3.5 Sockeye ESUs

3.5.1 Lake Wenatchee Sockeye ESU

This section provides an overview of the Lake Wenatchee Sockeye Salmon ESU. It contains a general description of the ESU, fisheries, habitat limitations, and hatchery programs that affect it. Overall recommendations for ESU-wide hatchery program changes are summarized, as are the results of implementing those changes on conservation and harvest goals. Detailed conclusions and recommendations for each population in the ESU can be found in the Appendix E.

3.5.1.1 HSRG Population Guidelines

In order to meet conservations goals for the ESU, numerous threats to these populations need to be addressed, including risks from hatchery programs. The key to controlling genetic and ecological risks due to straying and fitness loss is to manage hatchery broodstock and natural spawning escapement such that the natural habitat (and not the hatchery environment) drives the adaptation and productivity of the naturally spawning population. This is achieved by operating either (a) integrated programs where the proportion of natural-origin adults in the broodstock (pNOB) exceeds the proportion of hatchery-origin fish on the spawning grounds (pHOS); or (b) segregated programs where the contribution of hatchery fish to natural spawning is kept low (pHOS <5% to <10% depending on the population designation). The HSRG developed criteria for hatchery influence for three population types based on the importance of the population to the recovery of the ESU. This was done to provide a consistent method of reviewing populations and programs across the Columbia River Basin. The population designations used by the HSRG (Primary, Contributing, or Stabilizing) were adopted after discussions with managers and followed those developed in the Lower Columbia River Salmon Recovery Plan (LCFRB 2004). These designations are meant to reflect the conservation importance of a population within the ESU from most important (Primary), to moderately important (Contributing), to least important (Stabilizing). HSRG recommendations show how hatchery programs can be operated consistent with these designations based on the following standards:

HSRG criteria for hatchery influence on Primary populations:

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a proportionate natural influence (PNI) value of 0.67 or greater and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations:

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of one, corresponding to a PNI value of 0.50 or greater and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations:

- The current operating conditions were considered adequate to meet their conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI.

3.5.1.2 Current Conditions

Conservation

The Lake Wenatchee ESU consists of a single population, the Wenatchee River sockeye. The sockeye spawn in tributaries to the Wenatchee River (the White and Little Wenatchee rivers) and rear in Lake Wenatchee. This ESU was determined by NMFS to not warrant listing under the ESA in 1998. In 1998, WDFW rated the Lake Wenatchee population as healthy, but in 2002 rated it as depressed because of a short-term severe decline in escapements in 1998 and 1999 (WDFW 2002). The spawning escapement goal for this stock is approximately 23,000 fish. The return of sockeye to Lake Wenatchee in 2008 was over 28,000 (Tumwater Dam counts) and was part of the highest sockeye run in the Columbia River in over 50 years. More than 200,000 sockeye passed Bonneville Dam, most bound for the Canadian portion of the Okanogan River subbasin. The management goal for the Lake Wenatchee sockeye is to obtain returns of 65,000 adults measured at Priest Rapids Dam which, under average conditions, requires 75,000 sockeye passing Bonneville Dam.

For the purposes of this review, the HSRG designated the one population in this ESU as a Primary population (Table 1).

Table 1. Population designations for the Lake Wenatchee Sockeye ESU and HSRG broodstock criteria achieved for each population under current conditions and the HSRG recommended hatchery management solution.

Population	Designation[1]	HSRG Criteria Met[2]	
		Current	HSRG Solution
Wenatchee Sockeye	Primary	Primary	Primary

[1] Using the naming protocol of the Lower Columbia River Salmon Recovery Plan (LCFRB 2004), populations were classified based on information provided to the HSRG as Primary, Contributing, or Stabilizing. These designations are meant to reflect the conservation importance of a population within the ESU from most important (Primary- bold, red), to moderately important (Contributing-bold, blue), to least important (Stabilizing).

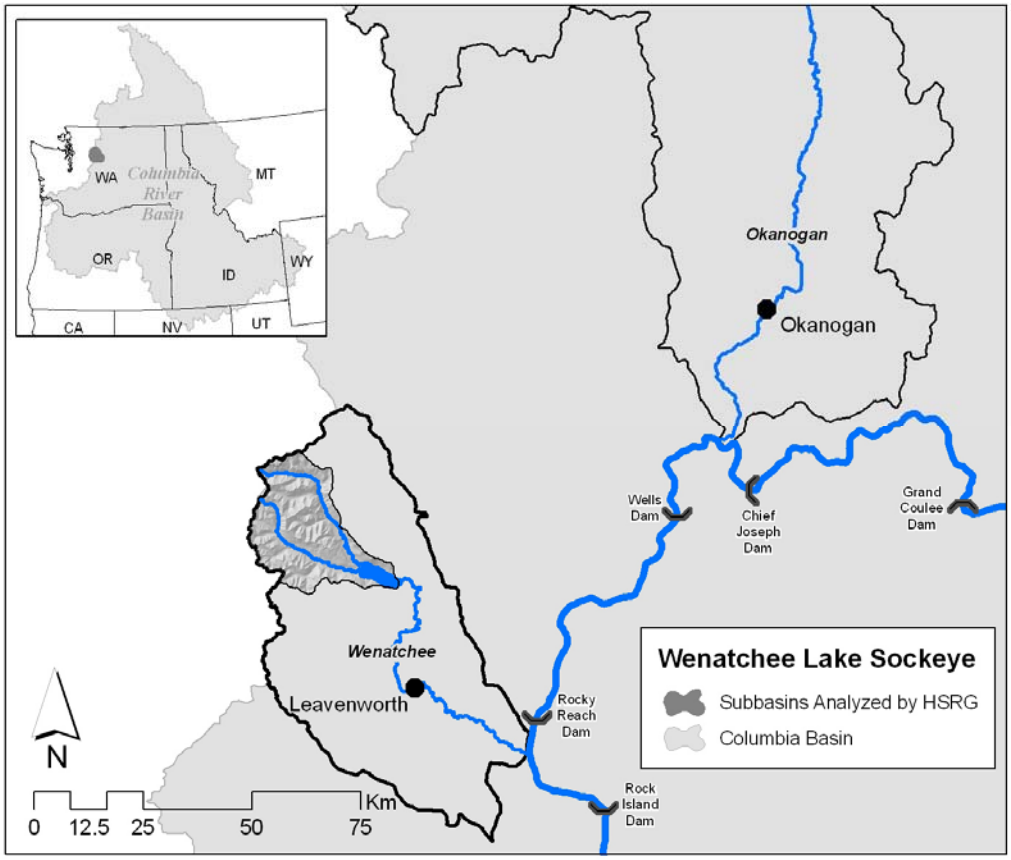
[2] The HSRG developed criteria for hatchery influence for the three population designations from low influence (Primary), moderate influence (Contributing) to high influence (Stabilizing).

Current Harvest

Non-Indian and commercial and recreational impacts are managed to minimize harvest effects on listed Snake River sockeye and are limited to one percent or less of the river mouth run. Treaty Indian harvest is limited to 5 percent at runs less than 50,000 sockeye and 7 percent when runs exceed 50,000 sockeye. Commercial harvest of sockeye has not occurred since 1988 except for small fisheries in 2000 and 2004. The 2008 escapement was large enough to allow a recreational and commercial sockeye fishery in the Columbia River and a sport fishery in the Wenatchee subbasin.

Current Habitat

Human alterations in the Wenatchee subbasin are exacerbating naturally limiting conditions by reducing habitat quality and quantity. These alterations have primarily occurred in the lower gradient, lower reaches of watersheds in the lower portions of the subbasin and include road building and placement, conversion of riparian habitat to agriculture and residential development, water diversion, reduced large woody debris recruitment, and flood control efforts that include large woody debris removal, berm construction, and stream channelization. One of the primary limiting factors for sockeye is the natural oligotrophic nature of Lake Wenatchee.



Current Hatchery Programs

A single hatchery program operates in the Lake Wenatchee ESU. The current population is a mixture of native sockeye and descendants of transfers during the Grand Coulee Dam Fish Maintenance Project (1939 to 1943). Quinault River sockeye have also been used in the past in Lake Wenatchee (WDFW 2002).

The current integrated hatchery program releases about 211,000 sub-yearling sockeye to Lake Wenatchee each year (Table 2). All hatchery juveniles released are adipose fin-clipped and a portion may be marked with PIT-tags or coded-wire tags. Only natural-origin sockeye salmon are used in the broodstock.

The program is intended to increase the abundance of the population while ensuring appropriate spatial distribution, genetic stock integrity, and productivity. It is also intended to provide more consistent harvest opportunities. Run size in recent years has averaged approximately 15,000 fish, and hatchery-origin fish make up less than 5 percent of the escapement due to poor survival of the hatchery fish.

Table 2. Hatchery releases and types of programs for Lake Wenatchee Sockeye ESU.

	Current (1,000s)			HSRG Solution (1,000s)		
Population/Program Name	Type	Purpose	# Released	Type	Purpose	# Released
Wenatchee Sockeye	Int	Both	211.7	Int	Both	211.7

3.5.1.3 HSRG Solutions

The HSRG analyzed the current condition and a range of hatchery program options that might address the managers' conservation and harvest goals for this population. It was observed that the replacement rate of hatchery-origin fish has averaged less than that of natural-origin fish (0.89 versus 1.24). This situation greatly limits the options available for meeting both conservation and harvest goals. The HSRG provides no recommendations for changes to program operations.

Conservation Outcome under the HSRG Solutions

Since the HSRG makes no suggestions to change the size of the hatchery program, hatchery influence (Figure 1) remains unchanged. The HSRG's recommended hatchery management solution reflects projected improved fish passage survival in the Snake and Columbia mainstem migration corridor (FCRPS Biological Opinion May 5, 2008), thus explaining the change in productivity and abundance shown in Figure 2.

Harvest Outcomes under the HSRG Solutions

Since the HSRG makes no suggestions to change the size of the hatchery program, harvest outcomes are unchanged; however, Figure 3 shows harvest increases that can be attributed to improved mainstem passage survival in response to the FCRPS Biological Opinion (2008).

Hatchery Program Changes under the HSRG Solutions

Operational program changes that improve survival of the hatchery releases will be necessary if there is to be any benefit in continuing the hatchery program (e.g., changing the rearing and the release strategies).

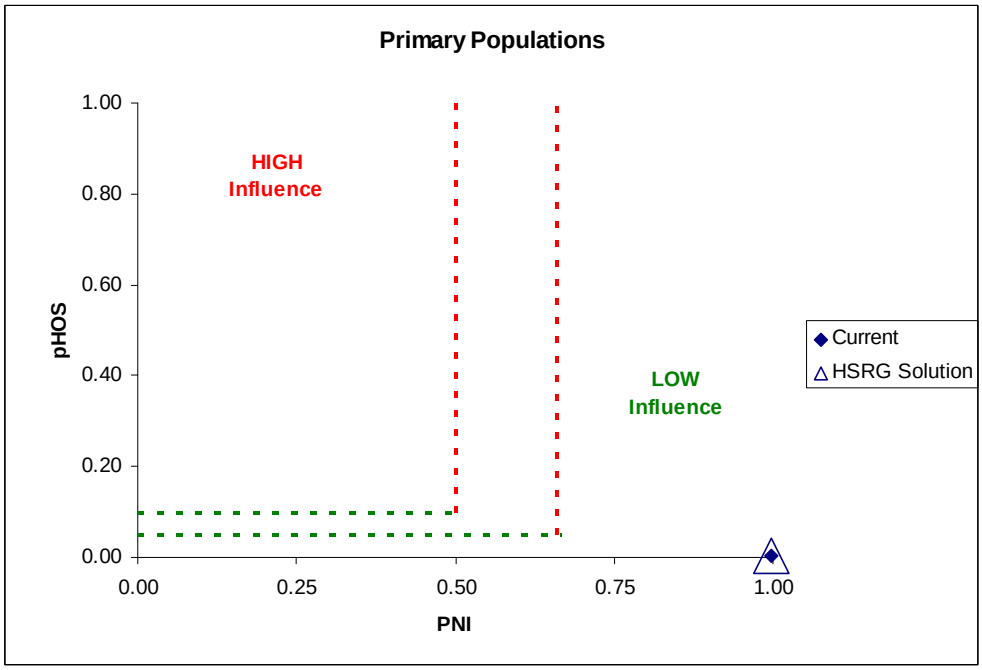


Figure 1. Relationship of the proportion of the fish on the spawning grounds that are of hatchery origin (pHOS) and the proportionate natural influence index (PNI) for the Primary sockeye population in the Lake Wenatchee Sockeye ESU. Solid diamonds represent values for current programs and open triangles represent values for the HSRG recommended hatchery management solution.

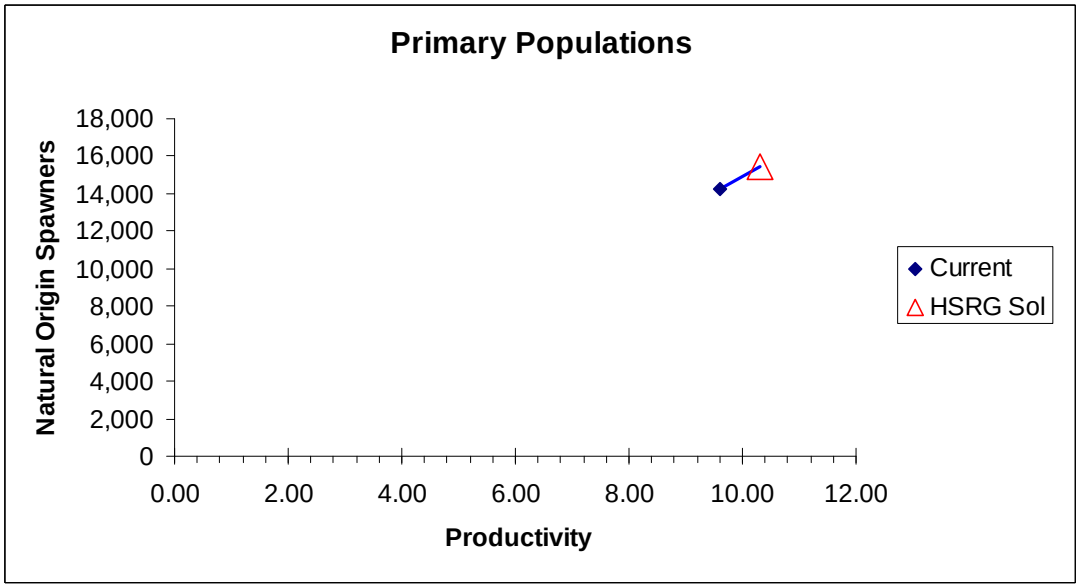


Figure 2. Productivity and spawner abundance for Primary sockeye population in the Lake Wenatchee Sockeye ESU. Solid diamonds represent existing productivity and spawner abundance levels, and triangles represent the HSRG recommended hatchery management solution. Lines connect current with HSRG solution for a particular population. The HSRG recommended hatchery management solution includes projected improved fish passage survival in the Snake and Columbia mainstem migration corridor (FCRPS Biological Opinion May 5, 2008).

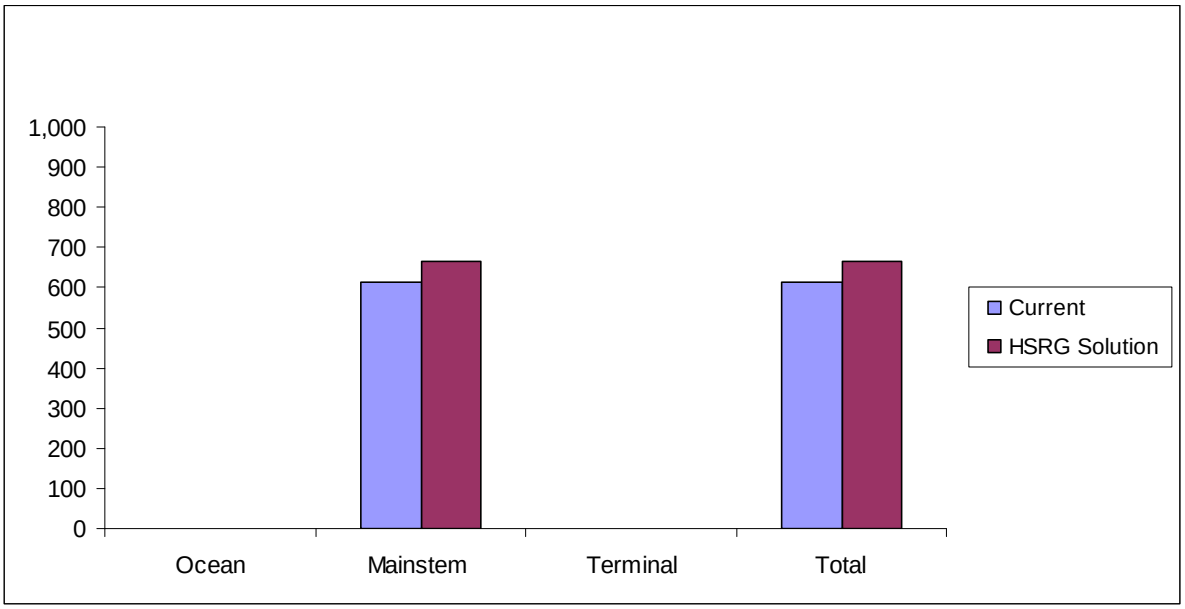


Figure 3. Estimated marine, mainstem Columbia, and terminal harvest under current and HSRG recommended hatchery management solution for Lake Wenatchee Sockeye ESU. The HSRG recommended hatchery management solution includes projected improved fish passage survival in the Snake and Columbia mainstem migration corridor (FCRPS Biological Opinion May 5, 2008).

3.5.1.4 Summary and Conclusions

The Lake Wenatchee sockeye population is the only population in the ESU and it is therefore important that this stock not be lost. The population is not listed but the escapement goal of 23,000 fish is not being consistently met.

Based on 11 years of data, the observation that the replacement rate for hatchery-origin fish averaged less than that for natural-origin fish (0.89 versus 1.24) led the HSRG to recommend that the program be discontinued if this situation cannot be reversed, possibly by making operational changes to the program. The HSRG recommends closer monitoring of out-migrating hatchery releases and returning hatchery adults to determine whether operational changes to the program improve replacement rates for hatchery releases.

3.5.2 Snake River Sockeye ESU

This section provides an overview of the Snake River sockeye ESU which was listed as Endangered under the ESA in 1991. It contains a general description of the ESU, fisheries, habitat limitations and hatchery programs that affect it. Overall recommendations for ESU-wide hatchery program changes are summarized as are the results of implementing those changes on conservation and harvest goals. Detailed conclusions and recommendations for each population in the ESU can be found in the Appendix E.

3.5.2.1 HSRG Population Guidelines

In order to meet conservations goals for the ESU, numerous threats to these populations need to be addressed, including risks from hatchery programs. The key to controlling genetic and ecological risks due to straying and fitness loss is to manage hatchery broodstock and natural spawning escapement such that the natural habitat (and not the hatchery environment) drives the adaptation and productivity of the naturally spawning population. This is achieved by operating either (a) integrated programs where the proportion of natural-origin adults in the broodstock (pNOB) exceeds the proportion of hatchery-origin fish on the spawning grounds (pHOS); or (b) segregated programs where the contribution of hatchery fish to natural spawning is kept low (pHOS <5% to <10% depending on the population designation). The HSRG developed criteria for hatchery influence for three population types based on the importance of the population to the recovery of the ESU. This was done to provide a consistent method of reviewing populations and programs across the Columbia River Basin. The population designations used by the HSRG (Primary, Contributing, or Stabilizing) were adopted after discussions with managers and followed those developed in the Lower Columbia River Salmon Recovery Plan (LCFRB 2004). These designations are meant to reflect the conservation importance of a population within the ESU from most important (Primary), to moderately important (Contributing), to least important (Stabilizing). HSRG recommendations show

how hatchery programs can be operated consistent with these designations based on the following standards:

HSRG criteria for hatchery influence on Primary populations:

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a proportionate natural influence (PNI) value of 0.67 or greater and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations:

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of one, corresponding to a PNI value of 0.50 or greater and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations:

- The current operating conditions were considered adequate to meet their conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI.

3.5.2.2 Current Conditions

Conservation

The Snake River sockeye salmon ESU was listed under the federal Endangered Species Act in 1991 and includes all anadromous and residual sockeye salmon from the Snake River Basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive brood propagation program. The ESU contains three populations within the Stanley Lakes subbasin: one extant spawning population in Redfish Lake and at least two extinct populations formerly found in Alturas Lake and Stanley Lake. Sockeye populations were also present in other regions of the Snake River Basin, such as the Payette, South Fork Salmon, and Grande Ronde subbasins, but these populations are extirpated. The relatively long distance between these systems suggests that each of these subbasins would likely have been separate major population groups and may have been separate ESUs. The recovery goal for abundance is 1,000 naturally-produced adults returning to Redfish Lake and 500 naturally-produced adults returning to two additional lakes. Even though the 2008 adult sockeye return was the highest on record for decades (636 anadromous adults returning to the Stanley subbasin), the numbers are far short of recovery goals. This ESU has a very high risk of extinction (NMFS 2008e).

The Interior Columbia Technical Recovery Team (ICTRT) designated at least three historical populations within the Stanley Lakes subbasin: Redfish Lake (including Little Redfish), Alturas Lake and Stanley Lake. The Redfish Lake sockeye population includes

both anadromous and residualized sockeye that spawn synchronously with the anadromous fish. In addition, two more lakes - Pettit Lake and Yellowbelly Lake - may have supported independent populations; however, currently available information did not allow the ICTRT to determine their status with certainty. The ICTRT therefore regarded them as potential populations.

Currently, there is one population described in this ESU (Redfish Lake sockeye salmon). For the purpose of this review, the HSRG designated it as a Primary population (Table 1).

Table 1. Population designations for the Snake River Sockeye ESU and HSRG broodstock criteria achieved for each population under current conditions and the HSRG recommended hatchery management solution.

Population	Designation[1]	HSRG Criteria Met[2]	
		Current	HSRG Solution
Snake River Sockeye	Primary	Stabilizing	Stabilizing

[1] Using the naming protocol of the Lower Columbia River Salmon Recovery Plan (LCFRB 2004), populations were classified based on information provided to the HSRG as Primary, Contributing, or Stabilizing. These designations are meant to reflect the conservation importance of a population within the ESU from most important (Primary- bold, red), to moderately important (Contributing-bold, blue), to least important (Stabilizing).

[2] The HSRG developed criteria for hatchery influence for the three population designations from low influence (Primary), moderate influence (Contributing) to high influence (Stabilizing).

Current Harvest

Ocean fishing mortality on Snake River sockeye is assumed to be zero (NMFS 2008e). Fisheries in the mainstem Columbia River that affect this population are now managed subject to the terms of the U.S. *v*. Oregon Columbia River Fish Management Plan. For the period of 2005-2007, these fisheries were limited to ensure that the incidental take of ESA-listed Snake River sockeye did not exceed one percent in the non-treaty fisheries. Treaty tribal fisheries were limited to a harvest rate of 5 to 7 percent depending on the run size of upriver sockeye stocks. Actual harvest rates have ranged from 0 to 0.95 percent for non-treaty fisheries, and 2.8 to 6.1 percent for treaty fisheries since 2001 (NMFS 2008e).

Current Habitat

At the time of the initial listing, the greatest habitat issue in the ESU was the lack access to spawning habitat in some Stanley Basin lakes, and passage challenges at the mainstem Columbia and Snake River dams. Access to spawning and rearing areas in other parts of the ESU, such as Wallowa and Payette lakes, was blocked by irrigation dams in the early 1900s. Anadromous sockeye returns to Pettit, Yellowbelly, and Stanley lakes were generally extirpated by the 1950s. The IDFG chemically treated these three lakes between 1955 and 1965 to manage recreational fisheries for trout (NMFS 2008e).

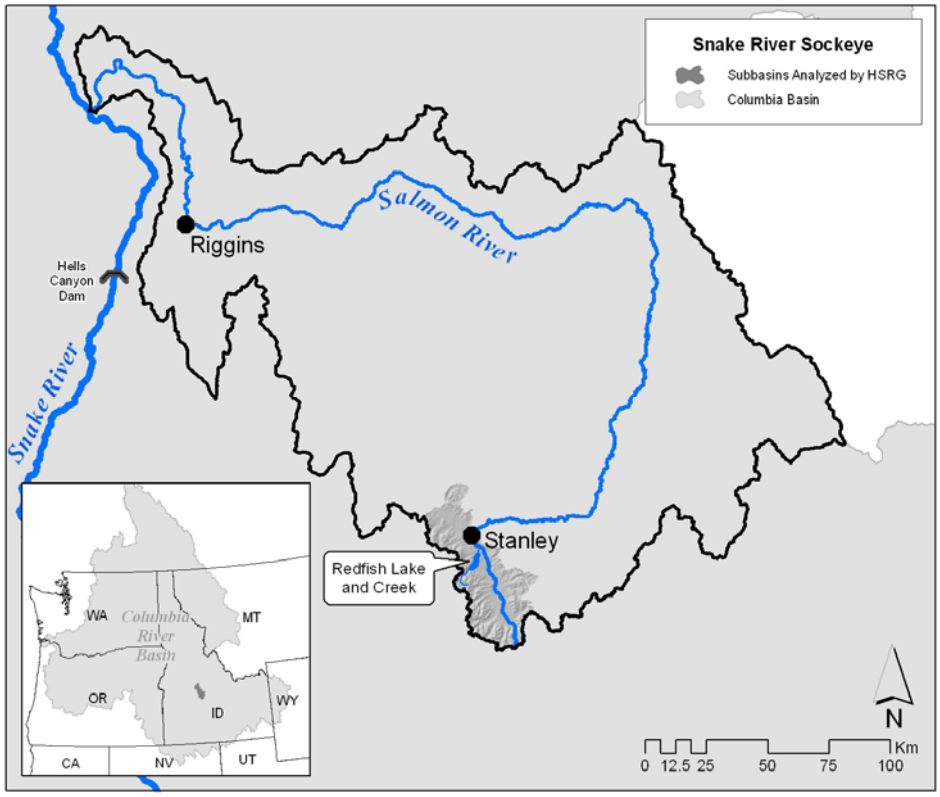
Currently, large portions of the migration corridor in the Salmon River (i.e., between Redfish Lake Creek and Yankee Fork Creek and between Thompson Creek and Squaw Creek) are water quality limited for temperature (IDEQ 2005), which may reduce the survival of adult sockeye returning to the Stanley subbasin in late July and August. The

US Forest Service recommends several measures to improve limiting factors for sockeye, including reducing lakeshore recreation pressure, particularly in shallow areas where sockeye spawn; restoring and maintaining native vegetation that provides naturally resilient and productive shoreline habitats; and taking corrective actions to address sediment and water temperature issues (USDA 2003). The NPCC (2004) also recommended that the natural hydrograph of the Salmon River be mimicked between the East Fork confluence and the headwaters.

Current Hatchery Programs

A captive broodstock hatchery program was initiated in 1991 to safeguard the remnant population (conserve the genome) and begin a population rebuilding process. All 16 anadromous adults that returned to Redfish Lake in the 1990s (1992 through 1998) were trapped and incorporated in the broodstock program. Other "founders" included residual sockeye salmon trapped in Redfish Lake and several hundred juvenile outmigrants trapped while emigrating from Redfish Lake.

A full-term captive broodstock is maintained at the IDFG Eagle Fish Hatchery and at NOAA's Burley Creek Fish Hatchery and the Manchester Research Station in Puget Sound. Spawning occurs annually at these locations and is guided by an inbreeding avoidance matrix developed at the IDFG genetics lab. Every effort is made to spawn all maturing adults and to equalize their representation in subsequent generations (within the captive safety net).



Annually, the program replaces the captive broodstock at IDFG and NOAA facilities by selecting eggs from all spawning crosses and by equalizing individual representation. The program also produces eggs and fish for reintroduction to natal waters using multiple strategies. These include approximately 50,000 eyed-eggs planted in egg boxes in Pettit Lake; 120,000 pre-smolts planted in Redfish, Alturas, and Pettit lakes (combined release); and 80,000 smolts planted in the outlet of Redfish Lake and in the upper Salmon River immediately upstream of the Sawtooth Fish Hatchery (equal split). The combined production from eyed-eggs, pre-smolts, and smolts results in a typical total out-migration of approximately 150,000 smolts. Additionally, the program produces up to 500 full-term hatchery adults that are planted primarily in Redfish Lake for natural spawning.

Efforts are underway to locate and acquire additional production rearing space for planned increases in the size of this program (500,000 to 1 million capacity). Recent modifications were also made to the IDFG and NOAA broodstock stations. Over the last three years, program smolt releases have increased from an average of 10,000 to 20,000 annually to over 100,000.

Table 2. Hatchery releases and types of programs for Snake River Sockeye ESU.

	Current (1,000s)			HSRG Solution (1,000s)		
Population/Program Name	Type	Purpose	# Released	Type	Purpose	# Released
Redfish Lake Sockeye	Int	Cons	151.7	Int	Cons	750.8

The HSRG's current estimates of PNI and pHOS indicate that under current conditions the population meets the criteria for a Stabilizing population (Table 1).

3.5.2.3 HSRG Solutions

The HSRG solutions for the Snake River sockeye ESU recommend increasing the size of the Snake River sockeye smolt program.

Conservation Outcomes under the HSRG Solutions

The HSRG solution makes rather large modifications to hatchery production for Snake River sockeye (Table 2). However, this solution is unable to improve hatchery influence criteria or productivity and spawner abundance (Figures 1 and 2) because all remaining fish are from the hatchery program and potential for local adaptation is reduced. Low out-of-basin survival is the primary limiting factor for this population.

Harvest Outcomes under the HSRG Solutions

Figure 3 describes current and estimated changes in harvest (marine, mainstem Columbia River and terminal areas) that would occur following implementation of the management solutions proposed by the HSRG. Overall, harvest opportunities increase slightly. Figure 4 shows the total returns of anadromous sockeye to the Snake River.

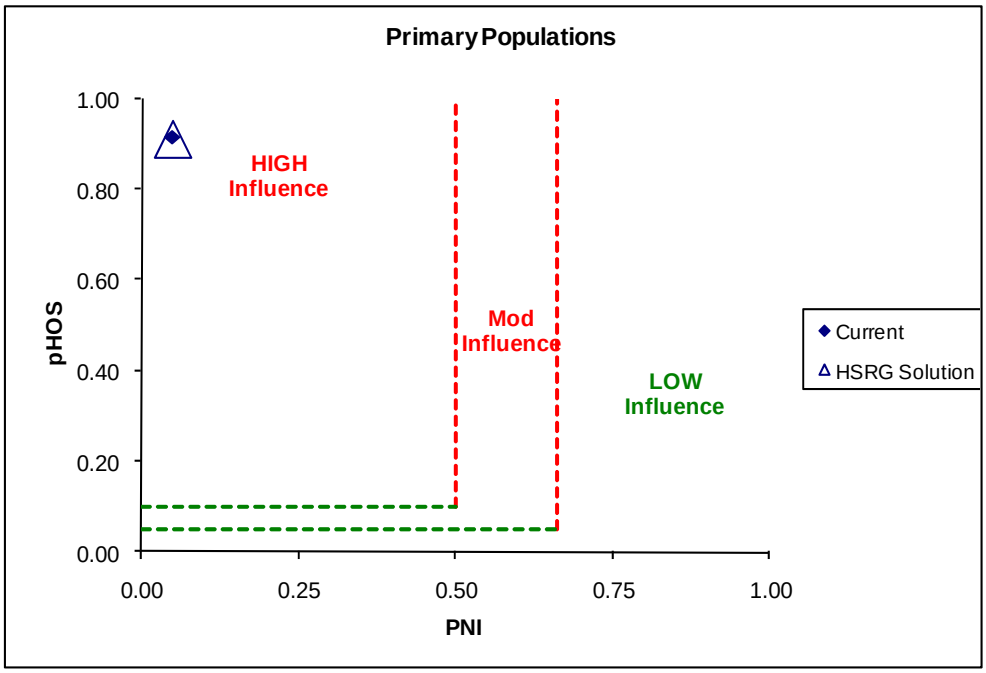


Figure 1. Relationship of the proportion of the fish on the spawning grounds that are of hatchery origin (pHOS) and the proportionate natural influence index (PNI) for Primary sockeye population in the Snake River ESU. Solid diamonds represent values for current programs and open triangles represent values for the HSRG recommended hatchery management solution.

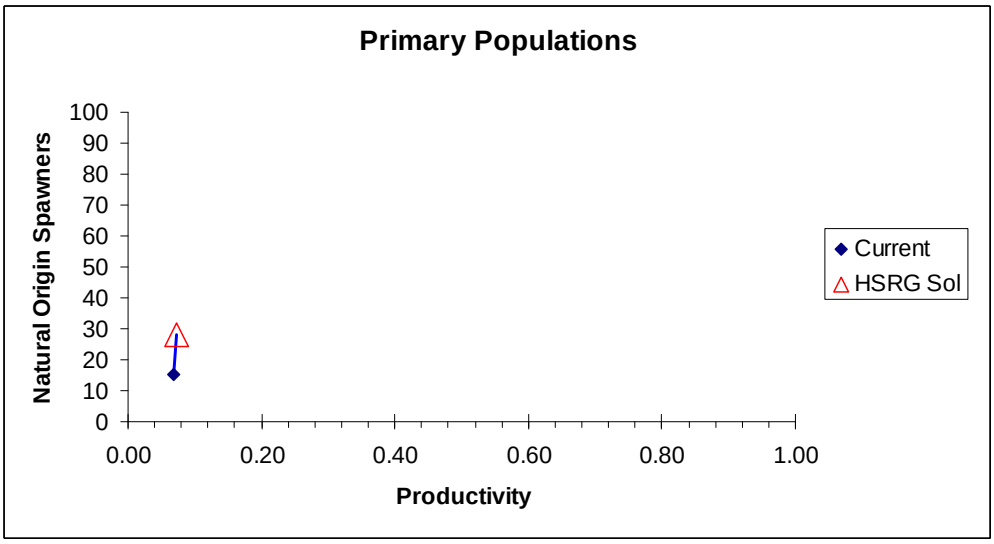


Figure 2. Productivity and spawner abundance for Primary sockeye populations in the Snake River ESU. Solid diamonds represent existing productivity and spawner abundance levels, and triangles represent the HSRG recommended hatchery management solution. Lines connect current with HSRG solution for a particular population. The HSRG recommended hatchery management solution includes projected improved fish passage survival in the Snake and Columbia mainstem migration corridor (FCRPS Biological Opinion May 5, 2008).

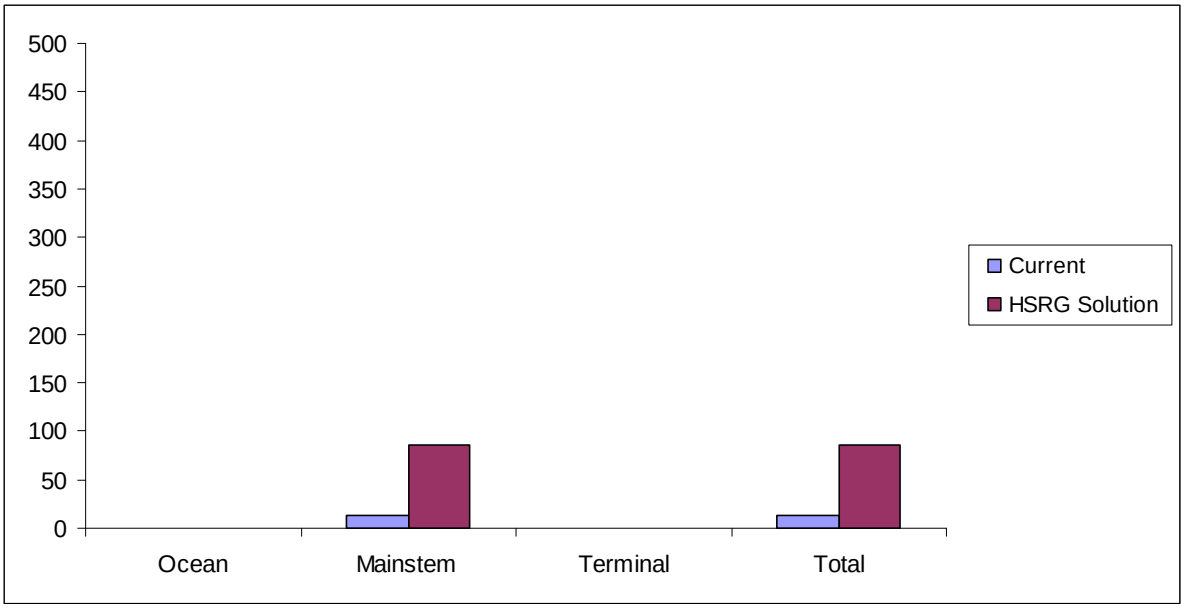


Figure 3. Estimated marine, mainstem Columbia, and terminal harvest under current and HSRG recommended hatchery management solution for Snake River Sockeye ESU.

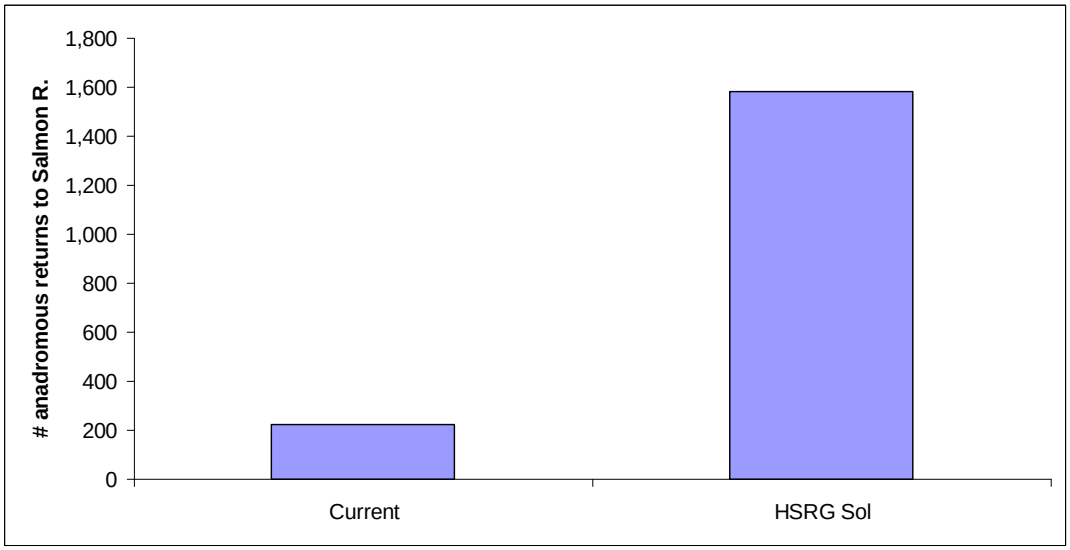


Figure 4. Total returns of anadromous sockeye to the Salmon River for the current scenario and the HSRG recommended hatchery management solution for the Snake River sockeye ESU.

Hatchery Program Changes under the HSRG Solutions

Table 2 shows current smolt production from the captive broodstock program as well as the proposed increase under the HSRG solution. For this ESU, the total number of smolts produced from all strategies (pre-spawning adults, eyed eggs, pre-smolt, and smolt release) increases from 151,700 to 750,800. Expansion of smolt releases is supported by language in the 2008 Federal Columbia River Power System Biological Opinion and the 2008 Fish Accords signed by the Bonneville Power Administration and the State of Idaho.

3.5.2.4 Summary and Conclusions

Without the boost provided by the hatchery program, this population likely would be extinct. This population has been supported almost entirely by a captive brood program and is characterized by low population productivity. The initial priority for this program should be to transition away from a captive brood program to one reliant upon natural returns. Long-term successful reintroduction into the wild will require addressing the low productivity problem.

The HSRG concurs with the decision initiated by managers to increase smolt releases from the program. This action to increase smolt production (500,000 to 1 million fish) is identified in the 2008 FCRPS Biological Opinion. Increased releases should increase anadromous adult returns that will be incorporated into hatchery broodstock or released to the habitat to increase natural production.

Additionally, the HSRG recommends that managers pursue other actions that have the potential to increase the availability of anadromous adults. One option is to capture adult Snake River sockeye salmon at Lower Granite Dam for transport back to Idaho. This action is also identified in the 2008 FCRPS Biological Opinion.

In addition to the above, the HSRG recommends that managers implement a downstream anadromous release and adult capture program at an appropriate lower Columbia River hatchery integrated with the expanded upriver program. This option would generate a more consistent return of anadromous sockeye salmon that could be spawned to augment the production of eggs and juveniles for incorporation into the suite of release strategies.

The overarching goal for implementing any or all of the above strategies is to return more anadromous adults that could be used selectively in spawning designs or released to the habitat to improve the fitness of this closed population. The HSRG also recommends that managers tag/mark all fish released by this program to facilitate subsequent collection and identification. The HSRG recommends finding alternative means of identifying fish and discontinuing the practice of ventral fin clipping.