Appendix C. Method Used to Select Core Populations

NOAA's National Marine Fisheries Service (NMFS) considers the role each population is expected to play in a recovered Evolutionarily Significant Unit (ESU) to determine population abundance and juvenile occupancy targets for all the populations in the SONCC coho salmon ESU. Independent populations are evaluated using a modified Bradbury et al. (1995) framework. This evaluation produces a set of biological and habitat scores for each independent population which informs development of demographic targets for each independent population. NMFS' objective is to develop scientifically sound demographic targets that reflect each population's capacity for coho salmon production and potential for meeting demographic and threat abatement recovery criteria. Professional judgment is relied upon to rate biological integrity parameters.

Demographic population targets

NMFS identifies five population categories and the method to establish demographic targets for each (Table C - 1). The rationale for NMFS' choice of category type and associated demographic targets is described in Exhibits 1 to 7.

Table C - 1. Population type (as determined by Williams et al. 2006), category, demographic target, and life stage used to measure progress toward target.

Type	Category	Demographic Target	Life Stage
Dependent or Independent	Extirpated	No requirement for spawner abundance, juvenile occupancy, or habitat	None
Dependent	Dependent	Juvenile occupancy (20 percent of habitat occupied in years following spawning of brood years with high marine survival)	Juvenile
Independent	Non-Core 2		
	Non-Core 1	Moderate risk threshold (depensation threshold multiplied by four)	Spawner
	Core	≥ Low risk threshold	

Extirpated Populations

Some populations in the SONCC coho salmon ESU may be extirpated. To determine whether each extirpated population should have any recovery targets, NMFS considers several questions related to absence and potential.

Evidence of coho absence

Have there been surveys that document the absence of coho salmon? How extensive have they been? How recently were they completed? Is there documented past presence or absence of coho salmon? How much uncertainty surrounds the information?

Prospects of coho salmon use

Are there characteristics of the watershed which suggest it will likely not support coho salmon in the future? For example, is there a barrier blocking most of the habitat, which is expected to remain in place? What is the current condition of accessible habitat? What are the prospects for improvement of accessible habitat? What are the prospects for threat abatement?

Connectivity

Would designation as an extirpated population create a gap of more than 30 km between population river mouths along the coastline? If so, a target of juvenile occupancy is minimally required.

Dependent populations

All populations identified as dependent by Williams et al. (2006), are assigned the juvenile occupancy demographic target. If NMFS determines a dependent population is extirpated, it has no juvenile occupancy requirement.

Independent populations

To determine the appropriate target for each independent population, NMFS considers the current condition of the population and its habitat, as well as the role that population is expected to play in a recovered ESU (i.e., core, non-core).

Method used to score characteristics of independent populations

NMFS developed a framework to describe characteristics of each independent population, starting with a model provided by Bradbury et al. (1995). This model uses three groupings of criteria for ranking watersheds for Pacific salmon restoration prioritization: 1) biological and ecological resources (Biological Importance); 2) watershed integrity and salmonid extinction risk (Integrity and Risk); and 3) potential for restoration (Optimism and Potential). Some of the ranking criteria proposed under these categories are also used in the NMFS method, and NMFS developed additional criteria. Scores given to each criterion are based on information in the profiles and professional judgment. Other factors are considered. Although these factors do not change scores, they may influence the final choice of population category and demographic targets for independent populations. These other factors (e.g., economic, social or political) pertain to the potential success of restoration, and are described in Exhibits 1 through 7.

Biological Importance

Scores for Biological Importance are based on the concept of viable salmonid populations (VSP) (McElhany et al. 2000), and are used to describe the current status of the population – population size, productivity, spatial structure, and diversity. Almost all populations are information limited, so perceived differences between populations in population size, productivity, spatial structure, and diversity could be due to a lack of data rather than true, physical or biological differences. These limitations are described in Exhibits 1 to 7.

Population Size and Productivity

Coho salmon typically follow a three year life cycle, producing three cohorts. NMFS' rating of the current population size and productivity of populations is based on the number of cohorts present, the consistency of runs, and trends over time. The number of individuals (population size) and growth rate (productivity) of a population are interrelated risk factors that affect population viability over time. Small populations are subject to numerous risks due to low abundance, whereas large populations are more resilient to the same risks. Productivity refers to production over the entire life cycle. The trends in abundance reflect the long-term population growth rate (McElhany et al. 2000).

The following metrics, described in Table C - 2 through Table C - 7, are especially important because a coho salmon population that drops to extremely low levels of abundance and productivity represent greater challenges for restoration and recovery. Scores are determined based on the following guidance.

Population Size

Table C - 2. Metric used to assess population size parameter.

Score	Description
0	No coho salmon are produced by any cohort, AND any adults are likely strays.
1	Number of spawners is consistently (multiple generations) < 50 percent of the depensation threshold.
2	Number of spawners is consistently (multiple generations) ≥ 50 percent of the depensation threshold.
3	Number of spawners is consistently (multiple generations) > the depensation threshold.

Population Productivity

Table C - 3. Metric used to assess population productivity parameter.

Score	Description
0	No coho salmon are produced in any cohort, AND any adults are likely strays.
1	At least one naturally-spawned cohort is absent, or about to be absent, AND the other cohorts is not consistently present (at least six consecutive years) or show decreasing trends in abundance.
2	Three cohorts are consistently present (at least six consecutive years) AND all cohorts show decreasing trends in abundance.
3	Three cohorts are consistently present (at least six consecutive years) AND at least one cohort shows no change in trend in abundance, or an increasing trend in abundance.

Spatial structure and diversity

NMFS expects that populations that are well distributed have a diverse array of life history traits and maintain greater genetic diversity. NMFS expects such populations will be more resilient and have

higher potential for recovery to the low risk spawner threshold than populations with diminished spatial structure and diversity.

Spatial Structure

The spatial structure of a population depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population (McElhany et al. 2000). The spatial structure rating is based on the current spatial extent of the population compared with the potential juvenile habitat, as described by a model of intrinsic habitat potential (IP).

Table C - 4. Metric used to assess spatial structure parameter.

Score	Description
0	No coho salmon are present from any cohort, and any adults are likely strays.
1	Coho salmon occur in 0-25 percent of the IP habitat outside the temperature mask*.
2	Coho salmon occur in ≥25 but ≤50 percent of the IP habitat outside the temperature mask*.
3	Coho salmon occur in >50 percent of IP habitat outside the temperature mask*.
*The temperature mask (Williams et al. 2006) was applied to the IP model results to exclude areas with high air temperatures from calculation of required spawner density.	

Diversity

This parameter was made up of 50 percent Life History Diversity and 50 percent Genetic Diversity. Genetic Diversity included two equally-weighted elements: Hatchery Influence and Population Size.

Life History Diversity

Within and among populations, coho salmon exhibit diverse life history traits which have the potential to enhance growth and survival of individuals in a spatially and temporally variable environment. Because populations are made up of individuals, maintaining diverse life history traits (1) allows for individuals to utilize a wide range of habitats; (2) protects species against short term spatial and temporal changes in habitat; and (3) increases the likelihood that some individuals will survive and reproduce. The diversity of life history traits expressed by individuals, and the availability of a diversity of habitats, spreads any risk to population viability over space and time (Weitkamp et al 1995, Spence et al. 1996, McElhany et al. 2000).

Life history traits are phenotypic and genotypic characteristics which provide the potential for individuals to utilize multiple habitats in order to enhance growth and survival. These traits include: adult age, size, fecundity, run and spawning timing, and spawning behavior; egg size and developmental rate; juvenile physiology and behavior; smolt size, age, and outmigration timing; disease resistance; and ocean distribution patterns (Weitkamp et al 1995, Spence et al. 1996, McElhany et al 2000).

Adult coho salmon typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, and then die. Juveniles typically feed and rear within the streams of their natal watershed for a year before migrating to the ocean in the spring. Coho salmon typically spend 2 growing seasons in the ocean before returning to their natal stream to spawn as 3 year-olds.

Table C - 5. Metrics used to assess life history diversity parameter.

Score	Description
0.5	Diverse habitat types are not present, so potential for expression of atypical life history traits is not apparent, AND there is no evidence of expression of atypical life history traits.
1	Diverse habitat types are present, suggesting potential for expression of atypical life history traits, AND there is no evidence of expression of atypical life history traits.
1.5	Diverse habitat types are present, suggesting potential for expression of atypical life history traits, AND there is evidence of expression of atypical life history traits.

Hatchery Influence

Table C - 6. Metrics used to assess hatchery influence parameter.

Score	Description
0.25	The proportion of hatchery strays in the spawning population is high (Proportion of Natural Influence [PNI] <0.3) in >50 percent of years, and these strays support the population.
0.5	The proportion of hatchery strays in the spawning population is moderate (PNI >0.5) in >50 percent of years, and these strays do not support the population .
0.75	The proportion of hatchery strays in the spawning population is low or zero (PNI >0.7) in >50 percent of years, and these strays do not support the population.

Population size

Small populations tend to have less genetic diversity than large ones. The depensation threshold is used to define a small population. The score for population size as it relates to genetic diversity can be calculated by multiplying the population's score for population size (calculated using the table in Section 1.3.1.1.1.1) by 0.25.

Table C - 7. Metrics used to assess population size parameter.

Score	Description
0	No coho salmon are produced by any cohort, AND any adults are likely strays.
1	Number of spawners is consistently (multiple generations) < 50 percent of depensation threshold.
2	Number of spawners is consistently (multiple generations) 51 percent to 100 percent of depensation threshold.
3	Number of spawners is consistently (multiple generations) greater than depensation threshold.

Habitat Integrity and Risks

The Habitat Integrity and Risks parameter describes the relative habitat integrity (lack of human-caused disturbance; Bradbury et al. 1995) and relative risk to current biological and ecological resources (Bradbury et al. 1995) in each population. The following metrics were chosen to assess Habitat Integrity and Risks because they were related to the parameter, and because numeric data describing them were readily available.

Road Density

This metric is the average density of roads in the population area. It is based on the rationale that areas with high road densities are more prone to unnatural levels of disturbance and relatively high rates of chronic sedimentation, while areas with lower road densities have a higher integrity and less risk. Scores were based on a frequency distribution of road density data from the populations in the ESU divided into roughly equal thirds and scored as 3 for the lowest third (road density 1.6-2.5), 2 for the middle third (2.6-3.0), and 1 for the highest third (3.24-12.59).

Number of Stresses Ranked High or Very High

This metric is the total number of high or very high stresses indicated in the stress summary tables from population profiles. It is based on the rationale that numerous high-level stresses are an indication of a lower ecological integrity and higher degree of risks. Scores were based on a frequency distribution of the number stresses for each population in the ESU divided into roughly equal thirds and scored as 3 for the lowest third (0-3), 2 for the middle third (4-6), and 1 for the highest third (7-9).

Slope

This metric is the total area of the watershed with a percentage of slope ≥ 55 percent based on GIS analysis of 30-meter digital elevation model. It is based on the rationale that populations within a stratum with more high-gradient area are more likely to experience large-scale disturbance (e.g., mass-wasting), whereas areas with a less high-gradient habitat are likely to experience these disturbances on a smaller scale within the landscape. Scores were based on a frequency distribution of proportion watershed with slope ≥ 55 percent for each population divided into roughly equal thirds and scored as 3 for the lowest third (proportion 0.04-0.09), 2 for the middle third (0.11-0.24), and 1 for the highest third (0.26-0.51).

Forest Integrity

This metric is based on the percentage of large trees (>30” or >20” depending on location) and change scene detection (percent harvested, percent change due to other impacts). Both are GIS-based and determined from LandSat imagery. This metric was chosen based on the rationale that areas that have a higher degree of mature forest and/or have been less impacted by timber harvest have a higher resiliency and more ecological integrity. Large tree scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 0.5 for the lowest third, 1 for the middle third, and 1.5 for the highest third. Harvest scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 1.5 for the lowest third, 1 for the middle third, and 0.5 for the highest third. These two scores were then combined for the overall score.

Optimism and Potential

The Optimism and Potential parameter describes the relative degree of optimism that freshwater or estuarine ecosystems can be protected or restored and the potential increase to populations if protection and restoration are effective (Bradbury et al. 1995). The following metrics were chosen to assess Optimism and Potential because they are related to the parameter, and numeric data is readily available.

Public Land

This metric is the percent of land within the population that is in public ownership. Populations within a stratum with more public land are assumed to benefit from higher standards of management and greater ease of implementation of recovery measures. Individual scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 1 for the lowest third, 2 for the middle third, and 3 for the highest third.

California State Recovery Priority

The California Department of Fish and Game (CDFG) Coho Recovery Strategy (CDFG 2004) used a prioritization model to predict restoration and management potential based on the existing population status, risks, and watershed condition. This metric, which is based on the CDFG scores of restoration and management potential, indicate which areas the state of California believes have the greatest likelihood for successful coho recovery. A similar metric is not available for Oregon populations. Scores were based on a frequency distribution of scores for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third (score 1.0-1.5), 2 for the middle third (2.0-3.2), and 3 for the highest third (3.3-5.0).

Number of Threats Ranked High or Very High

This metric is the total number of high or very high threats as shown in the threat summary tables from population profiles. It is based on the rationale that numerous high-level threats means there likely is a lower ecological integrity, higher degree of risk, and a reduced potential for success. Scores were based on a frequency distribution of the number of high/very high stresses for each population in the ESU and were divided into roughly equal thirds and scored as 1 for the lowest third (7-8), 2 for the middle third (4-6), and 3 for the highest third (1-3).

Number of Other Listed Anadromous Salmonid Species

This metric is the number of other NMFS-listed anadromous species that occur within the population area. It is based on the rationale that a population with more listed species is more likely to be a focus for restoration and so attract restoration dollars than a population with less listed species. Scores were based on a frequency distribution of number species for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third, 2 for the middle third, and 3 for the highest third.

Number of Other Non-Listed Anadromous Salmonid Species

This metric is the number of non-listed anadromous salmonid species that occupy the population area. It is based on the rationale that populations with other anadromous salmonid species maintain some of the habitat features that are critical for supporting coho salmon populations. Scores were based on a frequency distribution of number salmonid species for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third (0-2 species), 2 for the middle third (3-4), and 3 for the highest third (5-6).

Using Ratings to Choose Core Populations

NMFS considers the population ratings to inform the choice of core population. Consistent with Bradbury et al. (1995), NMFS places most importance on the Biological Importance (BI) score. Independent populations with the highest BI scores may be chosen as core populations based on the BI scores alone. The BI scores, and other BI-related considerations, play a strong role in the decision because they are very relevant to how quickly a population can improve from its current state. Populations with the highest BI scores are likely in the best condition and are expected to recover more quickly than populations with lower BI scores. The scores for the other two categories are considered if the BI scores do not support a clear choice.

Using Ratings to Determine Targets for Non-Core Populations

There are a range of possible targets for non-core populations, and reasons why a particular target may be chosen. NMFS considers two factors when setting these targets. 1. What are the prospects for recovery in a particular population? NMFS uses the scores described in Section 1.3.2 to answer this question. 2. Given what was learned for factor 1, what role does each population need to play in a recovered ESU? Is the population more or less important as a source to recolonize areas? The rationale for selection of particular targets for each population is explained in the appropriate Exhibit (1 through 7).

Non-Core 2

The target for populations in this category is 20 percent of habitat occupied in years following spawning of brood years with high marine survival. NMFS chooses this target if the chance of recovery of a coho salmon population in a basin is very low, but it is feasible that some habitat could be restored to support all life stages of coho salmon. If strays were to arrive, the basin would be able to support all life stages, and juveniles may be observed in some years. A population with this target would not be relied upon to provide a source of colonists for other populations.

Non-Core 1

The target for populations in this category the moderate risk threshold, which is the depensation threshold multiplied by four. NMFS chooses this target if the population is likely to ultimately produce considerably more than the depensation threshold, but less than the low risk threshold.

Core

The target for populations in this category is the low risk threshold. NMFS chooses this target for a population after considering its current condition, its geographic location in the ESU, its low risk threshold compared to the number of spawners needed for the entire stratum, and other factors. The rationale for selection of particular core populations is explained in the appropriate Exhibit (1 through 7).

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Exhibit 1.

Northern Coastal Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Chetco River	2	3	2	1	0.75	0.25	9
Elk River	2	2	2	1	0.75	0.25	8
Lower Rogue River	2	2	1	1	0.5	0.75	7.25
Winchuck River	1	1	1	1	0.75	0.25	5

Available data indicate the Winchuck River population abundance is currently well below the depensation threshold, while the Elk River, Chetco River, and Lower Rogue River populations have at least one year class that is likely above the depensation threshold. Coho salmon in the Chetco River and Elk River populations are believed to occupy a higher percentage of the IP habitat in their basins, while the Lower Rogue River population is believed to be constrained to a few tributaries.

The extent of life history diversity is rated the same for all populations due to similar coastal and estuary condition. Hatchery influence is of low concern in the Chetco River, Elk River, and Winchuck populations. However, stray coho salmon from the Cole Rivers hatchery are known to occasionally spawn in the Lower Rogue River. The Lower Rogue River population supports more coho salmon than the others, so it is less affected by depensatory effects.

(b) Integrity and Risks (IR) Scores

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Chetco River	3	2	1	3	9
Elk River	3	2	1	3	9
Lower Rogue River	1	2	2	2	7
Winchuck River	3	2	1	2	8

Road density is higher in the Lower Rogue River than in the other populations. There were no scored differences in the number of high or very high stresses across populations. The Lower Rogue River has a lower incidence of steep slopes compared to the other populations. Populations with more high-gradient areas may be more vulnerable to large-scale disturbance than areas with less high-gradient areas. The forest integrity of the Chetco and Elk Rivers was rated higher than that of the other population area, suggesting more mature forest and more resiliency and ecological integrity in the Chetco River and Elk River populations.

(c) Optimism and Potential (OP) Scores

Optimism and Potential						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Chetco River	3	0	0	2	2	7
Elk River	3	0	0	2	3	8
Lower Rogue River	2	0	0	3	2	7
Winchuck River	3	0	0	2	3	8

The proportion of publicly–owned land is greater in the Chetco River, Elk River, and Winchuck River populations than in the Lower Rogue River population. Populations with more public land are assumed to benefit from higher standards of management and greater ease of implementation of recovery measures. There are more salmonid species in the Lower Rogue River than in the other populations. A population with more salmonid species may maintain more of the habitat features critical for supporting coho salmon populations than a population with less salmonid species. There are less highly-ranked threats in the Elk River and Winchuck River than the other populations, possibly indicating greater ecological integrity and a greater potential for success in restoring coho salmon.

The Elk River has great potential for recovery due to an ongoing public effort to protect and restore salmon habitat, as well as the management of a large portion of the watershed as Wilderness or a Late Successional Reserve. All population areas possess suitable private land which could contribute toward restoration if state, federal, or private funding was available.

d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows:

Elk River – $7 million
Lower Rogue River - $58 million
Chetco River - $14 million
Winchuck River - $5 million

Recognize that the cost estimate for recovery actions identified for the Winchuck River and Lower Rogue River do not include recovery actions necessary for a core population; and the Elk River and Chetco River costs may include recovery actions not necessary for a non-core 1 population.

Preliminary cost estimates reveal the cost of recovery actions identified for the Lower Rogue River population is much higher than the cost for the other populations. This result is due to extensive road treatment and decommissioning actions, as well as estuarine restoration, in the Lower Rogue River. Although the Lower Rogue River is not proposed as a core population, the estuarine restoration actions there are needed by other populations in the Rogue basin. If the Chetco River was not selected as a core population, then the remaining three populations would have to be selected in order to meet the stratum 50% abundance threshold. This scenario would result in a more costly scenario.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Chetco River	9	9	7	25	4,500
Elk River	8	9	8	25	2,400
Lower Rogue River	7.25	7	7	21.25	3,000
Winchuck River	5	8	8	21	2,200
Number spawners needed to meet stratum requirement (50% of total)					6,050

(f) Conclusion

Population	Type	Target
Chetco River	Core	4,500
Elk River	Core	2,400
Lower Rogue River	Non-Core 1	324
Winchuck River	Non-Core 1	228
		Total Core : 6,900 Spawners

The Chetco River and Elk River populations are the best choices for core populations in this stratum primarily because the coho salmon populations found there are in the best condition. In addition, their IR scores are the highest, indicating greater watershed integrity. The core population targets would result in a low risk of extinction. The Lower Rogue River and Winchuck River targets would result in a moderate risk of extinction.

Exhibit 2

Interior Rogue Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Upper Rogue River	3	2	2	1	0.5	0.5	9
Middle Rogue/Applegate	3	2	1	1	0.75	0.5	8.25
Illinois River	3	2	2	1	0.75	0.5	9.25

The number of adults in each population is consistently greater than the depensation threshold, and all populations have three cohorts consistently present. The Illinois and Upper Rogue have more adult coho salmon than the Middle Rogue/Applegate River.

Juvenile coho salmon are better distributed in the Upper Rogue River and Illinois River population areas than in the Middle Rogue/Applegate population areas (between 25 and 50 percent of IP occupied, compared to 0 to 25 percent occupied). Juvenile density is higher in the Upper Rogue River and Illinois River populations than in the Middle Rogue/Applegate River.

Diversity measures are the same across all populations, except hatchery influence is greater in the Upper Rogue River than in the other two populations.

(b) Integrity and Risks (IR) Scores

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Upper Rogue River	1	2	3	3	9
Middle Rogue/Applegate	1	2	1	2	6
Illinois River	2	2	1	2	7

The road density is lower in the Illinois River than in the other two populations. There were no scored differences in the number of high or very high stresses in the three populations. The Upper Rogue River has a lower incidence of steep slopes than seen in the other two populations. Populations with more high-gradient areas may be more vulnerable to large-scale disturbance than areas with less high-gradient areas. The forest integrity of the Upper Rogue River was rated higher than that of the Middle Rogue/Applegate and Illinois Rivers, indicating there is more mature forest and so more resiliency and ecological integrity in the Upper Rogue River.

The natural hydrograph of the Illinois River is still in place and functional, not affected by dams as are the Upper Rogue (William L. Jess Dam) and Middle Rogue/Applegate Rivers (William L. Jess and Applegate Dams).

(c) Optimism and Potential (OP) Scores

Optimism and Potential Score						
Population	Public Land	CDFG	Listed Species	Species	Threat	Total
Upper Rogue River	2	0	0	3	1	6
Middle Rogue/Applegate	3	0	0	2	2	7
Illinois River	3	0	0	3	2	8

The proportion of publicly–owned land is greater in the Middle Rogue/Applegate River and Illinois Rivers than in the Upper Rogue River. Populations with more public land may benefit from higher standards of management and greater ease of implementation of recovery measures. More public land is owned by the U.S. Forest Service than BLM in the Illinois River basin. The U.S. Forest Service currently manages land under the Northwest Forest Plan, while BLM in the Rogue basin manages under a revised system which is less protective of fish and their habitat. There are fewer salmonid species in the Middle Rogue Applegate River than in the other two populations. A population with more salmonid species may maintain more of the habitat features critical for supporting coho salmon populations than a population with less salmonid species. The threat rating for the Upper Rogue River was less than for the other two populations, possibly indicating greater ecological integrity and a greater potential for success in restoring coho salmon.

Recent removal of mainstem dams on the Upper Rogue has restored passage to much of the basin. Much of the Middle Rogue River is too steep for coho salmon, and many of the lower gradient areas are highly impacted and do not present a great opportunity for restoration. The Applegate is less impacted, but has less recovery potential than the Illinois River. All population areas possess suitable private land which could contribute toward restoration if state, federal, or private funding was available.

d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows:

Illinois River – $173 million
Upper Rogue River - $224 million
Middle Rogue/Applegate River - $5 million

Recognize that the cost estimate for recovery actions identified for the Middle Rogue/Applegate River does not include recovery actions necessary for a core population; and the Illinois River and Upper Rogue River costs may include recovery actions not necessary for a non-core 1 population.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Upper Rogue River	9	9	6	24	16,100
Middle Rogue/Applegate	8.25	6	7	21.25	15,200
Illinois River	9.25	7	8	24.25	11,800
Number spawners needed to meet stratum requirement (50% of total)					21,550

(f) Conclusion

Population	Type	Target
Upper Rogue River	Core	16,100
Middle Rogue/Applegate	Non-Core 1	2,700
Illinois River	Core	11,800
		Total Core : 27,900 Spawners

The Upper Rogue River and Illinois River populations are the best choices for core populations in this stratum, primarily because the coho salmon populations found there are in the best condition. In addition, the Upper Rogue has more mature forest and the lowest number of threats compared to the other population areas, and the Illinois has greater recovery potential than the Middle Rogue because it is less urbanized. The core population targets would result in a low risk of extinction. The Middle Rogue/Applegate River target would result in a moderate risk of extinction.

Exhibit 3

Central Coastal Stratum Population Targets

NMFS applied the modified Bradbury et al. (1995) framework to the Central Coastal Stratum to select population type (i.e., core, non-core 1 or 2, extirpated) and to identify the population spawner abundance or juvenile occupancy targets. Application of the framework resulted in the following Biological Importance (BI), Integrity and Risk (IR), and Optimism and Potential (OP) scores. The BI score for this stratum represents the mean of four staff scores, which are largely based upon best professional judgment given the paucity of data within the stratum. Otherwise, results are based on information presented in the Central Coastal Stratum population profiles.

(a) Biological Importance (BI) Scores

Biological Importance							
Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Genetic Score	Depensation Score	BI Score
Little River	3	3	3	1.13	0.75	0.75	11.63
Lower Klamath R.	2.75	2	2.75	1.5	0.44	0.79	10.13
Mad River	2	2	3	1.5	0.75	.5	9.75
Maple Ck/Big Lagoon	1	1	1	1	0.75	0.25	5
Redwood Creek	2	2	2	1.5	0.75	0.5	8.75
Smith River	1.5	2	3	1	0.75	0.38	8.63

Population abundance is uncertain as surveys are few and results are variable. Data from Redwood Creek are some of the most robust within the stratum, with data sets spanning 12 years. However, the most robust data on spawner abundance is from Prairie Creek, a tributary to Redwood Creek. Data indicate that spawner escapement in Prairie Creek is highly variable between years, ranging from 680 spawners in 2002 to a low of 28 adults in 2010. Within the five-year period from 2007 to 2011, three of five years the spawner estimates for Prairie Creek exceeded the depensation threshold of 151 spawners calculated for Redwood Creek watershed, although during one of those years the estimate was very close to depensation. Prairie Creek is a stronghold for coho salmon in Redwood Creek, whereas very little production is documented elsewhere in the watershed. In contrast, data are limited for the Little River, Mad River, Smith River, and Maple Creek. Based upon the team's best professional judgment, Little River likely produces equal to or greater than the depensation threshold (34), whereas population abundance in the Mad and Smith rivers, are likely below depensation (153 and 325, respectively). Finally, the team debated whether the data from the Lower Klamath was reliable. While the data suggest that the Lower Klamath is likely above the depensation threshold, staff members were concerned that the use of juvenile data may poorly reflect abundance and distribution of the population due to the presences of juveniles from upper basin populations (non-natal rearing).

(b) Integrity and Risks (IR) Scores

Integrity and Risks					
Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Little River	1	3	3	2	9
Lower Klamath River	1	2	2	2	7
Mad River	1	2	2	2	7
Maple Ck/Big Lagoon	1	3	3	1	8
Redwood Creek	1	2	3	3	9
Smith River	1	2	1	2	6

Road density is of concern throughout the stratum, and as such, each basin scored a one for road density. Populations differ, however, according to the remainder of the metrics that make up the Integrity and Risk score. The larger of the basins in this stratum, the Lower Klamath, Smith, and Mad rivers, and Redwood Creek scored as a two for high-level stresses. The Smith River scored low in the slope metric due to the proportion of the basin contained in high gradient reaches; however, the metric oversimplifies the relationship between slope and the risk of mass wasting. While the Smith River may have a higher proportion of steep slopes than other watersheds within the stratum, the underlying geology is inherently different between the Smith River and the other basins within the stratum. The Smith River basin contains more competent rocks (primarily Josephine Ophiolite sequence) and produces courser grain landslides that tend to be less detrimental to fish and their habitat, and can contribute to the formation and maintenance of spawning habitat. In contrast, other basins within the stratum consist primarily of sedimentary rocks, which produce finer grain landslides that can several damage salmonid habitat. Consequently, NMFS considered the final IR scores for each population in concert with relative strength of each metric in arriving at the final recommendation for the core populations for the stratum.

(c) Optimism and Potential (OP) Scores

Optimism and Potential						
Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Little River	1	3	2	2	3	11
Lower Klamath River	2	3	1	3	2	11
Mad River	2	3	3	3	3	14
Maple Ck/Big Lagoon	1	3	0	2	3	9
Redwood Creek	2	3	3	3	2	13
Smith River	3	3	1	3	3	13

The three highest scoring populations for Optimism and Potential (OP) are the Mad River, Smith River, and Redwood Creek. The number of listed anadromous fish species influences this score with the Mad River and Redwood Creek occurring within the range of all listed anadromous fish within the stratum. That is, although Pacific eulachon are listed within the Central Coastal stratum, they are generally relegated to larger watersheds such as the Lower Klamath, Smith, and Mad rivers. In contrast, the Northern California steelhead DPS and the Central Coast Chinook salmon ESU are limited to watersheds south of the Klamath River. Thus, the Mad River and Redwood Creek contain the highest number of listed anadromous fish species. The final OP score for the Smith River also reflects the fact that this basin has the highest proportion of lands within public ownership.

(d) Other Considerations

Climate change

The anticipated effect of future climate change influenced the final core populations selected for this stratum. NMFS expects that projected temperature increases and changes in precipitation patterns from climate change models would have a relatively smaller effect on coho salmon and their habitat in the Smith River basin than other watersheds within the stratum. Because the headwaters of the Smith River originate on US Forest Service land, which is managed to protect water quality and quantity, and water quantity and water temperatures are not currently limiting coho salmon in the Smith River, the Smith River population may be more buffered from the effects of climate change. NMFS expects that climate change would not decrease the availability of suitable habitat for coho salmon in the Smith River, or if suitable habitat were to decline due to climate changes, then we would expect such declines to be less severe than the declines that would occur in neighboring basins.

Cost

Preliminary results indicate the total cost of recovery actions needed in each population of this stratum is as follows:

Smith River—$169 million
Lower Klamath River—$148 million
Redwood Creek—$248 million
Mad River—$191 million

The cost estimate for recovery actions identified in the Mad River may include actions that are not necessary for a non-core population.

(e) Summary

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold
Little River	11.63	9	11	31.6	1,600
Lower Klamath River	10.13	7	11	28.1	5,900
Mad River	9.75	7	14	30.8	4,900
Maple Ck/Big Lagoon	5	8	9	22.0	1,600
Redwood Creek	8.75	9	13	30.8	4,900
Smith River	8.63	6	13	27.6	6,500
Number spawners needed to meet stratum requirement (50% of total)					12,600

NMFS staff members were not confident in the scoring methodology or the output from applying the methodology given the paucity of data, and thus spent considerable time deliberating the merits of choosing the populations with the highest scores. According to above BI scores the Little River, Lower Klamath, and Mad River are the top three highest scoring populations. However, the combined low risk spawner threshold for these three populations equals 12,200 spawners; 400 adult coho salmon less than the 50% stratum target. After several meetings to deliberate the core population configuration for the Central Coast stratum, the team arrived at the following recommendation by majority vote for core populations: **Lower Klamath River, Redwood Creek and Smith River.** Rationale for recommendation:

Lower Klamath River –CORE

- Abundance may be above depensation threshold
- Estuarine habitat is considered some of the highest quality in the stratum
- Supports upstream populations in the Interior Klamath Stratum and the Interior Trinity Stratum, five of which are core populations
- Currently coho salmon are widely distributed

Smith River – CORE

- Northern expression within stratum, key basin for seeding dependent populations nearby and maintaining metapopulation structure with populations in most northern extent of SONCC coho salmon range (northern coastal stratum)
- Unique geology (Siskiyou bioregion)
- Cold water tributaries originate in Siskiyou Mountains; within stratum considered basin most resilient to climate change; water temperatures likely least impacted within stratum
- Hydrology considered less impacted than other basins within stratum; no large hydroelectric dams, headwaters contained within wilderness or other public land
- Steep geology, possibly more springs than other basin
- Currently coho salmon are widely distributed

Redwood Creek –CORE

- Abundance near or above depensation

- Only basin in stratum with documented 2 year freshwater rearing of juveniles
- Lower watershed managed by Redwood National and State Parks, which has goals that include recovering listed species
- Currently coho salmon are suspected to have a limited distribution

Mad River –Non-Core

- Neighboring basin to south coastal stratum; would assist in seeding and maintaining metapopulation dynamics
- Optimism increasing; increasing interest in disperse parties for restoring/making improvements; most urban of basins within stratum
- Currently coho salmon are widely distributed

Little River –Non-Core

- Abundance may be above depensation threshold; however, population considered too small to contribute substantially to the 50% target for stratum viability
- Presently considered "potentially independent" population; genetic studies needed to determine if supports a unique population or clusters with neighboring basin
- Majority of watershed in Green Diamond ownership and covered by HCP; fate of population highly dependent upon Green Diamond management practices.
- Estuarine habitat degraded by grazing practices
- High spawner requirement likely difficult to meet

Maple Creek/Big Lagoon –Non-Core

- Population too dependent on breaching of the spit
- Abundance considered less than depensation
- Estuarine habitat is considered some of the highest quality in the stratum
- Population too small to contribute to stratum viability target

(f) Conclusion

Population	Category	Target
Little River	Non-Core 1	136
Lower Klamath River	**Core**	**5900**
Mad River	Non-Core 1	612
Maple Ck/Big Lagoon	Non-Core 2	Juvenile occupancy
Redwood Creek	**Core**	**4900**
Smith River	**Core**	**6500**
		Total Core : **17,300 spawners**

The Lower Klamath River, Redwood Creek, and Smith River are considered the best candidates to serve as the core populations in this stratum because these populations represent the populations that the NMFS has the most optimism will persist as strongholds in the face of climate change. With the exception of Redwood Creek, these basins also currently contain the widest in-basin distribution of coho salmon, which suggests that these basins are more resilient

to stochastic events and within basin re-seeding can occur. Although the distribution of coho salmon within Redwood Creek is limited, Redwood Creek, in particular Prairie Creek, is an important stronghold within the stratum at present and is expected to persist due to the protections afforded the watershed by Redwood National and State Parks. Similarly, the Smith River contains a considerable amount of protected habitat because much of the watershed is contained within US Forest Service lands and the Redwood National and State Parks.

Literature Cited

Bradbury, B., W. Nehlsen, T.E. Nickelson, K.M.S. Moore, R.M. Huges, D. Heller, J. Nicholas, D.L.Bottom, W.E. Weaver, R.L. Beschta. 1995. Handbook for prioritizing watershed protection and restoration to aid recovery of native salmon. 56 p.

Exhibit 4

Interior Klamath Population Targets

Application of the method used to select population type (i.e., core 1, core 2, non-core, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; summary of findings; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Klamath Stratum population profiles.

(a) Biological Importance (BI) Score

Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Genetic Score	Depensation Score	BI Score
Mid-Klamath	2	2	3	1	0.75	0.5	9.25
Salmon	1	2	1	0.5	0.75	0.25	5.5
Scott	1	2	3	1	0.5	0.25	7.75
Shasta	1	1	1	1.5	0.25	0.25	5
Upper Klamath	3	3	1	1	0.25	0.5	8.75

(b) Integrity and Risks (IR) Scores

Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Mid-Klamath	3	1	1	3	8
Salmon	3	3	1	3	10
Scott	2	2	2	3	9
Shasta	3	2	3	3	11
Upper Klamath	2	1	2	3	8

(c) Optimism and Potential (OP) Scores

Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Mid-Klamath	3	2	0	3	3	11
Salmon	3	2	0	3	3	11
Scott	2	3	0	2	1	8
Shasta	2	3	0	2	2	9
Upper Klamath	2	3	0	2		9

(d) Summary of Population Profile Findings

Scott River Population

- High natural production in recent history (2004) .
- Current distribution of coho salmon in the Scott River is widespread
- Exhibits a wide variety of habitats and life histories
- Limiting factors that currently limit production are well understood.
- Potential for high production given the high IP, and large runs of Chinook.
- One strong brood year.
- Strong monitoring program exists

Shasta River Population

- Low numbers of abundance contrast with high value of Integrity and Optimism.
- High production of Chinook salmon currently exists, indicating production value for coho could exist if limiting factors are addressed.
- Diversify of habitat features (e.g., spring flow dominated hydrology) and life history traits contribute to the overall adaptability and resiliency of the stratum to combat future climate effects and catastrophic events.
- Stressors are well understood, as are the identification of effective restoration priorities.
- Location allows for strays to support other populations.
- Recent success in acquiring more than 6,000 acres within the Big Springs Complex increases optimism for long term recovery.
- Large quantity of high IP habitat
- Strong monitoring program exists

Upper Klamath Population

- Optimism guarded high given the KHSA/KBRA
- Population comprised of a series of small streams, some intermittent.
- High quality habitat above Iron Gate Dam will be made available upon fish passage. Cold water tributaries will provide refugia from climate effects.
- Selection as core allows for full extent and range of occupied habitat to be restored, enhancing the spatial structure of the ESU.
- Location allows for strays to support other populations.
- Moderate monitoring program exists (Bogus Creek, Iron Gate Hatchery)

Middle Klamath Population

- Population may be above depensation threshold.
- Provides non-natal rearing habitat and migratory habitat
- Comprised of a series of low production tributaries with generally monotypic habitat features.
- Formation of low gradient coho habitat systems is constrained by the geology of the Klamath Mountain geomorphic province (particularly the northern range). Deep soils, steep slopes, high precipitation and sediment yields are natural factors controlling the geomorphology within the Middle Klamath population unit. This geomorphology naturally confines coho distribution and abundance.

- Habitat condition is currently good relative to Shasta and Scott.
- High amount of public land ownership
- Concern that recovery actions will not result in population response to the degree necessary to meet the low risk threshold.
- Poor monitoring program exists.

Salmon River Population

- Geology is rocky and does not provide a lot of IP habitat
- Carrying capacity of the sub-basin is likely lower than other populations in stratum

e) Other Considerations

Co-manager comments

Co-manager comments included recommendations to (1) re-consider the Shasta population as a core population and replace the selection with the Middle Klamath population; and (2) re-evaluate depensation threshold targets for non-core populations.

We did not find compelling evidence to re-configure the original recommendation to select Upper Klamath, Shasta River, and Scott River as core populations for the Klamath Interior stratum. The decision to select the Shasta population is based on the factors described above in (d) including: a clear understanding of limiting factors and restoration priorities, a high potential for production value, a diversity of life history strategies and habitat features, and a long term data and strong monitoring program. No new information was discovered that warranted changing the selections of the Scott and Upper Klamath populations as core.

Revised IP

We are aware of impassable barriers in the Shasta River Basin. IP values were re-calculated and habitat above Dwinnell Reservoir and Greenhorn Dam (Yreka Creek) was removed from the Shasta IP calculation. The resulting adult spawner target (8,778 fish) to achieve a low risk threshold is approximately 2,000 fish less than the original target.

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows:

Upper Klamath	$614,708,410
Shasta River	$90,786,729
Scott River	$52,325,005

f) Score Summary

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold	Core Spawners Needed
Mid-Klamath	9.25	8	11	28.25	3,900	
Salmon	5.5	10	11	26.5	4,000	
Scott	7.75	9	8	24.75	8,800	8,800
Shasta	5	11	9	25	8,778	8,778
Upper Klamath	8.75	8	9	25.75	8,500	8,500
				Total abundance	33,978	26,078
				50% total stratum N_a	16,989	

(f) Conclusion

Population	Type	Target
Scott	Core	8,800
Shasta	Core	8,778
Upper Klamath	Core	8,500
Middle Klamath	Non-Core 1	450
Salmon	Non-Core 1	460
		Total : 26,988 Spawners

Three core populations, the Upper Klamath, Shasta River, and Scott River populations are proposed to be chosen in this diversity stratum. This combination would allow for the largest amount of IP habitat, spatial diversity, greatest production potential, most appropriate habitat, and unique life history traits to be restored and will achieve the goal of 50% stratum abundance. Non-core population targets represent a four-fold increase in abundance over depensation thresholds.

Exhibit 5

Interior Trinity River Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in the Interior Trinity River Stratum population profiles.

(a) Biological Importance (BI) Scores

Biological Importance							
Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Genetic Score	Depensation Score	BI Score
Lower Trinity River	3	3	3	1	0.25	0.5	10.75
South Fork Trinity River	2	2	1	0.5	0.25	0.25	6
Upper Trinity River	3	3	1	1.5	0.25	0.75	9.5

The two highest scoring populations for Biological Importance (BI) are the Lower Trinity and the Upper Trinity. Of great concern across the stratum is the high proportion of hatchery fish within the Trinity watershed. This concern is greatest for the Upper Trinity population where hatchery fish dominate the run (typically, greater than 85% with some years as high as 97% hatchery fish comprising the run [see 2000, table 1-2 Upper Trinity River population profile]). Population abundance is uncertain for all three populations because surveys are few throughout the basin, although estimates are most robust for Upper Trinity population due to the survey efforts at the Willow Creek weir. Based on this effort, it appears that in some years naturally spawning coho salmon to the Upper Trinity River may exceed the low risk spawner threshold. In contrast, best available information suggests that the South Fork Trinity River and the Lower Trinity River are not likely to meeting the population's depensation thresholds.

(b) Integrity and Risks (IR) Scores

Integrity and Risks					
Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Lower Trinity River	3	2	1	2	8
South Fork Trinity River	1	2	2	2	7
Upper Trinity River	3	2	1	3	9

(c) Optimism and Potential (OP) Scores

Optimism and Potential						
Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Lower Trinity River	3	2	0	3	2	10
South Fork Trinity River	3	2	0	3	3	11
Upper Trinity River	3	2	0	2	2	9

(d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population of this stratum is as follows:

Lower Trinity River—$75 million
South Fork Trinity River—$127 million
Upper Trinity River—$15 million

The cost estimate for recovery actions identified in the South Fork Trinity River may include actions that are not necessary for a non-core population. In contrast, more actions may be necessary to ensure that the Upper Trinity River population meets the low risk spawner threshold, and as such the cost estimate provided here may significantly underestimate the cost of actions necessary to achieve recovery.

(e) Summary

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold
Lower Trinity River	10.75	8	10	28.75	3,900
South Fork Trinity River	6	7	11	24	6,400
Upper Trinity River	9.5	9	9	27.5	7,300
Number spawners needed to meet stratum requirement (50% of total)					8,800

(f) Conclusion

Population	Category	Target
Lower Trinity River	Core	3,900
South Fork Trinity River	Non-core 1	1,000
Upper Trinity River	Core	7,300
		Total Core : 11,200 Spawners

The Lower Trinity and Upper Trinity River populations are considered the best candidates to serve as the core populations in this stratum for several reasons. Chief among these is a concern that the IP model grossly overestimates the production potential of the South Fork, given the severe degradation that has occurred within the basin as a result of historic flooding. In addition, only a small portion of the tributaries in the South Fork is likely to support coho salmon or their reintroduction. In comparison, the Lower Trinity and Upper Trinity have nearly three times the number of tributaries that could support coho salmon (See also CDFG 2004). Moreover, according to the Trinity River Flow Evaluation document (USFWS and HVT 1999) about 80 percent of the best coho salmon habitat within the basin historically occurred upstream of the dams. It is a widely shared opinion that the South Fork probably never was a particularly important basin for coho salmon production within the Trinity/Klamath watershed.

Reference:

California Department of Fish and Game (CDFG). 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594pp. Copies/CD available upon request from California Department of Fish and Game, Native Anadromous Fish and Watershed Branch, 1419 9th Street, Sacramento, CA 95814, or on-line: http:www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

U.S. Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT). 1999. Trinity River Flow Evaluation Final Report. Report to the Secretary, U.S. Department of the Interior. Washington, D.C. Available at: http://www.fws.gov/arcata/fisheries/reportsDisplay.html. Accessed October 2008.

Exhibit 6

Southern Coastal Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Bear River	0	0	0	0.5	.75	0	1.25
Humboldt Bay Tributaries	3	2	3	1.5	.75	.75	11
Lower Eel / Van Duzen	2	2	1	1.5	.75	.50	7.75
Mattole River	1	2	1	1	.75	.25	6

Population abundance is uncertain as surveys are few and the results are variable. The Bear River population has a conspicuous absence of coho salmon. Surveyed streams in the Humboldt Bay population indicate regular adult abundance greater than depensation (191), while the adult abundance is likely below depensation in the Lower Eel / Van Duzen (394) and Mattole (250) populations. All populations show evidence of decline in all three cohorts, except for Bear River which has no evidence of coho salmon being present.

Coho salmon are found well-distributed throughout the Humboldt Bay tributaries and estuary. However, they are found in less than a quarter of IP habitat in the Mattole River and Lower Eel / Van Duzen River populations – likely as a result of degraded or inaccessible habitat or lack of survey effort. In 2008, coho salmon adult spawners were found in just one Mattole River tributary.

Diversity across the stratum can be influenced by many factors, including life history strategies, hatcheries, and abundance proximity to depensation. The amount of environmental diversity in an area can indicate the degree of potential diversity that same area can support. Life history strategies are greater in Humboldt Bay and Lower Eel / Van Duzen River populations where greater environmental and habitat variability exists. Humboldt Bay Tributaries include life history strategies that take advantage of relatively stable temperature and estuarine and bay habitat. The Lower Eel / Van Duzen River population likely possess many of the same life

history strategies as found in Humboldt Bay, plus strategies that succeed in warmer and dryer conditions farther inland.

(b) Integrity and Risks (IR) Scores

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Bear River	1	2	2	2	7
Humboldt Bay Tributaries	1	1	3	1	6
Lower Eel / Van Duzen	1	1	2	2	6
Mattole River	2	1	1	2	6

Water in the mainstem Eel River is closely regulated in accordance with provisions identified in NMFS' biological opinion addressing the Potter Valley Project diversion, including opportunity to augment flow by 2,000 acre-feet. Water diversion in all other streams is largely unregulated or uncontrolled.

Humboldt Bay Tributaries and Lower Eel / Van Duzen populations are comprised of much low-grade slope areas, often associated with a delta or valley. Road densities on low-grade slopes likely produce less erosion and sedimentation than those on steep slopes or inherently unstable geologic material.

Principle stresses in the Lower Eel / Van Duzen population are altered sediment supply and impaired estuary function, compared to the Mattole River population where they are impaired water quality and altered hydrologic function. Cooling and increasing the volume of water in the Mattole River population is challenging, and severely influences survival. Decreasing sediment and improving estuary function in the Lower Eel / Van Duzen population appears feasible.

Much of the forest in the Humboldt Bay Tributaries has been harvested. However, several decades have passed since most harvest activity, resulting in mid-mature forests which provide more suitable habitat elements than less mature forest. A large portion of the Humboldt Bay Tributaries population area is managed under a federal aquatic habitat conservation plan or by federal agencies with salmonid conservation goals. Other forested areas in the Humboldt Bay Tributaries, and other populations, are primarily regulated by the California Forest Practice Rules.

(c) Optimism and Potential (OP) Scores

Optimism and Potential Score						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Bear River	1	2	1	1	3	8
Humboldt Bay Tributaries	1	3	3	2	2	11
Lower Eel / Van Duzen	2	3	3	2	1	11
Mattole River	2	3	3	2	2	12

There is high non-government organization (NGO) interest in salmon recovery in all populations, except Bear River. The Humboldt Bay population is located in the heart of Humboldt County's hub, near Arcata and Eureka, California. Generating interest and support for restoring habitats in highly visible locals such as the Humboldt Bay and Lower Eel / Van Duzen River population areas is generally much easier than rural sites. However, some rural locations, such as in the Mattole River population, have created a culture centered on salmon restoration and conservation.

Moderate amounts of federal land managed with salmon conservation goals in the Lower Eel / Van Duzen and Mattole River populations provide enhanced opportunity for restoration opportunities. All population areas possess suitable private land which can contribute toward restoration through development, or implementation, of a federal habitat conservation plan, or eligible for receipt of federal or state grant funding.

The number of threat categories that rank high or very high is a function of threat opportunity. The Lower Eel / Van Duzen scores low due to a larger array of different environs and thus human activity. For instance, the Lower Eel / Van Duzen may have more opportunity for agricultural threat because a large portion of the area is conducive to farming. Compare it to the Mattole River population area where little traditional farming opportunities exist. Threat opportunity may be linked to the size of the population area – potentially explaining why the Lower Eel / Van Duzen received a low threat score.

In addition, the larger population areas with the greatest amount of IP habitat may equate to more opportunity for active and passive restoration.

d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows: Bear River - $29 million
Humboldt Bay Tributaries - $81 million
Lower Eel / Van Duzen - $21 million
Mattole River - $70 million

Recognize that the cost estimate for recovery actions identified for Lower Eel / Van Duzen River population does not include recovery actions necessary for a core population; and the Mattole River population may include recovery actions not necessary for a non-core 1 population. Cost calculation method and assumptions likely resulted in a gross estimate, lending the greatest utility to relative comparisons between like population types. Refer to chapter 6 additional information about cost.

Preliminary cost estimates reveal the cost of recovery actions identified for Lower Eel / Van Duzen population is much less than the cost for Mattole River population. This result is due to the fact that many recovery actions identified for the Mattole River population may not be necessary; and additional recovery actions are needed for the Lower Eel / Van Duzen River population. Cost estimates are often based on the size of a watershed, or length of IP, making

costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Bear River	0	7	8	15	1900
Humboldt Bay Tributaries	11	6	10	27	5700
Lower Eel / Van Duzen	7.75	7	11	25.75	7900
Mattole River	6	6	12	24	6500
Number spawners needed to meet stratum requirement (50% of total)					11000

(f) Conclusion

Population	Type	Target
Bear River	Non-Core 2	Juvenile occupancy
Humboldt Bay Tributaries	Core	5700
Lower Eel / Van Duzen	Core	7900
Mattole River	Non-Core 1	1000
		Total Core : 13600 Spawners

Humboldt Bay Tributaries and Lower Eel / Van Duzen populations are the best candidates to efficiently serve as core populations in this stratum because they have the total highest BI scores, and their collective adult spawner abundance target exceeds the minimum stratum requirement. IR scores are nearly equal for all populations.

Targets for Humboldt Bay Tributaries and Lower Eel / Van Duzen populations reflect the adult spawner abundance required for a low risk of extinction. The Mattole River population spawner abundance target is a product of depensation times four, serving as a non-core 1 role. The Bear River population target is juvenile occupancy, serving as a non-core 2 role.

Exhibit 7

Interior Eel River Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Mainstem Eel River	1	1	1	1	0.75	0.25	5
Middle Mainstem Eel River	1	1	1	1	0.75	0.25	5
Upper Mainstem Eel River	0	0	0	1	0.75	0	1.75
Middle Fork Eel River	0	0	0	1	0.75	0	0.75
South Fork Eel River	3	3	2	1	0.75	0.75	10.5

Population abundance is uncertain as surveys are few and the results are variable. Surveys of the Upper Mainstem Eel River and Middle Fork Eel River sub-basins suggest that they do not support coho salmon consistently. The South Fork Eel River population abundance is likely above depensation (i.e., 481) in some years. All populations show evidence of decline in all three cohorts, particularly for the Upper Mainstem Eel and Middle Fork Eel populations, which may have lost all three year classes.

Coho salmon distribution is largely un-documented in the populations within this stratum and rated as very limited in all areas except the South Fork Eel River population. In the South Fork Eel River, coho salmon occur in 25 to 50 percent of Intrinsic Potential (IP) habitat, primarily in the western tributaries such as Hollow Tree Creek. In the western tributaries of the South Fork Eel River population, coho salmon are well distributed and occupy the majority (>90%) of IP habitat.

Diversity across the stratum is influenced by many factors, including life history strategies and abundance which is often below the depensation threshold. The rating for life history diversity assigned to all populations indicates they contain diverse habitat types which could support

atypical life history strategies. Most populations in this stratum could be considered "long run" given the distance adult fish must migrate to their natal spawning grounds from the ocean, which constitutes a unique life history strategy. All populations rated the same for hatchery influence, with a presumed low proportion of hatchery strays in the spawning populations. All populations except the South Fork Eel River received a low score for depensation, because the number of spawners is likely significantly less than the depensation threshold.

(b) Integrity and Risks (IR) Scores

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Mainstem Eel River	1	3	2	2	8
Middle Mainstem Eel River	1	2	2	3	8
Upper Mainstem Eel River	2	2	2	3	9
Middle Fork Eel River	2	3	2	2	9
South Fork Eel River	1	2	2	2	7

Water in the mainstem Eel River is closely regulated in accordance with provisions identified in NMFS' biological opinion addressing the Potter Valley Project diversion, including opportunity to augment flow which may assist in reducing issues with water quality during periods of extremely low flows or muted spring flow. Water diversion in all other streams is largely unregulated or uncontrolled.

The Upper Mainstem Eel River and Middle Fork Eel River high IP lay mostly under the temperature mask, indicating water temperature within these populations are likely inhospitably warm.

Road density in the Upper Mainstem Eel River and Middle Fork Eel River is higher than in the other populations. Principle stresses in most populations are sediment, degraded riparian condition, and floodplain and channel structure. The Upper Mainstem Eel River principal stresses, in contrast, are barriers obstructing passage and impaired water quality. These stresses in these populations may be more difficult to resolve than those in the other populations. All populations are comprised of primarily low gradient stream reaches, often associated with a delta or valley. Forest integrity in the Middle Mainstem Eel River and Upper Mainstem Eel River populations was rated lower than that of the other populations due to reduced tree size and density, and species composition.

(c) Optimism and Potential (OP) Scores

Optimism and Potential Score						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Mainstem Eel River	1	2	2	2	2	9
Middle Mainstem Eel River	2	3	1	2	2	10
Upper Mainstem Eel River	3	1	2	1	2	9
Middle Fork Eel River	2	1	3	2	3	11
South Fork Eel River	1	3	3	2	1	10

There is a high level of interest in the South Fork Eel River population area, and hosts the most abundant and stable spawning cohorts in the stratum. One of the most significant tributaries, Hollow Tree Creek, has consistent presence of all three cohorts of coho salmon. Out-migrant trapping efforts indicate that Hollow Tree Creek can produce more than 35,000 smolts per season. There is a draft federal aquatic Habitat Conservation Plan (HCP) throughout most of the Hollow Tree Creek watershed. The HCP, when finalized, would reduce sediment and improve habitat complexity in the near future. Several long-standing and well-supported non-government organizations, as well as state, federal and tribal entities regularly express interest in conserving salmon and aquatic habitat within the Eel River basin.

The Eel River estuary is located within the Lower Eel/Van Duzen population area (downstream of the Interior Eel River stratum) and has great potential for restoration because the estuary remains functional and there is high opportunity for increasing the size and availability of the floodplain and off channel habitats. The Eel River estuary likely serves as essential non-natal juvenile rearing habitat, which is a key limiting factor (stress) for all populations in this stratum. All population areas possess suitable private land which can contribute toward restoration through development, or implementation, of a federal HCP. Much of the private land is eligible for receipt of federal or state grant funding.

(d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows: Mainstem Eel River - $105 million
Middle Mainstem Eel River - $144 million
Upper Mainstem Eel River - $6 million
Middle Fork Eel River - $5 million
South Fork Eel River - $229 million

Recognize that the cost estimate for recovery actions identified for non core populations do not include recovery actions that may be necessary were they made core populations. If the Upper Mainstem Eel River or Middle Fork Eel River populations were chosen as a core population, the

cost would likely be much greater because more recovery actions may be necessary to meet higher targets. Cost calculation method and assumptions likely resulted in a gross estimate, lending the greatest utility to relative comparisons between like population types. Refer to chapter 6 additional information about cost.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Mainstem Eel River	5	8	9	22	4,800
Middle Mainstem Eel River	5	8	10	23	6,400
Upper Mainstem Eel River	4	9	9	22	2,100
Middle Fork Eel River	1	9	11	21	2,900
South Fork Eel River	10.5	7	10	27.5	9,600
Number spawners needed to meet stratum requirement (50% of total)					12,900

(f) Conclusion

Population	Type	Target
Mainstem Eel River	Core	4,800 spawners
Middle Mainstem Eel River	Core	6,400 spawners
Upper Mainstem Eel River	Non-Core 2	Juvenile occupancy
Middle Fork Eel River	Non-Core 2	Juvenile occupancy
South Fork Eel River	Core	9,600 spawners
		Total Core : 20,800 Spawners

The Mainstem Eel River, Middle Mainstem Eel River, and South Fork Eel River populations are the best candidates to efficiently serve as core populations in this stratum because they have the total highest BI scores, and their collective adult spawner abundance target exceeds the minimum stratum requirement. Equally important, the other two populations – Upper Mainstem Eel River and Middle Fork Eel River – have inherently extremely low potential to produce coho salmon and several anthropogenic-derived challenges.

Targets for the Mainstem Eel River, Middle Mainstem Eel River, and South Fork Eel River populations reflect the adult spawner abundance required for core populations. Targets for core populations were set to achieve a low risk of extinction.

The target for the Upper Mainstem Eel River and Middle Fork Eel River populations is juvenile occupancy, which is the target for a non-core 2 population. The Middle Fork Eel River population may be functionally extinct as there have been no documented occurrences of coho salmon for many decades. Given the lack of coho salmon in the Middle Fork Eel River, the most reasonable target to accommodate recovery would be the juvenile occupancy target established for non-core 2 populations.

Over a period of several decades, the Upper Mainstem Eel River population has had very few observations of coho salmon at the fish counting station at Van Arsdale. However, returns of coho salmon at Van Arsdale in the 2010/2011 spawning season were the best since 1948. Although these recent observations appear promising, the Upper Mainstem Eel River population remains unoccupied during almost all years on record. Furthermore, all of the IP habitat which is not covered by the temperature mask is located upstream of the Scott Dam. When IP habitats upstream of the dam or under the temperature mask are removed, it leaves this population with only 0.5 km of IP habitat (which is not enough lineal habitat to be considered as a population). Given the extremely episodic nature of coho salmon observations in the Upper Mainstem Eel River population, the non-core 2 population target for juvenile occupancy is the most reasonable target.