7.0 METHODS

"The wide-ranging migration patterns and unique life histories of anadromous salmonids take them across ecosystem and management boundaries in an increasingly fragmented world, which creates the need for analyses and strategies at similarly large scales."

- Good et al. 2007. Recovery Planning for Endangered Species Act-listed Pacific Salmon: Using Science to Inform Goals and Strategies

7.1 INTRODUCTION

This chapter summarizes the methods used to: (1) select focus populations essential for recovery using the recovery framework provided by Bjorkstedt *et al.* (2005) and Spence *et al.* (2008); (2) assess current conditions, identify future stresses and threats to these populations and their habitats; and (3) develop site-specific and range-wide recovery actions designed to restore conditions and abate threats. A detailed description of criteria and protocols developed to assess current habitat conditions, stresses and threats are provided in a Viability and Threats Report in Appendix B.

7.2 SELECTING FOCUS POPULATIONS FOR RECOVERY

The biological viability criteria, described in Spence *et al.* (2008) (Volume III; Appendix E), sets the foundation for understanding the long-term biological viability of CCC coho salmon populations. These viability criteria, however, are not synonymous with recovery criteria. The viability criteria define "sets of conditions or rules for viable populations that, if satisfied, would suggest that the ESU or DPS is at low risk of extinction" (Spence *et al.* 2008). These general conditions include: (1) achieving population viability across selected populations; and (2) attaining a number and configuration of viable populations across the landscape to ensure long-term viability of the ESU or DPS as a whole. The criteria, however, "…do not explicitly specify which populations must be viable for the ESU or DPS to be viable…, but rather they establish a framework within which there may be several ways by which ESU or DPS viability can be achieved" (Spence *et al.* 2008). Furthermore, the biological viability criteria do not include specific numeric abundance targets for "Dependent" populations. The viability criteria provide a theoretical foundation and practical basis for recovery planners to select populations for inclusion into the recovery scenario, and to develop criteria for measuring population response to recovery actions. The viability criteria include metrics for population abundance, productivity, spatial structure, and diversity. Populations that are abundant at each life stage, highly productive, widely distributed, and exhibit the full variety of life-history traits available are considered at low risk of extinction.

A total of 75 watersheds (*e.g.*, populations), between Mendocino County and Santa Cruz County (including San Francisco Bay tributaries) were identified by Bjorkstedt *et al.* (2005) to historically support CCC coho salmon. Not all populations are needed for, or capable of supporting, recovery. A subset of the 75 populations was selected for this recovery plan. Working from Bjorkstedt *et al.* 2005 and Spence *et al.* (2008), quantitative and qualitative information were evaluated regarding current presence or prolonged absence of coho salmon, habitat suitability, status (*e.g.*, independent or dependent status), threats and current protective efforts ongoing in the watershed. This assessment led to the selection of 28 populations (12 independent populations and 16 dependent populations) and 11 supplemental populations across four Diversity Strata, to represent the CCC coho salmon ESU recovery strategy. Historical presence of coho salmon in the San Francisco Bay stratum is well documented. However, the degree to which the tributaries of the San Francisco Bay were historically capable of supporting coho salmon populations is uncertain. The general conclusion reached by Bjorkstedt *et al.* (2005) was San Francisco Bay watersheds supported only small and/or ephemeral populations, particularly in the drier and warmer interior watersheds and no independent populations historically existed. Thus, no populations were chosen for the San Francisco Bay Diversity Stratum.

The 28 populations selected are the "focus populations" (Table 8) with 11 supplemental populations designated to fulfill the occupancy and connectivity criteria as outlined in Spence *et al.* 2008 (Figure 18). To provide a contemporary context on extent of potential habitat for these focus populations, we evaluated the historical spawner abundances and associated IP-km calculated by the TRT. The IP-kms were assessed against habitat survey information, local knowledge, Google Earth images, watershed documents, several ground-truthing surveys and outreach to agencies and other entities for information. The exercise yielded changes to the IP-kms for several watersheds where natural barriers, steep gradient changes or stream flow dynamics were undetected by the model or where the temperature mask incorrectly removed potential habitats where coho salmon persist. Revisions to the extent of potential habitat were made and recalculated into potential miles of habitat (Table 8). Associated spawner targets for each population were re-calculated by multiplying the number of spawning adults needed per IP-km based on Spence *et al.* 2008. These new spawner abundances correspond to the biological delisting criteria with downlisting targets set at a moderate risk of extinction and approximately 50% of the delisting criteria (see Chapter 10). These spawner targets individually and collectively meet the population viability criterion (*e.g.*, each population is expected to achieve a density equal to or greater than 640 spawning adults) as well as the Diversity Strata criterion (*e.g.*, total stratum abundances meets or exceeds 50 percent of the aggregate historical abundance for the FIPs and PIPs based on the density criteria Spence *et al.,* 2008). Occupancy targets for dependent populations were derived from abundance estimates from Waddell Creek (Santa Cruz County, CA) data from the 1930's (Shapavolov and Taft 1954). Additional populations were selected to fulfill occupancy patterns criteria (called supplemental populations). The selection of supplement populations was predicated on presence or recent presence of CCC coho salmon. Occupancy delisting goals were developed for supplemental populations. The combined abundance targets and recovery criteria provide a recovery framework to achieve multiple recovery goals that include ecological benefits and commercial, recreational, and tribal harvest. The plan's approach of designating 28 focus populations and 11 supplemental populations provides redundancy, resiliency and representation in the ESU.

Table 8: Diversity Strata, Focus Populations, Status of Population and Miles of Potential Habitat

Diversity Strata	Population	(Independent or Dependent)	Miles of Potential Habitat
Lost Coast	Usal Creek	D	10.9
	Cottaneva Creek	D	14.5
	Wages Creek	D	9.8
	Ten Mile River	I	118.5
	Pudding Creek	D	26.4
	Noyo River	I	127.0
	Caspar Creek	D	12.5
	Big River	I	214.8
	Albion River	I	59.2
	Big Salmon Creek	D	16.8
Navarro-Gualala Point	Navarro River	I	220.4
	Garcia River	I	103.7
	Gualala River	I	266.6
Coastal	Russian River	I	457.5
	Salmon Creek	D	35.9
	Pine Gulch	D	11.4
	Walker Creek	I	67.6
	Lagunitas Creek	I	64.5
	Redwood Creek	D	6.8
Santa Cruz Mountains	San Gregorio	D	36.7
	Pescadero Creek	I	54.9
	Gazos Creek	I	7.1
	Waddell Creek	D	8.0
	Scott Creek	D	13.9
	San Vicente Creek	D	3.4
	San Lorenzo River	I	117.5
	Soquel Creek	D	31.9
	Aptos Creek	D	26.0

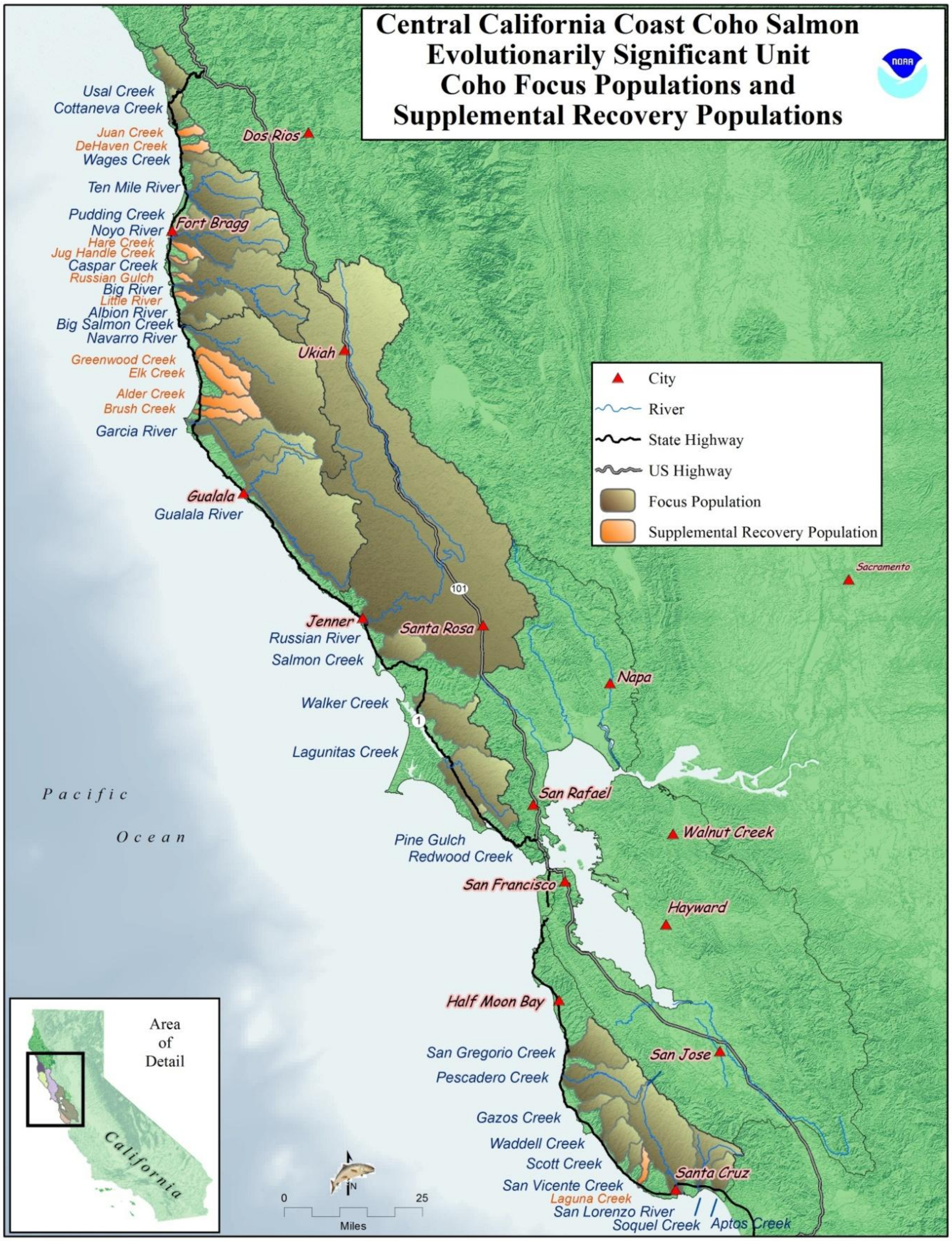

Figure 18: CCC coho salmon ESU Focus Populations & Supplemental Populations

7.3 CURRENT CONDITIONS AND THREATS

Instream and watershed conditions and threats for the 28 focus populations were assessed using The Nature Conservancy's (TNC) Conservation Action Planning (CAP) workbook. The CAP was developed in collaboration with the World Wildlife Fund, Conservation International, Wildlife Conservation Society and others. The CAP protocols and standards were developed by the Conservation Measures Partnership, a partnership of ten different non-governmental biodiversity organizations (www.conservationmeasures.org). The method is a "structured approach to assessing threats, sources of threats, and their relative importance to the species' status" and a method recommended in the Interim Guidance (NMFS 2010a). The CAP process was adopted as the recovery planning assessment tool for the NCCC Domain, and in 2006, we partnered with TNC for assistance, training and support in applying the CAP process for recovery planning. CAP is a Microsoft Excel-based tool adaptable to the needs of the user. The NMFS application of the CAP protocol included; (1) defining current conditions for habitat attributes across freshwater life stages essential for the long term survival, and (2) identifying activities reasonably expected to continue, or occur, into the future that will have a direct, indirect, or negative effect on life stages, populations and the ESU (*e.g.*, threats). Results from this assessment provided an indication of watershed health and likely threats to coho salmon survival and recovery. These results were the basis used to formulate recovery actions designed to improve current conditions (restoration strategies) and abate future threats (threats strategies). The CAP is expected to be used to track recovery criteria overtime since it is both a warehouse to store information and is iterative as this new information becomes available.

7.4 CAP WORKBOOK STRUCTURE

A CAP workbook was developed for each focus population and each component of the analyses includes an assessment of conditions and threats for each key coho salmon life stage (*i.e.*, adults, eggs, summer juveniles, winter juveniles and smolts). CAP facilitates user input of quantitative and qualitative information. Each workbook is organized to input and display data, information and best professional judgments for each specific criterion. Algorithms in the Excel CAP workbook summarize these data into general score cards. Score cards are assembled into spreadsheets, facilitating assessment of conditions and threats across the three levels of biological organization described in Spence *et al.* (2008). These three levels are (1) focus population, (2) Diversity Strata, and (3) overall ESU.

The CAP method provided a number of features to assess the magnitude and extent of threats to CCC coho salmon and their habitats, including:

- Incorporation of both quantitative and qualitative measures of existing and future conditions;
- Objective, consistent tracking for changes in the status of each conservation target (*i.e.*, life history stages) over time;
- Assessment of a watershed's condition or focus population viability and objective comparisons to other watersheds or populations;
- Focusing of recovery actions by identifying past, current and potential future threats to CCC coho salmon and their habitats; and
- Providing a central repository for documenting and updating information and assumptions about existing conditions.

Each CAP workbook has two assessment components: viability for evaluating current conditions (Figure 19) and Threats for evaluating future stresses and source of stress (Figure 20).

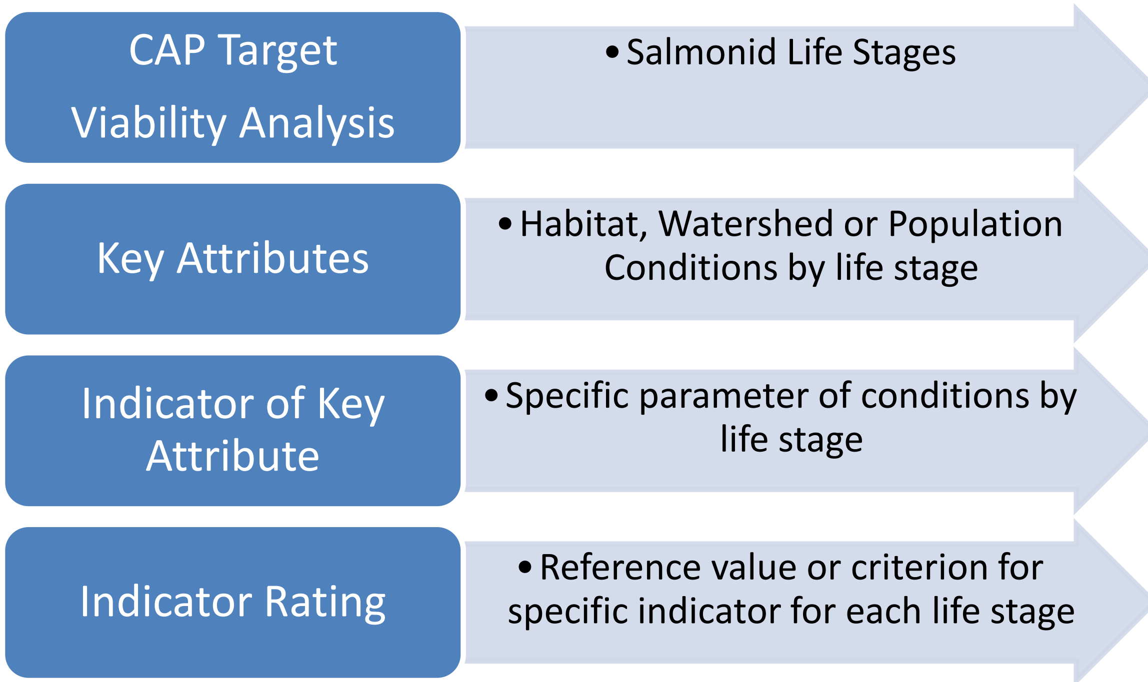

Figure 19: Structure of CAP workbooks for Viability Analysis

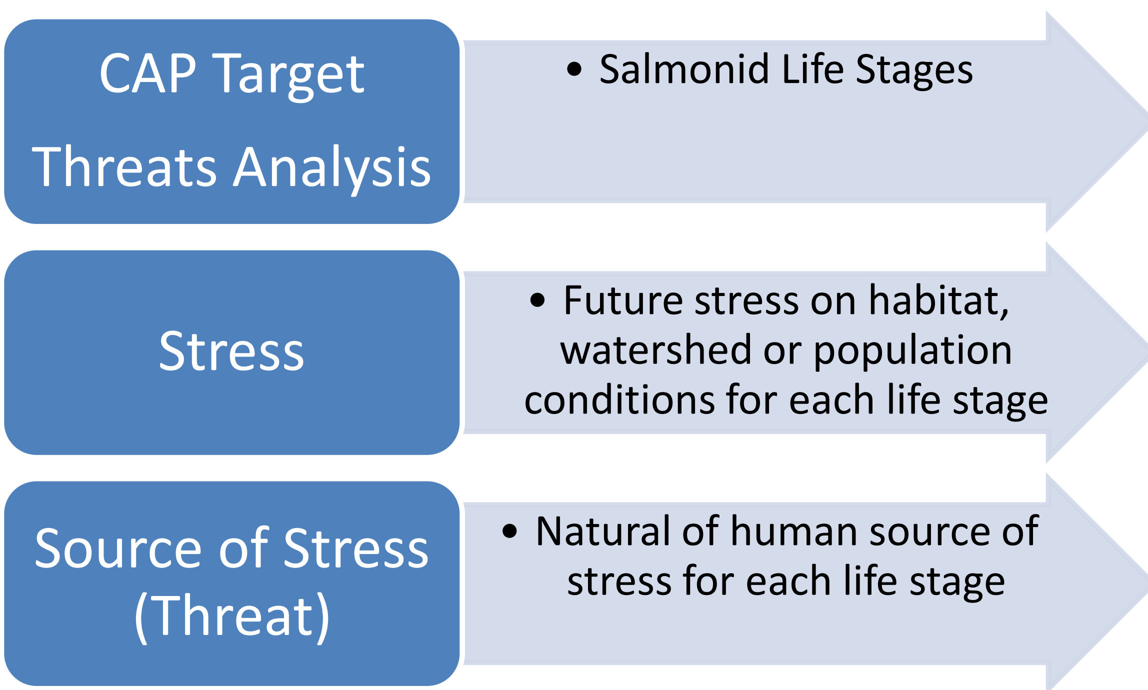

Figure 20: Structure of CAP workbooks for Threats Analysis

7.5 ASSESSING CURRENT CONDITIONS: VIABILITY

The viability table defines the specific life stages for each species as "conservation targets" and provides the structure for an assessment of current conditions supported by data from NMFS, other agencies, recovery partners, and the scientific literature.

CONSERVATION TARGETS

Conservation targets are the five freshwater life stages specific to coho salmon and watershed processes. These life stages are described below and were incorporated in each CAP workbook (Table 9).

- Spawning Adults - Includes adult fish from the time they enter freshwater, hold or migrate to spawning areas, and complete spawning (September 1 to March 1);
- Eggs - Includes fertilized eggs deposited into redds and incubation of through the time of emergence from the gravel (December 1 to April 1);
- Summer Rearing Juveniles - Includes juvenile rearing in streams and estuaries (when applicable) during summer and fall (June-October) prior to the onset of winter rains;
- Winter Rearing Juveniles - Includes rearing of juveniles from onset of winter rains through the winter months up to the initiation of smolt outmigration (November 1 to March 1);
- Smolts - Includes juvenile migration from natal rearing areas until they enter the ocean (March 1 to June 1); and
- Watershed processes - Includes instream habitat, riparian, upslope watershed conditions and landscape scale patterns related to land use.

Table 9: CAP Workbook Homepage showing life stage targets

The Nature Conservancy — Protecting nature. Preserving life.™	Conservation Action Planning Workbook A tool for developing strategies, taking action, and measuring success © 2010 The Nature Conservancy Version: CAP_v6b October 15, 2010		ConserveOnline Help Changes for Excel 2007 Full Version
Welcome	Hide/Zoom Worksheets	Workbook Setup (Establecer libro de trabajo) (Organização do Programa)	Reset Menus and Tables / Switch to Basic Version

To enter, edit or delete data in protected cells (which are shaded or contain entries in black font), double-click on the cell. An entry form will appear.
To change the table format, double-click on the table header. A table format form will appear.

Project and Conservation Targets	
Project	**Central California Coast Coho Salmon ~ Soquel Creek**
Target #1	**Adults**
Target #2	**Eggs**
Target #3	**Summer Rearing Juveniles**
Target #4	**Winter Rearing Juveniles**
Target #5	**Smolts**
Target #6	**Watershed Processes**

Key Attributes

Key attributes are defined as critical components of a conservation target's biology or ecology (TNC 2007). Viable populations result when key attributes function and support transitions between life history stages. By this definition, if attributes are missing, altered, or degraded, survival is adversely affected. Factors with the greatest potential to impair survival across life stages and limit salmonid production at the population scale were defined as key attributes.

There are three general categories of attributes (Table 10):

- Specific elements of aquatic habitats (*e.g.*, site specific conditions of water, wood, sediment);
- Watershed processes; and
- Life stage and population viability.

7.5.1 INDICATORS AND INDICATOR RATINGS

Indicators are a specific habitat, watershed process or population parameter providing a method to assess the status of a key attribute. An attribute may have one or more indicators. Each indicator has a rating which is a reference value describing the conditions of the key attribute as it relates to life stage survival. These conditions are described as poor, fair, good or very good. Reference values or indicator ratings were developed using established values from published scientific literature or the best available information. Measurable quantitative indicators were used for most indicators; however, the formulation of other more qualitative decision making structures were used when data were limited or non-existent. Qualitative decision structures were used to rate three attributes: instream flow conditions, estuary conditions, and toxicity.

Very good values were considered fully functional to allow complete life stage function and life stage transition. Good values were considered functional but slightly impaired, fair values were considered functional but significantly impaired, and poor values were considered inadequate for transition from one life stage to the next life stage. In watersheds where the majority of indicators were rated as good or very good, overall conditions were likely functional and support transitions between life history stages within the historical range of variability.

Based on the quantitative or qualitative data for each indicator, key attributes were rated for each life stage at the population level. Due to natural variability within watersheds and influences of human caused changes to streams and landscapes, habitat conditions vary greatly within and across streams, watersheds, and populations. To capture this variability, rating values and thresholds varied by indicator type and scale of the available data (*e.g.*, site, reach, stream, watershed or population). All final indicator ratings are reported at the population level; however, some rating required additional steps to arrive at a population level rating. For example, landscape pattern data (*e.g.*, percent of urban development) are readily available at the watershed scale, and a single-step rating process can characterize conditions for an entire population. However, habitat condition data (*e.g.*, percent of primary pools), collected at the habitat unit scale, were averaged to obtain reach, then stream, then watershed level values. This multiple step analysis was necessary to evaluate condition at a population (watershed) scale. Stream level rating criteria were based on indicator thresholds developed from the scientific literature values, while population scale rating criteria incorporated a spatial element. To rate current condition of each habitat attribute at the population level, NMFS determined the percentage of streams, or the percentage of IP-km, within a population meeting criteria for a very good, good, fair, or poor rating. Spatializing information enabled scaling up of stream level habitat data to the population level without compromising data protocol or integrity.

Table 10: CCC coho salmon CAP Conditions by Target Life Stage

CCC Coho Population Conditions By Target Life Stage		
Target	Attribute	Indicator
Adults	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)
Adults	Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)
Adults	Habitat Complexity	Pool/Riffle/Flatwater Ratio
Adults	Habitat Complexity	Shelter Rating
Adults	Hydrology	Passage Flows
Adults	Passage/Migration	Passage at Mouth or Confluence
Adults	Passage/Migration	Physical Barriers
Adults	Riparian Vegetation	Tree Diameter (North of SF Bay)
Adults	Riparian Vegetation	Tree Diameter (South of SF Bay)
Adults	Sediment	Quantity & Distribution of Spawning Gravels
Adults	Velocity Refuge	Floodplain Connectivity
Adults	Water Quality	Toxicity
Adults	Water Quality	Turbidity
Adults	Viability	Density
Eggs	Hydrology	Flow Conditions (Instantaneous Condition)
Eggs	Hydrology	Redd Scour
Eggs	Sediment	Gravel Quality (Bulk)
Eggs	Sediment	Gravel Quality (Embeddedness)
Summer Rearing Juveniles	Estuary/Lagoon	Quality & Extent
Summer Rearing Juveniles	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)
Summer Rearing Juveniles	Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)
Summer Rearing Juveniles	Habitat Complexity	Percent Primary Pools
Summer Rearing Juveniles	Habitat Complexity	Pool/Riffle/Flatwater Ratio

Summer Rearing Juveniles	Habitat Complexity	Shelter Rating
Summer Rearing Juveniles	Hydrology	Flow Conditions (Baseflow)
Summer Rearing Juveniles	Hydrology	Flow Conditions (Instantaneous Condition)
Summer Rearing Juveniles	Hydrology	Number, Condition and/or Magnitude of Diversions
Summer Rearing Juveniles	Passage/Migration	Passage at Mouth or Confluence
Summer Rearing Juveniles	Passage/Migration	Physical Barriers
Summer Rearing Juveniles	Riparian Vegetation	Canopy Cover
Summer Rearing Juveniles	Riparian Vegetation	Tree Diameter (North of SF Bay)
Summer Rearing Juveniles	Riparian Vegetation	Tree Diameter (South of SF Bay)
Summer Rearing Juveniles	Sediment (Food Productivity)	Gravel Quality (Embeddedness)
Summer Rearing Juveniles	Water Quality	Temperature (MWMT)
Summer Rearing Juveniles	Water Quality	Toxicity
Summer Rearing Juveniles	Water Quality	Turbidity
Summer Rearing Juveniles	Viability	Density
Summer Rearing Juveniles	Viability	Spatial Structure
Winter Rearing Juveniles	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)
Winter Rearing Juveniles	Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)
Winter Rearing Juveniles	Habitat Complexity	Pool/Riffle/Flatwater Ratio
Winter Rearing Juveniles	Habitat Complexity	Shelter Rating
Winter Rearing Juveniles	Passage/Migration	Physical Barriers
Winter Rearing Juveniles	Riparian Vegetation	Tree Diameter (North of SF Bay)
Winter Rearing Juveniles	Riparian Vegetation	Tree Diameter (South of SF Bay)
Winter Rearing Juveniles	Sediment (Food Productivity)	Gravel Quality (Embeddedness)
Winter Rearing Juveniles	Velocity Refuge	Floodplain Connectivity
Winter Rearing Juveniles	Water Quality	Toxicity
Winter Rearing Juveniles	Water Quality	Turbidity
Smolts	Estuary/Lagoon	Quality & Extent
Smolts	Habitat Complexity	Shelter Rating
Smolts	Hydrology	Number, Condition and/or Magnitude of Diversions
Smolts	Hydrology	Passage Flows
Smolts	Passage/Migration	Passage at Mouth or Confluence
Smolts	Smoltification	Temperature
Smolts	Water Quality	Toxicity
Smolts	Water Quality	Turbidity
Smolts	Viability	Abundance
Watershed Processes	Hydrology	Impervious Surfaces
Watershed Processes	Landscape Patterns	Agriculture
Watershed Processes	Landscape Patterns	Timber Harvest
Watershed Processes	Landscape Patterns	Urbanization
Watershed Processes	Riparian Vegetation	Species Composition
Watershed Processes	Sediment Transport	Road Density
Watershed Processes	Sediment Transport	Streamside Road Density (100 m)

7.6 FUTURE THREATS: STRESSES & SOURCES OF STRESS

Past, continuing, and newly identified threats are the ultimate cause for a species decline. To accurately address these issues, a threats assessment is required under NMFS' Interim Guidance (NMFS 2010a). The Interim Guidance recommends when "…discussing each threat and its sources, the geographic scope, severity, and frequency of the various threats should be indicated." Using the CAP method, a threats assessment was conducted to determine the severity, frequency, and contribution of a threat to each population.

7.6.1 ASSESSING FUTURE CONDITIONS: STRESSES

Stresses represent altered or impaired key attributes for each population, such as impaired hydrology or reduced habitat complexity. They are the inverse of the key attributes. For example, the attribute for passage becomes the stress of impaired passage. These altered conditions, irrespective of their sources, are expected to reduce population viability. For each population and life stage, stresses were ranked using two metrics, which are combined using algorithms contained in CAP to generate a single rank for each stress identified:

1. Severity of damage: The level of damage to the conservation target that can reasonably be expected to occur into the future under current circumstances (*i.e.*, given the continuation of the existing situation). Stresses ranked as very high for severity are likely to destroy or eliminate the target life stage over time. Stresses ranked as high are likely to seriously degrade the target. Medium ranks are likely to moderately degrade the target, and low ranks are applied to stresses that are likely to slightly impair the target.

2. Scope of damage: The geographic scope of impact on the conservation target at the site that can reasonably be expected into the future under current circumstances (*i.e.*, given the continuation of the existing situation). Stresses ranked as very high for scope are likely widespread or pervasive. Stresses ranked as high are likely to be widespread,

medium ranks are more localized, and low ranks are applied to stresses that are more limited.

Fifteen stresses were evaluated for specific life stages:

1. Altered Riparian Species Composition & Structure;
2. Altered Sediment Transport: Road Condition & Density;
3. Estuary: Impaired Quality & Extent;
4. Floodplain Connectivity: Impaired Quality & Extent;
5. Hydrology: Gravel Scouring Events;
6. Hydrology: Impaired Water Flow;
7. Impaired Passage & Migration;
8. Impaired Watershed Hydrology;
9. Instream Habitat Complexity: Altered Pool Complexity and/or Pool/Riffle Ratios;
10. Instream Habitat Complexity: Reduced Large Wood and/or Shelter;
11. Instream Substrate/Food Productivity: Impaired Gravel Quality & Quantity;
12. Landscape Disturbance;
13. Reduced Density, Abundance & Diversity;
14. Water Quality: Impaired Instream Temperatures; and
15. Water Quality: Increased Turbidity or Toxicity.

Stresses with a high level of severity and/or broad geographic scope are ranked as high or very high. For example, in Table 11 the stress of hydrology – impaired water flow was ranked as very high for its effects to the summer rearing life stage. This stress also ranked as high for smolts, because in low water years, flows are inadequate for out migration. This stress was ranked medium for adults and eggs, indicating it was not as severe and/or more limited in scope and, therefore, not as detrimental to those life stages, since flows during adult migratory periods and egg development periods are typically adequate. Stresses to the population are compiled in a summary table to describe major stresses for each population by target (Table 11).

Table 11: CAP Stress Table for Soquel Creek

Stress Matrix **Central California Coast Coho Salmon ~ Soquel Creek**							
	Stresses (Altered Key Ecological Attributes) Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes
		1	2	3	4	5	6
1	Reduced Density, Abundance & Diversity	Very High		Very High		Very High	
2	Instream Habitat Complexity: Reduced Large Wood and/or Shelter	High		Very High	High	Very High	
3	Hydrology: Impaired Water Flow	Medium	Medium	Very High		High	
4	Instream Substrate/Food Productivity: Impaired Gravel Quality & Quantity	Low	High	Medium	High		
5	Instream Habitat Complexity: Altered Pool Complexity and/or Pool/Riffle Ratios	High		Medium	High		
6	Floodplain Connectivity: Impaired Quality & Extent	Medium			High		
7	Water Quality: Impaired Instream Temperatures			High		Low	
8	Altered Sediment Transport: Road Condition & Density						High
9	Hydrology: Gravel Scouring Events		High				
10	Impaired Watershed Hydrology						High
11	Water Quality: Increased Turbidity or Toxicity	Medium		Medium	Medium	Medium	
12	Impaired Passage & Migration	Medium		Medium	Low	Low	
13	Estuary: Impaired Quality & Extent			Medium		Medium	
14	Landscape Disturbance						Medium
15	Altered Riparian Species Composition & Structure			Low			Low

7.6.2 ASSESSING FUTURE CONDITIONS: SOURCES OF STRESS (THREATS)

CAP defines direct threats to the species as the sources of stress likely to limit viability into the future. Threats may result from currently active issues such as ongoing land uses, or from issues likely to occur in the future (usually within ten years), such as increased water diversion or development. Threats are expected to contribute to stresses in ways likely to impair salmonid habitat into the future. Many threats are driven by human activities; however, naturally occurring events such as earthquakes may also threaten the habitat of the species. For each population and life stage, threats were ranked using two metrics, which were combined by CAP algorithms to generate a single rank for each threat identified:

1. Contribution: The expected contribution of the source, acting alone, to the full expression of a stress under current circumstances (*i.e.*, given the continuation of the existing management/conservation situation). Threats ranked as very high for contribution are very large contributors to the particular stress. Threats ranked as high are large contributors, medium ranks are moderate contributors, and low ranks are applied to threats that contribute little to the particular stress; and
2. Irreversibility: The degree to which the effects of a threat can be reversed. Threats ranked as very high for irreversibility produce a stress that is not typically reversible (*e.g.* wetland converted to a shopping center). Threats ranked as high are reversible, but are not practically feasible to reverse. Medium ranked threats produces a stress that is reversible with a reasonable commitment of resources, and threats ranked as low are easily reversible.

Fourteen threats were evaluated in relation to each stress for a specific life stage:

1. Agriculture;
2. Channel Modification;
3. Disease/Predation/Competition;
4. Fire, Fuel Management and Fire Suppression;

5. Fishing/Collecting;
6. Hatcheries;
7. Livestock Farming and Ranching;
8. Logging and Wood Harvesting;
9. Mining;
10. Recreational Areas and Activities;
11. Residential and Commercial Development;
12. Roads and Railroads;
13. Severe Weather Patterns; and
14. Water Diversion and Impoundments.

Threats with a high level of contribution to a stress and/or high irreversibility were ranked as high or very high. For example, in Table 12 the threat of residential and commercial development was ranked as very high for its effects to two life stages, and high for three others, because residential development is a very high contributor to poor water quality and impaired riparian conditions in Soquel Creek. Summary tables of threats ranked for each population describe major threats for each target (Table 12). Using the CAP taxonomy, fourteen threats were evaluated in relation to each stress for a specific life stage. A summary describing each threat is provided in Appendix B. The overall threat rank summarizes the aggregate threat rating and thereby identifies the most limiting threats to a population.

The threat status for each target summarizing the aggregate ranks applied across all life stages and illustrates the targets most vulnerable. Threats ranked as high or very high are more likely to contribute to a stress that in turn, reduces the viability of a life stage. When multiple life stages of a population had high or very high threats, the viability of the population was diminished.

Table 12: CAP Threats Table for Soquel Creek

Summary of Threats **Central California Coast Coho Salmon ~ Soquel Creek**								
	Threats Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes	Overall Threat Rank
	Project-specific threats	1	2	3	4	5	6	
1	Residential and Commercial Development	High	Medium	Very High	High	Very High	High	Very High
2	Water Diversion and Impoundments	Medium	Medium	Very High	Medium	Very High	High	Very High
3	Severe Weather Patterns	Medium	High	Very High	High	High	High	Very High
4	Roads and Railroads	High	High	High	High	High	High	Very High
5	Fire, Fuel Management and Fire Suppression	Medium	Medium	High	Medium	High	Medium	High
6	Logging and Wood Harvesting	Medium	Medium	High	Medium	High	Medium	High
7	Channel Modification	Medium	Medium	High	High	Medium	Low	High
8	Fishing and Collecting	High	-	Medium	-	High	-	High
9	Mining	Medium	Medium	Medium	Medium	Medium	Medium	Medium
10	Agriculture	Medium	Medium	Medium	Medium	Medium	Low	Medium
11	Disease, Predation and Competition	Medium	-	Medium	Low	Medium	Low	Medium
12	Recreational Areas and Activities	Low	Low	Medium	Low	Medium	Low	Medium
13	Livestock Farming and Ranching	Low	Low	Low	Low	Medium	Low	Low
14	Hatcheries and Aquaculture	-	-	-	-	-	-	-
	Threat Status for Targets and Project	High	High	Very High	High	Very High	High	Very High

Some threats occurred in all or most populations (*e.g.* roads), while others were limited in distribution (*e.g.* mining); thus, some threats not relevant were not rated in some populations. Table 13 is a matrix of the threats that were evaluated against the stresses. For example, the threat of fishing and collecting was only ranked against the population stress of reduced abundance, diversity, and competition. This approach reduced overestimating the impact of a stress across multiple threats. Threats that contribute to impaired water flow, for example, were evaluated under that category rather than under each factor (*e.g.*, agriculture, urban, *etc.*).

Table 13: Matrix of Stresses Compared Against Threats

Stresses	Habitat Condition											Watershed Processes			Population
Threats	Estuary: Impaired Quality & Extent	Floodplain Connectivity: Impaired Quality & Extent	Hydrology: Gravel Scouring Events	Hydrology: Impaired Water Flow	Instream Habitat Complexity: Altered Pool Complexity and/or Pool/Riffle Ratios	Instream Habitat Complexity: Reduced Large Wood and/or Shelter	Instream Substrate/ Food Productivity: Impaired Gravel Quality & Quantity	Impaired Passage & Migration	Water Quality: Increased Turbidity or Toxocity	Water Quality: Impaired Instream Temperatures	Altered Riparian Species Composition & Structure	Impaired Watershed Hydrology	Landscape Disturbance	Altered Sediment Transport: Road Condition/ Density, Dams, etc.	Reduced Density, Abundance & Diversity
Agriculture				N/A											N/A
Channel Modification															N/A
Disease/Predation/ Competition(Invasive Animals and plants)			N/A	N/A			N/A								
Fire				N/A											N/A
Fishing/Collecting	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Hatcheries	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A	
Livestock				N/A											N/A
Logging				N/A											N/A
Mining				N/A											N/A
Recreation				N/A											N/A
Residential Development				N/A											N/A
Roads				N/A											N/A
Severe Weather															N/A
Water Diversion and Impoundments															

7.7 CAP DATA SOURCES AND ANALYSIS

To inform the CAP analyses of current conditions, stresses and threats, NMFS used a variety of data sources and data types. Sources included the CDFG, SWRCB, U.S. EPA, RCDs, private timber companies, conservation organizations, consultants, local watershed groups and other contributors. In particular, CDFG provided extensive habitat typing data for most of the focus populations.

Some data required additional evaluation, analysis and synthesis. Major data sources and the methods used to analyze and apply the data for the CAP analyses are detailed in Appendix B, and discussed in more detail below. These sources and methods are briefly summarized into the following categories:

1. CDFG Stream Survey Data: Eight indicators were informed by the CDFG stream habitat typing data. These data provided wide coverage across many of the watersheds across the NCCC Domain using a standardized data collection protocol (Flosi *et al*. 2004). NMFS obtained all available CDFG reach level habitat typing data (Hab-8) for the NCCC Domain from CDFG Regional Offices. The UC Davis Hopland Research Center entered these data into an Access database with funding provided by SCWA;
2. Stream flow: Lack of sufficient gage data in rearing and migration habitats led NMFS to derive ratings for stream flow indicators from a structured decision making model informed by a panel of experts familiar with watershed conditions (see Appendix B for the complete protocol). Five indicators were developed using this method. The indicator for number of diversions was calculated using SWRCB data sets;
3. Stream temperature: A single indicator informed this habitat attribute, but it required extensive compilation of disparate datasets. Temperature data was grouped into condition classes when multiple location information was available and extrapolated to inform a watershed-wide rating. Final ratings were made by estimating the proportion of a watershed's IP network that fell within each temperature class;

4. Water quality (turbidity and toxicity): The indicator for turbidity was difficult to quantify, so ratings were informed by an assessment of the erosion potential developed by the California Department of Conservation, Division of Mines and Geology (NMFS GIS 2008), literature review and expert opinion. A structured decision making model was used to rate toxicity;
5. Estuary conditions: Multiple indicators for open estuaries and closed lagoons were used in a structured protocol informed by a panel of NMFS staff familiar with individual estuaries to provide an overall rating. Indicators included historical extent, current configuration, and alteration to physical extent, as well as other physical, chemical and biological parameters to describe conditions for rearing and smolt life stages;
6. Land use assessments: Nine indicators were informed by GIS queries of available spatial datasets (NMFS GIS 2008);
7. Population viability: Three viability indicators (abundance, density, and spatial structure) were informed by review and synthesis of readily available fisheries monitoring data in the ESU; and
8. Other indicators: The remaining indicators were informed by various methods ranging from queries of existing databases to best professional judgment. For example, physical barriers were assessed using the Pacific States Marine Fisheries Council Passage Assessment Database[14]. The indicator for passage at mouth or confluence was assessed by NMFS staff with local knowledge of the watershed conditions.

NMFS' Habitat Conservation Division Geographical Information System (GIS) unit provided extensive information and analysis, particularly for land use attributes. For each focus population, a report was developed with information on factors such as acreage and percentage of urbanization, land ownership, land cover, current and projected development, road densities,

[14] http://nrm.dfg.ca.gov/PAD/Default.aspx

erosion potential, amount of farmland, timber harvesting history, location and types of barriers, diversions, and industrial influences (mines, discharge sites, toxic release sites) and stream temperature. These reports are called watershed characterizations. The characterizations are available at: http://swr.nmfs.noaa.gov/sr/watershed_characterizations.htm. Other resources used to evaluate conditions and threats were watershed assessment documents, government planning documents, personal communications, staff expertise, spatial data (*e.g.* GIS and Google Earth), and CDFG habitat inventories.

7.7.1 CDFG Habitat Typing Survey Data and UC Hopland Research

NMFS secured all available CDFG habitat typing data for the NCCC Domain. These datasets were standardized into an Access database under funds provided by SCWA. This "*Stream Summary Application*" (Appendix C) was developed by UC Davis Hopland Research and CDFG. UC Hopland completed the following: (1) entering field data from datasheets and importing databases from individual surveys into the stream habitat application; (2) performing quality control and assurance on spatial datasets; (3) creating spatial representations of stream surveys; and (4) using the stream habitat application to summarize the data for use by NMFS, CDFG, SCWA, stakeholders and the general public. This database summarizes reach level data of all CDFG surveys across all habitat parameters collected under the CDFG Habitat Typing protocols.

7.7.2 Contributions from NMFS Contractors

NMFS contracted with the Sonoma Ecology Center (SEC) to manage data acquisition (from CDFG and other sources); spatially reference data, conduct bias analyses and quality control, as well as develop necessary queries to match data to the 28 focus populations and associated indicators. SEC supported assessments of passage issues using the Pacific States Marine

Fisheries Council Passage Assessment Database and used the National Landcover Database[15] to calculate the percent of impervious surface and percent of land in agricultural use.

7.8 FOCUS POPULATION PROFILES & CORE AREA MAPS

Population profiles (Volume II) were developed for each focus population to provide general information and results regarding status of coho salmon, watershed conditions supporting each focus populations, CAP results, maps and population specific recovery actions.

To align implementation of recovery actions to higher probabilities of improving coho salmon survival, an assessment was conducted of occupancy patterns of coho salmon across subwatersheds. Streams known to support coho salmon were mapped and an assessment was made of associated habitats. Population profile maps were developed displaying subwatersheds for each population as Core, Phase I or Phase II areas. Subwatershed boundaries coincide with existing CalWater units. The intent is to provide a guide for restoration and protection of the most important habitats first, direct actions to prevent extinction, and increase probability of survival and set a sequence to prioritize work and expenses.

This approach front-loads recovery actions into areas critical for species survival, and further emphasizes protection of remaining habitats and their populations. Restoration of Core areas is the highest priority for near-term restoration projects and threat abatement actions. Sequentially, Phase I and II areas will need to be rehabilitated to the extent necessary to achieve recovery goals. Once restoration of Core areas is accomplished, the next priority is to restore subwatersheds with generally suitable habitat conditions that are currently unoccupied, or rarely occupied (*i.e.*, Phase I areas). Finally, as a long-term goal, the plan recommends restoring unoccupied watersheds (*i.e.*, Phase II areas). Phase II areas can be occupied in the future once

[15] http://www.mrlc.gov/nlcd2001.php

conditions improve by expanding coho salmon populations. The three ranks, the rationale behind their definitions, and the strategy for restoration and subsequent monitoring are described below:

Core Areas are:

1. Locations known to have current or recent occupancy of CCC coho salmon according to (a) status reviews conducted prior to the initial listing on October 31, 1996 (61 FR 56138) and (b) data provided by numerous agencies, individuals, and others including the presence/absence database developed by CDFG; and
2. Areas within each watershed identified for immediate focus of restoration and threat abatement actions. Most focus watersheds have identified Core Areas.

Core Area Goals:

1. Implement Priority 1 actions without delay; and
2. Restoration or threat abatement should be designed to improve freshwater survival probability of individuals at any life stage.

Core Area Concepts:

1. High-cost and intensive restoration efforts are appropriate;
2. Projects should evaluate possible short term negative impacts against long term benefits to coho salmon life stage survival. Large scale restoration projects, for example, may have significant inputs of sediment and short term habitat degradation, but will result in large long term benefits. In some special cases, short term impacts cannot be tolerated if the species is particularly vulnerable to short term impacts (*i.e.*, relatively isolated populations with low abundance). All possible impacts to remaining CCC coho salmon populations should be carefully considered;
3. Watershed assessments to focus restoration actions, water quality monitoring, and fish population monitoring (including trend monitoring) are necessary to provide feedback on the effectiveness of restoration actions; and

4. Recovery actions in Core Areas are extremely high priorities for the near term.

Phase I Areas are:

1. Areas identified for near-term expansion of coho salmon populations;
2. Locations with high potential for supporting all or some coho salmon life stages;
3. Extensive habitat restoration and threat abatement may be required; and
4. May or may not currently support low numbers of coho salmon.

Phase I Area Goals:

1. Rehabilitate, maintain, and enhance instream habitat conditions to support all freshwater life stages;
2. Projects should consider instream, upstream, and upslope processes affecting downstream habitat conditions (*e.g.*, recruit upstream wood to ensure downstream wood supply, where limited); and
3. Careful analysis of limiting factors and connectivity of project sites are necessary to ensure restoration activities address critical limiting factors in the correct sequence.

Phase I Concepts:

1. Recovery actions in Phase I areas are high priorities for the next 12 years (four coho salmon generations); and
2. Coordinate Priority I actions in Core Areas and adjacent Phase I areas.

Phase II Areas are:

1. Likely to support high valued seasonal habitat or connectivity between habitats;
2. Habitats often highly divergent from historical conditions and often require large-scale and sustained long-term restoration and threat abatement actions;
3. All remaining habitats needed by CCC coho salmon to achieve full recovery; and
4. Areas providing watershed conditions necessary for a full range of variability commensurate with historical conditions.

Phase II Area Goals:

1. Consideration for Phase II areas should focus primarily on re-establishing or maintaining watershed processes and preventing further degradation.
2. Enhance, and prevent degradation of, habitat conditions for expanding populations such that distribution and abundance begin to shift towards patterns resembling historical patterns; the long-term survival of the species depends on this shift.

Phase II Concepts:

1. Recovery actions in Phase II areas will require sustained efforts to return watersheds to more suitable conditions.

7.9 RECOVERY ACTIONS

Section 4(f)(1)(B)(i) of the ESA outlines that each recovery plan must include to the maximum extent practicable, "(i) a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation of the species." The Interim Guidance (NMFS 2010a) outlines that "recovery actions must include specific actions needed to control each of the identified threats to the species, as categorized under the five statutory listing factors of the ESA." Case law has affirmed that an increase in population numbers is insufficient to delist a species. In the Fund for Animals v Babbitt (903 F. Supp. 96 D.D.C. 1995), the courts determined that (grammatically) the word "specific" modifies "site", not management actions. This ruling infers that recovery plans are required to have site specific management actions rather than just specific management actions. In the same case, the court found site specific management actions must link to identified threats (*i.e.*, the underlying causes of decline) organized by the five listing factors in section 4(a)(1) and the plan must document changes in threats since listing and must recommend appropriate actions to address threats. Id.

Recovery actions for CCC coho salmon are designed to meet ESA and case law requirements, are site-specific (*e.g.*, action steps), and organized by the section 4(a)(1) listing factors. Recovery actions in this plan were written to explicitly improve an indicator in poor condition according to the CAP viability assessment (called restoration strategies), and abate threats found to rank as high or very high (threat strategies). Few actions were developed for good conditions or low threats. The objective of all recovery actions is to shift the status of the listing factors and threats to allow CCC coho salmon to recover to the point they no longer require protection under the ESA.

NMFS reviewed a wide range of resources to develop and prioritize recovery actions including the California Recovery Strategy for California Coho Salmon (CDFG 2004), and the Draft SONCC Coho Salmon Recovery Plan (NMFS 2012a). Many relevant actions were also included from State and local watershed assessment reports, total maximum daily loads (TMDLs) plans, environmental impact reports (EIRs), strategic management plans from counties, coordination with other divisions of NOAA, outreach to knowledgeable constituents, staff expertise, and many other sources.

Recovery actions are hierarchical according to the recovery guidance: Objective, Recovery Action and Action Step (Figure 21 and Figure 22 are examples of this hierarchy). Action steps are site-specific recommendations to improve the status of conditions and threats. Recovery Actions are the conditions requiring improvements as it relates to CAP criteria and Objectives are assigned to one of the five statutory Section 4(a)(1) listing factors (Figure 21). There are two categories of recovery actions: actions to improve CAP viability ratings (more restoration-based actions) and actions to abate threats. Restoration actions link to the CAP rating criteria in the viability table (*e.g.*, increase large wood frequency to 6-11 key pieces per 100 meters). For threat abatement, recovery actions focus on preventing future impairments. Each recovery action is supported by a series of site-specific action steps (*e.g.*, install large wood in the lower reaches of Scott Creek to the maximum extent practicable). Action steps are site specific management actions required to restore conditions and prevent future threats.

Restoration- Estuary

1.1. **Objective:** Address the present of threatened destruction, modification or curtailment of the species habitat or range

1.1.1. **Recovery Action:** Increase the extent of estuarine habitat

1.1.1.1. **Action Step:** Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (CDFG 2004).

1.1.1.2. **Action Step:** Remove structures impairing or reducing the historical tidal prism, where feasible, and where benefits to coho salmon and/or the estuarine environment are predicted. Evaluate benefits to lagoon tidal prism from the proposed bridge replacement for the Highway 1 bridge over Scott Creek lagoon.

Figure 21: Example Recovery Action Structure (Restoration Actions for Scott Creek, Santa Cruz)

Photo Courtesy 45: Giacomini Estuarine Restoration, Marin County, CA; *Robert Campbell.*

Threat- Roads/Railroads

1.1. **Objective:** Address the inadequacy of existing regulatory mechanisms.

23.2.1. **Recovery Action:** Prevent impairment to instream substrate

23.2.1.1. **Action Step:** Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.

23.2.1.2. **Action Step:** Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.

23.2.1.3. **Action Step:** Improve enforcement of Erosion Control Ordinance for private roads. The current Santa Cruz Erosion Control Ordinance has provisions requiring the responsible parties to repair and alleviate erosion problems that are deemed severe. Santa Cruz Planning should create new erosion control staff positions to help coordinate the County's cooperative efforts, but also to conduct inspections and enforcement actions as necessary.

Figure 22: Example Recovery Actions (Threat Abatement Actions for Scott Creek, Santa Cruz)

Objective: One of the Five Section 4(a)(1) Listing Factors

Recovery Action: CAP Conditions or Threats

Action Step: Site specific action to restore a condition or abate a threat

Specific categories of actions (*e.g.*, habitat improvements, regulatory, *etc.*) were reassigned to one of the five listing factors as described in the FRN at the time of CCC coho salmon listing. Organizing actions and actions steps to a specific listing factor allows tracking of listing factors more directly through time. Figure 23 illustrates the relationship of actions and action steps to listing factors.

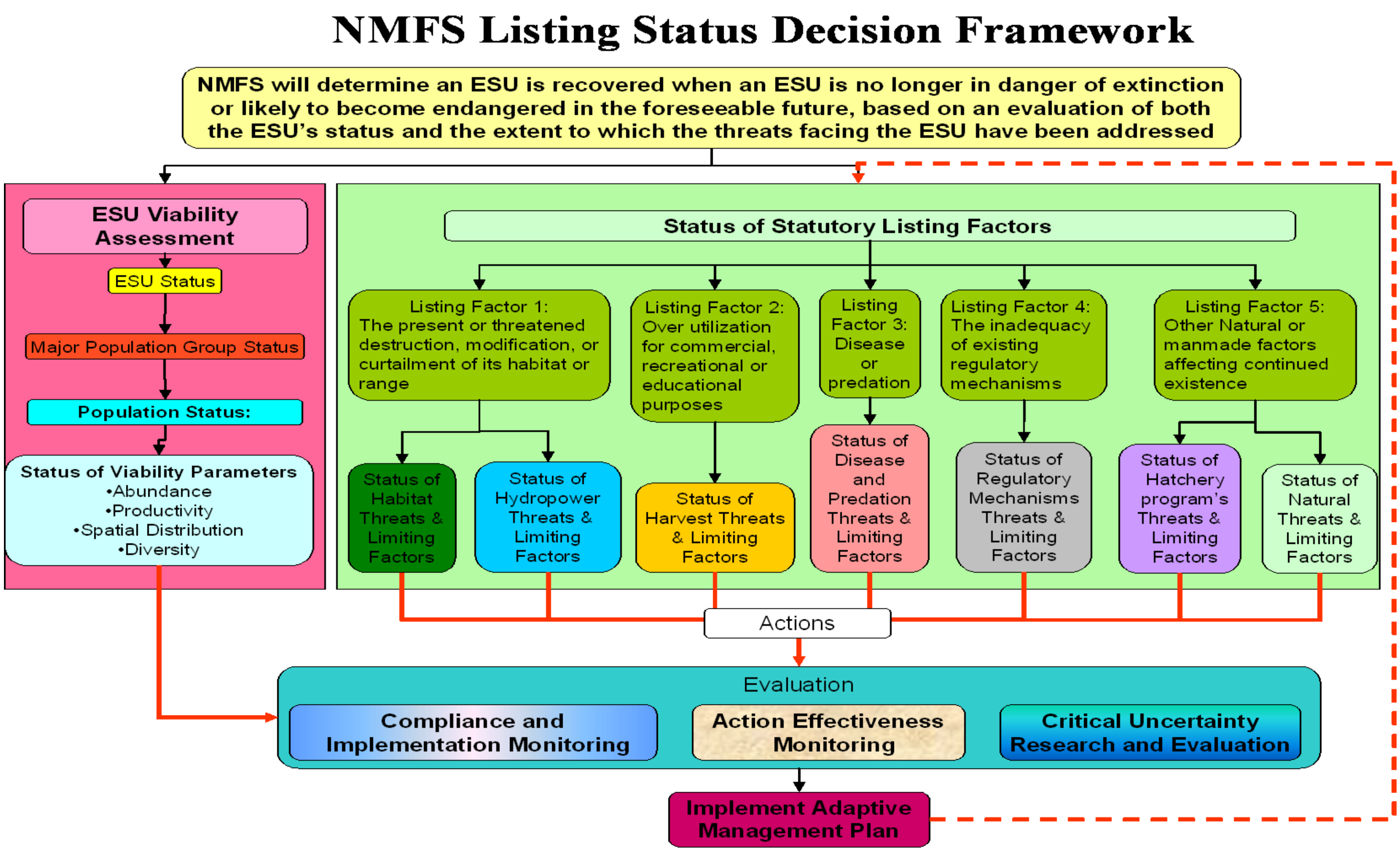

Figure 23: NMFS Listing Decision Framework

7.10 IMPLEMENTATION SCHEDULES

Volume II contains implementation schedules (tables) and outlines of all recovery actions specific to each focus population. The outline is a skeletal list of the objective, recovery actions, and action steps without accompanying descriptions found in the implementation schedule. It provides a succinct alternative to the more detailed implementation schedules. Implementation schedules satisfy the requirements under the ESA by including "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps towards that goal" (ESA section 4(f)(1)(A)(iii)). The implementation schedule provides the basis for tracking plan implementation performance. An example implementation schedule is provided in Table 14.

The Implementation Schedule in Volume II outlines actions and estimated costs for the recovery program for the CCC coho salmon ESU. It is a guide for meeting the recovery goals outlined in this plan. This schedule indicates action priorities, action numbers, action descriptions, duration of actions, the recovery partners (either funding or carrying out), and estimated costs. Entities with authority, responsibility, ownership, or expressed interest to implement a specific recovery action are identified in the Implementation Schedule. Designation of an entity in the Implementation Schedule does not require the identified party to implement the action(s) or to secure funding for implementing the action(s).

RECOVERY STRATEGY NUMBER

A unique recovery number is assigned to each objective, action, and action step and the numbers are hierarchical. The first series of digits correspond to the specific population, the second series to the ESU and the third series is the recovery action number (Table 15).

Table 14: Example Implementation Schedule (Scott Creek Population)

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
ScC-CCC-1.1	Objective	Estuary	Address the present of threatened destruction, modification or curtailment of the species habitat or range										
ScC-CCC-1.1.1	Recovery Action	Estuary	Increase the extent of estuarine habitat										
ScC-CCC-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	2	5	CA Coastal Commission, CalPoly, CalTrans, NOAA SWFSC, USACE	931					931	The Scott Creek estuary was reduced in size following European arrival and is currently believed to be a major limiting factor for the salmonids. The upper estuary was converted for agricultural purposes, and much of the historical tidal prism is reduced due to channelization for the Highway 1 Bridge constructed in the early 1940's. Estuary/lagoons on California's central coast have been extensively documented as superior rearing habitat for steelhead and can contribute a disproportionate total number of returning adults compared to stream habitats when conditions are even marginally suitable (Bond et al., 2008). This recommendation would include restoration of complex habitat features such as large woody material to deepen pools and provide cover. Coho will benefit from restoration during smolt transition and adult upmigration. Cost for treating 3 acres (assume 10% of total estuarine acres) at a rate of $310,216/acre.
ScC-CCC-1.1.1.2	Action Step	Estuary	Remove structures impairing or reducing the historical tidal prism, where feasible, and where benefits to salmonids and/or the estuarine environment are predicted. Work with Caltrans to restore estuary tidal prism as part of the proposed bridge replacement for the US Route 1 bridge over Scott Creek lagoon.	1	10	, CA Coastal Commission, CalPoly, CalTrans, NOAA SWFSC						TBD	Caltrans is currently evaluating bridge replacement - differentiating between anticipated replacement costs and additional actions for coho recovery benefits can not be estimated at this time due to uncertainty regarding Caltrans preferred alternative. Replacement of the bridge offers a rare opportunity to restore two sharp bends to the lower channel and replace the leveed and straightened channel.
ScC-CCC-1.1.2	Recovery Action	Estuary	Reduce frequency of artificial breaching events										
ScC-CCC-1.1.2.1	Action Step	Estuary	Post durable and attractive interpretive signage at the beach to discourage casual breaching of the lagoon sandbar.	2	10	CalTrans, CDFG, Santa Cruz County	1.50	1.50				3	Cost of signs vary widely depending on materials used and content of signs. Assume $1,000/sign with a minimum of 3 signs for lagoon.
ScC-CCC-1.1.2.2	Action Step	Estuary	Monitor sandbar to evaluate timing and frequency of natural and artificial breeching events.	2	10	CalPoly, CalTrans, CDFG, NOAA SWFSC						In-Kind	
ScC-CCC-1.1.3	Recovery Action	Estuary	Rehabilitate natural river mouth dynamics										
ScC-CCC-1.1.3.1	Action Step	Estuary	Highway 1 bridge reconstruction should restore historical river mouth dynamics to minimize delayed natural breaching.	1	10	CA Coastal Commission, CalPoly, CalTrans, Santa Cruz County						TBD	The major channel modification on Scott Creek is at the lagoon where Caltrans realigned (straightened) the stream to a new location for the original Highway 1 bridge. The original channel made a sharp bend to the west and then a second sharp bend at the cliff to enter the ocean. Both of these bends would have produced deep scour holes in the lagoon, serving as good feeding and transition habitat for down-migrating smolts. The sandbar at the mouth would also have been less likely to have delayed opening in the winter as currently occurs with the current alignment. Re-establishing the historical alignment will have major benefits to both steelhead and coho salmon.
ScC-CCC-2.1	Objective	Floodplain Connectivity	Address the present of threatened destruction, modification or curtailment of the species habitat or range.										
ScC-CCC-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
ScC-CCC-2.1.1.1	Action Step	Floodplain Connectivity	Encourage breeching of old levees in the lower riparian reaches of Scott Creek.	1	10	CalPoly, CDFG, NOAA SWFSC, Scotts Creek Watershed Council, USACE	62.00	62.00				124	Breeching will improve floodplain function and provide high water refuge for juvenile salmonids. Levees were constructed on the lower Scott Creek floodplain to facilitate farming and to concentrate and direct flows under the Route 1 Bridge in the estuary. These levees receive little if any maintenance, and in the riverine reach the levees are well vegetated. Nonetheless, the levees continue to function, and likely reduce the total amount of rearing habitat in the estuary and disconnect stream flood flow from its floodplain. Cost based on treating 3 miles (assume 1 project/mile in 25% High IP) at a rate of $41,092/mile.

Table 15: Recovery Strategy Number

Recovery Strategy Number Follows Example: **XXXX-A-1.2.3.4**	
XXXX:	Unique Identifier for Population Group
A:	Species Identifier
1:	Strategy Level
2:	Objective Level
3:	Recovery Action Level
4:	Action Step Level

Table 16: Strategy Categories & Unique Identifiers

Strategies	
1	Estuary
2	Floodplain Connectivity
3	Hydrology
4	Landscape Patterns
5	Pool Habitat
6	Riparian
7	Sediment
8	Viability
9	Water Quality
10	Agricultural Practices
11	Channel Modification
12	Severe Weather Patterns
13	Disease/Predation/Competition
14	Severe Weather Patterns
15	Fire/Fuel Management
16	Fishing/Collecting
17	Hatcheries
18	Livestock
19	Logging
20	Mining
21	Recreation
22	Residential/Commercial Development
23	Roads/Railroads
24	Severe Weather Patterns
25	Water Diversion/Impoundment
26	Habitat Complexity
27	Passage
28	Watershed Process

For example, the recovery action number ScC-CCC-3.1 corresponds to an action for the Scott Creek population in the CCC coho salmon ESU and is an objective for Hydrology. The recovery action number corresponds to the targeted attribute or threat (Table 16). Not all restoration or threat actions have recovery actions and therefore the numbering system may not be sequential (*e.g.*, 3.1, 4.1, 8.1) in the implementation schedule. This will show as "No species-specific actions were developed" in the recovery outline.

LEVEL

Indicates the level of action which can be an Objective, Recovery Action or Action Step.

TARGETED ATTRIBUTE OR THREAT

Describes whether the action is intended to improve a CAP attribute (*e.g.*, habitat, population or watershed condition) or abate a future threat (*e.g.*, minimizing impacts of a land use activity, reducing fire risk and planning for natural events such as floods). Many actions written to improve a CAP attribute are restoration type actions and actions for threat abatement are recommendations for best management practices, outreach, enforcement, compliance, and implementation of existing statutes, laws, policies and education, *etc*.

ACTION DESCRIPTION

The specific action needed to improve conditions or abate threats.

PRIORITY NUMBER

Priorities are assigned to each action step in the implementation table in concordance with the NMFS Endangered and Threatened Species Listing and Recovery Priority Guidelines (55 FR 24296). Assigning priorities does not imply that some recovery actions are of lower importance; instead it implies they may be deferred while higher priority actions are implemented (NMFS 2010a). All recovery actions have assigned priorities based on the following:

Priority 1: Actions that must be taken to prevent extinction or to prevent the species from declining irreversibly. These actions are generally focused on areas where CCC coho salmon persist and where actions can increase freshwater survival probabilities,

Priority 2: Actions that must be taken to prevent a significant decline in population abundance, habitat quality, or other negative impacts (55 FR 24296) and focus primarily on efforts directed to restore and expand the current range of CCC coho salmon.

Priority 3: All other actions necessary to achieve full recovery of the species. These actions focus on preventing further degradation and reestablishing long-term recovery for expanding populations.

ACTION DURATION

These time estimates are important in estimating the overall cost of recovery and describe the estimated length of time for the action to be implemented.

RECOVERY PARTNERS

This information outlines the suite of partners who may contribute to full and effective implement the action step. Listing a recovery partner does not commit any party to actually do, fund or support the work.

COSTS

Development of costs for the lowest level actions (*e.g.* specific action steps) is required pursuant to section 4(f) of the ESA. These estimates are presented in five year intervals out to 25 years and include a total cost for the duration of the action. Estimated costs are aggregated into an estimated total for the cost to recovery CCC coho salmon and presented in the Chapter 9. The accuracy of recovery cost estimates are governed by many factors such as the specificity of the recovery action step, labor, materials, site location, duration, and timing of action. As a result, predicting costs into the future becomes increasingly imprecise due to a lack of information regarding these various constraints. Furthermore, many actions either build on previous actions to create cost benefits or are required under mandates other than the ESA, such as other Federal, State and local laws.

To account for these uncertainties, NMFS recovery staff developed a framework to estimate costs. The framework was based on Southwest Region's *Habitat Restoration Cost References for Salmon Recovery Planning* (Thomson and Pinkerton 2008) and *Cost and Socioeconomic Impacts of Implementing the California Coho Recovery Strategy* (CDFG 2004). Wherever possible, this framework was applied to determine the cost of recovery actions. Due to the varying degree of specificity for most identified recovery actions, assumptions about the type, magnitude, number or extent of individual recovery action steps were necessary. Assumptions on the costs of recovery action steps were based on various information sources that estimated the cost of similar activities.

Assumption tables were adjusted for the NCCC Domain to include information from CDFG's cost estimates from the State Coho Salmon Recovery Strategy (CDFG 2004) and reflect regional variability in costs for labor wage, materials, and inflation. To account for regional variability in costs, a multiplier was applied to standard costs as outlined in the NMFS framework, CDFG (2004) and Thomson and Pinkerton (2008). For example, Mendocino and Sonoma counties have an average county wage similar to the average of all counties in California and no multiplier was applied to costs in those areas. The San Francisco Bay Area and San Mateo County have an average county wage 20% higher than the average of all California counties; thus, a multiplier of 0.20 was adjusted for these areas. For Santa Cruz County, a multiplier of 0.14 was added since the average county wage is 14% higher than the average across California.

Assumption tables were also adjusted to 2012 values. Annual average U. S. rate of inflation for the 98 year period of record is 3.3% (Bureau of Labor Statistics 2012). Using the 2004, CDFG estimate for cost of recovery, and applying the annual average rate of inflation, recovery cost for 2012, has risen by 26.4% since 2004. For example, a passage treatment with an estimated cost of $900,000 in 2004, was estimated to cost $1,137,600 in 2012, and $1,175,140 in 2013. NMFS cannot predict the future financial projections of the U.S. economy and based our recovery costs on current 2012, estimates. Appendix D provides all the cost estimates includes the difference in cost of recovery actions from 2004, to 2012.

Cost estimates are mainly focused on the direct expenditure required to physically perform the task, and may not always include secondary costs associated with administrative needs. In instances where the timing or extent of recommended action steps was not available or were undetermined, assumptions were developed from the CAP ratings and projected amount of potential habitat requiring improvements. These assumptions include:

- Large wood placement in 50% of potential habitats;
- Off channel habitat improvements are one project per mile across 25% of potential habitats;
- Water projects are assumed at one per mile across 55% of potential habitats;
- Riparian thinning assumes 80 acres/mile planted across 5% of potential habitats;
- Road decommissioning should reduce road density to two miles per squared miles;
- 25% of roads upgraded;
- Levee setback for 1% of potential habitat and cost of breach for 1% of potential habitat at a rate of one project per mile;
- Barrier removal assumes 1 barrier/5 miles of potential habitat;
- Stabilizing banks assumes 1% of potential habitat;
- Purchasing or leasing water rights assumes 10% of low flow volume affected;
- Fuel reduction assumes 25% of potential habitat treated with mechanical thinning and 25% of potential habitat fuel management; and
- Invasive vegetation species control assumed 80 acres/mile treated in 5% of potential habitats.

Actions were grouped into four categories described in more detail below: in-kind, planning, monitoring and implementation (Table 17).

Table 17: Recovery Action Categories

Recovery Action Categories and Types	
Category	**Action Type**
In-Kind	Cost of Doing Business
Planning	Scoping
	Design
	Permitting
Monitoring	Pre-project
	Post-Project
	Effectiveness
	Biological/Ecological
Implementation	Habitat Complexity
	Riparian Vegetation Structure
	Species Diversity
	Floodplain Connectivity
	Species Migration Pattern
	Sediment Transport
	Estuarine Ecology

IN-KIND ACTIONS

In-kind actions are those occurring irrespective of Federal listing. These include actions as mandated by other laws and policies (*e.g.*, State of California ESA, Clean Water Act, county and city ordinances, *etc.*). No costs were assigned to these types of actions and are defined as those associated with the "cost of doing business."

PLANNING

Planning actions were included in the cost of implementing the action. They were assigned a cost estimate when known. If it was unclear whether or not the action would coincide with another action, costs were not assigned. Planning actions include scoping, designing, and permitting.

MONITORING

Specific habitat and fish monitoring costs are provided in the Monitoring Chapter (Chapter 11). Actions organized into monitoring include pre-project, post-project, effectiveness, and biological/ecological. Costs were calculated by mile, year, and acre or project level. Costs were applied but may vary substantially between populations depending on level of intensity, duration, and protocol.

IMPLEMENTATION

These actions have a specific focus on improving freshwater habitat conditions and were assigned costs based on the type of action as described below:

Habitat Complexity

Cost of instream habitat complexity varies with techniques implemented. To determine the cost of increasing habitat complexity for recovery actions such as increasing LWD frequency, shelter ratings, and primary pools a flat rate of $25,000 per mile was applied. This assumes a minimum of one project per mile (involving multiple structures along the targeted stream reach). In instances when placement of LWD was not feasible, the cost of an engineered log jam at a rate of $101,120 per jam was applied.

Riparian Vegetation Structure

To rehabilitate riparian composition and distribution, an estimated cost of $20,057 per acre was used. The variability in riparian buffers is difficult to determine, therefore, we assumed that an average of 80 acres per mile (40 acres per streambank) would be treated to achieve the desired recovery targets.

Species Diversity

The variability in vegetative composition between regions and populations is diverse. Therefore, we established a standard rate of $1,422 per acre with the assumption of 80 acres per mile treated for upslope vegetative management. Non-native species recovery actions consist of several distinct activities, including assessment, control, education and outreach, as well as development of monitoring programs. The costs for controlling and removing non-native species were derived on a per acre basis.

Floodplain Connectivity

The costs to reconnect floodplains are contingent upon the restoration method implemented. Removing or setting back levees, creating alcove and backwater habitat, or off-channel wetlands are some methods used to reconnect floodplains; each with a varying degree of planning, design, and implementation. A rate of $36,046 per mile, assuming one project per mile, was considered the average across the various implementation methods outlined in this recovery plan.

Species Migration Patterns

The costs of recovery actions associated with dams and diversions were calculated using the CalFish.org mapping tool when available. When specific information was unavailable, the assumption table for fish passage improvement was used.

Culvert replacement costs were calculated from the assumption that a minimum of one culvert would be replaced in each identified watershed, or sub-watershed, annually for the first five years of Recovery Plan implementation.

Sediment Transport

Costs to execute recovery actions associated with road upgrades or decommissioning were calculated from 12,000 per mile to 21,000 per mile depending on method. If number of miles to be upgraded or decommissioned were unknown, then road densities were reduced to meet viable criteria.

Estuarine Ecology

Costs to implement estuarine recovery actions were calculated at a rate of $272,120 per acre. Estimates incorporate components of wetland restoration, LWD placement, and riparian planting. Each estuary was mapped for current extent of acres and a total of 10 percent of total estuarine habitat was estimated for treatment.

COMMENTS

In some instances comments are provided with the action to provide specificity regarding rationale, context, references, *etc.* to clarify the action.

7.11 NMFS RECOVERY ACTION DATA SOURCES

NMFS capitalized on a full range of resources to develop and prioritize recovery actions which included public comments, watershed assessment reports, online resources, personal knowledge, TMDLs, EIR documents, plans from counties, coordination with other divisions of NOAA, outreach to knowledgeable individuals, staff expertise, and many other sources. The California Recovery Strategy for California Coho Salmon (CDFG 2004) was used extensively for Diversity Strata, ESU/DPS, and domain level actions, as well as watershed specific strategies. The State Plan is often cited in the implementation tables as (16 U.S.C. 1531-1544, as amended). Furthermore, high levels of coordination occurred between CDFG staff and NMFS staff in the development and finalization of these actions. While these actions focused on the needs of coho salmon, many actions will benefit steelhead and/or Chinook salmon where populations overlap.

7.11.1 THE RECOVERY ACTION DATABASE

In 2008, NMFS developed a database to facilitate the development, revision process, and final output of recovery actions. The recovery actions database is in Access and has a user interface to allow staff to input and query actions across any and all fields. This capability will allow us to track implementation of actions for each listing factor over time.

7.12 CONCLUSIONS

We believe the described methods meet the goals in the Interim Recovery Planning Guidance (NMFS 2010a) which strongly recommends "a structured approach to assessing threats, sources of threats, and their relative importance to the species' status…" We selected populations for recovery, assessed the status of conditions and threats, and developed site specific recovery actions to shift the status of listing factors. Actions are linked with our analysis and organized according to the statutory Section 4(a)(1) listing factors. This approach will fully inform future status reviews and evaluations regarding the threats identified at the time of listing (*e.g.*, section 4(a)(1) factors A-E). This approach will also ensure that continuing or new threats are addressed to the extent recovery and delisting are possible.