3.2 Coho ESU

3.2.1 Lower Columbia River Coho Salmon ESU

This section provides an overview of the Lower Columbia River Coho 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.

3.2.1.1 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. The Lower Columbia River Salmon Recovery Plan (LCFRB 2004) classified populations as Primary, Contributing, or Stabilizing. 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 PNI (proportionate natural influence) value of 0.67 or greater and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.

- For integrated 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 conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI.

3.2.1.2 Current Conditions

Conservation

The Lower Columbia River coho salmon ESU was listed as threatened in 2005. It includes all naturally spawned coho populations in 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. It also includes the Willamette River to Willamette Falls, as well as 21 artificial propagation programs. There are 24 historical populations in three major population groups (MPGs) in the ESU, but for the purposes of this analysis 29 populations were evaluated by the HSRG (Table 1). Most of the large natural runs have been replaced by hatchery populations in response to habitat changes and historic overharvest. The risk of extinction is "high" or "very high" for all populations except the Clackamas in the Cascade MPG (LCFRB 2004, McElhany et al 2007).

Historically, conservation has not been a high priority in this ESU. With the recent listing of these populations under the ESA, however, conservation has been elevated to a higher management priority, and will require changes in hatchery, harvest and habitat actions to be successful. Delisting criteria have not been established and a Draft Recovery Plan has not been released. It is likely that the plan will suggest recovery criteria similar to the preliminary plan released in 2004 (LCFRB 2004). The preliminary plan states:

- A specified number of populations in each of the three geographical strata (Coast, Cascade, and Gorge ecological zones) have a high probability of persistence.
- Representative populations need to be preserved, but not every historical population needs to be restored.
- Selected populations should include "core" populations that are highly productive, "legacy" populations that represent historical genetic diversity and dispersed populations that minimize susceptibility to catastrophic events.

The Lower Columbia River Recovery plan, although not specific to coho salmon, provides an example of a recovery scenario that categorizes individual populations in terms of three levels of contribution to recovery: Primary, Contributing and Stabilizing. Primary populations would be restored to high or "high+" viability. Contributing populations would be restored to medium viability, and Stabilizing populations would be maintained at current levels i.e., likely low viability (LCFRB 2004). In the absence of a recovery plan, the HSRG assumed ten populations met the standards of Primary coho

populations and seven met the standards of Contributing populations. The remaining twelve populations were designated as Stabilizing populations (Table 1).

Table 1. Population designations for the Lower Columbia Coho ESU and HSRG broodstock criteria achieved for each population under current condition and the HSRG recommended hatchery management solution.

Population	Designation[1]	HSRG Criteria Met[2]	
		Current	HSRG Solution
Columbia Estuary-Big Creek Coho	Primary	Stabilizing	Stabilizing
Columbia Estuary-Scappoose Coho	Primary	Stabilizing	Stabilizing
Grays Coho (Late-Type N)	Primary	Stabilizing	Primary
Elochoman Coho (Late- Type N)	Primary	Stabilizing	Primary
Cowlitz-Lower Cowlitz Coho (Type N)	Primary	Stabilizing	Primary
Cowlitz-Coweeman Coho (Type N)	Primary	Primary	Primary
Cowlitz-Toutle Coho (Early-Type S Natural)	Primary	Stabilizing	Primary
Lewis-East Fork Lewis Coho	Primary	Primary	Primary
Sandy Coho	Primary	Primary	Primary
Willamette-Upper Clackamas Coho	Primary	Primary	Primary
Columbia Estuary: Mill-Abernathy-Germany Cr Coho (Type N)	Contributing	Primary	Primary
Cowlitz Upper Cowlitz Coho	Contributing	Stabilizing	Primary
Kalama Coho (natural)	Contributing	Stabilizing	Stabilizing
Washougal Coho	Contributing	Stabilizing	Contributing
Lewis-North Fork Lewis Coho (Late-Type N)	Contributing	Contributing	Contributing
White Salmon Coho (Early- Type S)	Contributing	Stabilizing	Stabilizing
Hood Coho	Contributing	Stabilizing	Stabilizing
Columbia Estuary-Youngs Bay Tribs Coho	Stabilizing	Stabilizing	Stabilizing
Columbia Estuary-Gnat Creek Coho	Stabilizing	Stabilizing	Stabilizing
Columbia Estuary-Clatskanie Coho (Late-Type N)	Stabilizing	Contributing	Contributing
Columbia Estuary-Chinook River Coho	Stabilizing	Stabilizing	Stabilizing
Lewis-North Fork Lewis Coho (Early-Type S)[3]	Stabilizing	Primary	Primary
Willamette-Lower Willamette Tribs Coho	Stabilizing	Stabilizing	Stabilizing
Willamette-Lower Clackamas Coho	Stabilizing	Stabilizing	Stabilizing
Willamette-Upper Willamette Tribs coho	Stabilizing	Stabilizing	Stabilizing
Columbia Gorge-Columbia Gorge Tributaries Coho (Oregon)	Stabilizing	Stabilizing	Stabilizing
Columbia Gorge-Columbia Gorge Tributaries Coho (WA)	Stabilizing	Stabilizing	Stabilizing
Fifteenmile Creek Coho	Stabilizing	Stabilizing	Stabilizing
Klickitat Coho	Stabilizing	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).

[3] This is a planned reintroduction program when passage is established into the upper watershed.

Current Harvest

Lower Columbia River coho are commercially harvested in non-selective ocean fisheries and non-Treaty fisheries in the mainstem Columbia River below Bonneville Dam. Recreational fisheries are selective and target marked hatchery fish. Until 1993 the total exploitation rates for Lower Columbia River coho fisheries were very high, fluctuating from approximately 60 to 90 percent, but rates have been reduced since ESA listing to 15 to 25 percent according to year-specific circumstances (LCRRB 2004, NMFS 2008e).

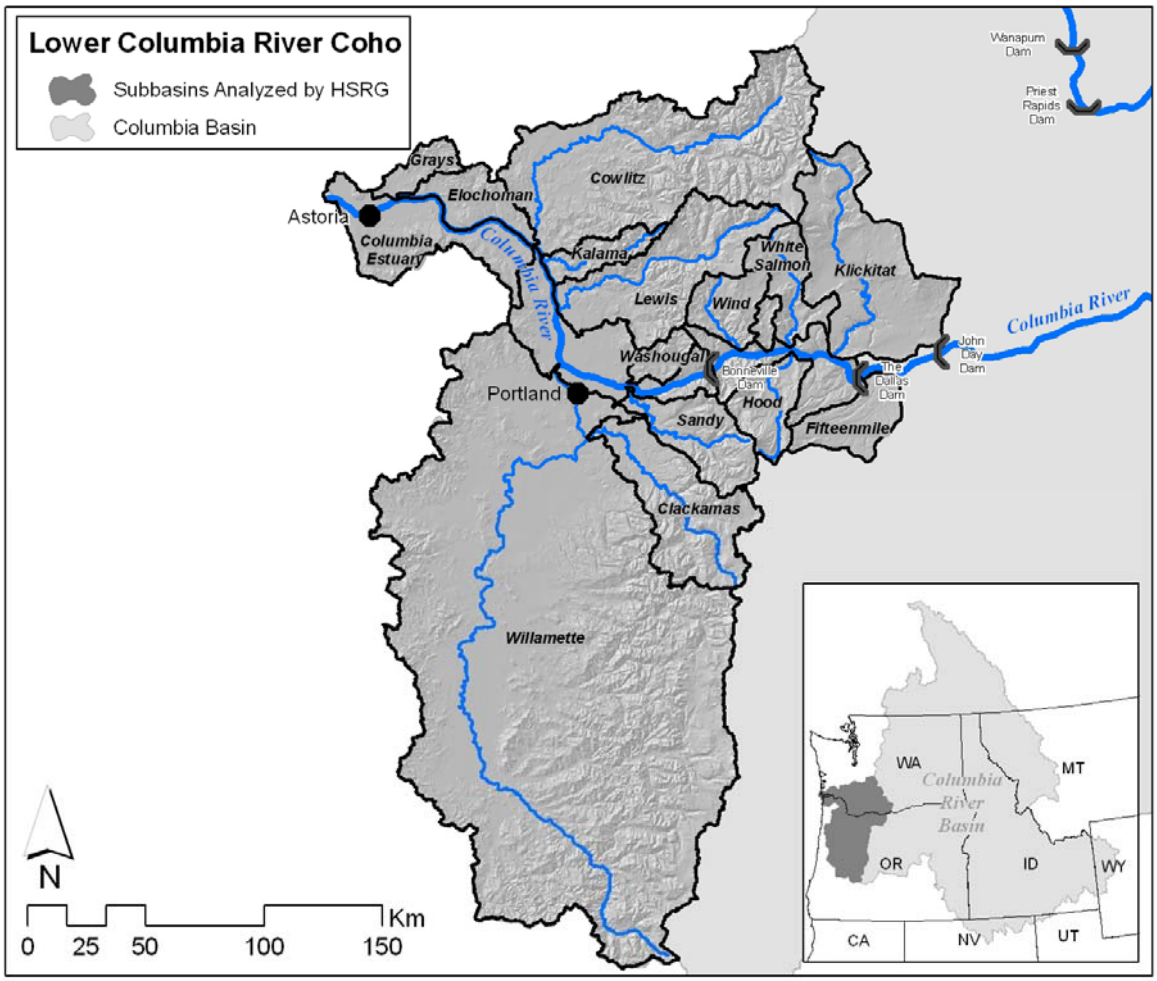
Current Habitat

Populations spawning above Bonneville Dam have been affected by both upstream and downstream passage and some by inundation of historical habitat by Bonneville pool. For populations found in tributaries below Bonneville, migration and habitat conditions in the mainstem and estuary have been affected by hydropower flow operations. Habitat degradation in tributaries is pervasive from land uses such as urbanization, agriculture, and timber harvest, increasing fine sediment in spawning reaches and dramatically reducing off-channel and complex habitats important for juvenile coho rearing. FERC-licensed hydroelectric projects have blocked access to large expanses of coho spawning and rearing areas; however, improvements have been implemented since 2000. These range from improved passage with culvert replacement to reintroducing fish upstream of existing dams (e.g., on the Cowlitz River and planned on the Lewis River).

Current Hatchery Programs

Currently, 21 hatchery programs operate in the ESU, releasing approximately 17 million coho. Most of the programs are in tributary streams. Two net pen programs, located in Young's Bay and Deep River, operate in terminal fishing areas, releasing approximately 2.1 million fish for harvest. Seventeen of the current programs (releasing approximately 15.7 million fish) are classified as segregated programs (Table 2). Four of the current programs (releasing approximately 1.27 million fish) are classified as integrated programs (Table 2).

The original purpose of most programs in the lower Columbia River was to provide harvest; most are now inconsistent with current conservation objectives. The HSRG and others have concluded that a major concern with these programs is the effect hatchery strays have on the long-term fitness of naturally spawning populations. Currently in the lower Columbia River, hatchery fish make a sizeable contribution to natural coho escapement. The percentage of fish effectively spawning in the wild that are hatchery fish (pHOS) exceeds 40 percent for most populations important to recovery. Hatchery contribution to natural spawning is generally not as high in Primary populations (averaging nearly 30 percent), but is approximately 50 percent in Contributing populations. These programs provide significant harvest benefits, and in some cases, help preserve genetic resources in the ESU. However, the ESU is dominated by many poorly segregated and a few poorly integrated programs. Reintroduction efforts using hatchery-origin fish are occurring or are planned in the Cowlitz and Lewis rivers.



Estimates of PNI and pHOS under current conditions show that only four of the ten populations in the ESU designated as Primary currently meet those criteria. One of the seven populations designated as Contributing currently meets that standard; however, one of the Contributing populations (Mill-Abernathy-Germany Creeks) currently meets the higher conservation standard of a Primary population. One Stabilizing population (North Fork Lewis River Early Type-S) currently meets the standards of a Primary population. Another Stabilizing population (Clatskanie River) currently meets the higher standards of Contributing population. The remaining populations identified only meet the broodstock criteria for Stabilizing populations (Table 1).

Table 2. Hatchery releases and types of programs for Lower Columbia River Coho ESU.

Population/Program Name	Current (1,000s)			HSRG Solution (1,000s)		
	Type		# Released	Type		# Released
Columbia Estuary-Bernie Creek Coho (Late-Type N-FFA)	Seg	Harv	16.5	Seg	Harv	16.5
Columbia Estuary-Big Creek Coho	None	NA	-	Int	Cons	-
Columbia Estuary-Big Creek Coho (Hatchery)	Seg	Harv	582.1	Seg	Harv	582.1
Columbia Estuary-Chinook River Coho	None	NA	-	None	NA	-
Columbia Estuary-Clatskanie Coho (Late-Type N)	None	NA	-	None	NA	-
Columbia Estuary-Deep River Coho (Early-Type S-Grays-Hatchery)	Seg	Harv	401.3	Seg	Harv	441.0
Columbia Estuary-Gnat Creek Coho	None	NA	-	None	NA	-
Columbia Estuary-Mill-Aber-Germ Coho (Type N)	None	NA	-	None	NA	-
Columbia Estuary-Scappoose Coho	None	NA	-	None	NA	-
Columbia Estuary-Youngs Bay Coho (Bonneville-Sandy-Hatchery)	Seg	Harv	1,726.2	Seg	Harv	2,701.9
Columbia Estuary-Youngs Bay Tribs Coho	None	NA	-	None	NA	-
Columbia Gorge-Columbia Gorge Tributaries Coho (Oregon)	None	NA	-	None	NA	-
Columbia Gorge-Columbia Gorge Tributaries Coho (WA)	None	NA	-	None	NA	-
Cowlitz Upper Cowlitz Coho	Int	Harv	238.8	Int	Both	501.3
Cowlitz-Coweeman Coho (Type N)	None	NA	-	None	NA	-
Cowlitz-Lower Cowlitz Coho (Type N Hatchery)	Seg	Harv	3,223.4	Seg	Harv	840.5
Cowlitz-Lower Cowlitz Coho (Type N)	None	NA	-	Int	Harv	850.0
Cowlitz-Toutle Coho (Early-Type S Hatchery)	Seg	Harv	801.3	Seg	NA	-
Cowlitz-Toutle Coho (Early-Type S Natural)	None	NA	-	Int	Harv	560.3
Elochoman Coho (Early- Type S Hatchery)	Seg	Harv	415.0	Seg	Harv	1,201.1
Elochoman Coho (Late- Type N)	Int	Both	496.1	Int	Both	146.5
Fifteenmile Creek Coho	None	NA	-	None	NA	-
Grays Coho (Early-Type S Hatchery)	Seg	Harv	150.4	Seg	NA	-
Grays Coho (Late-Type N)	None	NA	-	Int	Both	155.9
Hood Coho	None	NA	-	None	NA	-
Kalama Coho (Early- Type S)	Seg	Harv	353.1	Seg	Harv	353.1
Kalama Coho (Late- Type N)	Seg	Harv	350.8	Seg	Harv	350.8
Kalama Coho (Natural)	None	NA	-	Int	NA	-
Klickitat Coho	None	NA	-	None	NA	-
Klickitat Coho (Lewis-Hatchery)	Seg	Harv	1,238.6	Seg	Harv	1,052.3
Klickitat Coho (Washougal-Hatchery)	Seg	Harv	2,461.9	Seg	NA	-
Lewis-EF Lewis Coho	None	NA	-	None	NA	-
Lewis-NF Lewis Coho (Early-Type S Hatchery)	Seg	Harv	880.0	Seg	Harv	115.8
Lewis-NF Lewis Coho (Early-Type S)	None	NA	-	None	NA	-
Lewis-NF Lewis Coho (Late-Type N Hatchery)	Seg	Harv	815.1	Seg	Harv	-

Population/Program Name	Current (1,000s)			HSRG Solution (1,000s)		
	Type		# Released	Type		# Released
Lewis-NF Lewis Coho (Late-Type N)	Int	Harv	40.0	Int	Cons	231.6
Little White Salmon Coho (Hatchery)	Seg	Harv	-	Seg	NA	1,059.1
Lower Columbia-Bonneville Coho (Hatchery)	Seg	Harv	1,247.7	Seg	Harv	750.5
Sandy Coho	None	NA	-	Int	Harv	-
Sandy Coho (Hatchery)	Seg	Harv	700.1	Seg	NA	700.1
Washougal Coho	Int	Harv	497.9	Int	Both	231.6
Washougal Coho (Stepping Stone Hatchery)	Seg	Harv	-	Seg	Harv	280.2
White Salmon Coho (Early- Type S)	None	NA	-	None	NA	-
Willamette-Upper Willamette Tribs coho	None	NA	-	None	NA	-
Willamette-Clackamas-Eagle Creek Coho (Hatchery)	Seg	Harv	349.1	Seg	Harv	349.1
Willamette-Lower Clackamas Coho	None	NA	-	None	NA	-
Willamette-Lower Willamette Tribs Coho	None	NA	-	None	NA	-
Willamette-Upper Clackamas Coho	None	NA	-	None	NA	-
Total all Populations/Programs			16,985.3			13,471.3

3.2.1.3 *HSRG Solutions*

In this ESU, the HSRG made multiple recommendations to improve the contribution of hatchery programs to both harvest and conservation.

In the case of segregated programs, recommendations are made to improve the ability to control hatchery fish on the spawning grounds so that harvest benefits could be maintained while improving natural-origin spawning abundance and productivity. These recommendations include installing weirs or improvements in hatchery infrastructure on specific drainages where straying limited the ability to meet conservation goals. Recommendations are also made to move production from some locations with limited terminal harvest access to Select Area Fishery Evaluation areas, where excess hatchery fish could be removed by applying higher harvest rates in those areas. In one location with a Stabilizing population (Little White Salmon), a new harvest program is suggested to increase harvest contribution without affecting conservation goals. In the Klickitat River, recommendations are made to reduce the reliance on imported out-of-basin broodstock and rearing.

For integrated programs in the ESU, the HSRG recommendations generally increase the proportion of natural-origin fish in hatchery broodstocks and control the contribution of hatchery-origin fish to natural spawning areas in order to improve natural-origin spawning abundance and productivity. In some cases, meeting the criteria for the population designation requires reducing program size (e.g., Toutle, Cowlitz and North Fork Lewis rivers). In two instances (Lower Cowlitz and Washougal rivers), harvest benefits could be maintained and conservation improved by developing highly integrated conservation programs with associated segregated harvest programs (stepping-stone programs). More emphasis on monitoring and evaluation programs to accurately estimate straying is also recommended.

In the HSRG solution, total hatchery production in the ESU is reduced from approximately 17 million coho salmon to approximately 14 million fish, a reduction of about 20 percent. Production from segregated programs is reduced by approximately 5.0 million fish, while production from integrated programs is increased by approximately 1.5 million fish.

The HSRG also evaluated how harvest changes could improve population viability and productivity, while maintaining or improving harvest. For its solution, the HSRG recommends increasing harvest rates on hatchery-origin fish in both marine and lower mainstem Columbia River fisheries. It also recommends reducing harvest on natural-origin fish in the lower mainstem fishery by increasing the use of selective gears. To implement HSRG solutions, increased selective harvest in terminal areas is also necessary. Specific harvest rates in the HSRG solution can be found the individual population reports (Appendix E).

The HSRG also suggests managers consider population designations identified in Table 1 as the Lower Columbia Coho Recovery Plan is developed. The HSRG suggested designations differ from those in the 2004 preliminary plan for some populations where the available habitat appears to be inconsistent with the population goal.

Conservation Outcomes under the HSRG Solutions

Figure 1 compares the proportion of hatchery-origin fish on the spawning grounds (pHOS) and the proportionate natural influence (PNI) for current and proposed (HSRG) scenarios for designated Primary populations. Under current conditions, only four Primary populations meet the hatchery influence criteria for this designation and one Contributing population meets Primary population standards.

Under the HSRG solution, eight populations (Table 1) designated as Primary meet the hatchery influence criteria for this designation. Two (Big Creek and Scappoose Creek) are consistent with designations as Stabilizing populations. Two populations (Mill-Abernathy-Germany Creek and Upper Cowlitz) designated as Contributing in the recovery plan, meet the hatchery influence criteria for Primary populations; therefore, the HSRG recommends that recovery planners adopt this designation in their plan. Similarly, the HSRG recommends that the North Fork Lewis River Early Type-S population be designated as Primary by recovery planners. The solution does not improve the hatchery influence for the remaining two Primary populations beyond their current status as Stabilizing populations.

Also shown in Figure 1 for the current and proposed (HSRG) scenarios are results for Contributing populations. Under current conditions, two of the populations designated as Contributing in the recovery plan meet those criteria for hatchery influence. Under the HSRG solution, two of the populations designated as Contributing meet the hatchery influence criteria for this designation. One population designated as Stabilizing (Clatskanie River) meets the hatchery influence criteria for a Contributing population and one Stabilizing population (North Fork Lewis River Early Type-S) meets the criteria for a Primary population. The HSRG recommends that recovery planners consider adopting these designations. The solution does not improve the hatchery influence for the remaining three Contributing populations beyond their current status as Stabilizing populations.

Figure 2 compares spawner abundance and productivity relationships between current and HSRG-proposed scenarios for the Primary and Contributing coho populations. For Primary populations, productivity increases significantly in seven of the ten populations, with an average increase across all populations of approximately 40 percent. In two of the populations, productivity under the HSRG solution is nearly double that of the current levels. For Contributing populations, productivity increases significantly in three of the populations and averages approximately 30 percent over all populations.

For Primary populations, the number of natural-origin spawners under the HSRG solution increases in four of the populations by an average of about 25 percent above the current condition. For Contributing populations, the HSRG's solution increases the number of natural-origin spawners in only one population, although other factors contributed to an average increase across populations of approximately 6 percent above current conditions. This limited increase in natural-origin spawners, despite increased productivity for Contributing populations, is primarily due to limited habitat capacity for these populations. Making significant improvements in abundance will require habitat improvements along with the solutions suggested by the HSRG. For the combined Primary and Contributing populations across the ESU, the HSRG solution has the potential to increase natural-origin spawning by approximately 4,000 fish.

Harvest Outcomes under the HSRG Solutions

Figure 3 describes current and estimated changes in harvest (marine, mainstem Columbia River and terminal areas) that could occur following implementation of the management solutions proposed by the HSRG.

Compared to the current condition, the total ocean, mainstem Columbia River, and terminal area harvest increases by approximately 20 percent under the HSRG solution, while still improving the conservation status of some populations. Distribution in fisheries remains relatively unchanged, with a slightly higher increase in ocean and mainstem fisheries resulting from increased selective harvest.

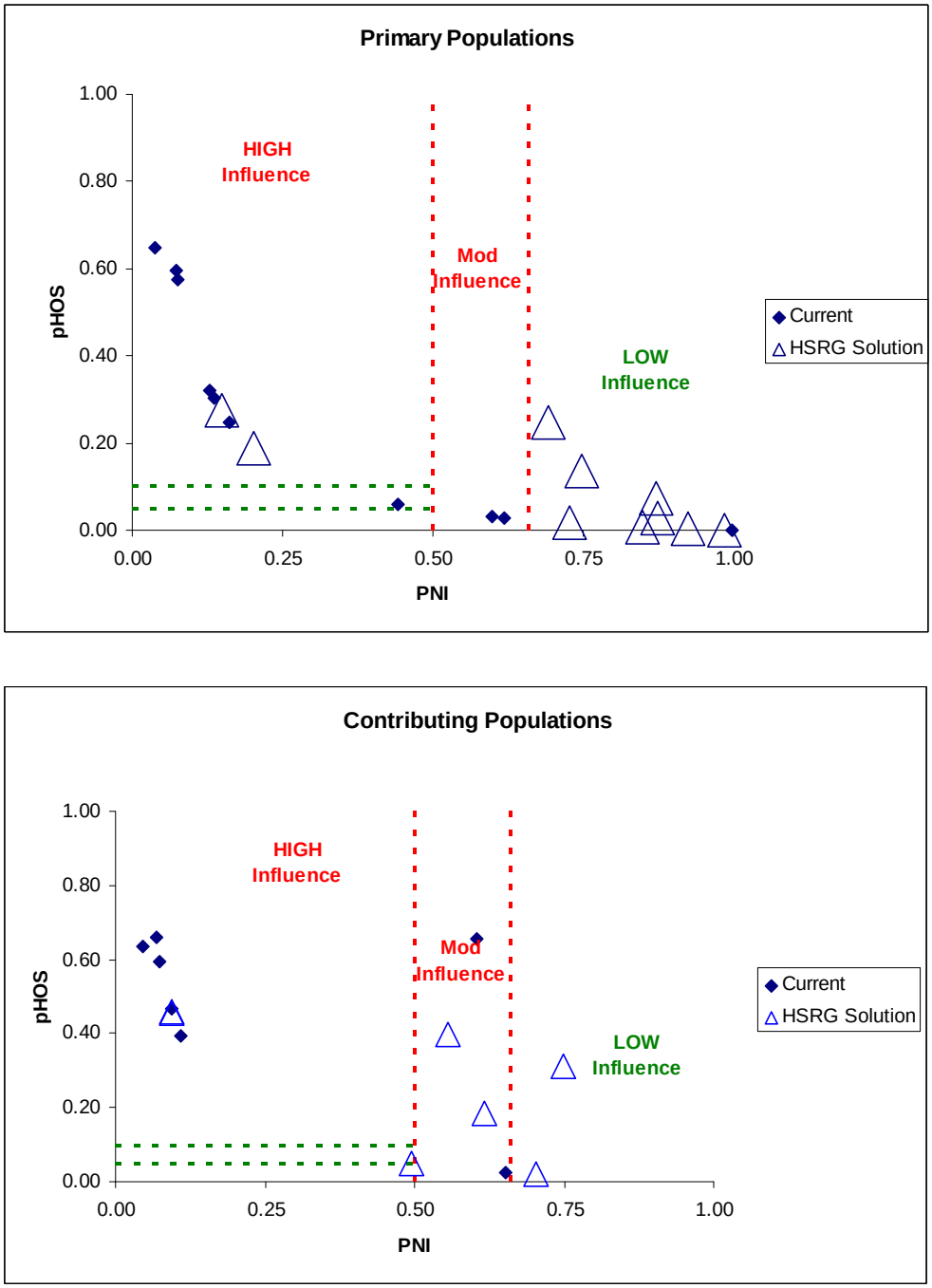
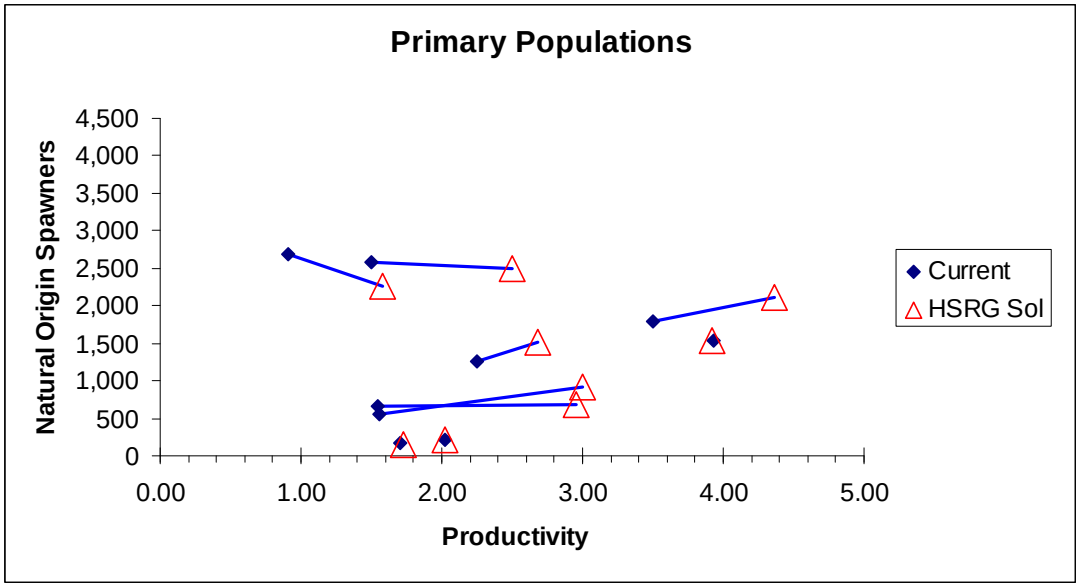


Figure 1. Relationship of the proportion of the fish on the spawning grounds that are of hatchery origin (pHOS) and the proportionate natural influence index (PNI) for Primary (top panel) and Contributing (bottom panel) coho populations in the Lower Columbia River ESU. Solid diamonds represent values for current programs and open triangles represent values for the HSRG recommended hatchery management solution.



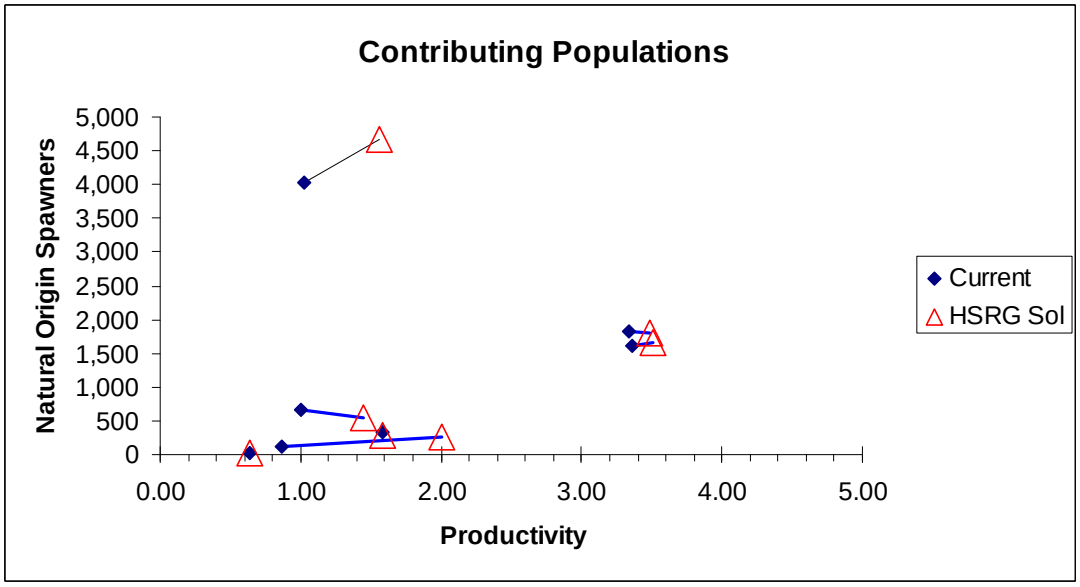


Figure 2. Productivity and spawner abundance for Primary (top panel) and Contributing (bottom panel) coho populations in the Lower Columbia River ESU. Solid diamonds represent existing productivity and spawner abundance levels, and triangles represent the HSRG recommended hatchery management solution. Lines connect current with HSRG solution for a particular population.

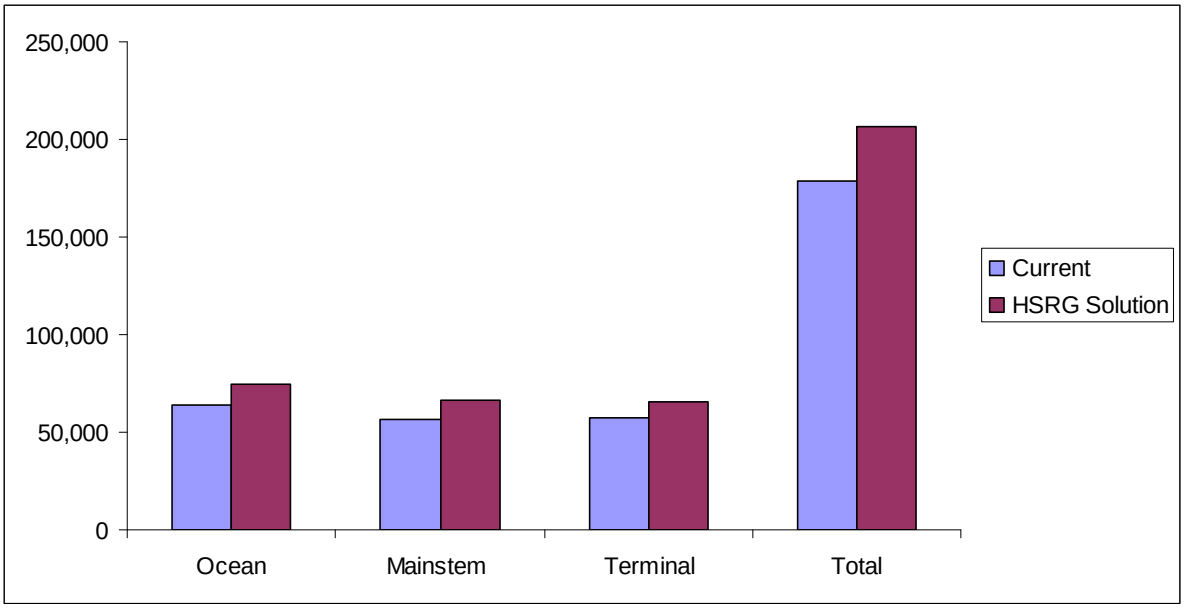


Figure 3. Estimated marine, mainstem Columbia, and terminal harvest under current and HSRG recommended hatchery management solution for Lower Columbia River Coho ESU.

3.2.1.4 Summary and Conclusions

In order to achieve conservation goals, it is recommended that managers implement both hatchery and harvest reforms. This will require implementing effective integrated or segregated hatchery broodstock protocols to achieve the standards described by the HSRG. For segregated programs, this means limiting the number of hatchery-origin fish spawning naturally. In some cases this will require nearly total exclusion of hatchery fish from natural populations through use of weirs or a combination of weirs and selective harvest. For integrated programs, this means including the appropriate number of natural-origin fish in hatchery broodstock as well as controlling the contribution of hatchery fish to natural spawning areas. Hatchery infrastructure modifications will be needed to accomplish this. New or improved weirs for broodstock and escapement management are recommended in the Toutle, Elochoman and Grays rivers, and in Abernathy Creek. Implementing these reforms in the Lower Columbia Coho ESU increases productivity and abundance of natural populations and can maintain harvest at current levels.

Expanding selective harvest in marine and lower Columbia River areas and moving some production to terminal Select Area Fishery sites would allow an increase in harvest despite a 20 percent reduction in total hatchery releases. Developing commercial harvest methods and gear that enable selective removal of hatchery fish with low mortality to natural fish will be required to achieve these harvest benefits. Maintaining harvest levels in this ESU also requires increasing the availability and harvest of fish where they are spatially and temporally segregated from natural populations (i.e., Select Area Fishery sites). Without increasing selective fisheries, solutions to meet conservation goals will require reducing hatchery production and catch.

The HSRG also concluded that the effectiveness of habitat actions will be greatly increased if combined with hatchery and harvest reforms. Analysis of the Primary populations in the Lower Columbia Coho ESU suggests that the benefits of habitat improvements would more than double if combined with hatchery reforms. Unless hatchery and harvest reforms are implemented, the potential benefits of current or improved habitat cannot be fully realized.

3.2.2 Upper Columbia River Coho Salmon

This section provides an overview of Upper Columbia River Coho Salmon. It contains a general description of the area, fisheries, habitat limitations and hatchery programs that affect it. Overall recommendations for Upper Columbia River coho 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 can be found in the Appendix E.

3.2.2.1 HSRG Population Guidelines

In order to meet conservations goals, 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 exceeds the proportion of hatchery-origin fish on the spawning grounds (pNOB > pHOS); or (b) segregated programs where the contribution of hatchery fish to natural spawning is kept low (pHOS < 5% to <10% depending on 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 species. 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 region 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:

- For segregated programs, the proportion of effective hatchery-origin spawners on the spawning grounds (pHOS) should be less than 5% of the naturally spawning population.
- For integrated populations, the proportion of natural-origin adults in the broodstock (pNOB) 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 levels should be no greater than 30%.

HSRG criteria for hatchery influence on Contributing populations:

- For segregated programs, the proportion of effective hatchery-origin spawners on the spawning grounds (pHOS) should be less than 10% of the naturally spawning population.
- For integrated populations, the proportion of natural-origin adults in the broodstock (pNOB) should exceed pHOS, 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 conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI.

3.2.2.2 Current Conditions

Conservation

There are five coho populations in the Upper Columbia River Basin, including coho from the Clearwater, Methow, Umatilla, Wenatchee and Yakima rivers. These populations have not been defined formally by Endangered Species Act petitions or listings because these populations are derived from reintroduced non-native stocks. All of the historic populations of coho in the Upper Columbia River Basin are now extinct. Because all of these populations are considered extinct and are subject to reintroduction efforts, the HSRG designated all populations as Stabilizing (Table 1).

Table 1. Upper Columbia River coho population designations and HSRG broodstock criteria achieved for each population under current condition and the HSRG recommended hatchery management solution.

Population	Designation[1]	HSRG Criteria Met[2]	
		Current	HSRG Solution
Umatilla Coho	Stabilizing	Stabilizing	Stabilizing
Yakima_Upper Yakima-Naches Coho	Stabilizing	Stabilizing	Contributing
Wenatchee Coho	Stabilizing	Stabilizing	Stabilizing
Methow Coho	Stabilizing	Stabilizing	Stabilizing
Clearwater Coho	Stabilizing	Stabilizing	Stabilizing

[1] Using the naming protocol of the Upper 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 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

Upper Columbia River coho are commercially harvested in non-selective ocean fisheries and non-Treaty fisheries in the mainstem Columbia River below Bonneville Dam. Recreational fisheries are selective and target marked hatchery fish. Until 1993 the total

exploitation rates for Lower Columbia River coho fisheries were very high, fluctuating from approximately 60 to 90 percent, but rates have been reduced to 15 to 25 percent since ESA listing of lower Columbia coho according to year-specific circumstances (LCRRB 2004, NMFS 2008e). The terminal fishery on Yakima coho is estimated at 1 percent by Yakama Nation biologists. The overall goal for all populations is to produce naturally self-sustaining populations that can expand harvest opportunities for tribal and non-tribal fisheries.

Current Habitat

The quality of coho habitat in the upper Columbia varies from highly degraded to poor quality. Mainstem Columbia River dams disrupt migration corridors and affect flow regimes and estuarine habitat (Myers et al. 1998). Within the range of the Upper Columbia River Coho, spawning and rearing habitat has been reduced by agriculture including water withdrawals, grazing, and riparian vegetation management. Diking to increase and protect farmland and developed land has depleted off-channel habitat, which is particularly important to coho salmon. Forestry and logging practices have increased erosion and sedimentation of spawning and rearing habitat.

Current Hatchery Programs

Currently there are four integrated coho programs operating in the Upper Columbia River (Clearwater, Methow, Wenatchee, and Upper Yakima-Naches) that release approximately 2.9 million hatchery coho smolts per year (Table 2). Two segregated programs (Umatilla and Yakima) release approximately 2 million smolts annually. Hatchery fish do not affect native local runs of coho because the native populations are all extirpated.

All of the coho populations in Upper Columbia River are derived from hatchery fish reintroductions using non-native stocks. Estimates of PNI and pHOS under current conditions show that none of the populations meet the broodstock criteria for either Primary or Contributing populations, but are only consistent with the HSRG population designation for Stabilizing populations (Table 1).

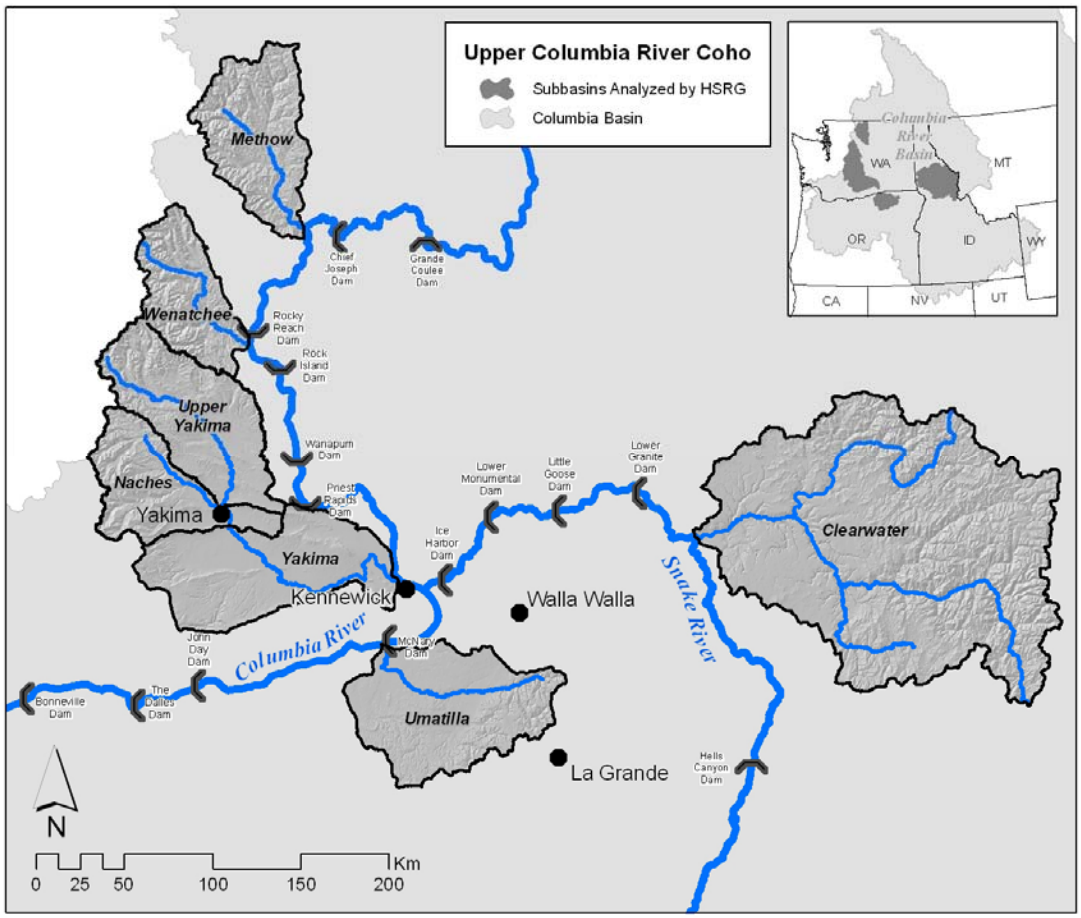


Table 2. Hatchery releases and types of programs for Upper Columbia River Coho.

	Current (1,000s)			HSRG Solution (1,000s)		
Population/Program Name	Type	Purpose	# Released	Type	Purpose	# Released
Umatilla Coho	None	NA	-	None	NA	-
Umatilla Coho (Bonneville-Cascade-Oxbow-Hatchery)	Seg	Both	1,530.0	Seg	Both	1,530.0
Yakima-Upper Yakima-Naches Coho	Int	Cons	452.1	Int	Cons	452.1
Yakima-Coho (Hatchery)	Seg	Harv	427.9	Seg	Harv	427.9
Wenatchee Coho	Int	Cons	1,048.0	Int	Cons	1,048.0
Methow Coho	Int	Cons	495.4	Int	Cons	495.4
Clearwater Coho	Int	Cons	833.9	Int	Cons	830.1
Total all Populations/Programs			4,787.3			4,783.5

3.2.2.3 HSRG Solutions

Most of the HSRG solutions involve recommendations to improve broodstock management in segregated and integrated programs and to transition the reintroduction programs to allow local adaptation in hatchery and natural populations. Local adaptation in hatchery programs could be improved by reducing the reliance on out-of-basin hatchery returns and collecting hatchery broodstock locally. Improvements could be made in the reintroduction program in the Yakima River by increasing the proportion of natural-origin broodstock (pNOB) in the conservation program. Additionally the HSRG recommendations include increasing marking of hatchery fish to allow monitoring of hatchery composition on the spawning grounds and to provide additional harvest access. Recommendations are also made to begin or reestablish monitoring and evaluation programs.

Conservation Outcomes from HSRG Solution

Currently there are no Primary or Contributing populations in the Upper Columbia River; however, the HSRG solution improves the status of one of the currently Stabilizing populations (Yakima River) so that this population meets the HSRG criteria for a Contributing population. Because the remaining reintroduction programs (Umatilla, Wenatchee, Methow and Clearwater rivers) are in different phases of their development, the HSRG recommendations focused on developing local hatchery broodstocks as a first step. This change would not be expected to show any difference in hatchery influence until the programs transition to collection of natural-origin broodstock.

Improvements in broodstock management in the Yakima River lead to a greater than 30 percent improvement in productivity in this population. Improvements in productivity in the other populations would be expected once they can reduce the proportion of hatchery fish spawning naturally and transition to better integrated programs.

Harvest Outcomes

Figure 1 describes current and estimated changes in harvest (marine, mainstem Columbia River and terminal harvest areas) that would occur following implementation of the management solutions proposed by the HSRG. In this case, total harvest as well as ocean and terminal area harvest increases by a total of approximately 30 percent. This is primarily due to increased marking and expanded selective harvest on hatchery fish.

Hatchery Program Changes under HSRG Solution

Table 2 shows the current size of each hatchery program as well as their size under the HSRG solution. The total number of smolts released under the HSRG solution remains the same as current programs (approximately 4.8 million fish). HSRG recommendations focus on transitioning the reintroduction programs to area-specific broodstock to allow local adaptation of hatchery and natural populations.

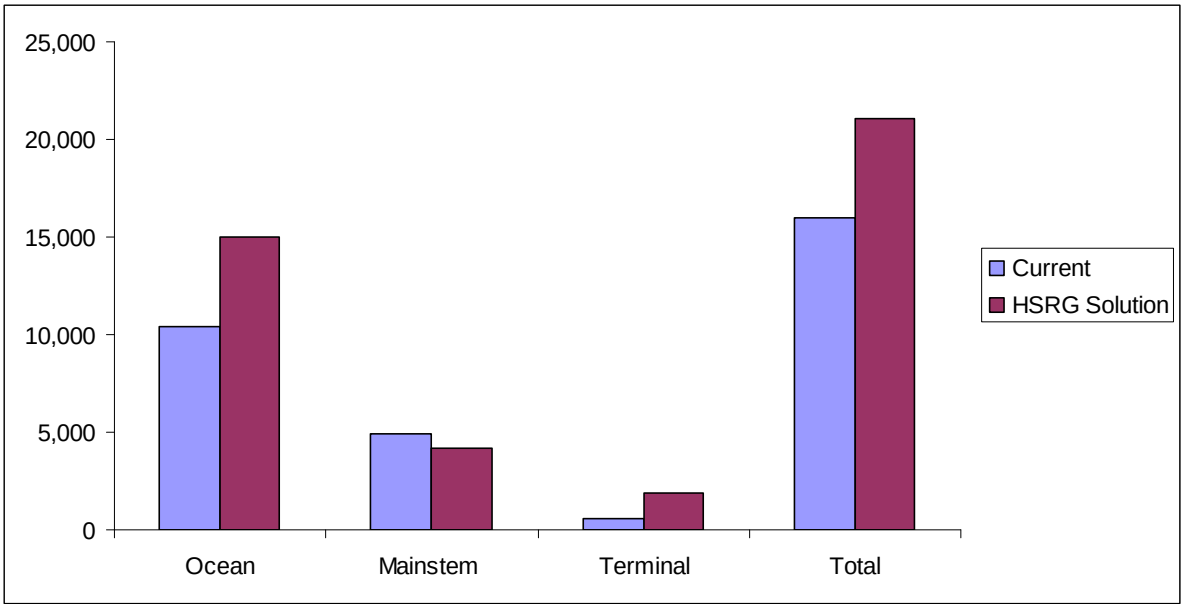


Figure 1. Estimated marine, mainstem Columbia, and terminal harvest under current and HSRG recommended hatchery management solution for Upper Columbia River Coho.

3.2.2.4 Summary and Conclusions

The purpose of these hatchery programs is to reintroduce coho back into historic habitat to meet conservation and harvest goals. The reintroduction programs are in various states of implementation, but all would benefit by promoting local adaptation of hatchery and natural spawning populations. Implementing the HSRG recommendations would improve the status of one population (Yakima River) to meet the standards of a Contributing population and would promote local adaptation in the remaining programs. Monitoring and evaluation of some of the programs needs to be improved and this can be assisted by increasing the marking of hatchery fish. This will also lead to improved harvest benefits by making these previously unmarked fish identifiable for harvest.