseason estimates of abundance. There is currently some uncertainty regarding adult conversion rates between the river mouth and Lower Granite Dam which affects our ability to estimate run size. NOAA Fisheries, in cooperation with the U.S. v. Oregon parties, shall complete a comprehensive review of all information to determine the best method for estimating the conversion rate of adult fall Chinook by no later than December 2008, and use that information in 2009 and thereafter for estimating the abundance of Snake River fall Chinook.

13.5 Terms & Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, NOAA Fisheries must ensure that the *U.S. v. Oregon* parties comply with the following terms and conditions, which implement the reasonable and prudent measures described above. The following terms and conditions amplify the described reasonable and Prudent Measures and are non-discretionary:

1a. NOAA Fisheries shall confer with the *U.S. v. Oregon* parties to ensure that in-season management actions taken during the course of implementing fisheries managed pursuant to the 2008 *U.S. v. Oregon* Agreement are consistent with the level of take specified in the Incidental Take Statement above.

1b. NOAA Fisheries shall ensure that the *U.S. v. Oregon* parties account for the catch throughout the season. If it becomes apparent in-season that specified take levels may be exceeded then NOAA Fisheries, in consultation with the *U.S. v. Oregon* parties, shall take additional management measures to reduce the anticipated catch as needed to conform to those expectations.

2a. NOAA Fisheries shall ensure that monitoring of catch in the *U.S. v. Oregon* fisheries shall be sufficient to provide statistically valid estimates of the catch. The catch monitoring program shall be stratified by gear, time and management area. Sampling of the commercial catch shall entail daily contact with buyers regarding the catch of the previous day. The non-Indian recreational fishery, and all tribal ceremonial and subsistence (C&S) fisheries, platform fisheries, and commercial fisheries shall be sampled using effort surveys and suitable measures of catch rate.

2b. NOAA Fisheries, in cooperation with the *U.S. v. Oregon* parties, shall monitor the catch and implementation of other management measures, e.g., non-retention fisheries, at levels that are comparable to those used in recent years. The monitoring is to ensure full implementation of, and compliance with, management actions specified to control the various fisheries within the scope of the action.

2c. NOAA Fisheries, in cooperation with the *U.S. v. Oregon* parties, shall sample fisheries for stock composition, including the collection of coded-wire-tags in all non-Treaty and treaty-Indian fisheries and other biological information, to allow for a thorough and statistically valid post-season analysis of fishery impacts on listed species.

2d. NOAA Fisheries shall ensure that the parties include estimates of mortality in any non-retention fisheries conducted by the states or tribes and a description of the methods used in the estimation of postseason harvest assessment by the *U.S. v. Oregon* parties.

3a. NOAA Fisheries, in cooperation with the U.S. v. Oregon parties, shall complete a comprehensive review of all information to determine the best method for estimating the conversion rate of adult fall Chinook by no later than December 2008, and use that information in 2009 and thereafter for estimating the abundance of Snake River fall Chinook.

Chapter 14

Magnuson-Stevens Fishery Conservation & Management Act

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Chapter 14 Magnuson-Stevens Fishery Conservation & Management Act

14.1 Background

The Magnuson-Stevens Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH (essential fish habitat) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));

- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)); and

- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries' EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as upstream and upslope activities that may adversely affect EFH.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

14.2 Identification of Essential Fish Habitat

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of federally-managed Pacific salmon: Chinook (*O. tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

14.3 Proposed Action & Action Area

For this EFH consultation, the proposed action and action area are as described in detail above. The proposed action is NOAA Fisheries signing of the 2008-2017 *United States v. Oregon* Management Agreement and issuance of the associated Incidental Take Statement. The action area includes the foot print of the proposed fisheries, and accessible salmon spawning and rearing areas in the Columbia River basin. Proposed fisheries may occur from the Columbia River mouth upstream to the Wanapum Dam, in adjacent off channel areas, in specified tributaries between Bonneville and McNary Dam, and in the Snake River upstream to Lower Granite Dam. Fisheries will also occur in the Walla Walla River, the Yakima River, and in Icicle Creek (Wenatchee River). The action area therefore extends from the fishery footprint upstream to include all accessible salmon spawning and rearing areas in the Columbia River basin. Thus, it includes portions of the states of Washington, Oregon, and Idaho. The action area includes habitats that have been designated as EFH for various life-history stages of Chinook and coho salmon. A more detailed description and identification of EFH for salmon is found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the impacts on these species' EFH from the above proposed action is based on this information. Southern resident killer whales do not occur in the Columbia River, but there may be indirect effects of Columbia River fisheries on prey availability in the ocean. The action area therefore includes areas off the Pacific Coast where salmonid species from the Columbia River, which are affected by the action, are available as prey for listed Southern resident killer whales; generally within 50 km of the coast from the river's mouth and plume south to southern Oregon and north to the Queen Charlotte Islands.

14.4 Effects of the Proposed Action

While harvest related activities do affect passage in that fish are intercepted, those impacts are accounted for explicitly in the ESA analyses regarding harvest related mortality. Most of the harvest related activities occur from boats or along river banks. Gears that are used include primarily hook-and-line, drift and set gillnets, and hoop nets that do not substantially affect the habitat. There will be minimal disturbance to vegetation, and negligible harm to spawning or rearing habitat, or to water quantity and water quality, particularly since most of the fishing activity occurs in Zones 1-6 on the Lower mainstem Columbia River. Thus, there will be minimal effects on the essential habitat features of the affected species from the action discussed in this Biological Opinion, certainly not enough to contribute to a decline in the values of the habitat.

14.5 Conclusion

Using the best scientific information, including information supplied by the TAC, NOAA Fisheries' analysis in the above ESA consultation, as well as the foregoing EFH sections, NOAA Fisheries has determined that the proposed action is not likely to adversely affect designated Pacific salmon EFH.

14.6 EFH Conservation Recommendation

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. Because NOAA Fisheries concludes that the proposed Federal action would not adversely affect designated EFH, it will not issue additional specific conservation recommendations.

14.7 Statutory Response Requirement

Because there are no conservation recommendations, there are no statutory response requirements.

14.8 Consultation Renewal

NOAA Fisheries must reinitiate EFH consultation if the fisheries proposed pursuant to the 2008 *U.S. v. Oregon* Agreement are substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for the EFH conservation recommendations (50 CFR Section 600.920(k)).

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