Eel River Watershed Overview for CC Chinook Salmon

CC Chinook salmon in the Eel River consist entirely of two independent populations (Spence *et al*. 2008). The Lower Eel River population includes fish that spawn in the South Fork Eel River as well as all mainstem and tributaries downstream of the South Fork confluence (*e.g.*, Van Duzen River and Larabee Creek). The Upper Eel River population includes all fish spawning upstream of the South Fork Eel River confluence (excluded), including major tributaries such as the Middle Fork and North Fork Eel River. Spring-run populations in the Eel River watershed are considered extirpated, and are therefore not required to meet viability criteria. Because the Lower Eel River population occupies two diversity strata, it must have two separate density based abundance targets.

Lower Eel River Population

Lower Mainstem/South Fork Eel River

- Role within ESU: A subset with the Lower Eel River Functionally Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 7,300 adults
- Current Intrinsic Potential: 364.8 IP-km

Van Duzen River/Larabee Creek

- Role within ESU: Role within ESU: A subset with the Lower Eel River Functionally Independent Population
- Diversity Stratum: North Mountain Interior
- Spawner Abundance Target: 2,900 adults (includes Van Duzen Subset)
- Current Intrinsic Potential: 143.7 IP-km

Upper Eel River Population

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North Mountain Interior
- Spawner Abundance Target: 10,400 adults
- Current Intrinsic Potential: 521.4 IP-km

Although the Van Duzen River and Larabee Creek together have one Recovery Target, each had a separate analysis. There is a profile, map, viablility table, threats table and recovery action implementation tables for Lower Mainstem/South Fork Eel, Van Duzen River, Larabee Creek and Upper Eel River.

The following sections provide a general overview of the abundance and distribution of CC Chinook salmon, history of land use, current resources and land management, and a brief summary of the CAP viability current condition, and threats results for CC Chinook salmon in the Eel River watershed.

Abundance and Distribution

Information on the historic abundance and distribution of Chinook salmon in the Eel River watershed is limited and poorly understood. Chinook salmon spawned throughout the mainstem and all of its major tributaries. Historically, the Eel River watershed was considered the third largest producer of salmon (and steelhead) among California watersheds (CDFG 1997). Inferences of population abundance in the second half of the 19th and early 20th centuries have been developed based on cannery data (SEC 1998). These represent minimal population estimates which averaged approximately 93,000 fish per year during the period of 1857-1921 with a peak of nearly 600,000 fish in 1877, mostly Chinook salmon (Yoshiyama and Moyle 2010). Using the minimum population estimates, Yoshiyama and Moyle (2010) suggest the historic runs of Chinook salmon could have ranged between 100,000 and 800,000 fish per year depending on environmental/ocean conditions. However, by the 1950s, they estimate the runs had declined to roughly 50,000-100,000 fish per year despite ongoing hatchery propagation in the watershed.

Beginning in the early 1930s, annual counts of returning adult salmonids have been recorded at the Van Arsdale Fisheries Station (VAFS) on the Upper Mainstem Eel River (Figure 1). For Chinook salmon, few counts were available between 1933-34 and the late 1950s, and counts through the 1990s (with the exception of 1986-87 and 1987-88) show relatively few Chinook salmon returned to VAFS. Between 1938-39 and 1975-76, counts of returning adult Chinook salmon were also collected at the Benbow Dam Fish Ladder on the South Fork Eel River (Figure 2). From these data, it is apparent that by the 1960s the Chinook salmon population in the Eel

River watershed had declined substantially from the numbers observed during the late 19th Century (the cannery years). After the significant floods of 1955 and 1964, annual Chinook salmon returns were generally much less than 10,000 fish (Yoshiyama and Moyle 2010). In 1962 and 1987, major modifications were made to the fish ladder at VAFS due to insufficient passage conditions (SEC 1998). Droughts have also impacted returns to the Upper Mainstem where between 1989-90 and 1993-94, fewer than 10 adults returned to the VAFS annually (Figure 1). Following a series of wetter years, improved ocean conditions, and mandated increases in stream flows from Cape Horn Dam (since 2004), adult Chinook salmon returns to Cape Horn Dam improved with three consecutive record counts at VAFS between 2010-11 and 2012-13. During these years, dive counts in the Lower Eel River mainstem and observations throughout the watershed also suggest the run in the Eel River population has improved from lows in previous decades (Higgins 2013). Most recently, adult returns have declined substantially with 168 and 584 adults returning to VAFS in 2013-14 and 2014-15 respectively.

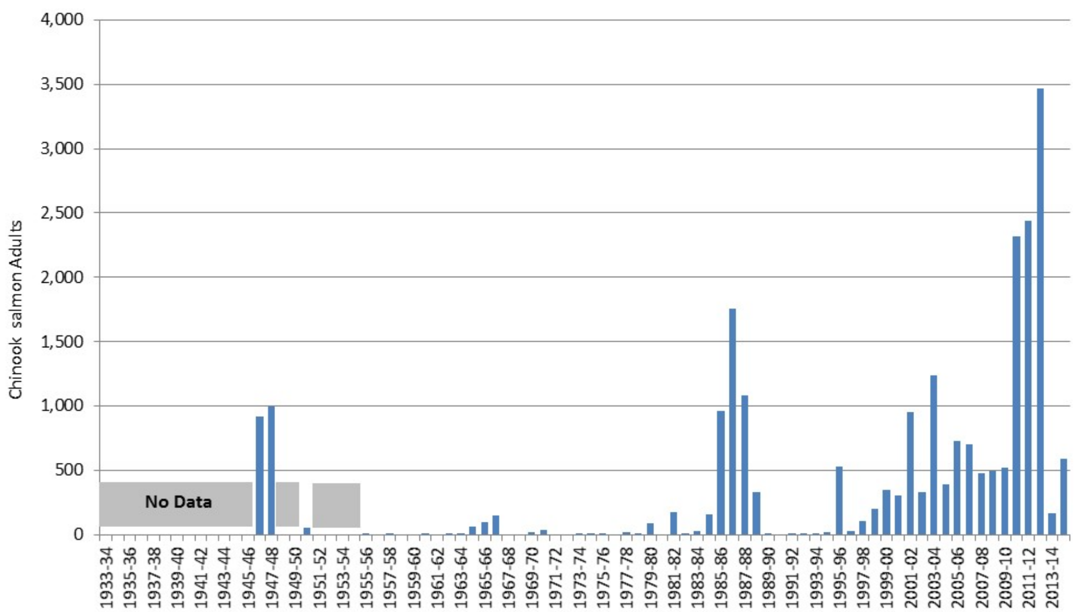

Figure 1: Adult Chinook salmon returns counted at the Van Arsdale Fisheries Station on the Upper Mainstem Eel River, 1933-34 through 2014-2015. Data on Chinook salmon returns were not collected (gray boxes) during the 1933-34 through 1945-46, 1948-49 through 1949-50, and 1951-52 through 1954-55.

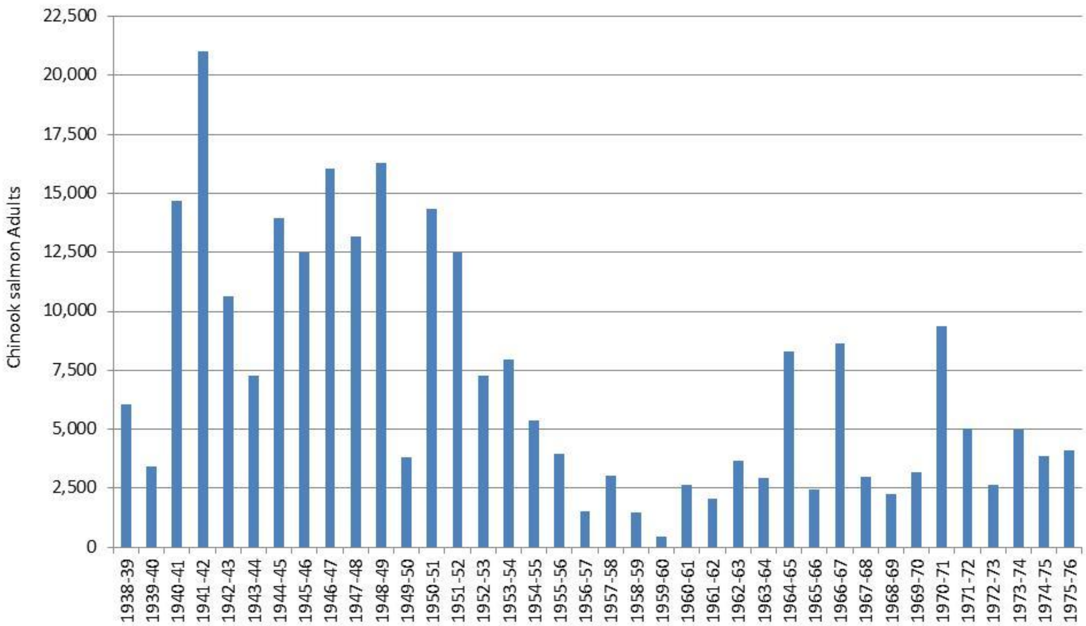

Figure 2: Adult Chinook salmon returns counted at the Benbow Dam Fish Ladder on the South Fork Eel River, 1938-39 through 1975-76. Counts in 1969-70 and 1970-71 are estimates as the station was closed before the end of the run.

History of Land Use

The Eel River watershed is the third largest watershed within California with a drainage area of approximately 3,684 square miles covering four major subbasins (Van Duzen River, South Fork Eel River, North Fork Eel River, and Middle Fork Eel River) and portions of five counties (Figure 3). Due to its size, the topography and climate within the watershed varies. Overall, the climate follows a Mediterranean pattern with cool wet winters, followed by dry and relatively warm summers. In summer, the coastal areas of the watershed typically experience fog while inland areas are dry and much warmer. The watershed is located in a geologically active area and is underlain by the Franciscan Formation which is highly erodible, particularly in steep terrain (Kubicek 1977; Yoshiyama and Moyle 2010).

Prior to Euro-American settlement, the Eel River watershed was inhabited by several native groups including the Wiyot, Sinkyone, Lassik, Nongatl, Yuki and Wailaki peoples. While these groups utilized the natural resources of the Eel River watershed, it is likely their collective impact on the resources or landscape were relatively minor. Euro-American settlement and exploitation of the watershed's natural resources began in the second half of the 19th Century. During this period, most of the low-elevation forested areas were logged and converted to other uses such as dairies and agriculture. The abundant fish populations in the watershed (primarily Chinook salmon), supported a commercial fishery including cannery operations. The canneries operated until 1912 and the commercial fishery was closed by 1926 as salmon numbers declined despite substantial artificial propagation (Yoshiyama and Moyle 2010).

Figure 3: Eel River watershed overview map

Although logging and fishing continued through the early 20th Century, two of the more significant anthropogenic changes to the watershed during this period were the construction of Cape Horn (1908) and Scott (1922) dams on the Upper Mainstem Eel River (SEC 1998). Unlike Cape Horn, Scott Dam (farther upstream) was constructed without fish passage facilities and therefore blocks a significant amount of potential anadromous salmonid habitat. The dams and impounded reservoirs were built to generate hydro-electric power and provide water south to the Russian River watershed (NMFS 2002).

Following World War II, much of the remaining virgin forest as well as substantial areas of second-growth forest were logged at a rapid pace throughout the watershed. Logging spread to steeper slopes and remote areas which required development of a vast network of mostly poorly constructed roads. The removal of vegetation and road construction increased sediment erosion on an unprecedented scale. The large floods in 1955 and 1964 exacerbated the erosion and caused significant sedimentation within the Eel River, its tributaries, and the estuary. Deep pools that were common in the river channels were mostly filled in and most of the riparian vegetation was eliminated. While some areas have improved since the floods, legacy effects of the logging and floods remains in many areas of the watershed, which contribute to the poor habitat quality evident throughout much of the watershed today.

Throughout the 20th Century, both Chinook salmon and steelhead were propagated and released into the Eel River. For Chinook salmon, most of the eggs and fry were harvested from out-of-basin stocks (Sacramento and Trinity basins) (Yoshiyama and Moyle 2010). After 1981, all Chinook salmon planted in the Eel River watershed were of native origin. The impacts of the hatchery practices on the genetic integrity and population status are unknown or poorly understood due to insufficient information (SEC 1998; Yoshiyama and Moyle 2010).

In 1980, predatory Sacramento pikeminnow were introduced into Lake Pillsbury (CDFG 1997), and are now found throughout the Eel River watershed. Based on recent surveys by the California Department of Fish and Wildlife (CDFW), Sacramento pikeminnow are present in large numbers in Lake Pillsbury, and many of the larger tributaries that drain into the lake such as the mainstem Eel River, and much of the South Fork system (S. Harris, CDFG, personal communication, 2013).

Current Resources and Land Management

Approximately 67% of the Eel River watershed is privately owned, 30% managed as federal lands, and 3% managed as state lands. A majority of the federally managed lands are within the Six Rivers National Forest and the Yolla Bolly-Middle Eel Wilderness Area. Approximately 60,000 acres of the watershed is managed under the State of California Department of Parks and Recreation, much of which is within Humboldt Redwoods State Park. In 1981, portions of the Eel River and its major tributaries (a total of 398 miles) were designated under the National Wild and Scenic River system.

Nearly 75% of the watershed is forested with Douglas fir (27%), montane hardwood (26%), and Coast redwood (10%) being the most common forest communities. Urban areas represent less than 1% of the watershed area with the largest developments located near the coast and extreme headwaters. In addition to parks and other recreational areas, logging, grazing, and agriculture are the primary land uses in the watershed.

The Eel River Estuary

The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River salmonid populations. Currently, the Eel River estuary is severely impaired due to past diking and filling of tidal wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes, and CDFG (2010) estimated only 10 percent of historic salt marsh habitat remains today. The function of the estuary (*e.g.*, rearing, refugia, salt water transition) for Eel River salmonids is particularly important given the degraded habitat conditions and predation and competition from non-native Sacramento pikeminnow in the mainstem Eel River. Juveniles and smolts suffer from the lost opportunity for increased growth, which affects their survival at ocean entry. The quantity and quality of estuary habitat available to salmonids in the Eel River is expected to expand in the near future due to the Salt River Ecosystem Restoration Project and restoration efforts on the The Wildland Conservancy's Eel River Estuary Preserve and CDFW's Ocean Ranch Unit of the Eel River Wildlife Area.

Salmonid Viability and Habitat Conditions

A summary of attribute indicator ratings for Eel River populations of CC Chinook salmon are presented in Table 1 and Table 2. Across the Eel River watershed, attribute indicators frequently rated Poor for two or more subsets/population and at least one life stage were:

- Estuary: Quality and Extent;
- Habitat Complexity: Large Wood & Shelter
- Habitat Complexity: Percent Primary/Staging Pools & Pool/Riffle/Flatwater Ratios
- Hydrology: Baseflow & Number, Condition, and/or Magnitude of Diversions
- Landscape Patterns: Timber Harvest
- Passage/Migration: Mouth or Confluence
- Riparian Vegetation: Tree Diameter
- Sediment: Gravel Quality (Bulk and Embeddedness)
- Sediment Transport: Road Density and Streamside Road Density
- Water Quality: Turbidity

Throughout the Eel River watershed, all life stages are impaired with 75% or more attribute indicators rated as Poor or Fair and all with at least 25% or more rated as Poor (Figure 4). Pre smolt is the most impaired life stage with 84% of attribute indicators rated Poor or Fair, followed by adults (80%) and smolts (79%). Of the watershed processes, streamside road density was identified as the most significant impact to instream and riparian habitat quality with all populations rated Poor (Table 2). Timber harvest was also rated Poor for the Larabee Creek and Van Duzen River populations. The extent and impact of impervious surfaces, urban development, and agriculture are minimal as all populations were rated Fair or better with most rated Very Good.

The Lower Eel River-South Fork Eel River subset is within the North Coastal Diversity Stratum, and the Van Duzan River/ Larabee Creek subset and Upper Eel River population represents the entirety of the North Mountain Interior Diversity Stratum. The ESU and Diversity Strata results from the CAP viability analysis are described in greater detail in the section above, CC Chinook Salmon CAP results. Subset/population-specific results are described below in the population profiles.

Table 1: CC Chinook salmon CAP Viability Summary by Attribute for Eel River populations

CC Chinook Salmon Population Conditions (Sorted By Attribute)			N.C.	North Mountain Interior		
Target	Attribute	Indicator	S. F. Eel River	Van Duzen	Larabee Creek	Upper Eel River
Adults	Estuary/Lagoon	Quality & Extent	P	P	P	P
Pre Smolt	Estuary/Lagoon	Quality & Extent	P	P	P	P
Smolts	Estuary/Lagoon	Quality & Extent	P	P	P	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	F	F	F	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	P	F	F	P
Pre Smolt	Habitat Complexity	Percent Primary Pools	F	P	F	P
Adults	Habitat Complexity	Percent Staging Pools	P	P	F	F
Adults	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	P
Pre Smolt	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	F
Pre Smolt	Habitat Complexity	Shelter Rating	P	P	P	P
Smolts	Habitat Complexity	Shelter Rating	P	P	P	P
Pre Smolt	Hydrology	Flow Conditions (Baseflow)	P	P	P	F
Eggs	Hydrology	Flow Conditions (Instantaneous Condition)	G	G	G	F
Pre Smolt	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Smolts	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Watershed Processes	Hydrology	Impervious Surfaces	V	V	V	V
Pre Smolt	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Smolts	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Adults	Hydrology	Passage Flows	F	P	F	G
Pre Smolt	Hydrology	Passage Flows	F	F	F	G
Smolts	Hydrology	Passage Flows	F	F	F	G
Eggs	Hydrology	Redd Scour	F	F	F	F
Watershed Processes	Landscape Patterns	Agriculture	V	F	G	V
Watershed Processes	Landscape Patterns	Timber Harvest	G	P	P	V
Watershed Processes	Landscape Patterns	Urbanization	V	V	V	V
Adults	Passage/Migration	Passage at Mouth or Confluence	P	P	G	F
Pre Smolt	Passage/Migration	Passage at Mouth or Confluence	F	F	G	F
Smolts	Passage/Migration	Passage at Mouth or Confluence	F	F	G	G
Adults	Passage/Migration	Physical Barriers	V	G	V	F
Smolts	Passage/Migration	Physical Barriers	V	G	V	V
Watershed Processes	Riparian Vegetation	Species Composition	F	V	G	F
Adults	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Pre Smolt	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Eggs	Sediment	Gravel Quality (Bulk)	P	P	G	F
Eggs	Sediment	Gravel Quality (Embeddedness)	F	P	F	P
Adults	Sediment	Quantity & Distribution of Spawning Gravels	G	F	F	G
Pre Smolt	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Smolts	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Watershed Processes	Sediment Transport	Road Density	P	P	P	G
Watershed Processes	Sediment Transport	Streamside Road Density (100 m)	P	P	P	P
Smolts	Smoltification	Temperature	P	F	F	F
Adults	Velocity Refuge	Floodplain Connectivity	F	F	G	F
Pre Smolt	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Smolts	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Smolts	Viability	Abundance	F	F	F	F
Adults	Viability	Density	F	F	F	F
Adults	Viability	Spatial Structure	G	G	G	F
Pre Smolt	Viability	Spatial Structure	G	G	G	F
Pre Smolt	Water Quality	Temperature (MWMT)	F	F	G	F
Adults	Water Quality	Toxicity	F	F	G	F
Pre Smolt	Water Quality	Toxicity	F	F	G	F
Smolts	Water Quality	Toxicity	F	F	G	F
Adults	Water Quality	Turbidity	P	P	F	F
Pre Smolt	Water Quality	Turbidity	F	P	F	F
Smolts	Water Quality	Turbidity	P	P	F	F

Table 2: CC Chinook salmon CAP Viability Summary by Life Stage for Eel River populations.

CC Chinook Salmon Population Conditions (Sorted By Conservation Target)			N.C.	North Mountain Interior		
Target	Attribute	Indicator	S. F. Eel River	Van Duzen	Larabee Creek	Upper Eel River
Adults	Estuary/Lagoon	Quality & Extent	P	P	P	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	F	F	F	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	P	F	F	P
Adults	Habitat Complexity	Percent Staging Pools	P	P	F	F
Adults	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	P
Adults	Hydrology	Passage Flows	F	P	F	G
Adults	Passage/Migration	Passage at Mouth or Confluence	P	P	G	F
Adults	Passage/Migration	Physical Barriers	V	G	V	F
Adults	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Adults	Sediment	Quantity & Distribution of Spawning Gravels	G	F	F	G
Adults	Velocity Refuge	Floodplain Connectivity	F	F	G	F
Adults	Water Quality	Toxicity	F	F	G	F
Adults	Water Quality	Turbidity	P	P	F	F
Adults	Viability	Density	F	F	F	F
Adults	Viability	Spatial Structure	G	G	G	F
Eggs	Hydrology	Flow Conditions (Instantaneous Condition)	G	G	G	F
Eggs	Hydrology	Redd Scour	F	F	F	F
Eggs	Sediment	Gravel Quality (Bulk)	P	P	G	F
Eggs	Sediment	Gravel Quality (Embeddedness)	F	P	F	P
Pre Smolt	Estuary/Lagoon	Quality & Extent	P	P	P	P
Pre Smolt	Habitat Complexity	Percent Primary Pools	F	P	F	P
Pre Smolt	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	F
Pre Smolt	Habitat Complexity	Shelter Rating	P	P	P	P
Pre Smolt	Hydrology	Flow Conditions (Baseflow)	P	P	P	F
Pre Smolt	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Pre Smolt	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Pre Smolt	Hydrology	Passage Flows	F	F	F	G
Pre Smolt	Passage/Migration	Passage at Mouth or Confluence	F	F	G	F
Pre Smolt	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Pre Smolt	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Pre Smolt	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Pre Smolt	Water Quality	Temperature (MWMT)	F	F	G	F
Pre Smolt	Water Quality	Toxicity	F	F	G	F
Pre Smolt	Water Quality	Turbidity	F	P	F	F
Pre Smolt	Viability	Spatial Structure	G	G	G	F
Smolts	Estuary/Lagoon	Quality & Extent	P	P	P	P
Smolts	Habitat Complexity	Shelter Rating	P	P	P	P
Smolts	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Smolts	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Smolts	Hydrology	Passage Flows	F	F	F	G
Smolts	Passage/Migration	Passage at Mouth or Confluence	F	F	G	G
Smolts	Passage/Migration	Physical Barriers	V	G	V	V
Smolts	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Smolts	Smoltification	Temperature	P	F	F	F
Smolts	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Smolts	Water Quality	Toxicity	F	F	G	F
Smolts	Water Quality	Turbidity	P	P	F	F
Smolts	Viability	Abundance	F	F	F	F
Watershed Processes	Hydrology	Impervious Surfaces	V	V	V	V
Watershed Processes	Landscape Patterns	Agriculture	V	F	G	V
Watershed Processes	Landscape Patterns	Timber Harvest	G	P	P	V
Watershed Processes	Landscape Patterns	Urbanization	V	V	V	V
Watershed Processes	Riparian Vegetation	Species Composition	F	V	G	F
Watershed Processes	Sediment Transport	Road Density	P	P	P	G
Watershed Processes	Sediment Transport	Streamside Road Density (100 m)	P	P	P	P

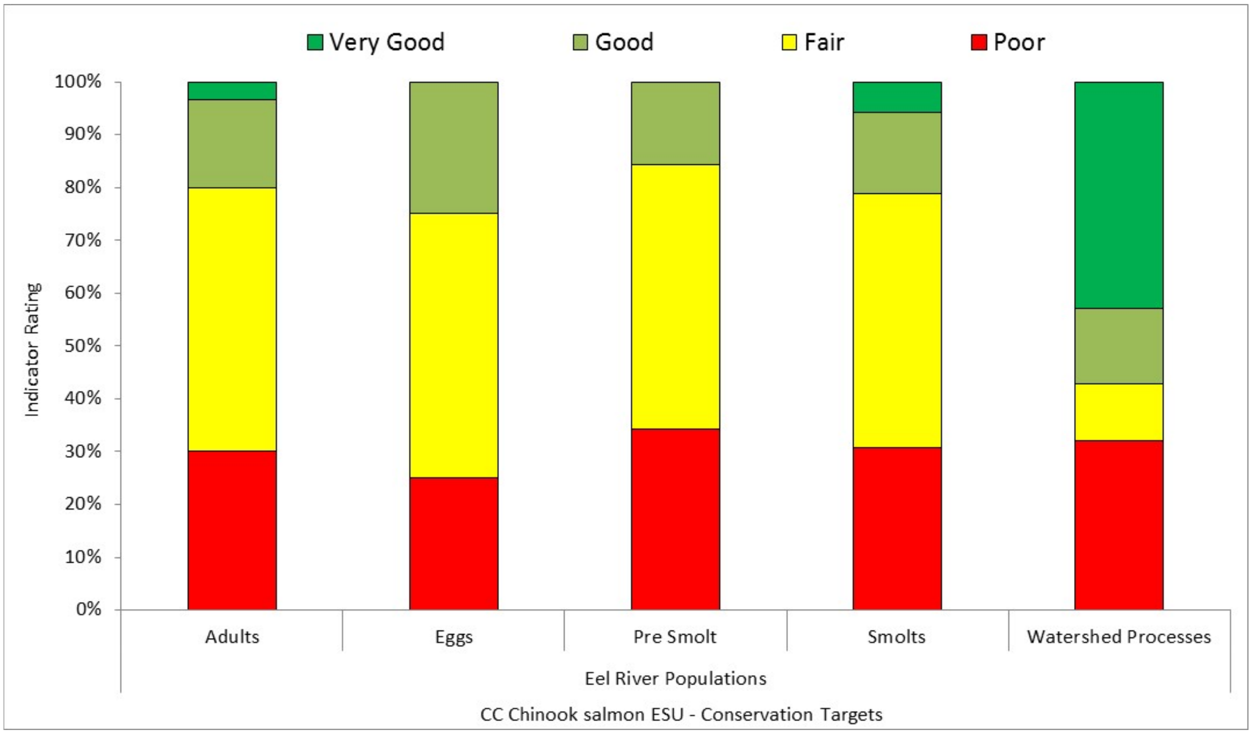

Figure 4: CAP Attribute Indicator ratings for the CC Chinook salmon life stages in the Eel River watershed.

Threats

Table 3 summarizes the CAP threat results across the three subsets of the Lower Eel River population and the Upper Eel population. Based on the occurrence of multiple High or Very High ratings, the threats of greatest concern for CC Chinook salmon in the Eel River watershed were Channel Modification, Disease, Predation and Competition (due to the introduction of Sacramento pikeminnow and other nonnative piscivorous fish), Roads and Railroads, and Water Diversions and Impoundments. Other threats identified as High in the Eel River were Fishing and Collecting (Upper Eel River), and Severe Weather Patterns (Lower-South Fork Eel River). Specific results of threats and actions to ameliorate them are described in greater detail below under each profile.

Table 3: Summary of threat ratings for populations of CC Chinook in the Eel River watershed, where L=Low, M=Medium, H=High, and VH=Very High threat.

Diversity Strata	N.C	North Mountain Interior		
CC Chinook Threat/Population	Lower - S. F. Eel River	Van Duzen River	Larabee Creek	Upper Eel River
Agriculture	M	M	M	L
Channel Modification	H	H	M	L
Disease, Predation and Competition	M	H	H	M
Fire, Fuel Management and Fire Suppression	M	M	M	M
Fishing and Collecting	M	M	M	H
Hatcheries and Aquaculture	-	-	-	-
Livestock Farming and Ranching	M	M	M	L
Logging and Wood Harvesting	M	M	M	M
Mining	M	M	M	L
Recreational Areas and Activities	M	M	M	L
Residential and Commercial Development	M	M	M	L
Roads and Railroads	H	M	M	H
Severe Weather Patterns	H	M	M	M
Water Diversion and Impoundments	H	H	M	L

Literature Cited

CDFG (California Department of Fish and Game). 1997. Eel River Salmon and Steelhead Restoration Action Plan. California Department of Fish and Game, Inland Fisheries Division, Sacramento.

Higgins, P. 2013. Eel River Recovery Project: Eel River 2012 Fall Chinook Run Distribution and Observations on Other Fish Species. Report Prepared for: Eel River Recovery Project & Trees Foundation With funding from: Humboldt County Fish and Game Advisory Committee.

Kubicek, P. F. 1977. Summer water temperature conditions in the Eel River System; with reference to trout and salmon. Master's Thesis. Humboldt State University, Arcata, CA.

NMFS (National Marine Fisheries Service). 2002. Biological Opinion for the Proposed license amendment for the Potter Valley Project (Federal Energy Regulatory Commission Project Number 77-110). National Marine Fisheries Service, Santa Rosa, CA.

Spence, B. C., E. P. Bjorkstedt, J. C. Garza, J. J. Smith, D. G. Hankin, D. Fuller, W. E. Jones, R. Macedo, T. H. Williams, and E. Mora. 2008. A Framework for Assessing the Viability of Threatened and Endangered Salmon and Steelhead in the North-Central California Coast Recovery Domain. U.S. Department of Commerce. NOAA Technical Memorandum. NOAA-TM-NMFS-SWFSC-423.

SEC (Steiner Environmental Consulting). 1998. Potter Valley project monitoring program (FERC Project Number 77-110, Article 39): effects of operations on upper Eel River anadromous salmonids: March 1998 final report. Prepared for the Pacific Gas and Electric company San Ramon, CA.

Yoshiyama, R. M., and P. B. Moyle. 2010. Historical review of Eel River anadromous salmonids, with emphasis on Chinook salmon, coho salmon and steelhead. University of California Davis, Center for Watershed Sciences working paper. A Report Commissioned by California Trout, 2010. Center for Watershed Sciences University of California, Davis, CA.