SOUTHERN OREGON/NORTHERN CALIFORNIA COAST RECOVERY DOMAIN

5-Year Review:
Summary and Evaluation of

Southern Oregon/Northern California Coast Coho Salmon ESU

National Marine Fisheries Service
Southwest Region
Long Beach, CA

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5-YEAR REVIEW
Southern Oregon Northern California Coast Recovery Domain

Species Reviewed	Evolutionarily Significant Unit or Distinct Population Segment
Coho Salmon (*Oncorhynchus kisutch*)	**Southern Oregon/Northern California coho salmon ESU**

1.0 GENERAL INFORMATION

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1.2 Introduction

Many West Coast salmon and steelhead (*Oncorhynchus* sp.) stocks have declined substantially from their historic numbers and now are at a fraction of their historical abundance. There are several factors that contribute to these declines, including: overfishing, loss of freshwater and estuarine habitat, hydropower development, poor ocean conditions, and hatchery practices. These factors collectively led to the National Marine Fisheries Service (NMFS) listing of 28 salmon and steelhead stocks in California, Idaho, Oregon, and Washington under the Federal Endangered Species Act (ESA).

The ESA, under Section 4(c)(2), directs the Secretary of Commerce to review the listing classification of threatened and endangered species at least once every five years. After completing this review, the Secretary must determine if any species should be: (1) removed from the list; (2) have its status changed from threatened to endangered; or (3) have its status changed from endangered to threatened. The most recent listing determinations for salmon and steelhead occurred in 2005 and 2006. This document reflects the agency's 5-year status review of the ESA-listed Southern Oregon/Northern California Coast (SONCC) coho salmon Evolutionarily Significant Unit (ESU).

1.2.1 Background on Listing Determinations

Under the ESA, a species, subspecies, or a distinct population segment (DPS) may be listed as threatened *or* endangered. To identify the proper taxonomic unit for consideration in an ESA listing for steelhead, we, NMFS, draw on our "Policy on Applying the Definition of Species under the ESA to Pacific Salmon" (ESU Policy) (56 FR 58612). According to this policy guidance, populations of salmon substantially reproductively isolated from other con-specific populations and representing an important component in the evolutionary legacy of the biological species are considered to be an ESU. In our listing determinations for Pacific salmon under the ESA, we treated an ESU as constituting a DPS, and hence a "species."

In 2006, we announced that NMFS would apply the joint U.S. Fish and Wildlife Service-National Marine Fisheries Service DPS policy (61 FR 4722) rather than our agency's ESU policy to populations of West Coast steelhead (*O. mykiss*). Under this policy, a DPS of steelhead must be discrete from other con-specific populations, and it must be significant to its taxon. A group of organisms is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors" (61 FR 4722). According to the DPS policy, if a population group is determined to be discrete, we must then consider whether it is significant to the taxon to which it belongs. Considerations in evaluating the significance of a discrete population include: (1) persistence of the discrete population in an unusual or unique ecological setting for the taxon; (2) evidence that the loss of the discrete population segment would cause a significant gap in the taxon's range; (3) evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere outside its historical geographic range; or (4) evidence that the discrete population has marked genetic differences from other populations of the species.

Artificial propagation (fish hatchery) programs are common throughout the range of ESA-listed West Coast salmon and steelhead. On June 28, 2005, we announced a final policy addressing the role of artificially propagated Pacific salmon and steelhead in listing determinations under the ESA (70 FR 37204). Specifically, this policy: (1) establishes criteria for including hatchery stocks in ESUs and DPSs; (2) provides direction for considering hatchery fish in extinction risk assessments of ESUs and DPSs; (3) requires that hatchery fish determined to be part of an ESU be included in any listing of an ESU or DPS; (4) affirms our commitment to conserving natural salmon and steelhead populations and the ecosystems upon which they depend; and (5) affirms our commitment to fulfilling trust and treaty obligations with regard to the harvest of some Pacific salmon and steelhead populations, consistent with the conservation and recovery of listed salmon ESUs and steelhead DPSs.

To determine whether a hatchery program was part of an ESU or DPS, NMFS convened the Salmon and Steelhead Hatchery Advisory Group (SSHAG), which divided existing hatchery programs into 4 categories (SHAGG 2003):

Category 1: The hatchery population was derived from a native, local population; is released within the range of the natural population from which is was derived; and has experienced only relatively minor genetic changes from causes such as founder effects, domestication or non-local introgression.

Category 2: The hatchery population was derived from a local natural population, and is released within the range of the natural population from which is was derived, but is known or suspected to have experienced a moderate level of genetic change from causes such as founder effects, domestication, or non-native introgression.

Category 3: The hatchery population is derived predominately from other populations that are in the same ESU/DPS, but is substantially diverged from the local, natural population(s) in the watershed in which it is released.

Category 4: The hatchery population was predominately derived from populations that are not part of the ESU/DPS in question; or there is substantial uncertainty about the origin and history of the hatchery population.

Based on these categorical delineations, hatchery programs in SSHAG categories 1 and 2 are included as part of an ESU or DPS (70 FR 37204) although in some instances category 3 or programs can be included.

Because the new hatchery listing policy changed the way NMFS considered hatchery fish in ESA listing determinations, we completed new status reviews and ESA-listing determinations for West Coast salmon ESUs and steelhead DPSs. On June 28, 2005, we issued final listing determinations for 16 ESUs of Pacific salmon (including the SONCC coho ESU) and on January 5, 2006 we issued final listing determinations for 10 DPSs of steelhead.

1.3 Methodology used to complete the review

A public notice initiating this review and requesting information for all California ESUs and DPSs was published on March 18, 2010, with a 60-day response period (75 Federal Register [FR] 13082). The Southwest Region did not receive any information on SONCC coho salmon in response to this information request.

The Southwest Region instituted a two-step process to complete this review. First, we asked scientists from our SWFSC to collect and analyze new information about viability of all ESUs and DPSs in California. To evaluate viability, our scientists used the Viable Salmonid Population concept (McElhany et al. 2000). The VSP concept relies on evaluating four criteria, abundance, productivity, spatial structure, and diversity to assess species viability. Through the application of this concept, they considered new information on the four salmon and steelhead population viability criteria. They also considered new information on ESU and DPS boundaries. At the end of this process, the Southwest Fisheries Science Center prepared a report (Williams et al. 2011) detailing the results of their analyses.

Salmon management biologists from the Southwest Region' Protected Resources Division completed the second step in the review process. These biologists, organized by recovery domain, reviewed new information on the five ESA statutory listing factors. They also evaluated new information on hatchery programs to inform an updated assessment of the ESU/DPS membership status of hatchery programs, as well as to inform the consideration of hatchery risks and benefits in the analysis of the statutory listing factors. Information from each of these steps of the review process forms the basis for this report.

Key information sources used in the SONCC coho salmon ESU review included:

- drafts of the recovery plan for the SONCC coho salmon ESU;
- the draft status review update for Pacific salmon and steelhead in California under the ESA (Williams et al. 2011)
- various peer-reviewed scientific publications;
- the final rule listing the SONCC coho salmon ESU as threatened (62 FR 24588; May 6, 1997);
- the final rule reaffirming the listing of the SONCC coho salmon ESU as threatened (70 FR 37160; June 28, 2005);
- the final rule designating critical habitat for the SONCC coho salmon ESU (64 FR 24049) (May 5, 1999).
- the 2005 status update for the SONCC coho salmon ESU (Good et al. 2005)

All literature and documents used for this review are on file at the Southwest Region's Protected Resources Division office in Arcata, California.

1.4 Background – Summary of Previous Reviews, Statutory and Regulatory Actions, and Recovery Planning

1.4.1 FR Notice citation announcing initiation of this review

75 FR 13082; March 18, 2010

1.4.2 Listing history

NMFS originally listed the SONCC coho salmon ESU as threatened under the ESA in 1997. In 2005 following a reassessment of its status and after applying NMFS' hatchery listing policy, we reaffirmed its status as threatened and also included several hatchery programs in the listed ESU See Table 1 for details.

Table 1. Summary of the listing history for the SONCC coho salmon ESU under the ESA.

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Coho Salmon (*O. kisutch*)	SONCC coho salmon ESU	**FR notice:** 62 FR 24588 **Date listed:** 05/06/1997 **Classification**: Threatened	**FR notice:** 70 FR 37160 **Date:** 06/28/2005 **Re-classification**: Threatened

1.4.3 Associated rulemakings

The ESA requires that NMFS designate critical habitat for any species it lists under the ESA. Critical habitat is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing that contain physical or biological features essential to conservation and that may require special management consideration or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. NMFS designated critical habitat for SONCC coho salmon in 1999 (Table 2).

Section 4(d) of the ESA directs NMFS to issue regulations to conserve species listed as threatened. This applies particularly to "take," which can include any act that kills or injures fish, and may include habitat modification. The ESA prohibits any take of species listed as endangered, but some take of threatened species that does not interfere with salmon survival and recovery can be allowed. NMFS initially promulgated a 4(d) protective regulation for this ESU in 2000 and subsequently modified the rule in 2005 (Table 2).

Table 2. Summary of rulemaking for 4(d) protective regulations and critical habitat for the SONCC coho salmon ESU.

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Coho Salmon (*O. kisutch*)	SONCC coho salmon ESU	**FR notice:** 65 FR 42421 **Date:** 07/10/2000; Revised: 6/28/05 (70 FR 37160)	**FR notice:** 64 FR 24049 **Date:** 05/05/1999

1.4.4 Review History

Numerous scientific assessments have been conducted to evaluate the biological status of the SONCC coho salmon ESU. A list of those assessments is found in Table 3.

Table 3. Summary of previous scientific assessments for the SONCC coho salmon

Salmonid Species	ESU/DPS Name	Document Citation
Coho Salmon (*O. kisutch*)	SONCC coho salmon ESU	Williams, T.H., Spence, B.C., Duffy, W., Hillemeier, D., Kautsky, G, Lisle, T., McCain, M., Nickelson, T., Mora, E., and T. Pearson. 2008. Framework for assessing viability of threatened coho salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit. NOAA-TM-NMFS-SWFSC-432. 96 p.
		Williams, T.H., Bjorkstedt, E.P., Duffy, W.G., Hillemeier, D., Kautsky, G., Lisle, T.E., McCain, M., Rode, M., Szerlong, R.G., Schick, R.S., Goslin, M.N., and A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California Coasts Evolutionarily Significant Unit. NOAA-TM-NMFS-SWFSC-390. 71 p.
		Good, T.P., R.S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.
		National Marine Fisheries Service. 2001. Status review update for coho salmon (*Oncorhynchus kisutch*) from the Central California Coast and the California portion of the Southern Oregon/Northern California Coasts Evolutionarily Significant Units. 40 p.
		Weitkamp, L.A., Wainwright, T.C., Bryant, G.J., Milner, G.B., Teel, D.J., Kope, R.G., and R.G. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-24. 258 p.

1.4.5 Species' Recovery Priority Number at start of 5-year review

NMFS issued guidelines in 1990 (55 FR 24296) for assigning listing and recovery priorities. Three criteria are assessed to determine a species' priority for recovery plan development, implementation, and resource allocation: 1) magnitude of threat; 2) recovery potential; and 3) existing conflict with activities such as construction and development. The recovery priority number for the SONCC coho salmon ESU is 1, as reported in the *2006-2008 Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species (available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esabiennial2008.pdf)*, and as listed in Table 4 below.

1.4.5 Recovery Plan or Outline

A recovery outline was prepared for this ESU in 2007 to provide interim recovery guidance until a recovery plan could be developed (Table 4). Section 4 of the ESA requires NMFS to develop recovery plans for all threatened and endangered species under its jurisdiction and efforts are currently underway to develop a recovery plan for the SONCC coho salmon ESU (Table 4).

Table 4. Recovery Priority Number and Endangered Species Act Recovery Plans for the SONCC coho salmon ESU.

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plans/Outline
Coho Salmon (*O. kisutch*)	SONCC coho Salmon ESU	1	Name of Plan: 2007 Federal Recovery Outline: Southern Oregon/Northern California Coast coho salmon (December 12, 2007) Plan Status: Completed
Coho Salmon (*O. kisutch*)	SONCC coho salmon ESU	1	Name of Plan: Recovery Plan for the Evolutionarily Significant Unit of Southern Oregon Northern California Coast Coho Salmon (*Oncorhynchus kisutch*) Co-Manager Review Draft (June 15, 2009) Plan Status: Draft

2.0 REVIEW ANALYSIS

In this section we review new information to evaluate whether the species ESU delineation is still appropriate.

2.1 Delineation of Species under the Endangered Species Act

2.1.1 Is the species under review a vertebrate?

ESU/DPS Name	YES*	NO**
SONCC coho salmon ESU	X	

** if "Yes," go to section 2.1.2*
*** if "No," go to section 2.2*

2.1.2 Is the species under review listed as a DPS?

ESU/DPS Name	YES*	NO**
SONCC coho salmon ESU	X	

** if "Yes," go to section 2.1.3*
*** if "No," go to section 2.1.4*

2.1.3 Was the DPS listed prior to 1996?

ESU/DPS Name	YES*	NO**	Date Listed if Prior to 1996
SONCC coho salmon ESU		X	n/a

** if "Yes," give date go to section 2.1.3.1*
*** if "No," go to section 2.1.4*

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

In 1991 NMFS issued a policy on how the agency would delineate DPSs of Pacific salmon for listing consideration under the Endangered Species Act (ESA) (56 FR 58612). Under this policy a group of Pacific salmon populations is considered an "evolutionarily significant unit" (ESU) if it is substantially reproductively isolated from other con-specific populations, and it represents an important component in the evolutionary legacy of the biological species. The 1996 joint NMFS-Fish and Wildlife Service (FWS) Distinct Population Segment (DPS) policy (61 FR 4722) affirmed that a stock (or stocks) of Pacific salmon is considered a DPS if it represents an ESU of a biological species. Accordingly, in listing the SONCC coho salmon ESU under the ESU policy in 1997, NMFS treated the ESU as a DPS under the ESA. NMFS considers its ESU policy to be a detailed extension of the joint DPS policy and consequently is continuing to use the ESU policy with respect to Pacific salmon. In the case of steelhead (*O. mykiss*), NMFS now uses the joint DPS policy to delineate DPSs under the ESA.

2.1.4 Summary of relevant new information regarding the delineation of the ESU under review

New genetic data are available, including microsatellite genotypes for fish from most extant populations in California, and including samples from populations distributed coast wide (Garza et al. unpublished data). These recent genetic data do not suggest a need to re-examine the boundaries between the Central California Coast coho salmon ESU and the SONCC coho salmon ESU. These data show clear separation between populations south and north of Punta Gorda which is the current southern boundary of the ESU. Recently, a Biological Review Team (BRT) for Oregon Coast coho salmon ESU reviewed new information, primarily genetic data, to determine if a reconsideration of the northern boundary of the SONCC coho salmon ESU and the southern boundary of the Oregon Coast coho salmon ESU was warranted (Stout et al. 2010). After considering the new information, this BRT concluded that a reconsideration of the boundary between the SONCC and Oregon Coast coho salmon ESUs was not necessary. The basis for the BRT’s conclusion was that (a) the environmental and biogeographical information considered by Weitkamp et al. (1995) remains unchanged, and (b) new tagging and genetic analysis published subsequent to the original ESU boundary determination continues to support the current ESU boundary at Cape Blanco, Oregon.

NMFS determined that the artificially propagated coho salmon hatchery stocks from Cole Rivers Hatchery, Iron Gate Hatchery, and the Trinity River Hatchery were part of the SONCC coho salmon ESU as part of its 2005 review and listing determination (70 FR 37160). These artificially propagated stocks were considered no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (70 FR 37160). An updated review of these hatchery programs indicates that all three continue to be operational and that no substantial changes in their management have been implemented since the last status review that would increase their divergence from natural populations. Based on this updated information all three programs continue to propagate fish that are considered part of the SONCC coho salmon ESU.

2.2 Recovery Criteria

The ESA requires recovery plans to incorporate (to the maximum extent practicable) objective, measureable criteria which when met would result in a determination in accordance with the provisions of the ESA that the species can be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). In addition to recovery criteria, recovery plans must contain site-specific management actions necessary to recover the species, and estimates of the time and cost for their implementation.

2.2.1 Does the species have final, approved recovery plans containing objective, measurable criteria?

ESU/DPS Name	YES	NO
SONCC coho salmon ESU		**X**

Although a recovery plan for the SONCC coho salmon has not been finalized, a draft plan is currently under development and is expected to be released for public review in 2011. The recovery criteria under development are objective and measurable, and are based on the best available information on the status of the ESU and the applicable five listing factors.

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

ESU/DPS Name	YES	NO
SONCC coho salmon ESU	**N/A**	

See section 2.2.1 above.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?

ESU/DPS Name	YES	NO
SONCC coho salmon ESU	**N/A**	

See section 2.2.1 above.

2.2.3 List the recovery criteria as they appear in any final or interim recovery plan, and discuss how each criterion has or has not been met, citing information

The draft recovery plan under development is expected to be released for public comment in 2011. The recovery criteria in the draft plan are based on meeting viable salmonid population (VSP) and threats abatement objectives. These recovery criteria are objective and measurable, based on the best available information on the viability of the ESU (Table 5) and the applicable five listing factors (Table 6).

To achieve viability, the ESU must have sufficient representation, redundancy, connectivity, occupancy, and resiliency (Williams et al. 2008) which is accomplished by having populations meet demographic criteria that encompasses the viable salmonid population (VSP) parameters, (i.e., abundance, productivity, spatial structure, and diversity criteria; see Table 5 below). The

ESU demographic recovery criteria highlight the need for a continuous set of functional populations across the ESU, which together form the basis for a viable ESU. Core populations will play a major role in recovering this ESU while the other populations will contribute to maintaining and increasing connectivity and diversity (Table 5). Because the recovery plan has not been finalized, the draft demographic recovery criteria are subject to change.

In addition, the stresses and threats that adverse impact this ESU and its habitat must be abated to levels that will allow for long-term viability. Table 6 below summarizes the draft stress and threat abatement criteria contained in the draft plan. These criteria are framed in terms of threats as assessed under the five listing factors described in section 4(a)(1) of the ESA:

Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range
Factor B: Over-utilization for commercial, recreational, scientific or educational purposes
Factor C: Disease or predation
Factor D: The inadequacy of existing regulatory mechanisms
Factor E: Other natural or manmade factors affecting the species' continued existence

In developing the draft criteria, we developed a series of objectives aimed at addressing the stresses and threats and a set of criteria by which to gauge our progress in achieving them. Because the recovery plan has not been finalized, the draft stresses and threats recovery criteria are subject to change.

Table 5: Draft demographic recovery criteria for SONCC coho salmon ESU (from draft recovery plan - NMFS 2011)

VSP Parameter	**Population Type**	**Objective**	**Recovery Criterion**	**Status of Criterion**	**Supporting Information**
Abundance	Core	Achieve a low risk of extinction[1].	The geometric mean of spawners over 12 years must be at least the "low risk threshold" of spawners [1, 2, 3]	Unmet	Spawner abundance extremely low for most core populations, where data is available.
	Non-Core independent	Achieve a moderate risk of extinction[1] or better.	The annual number of spawners must exceed the "depensation threshold" [1] for each non-core population	Unmet	Spawner abundance extremely low for most non-core independent populations, where data is available.
Productivity	Core and Non-Core independent	Population growth rate is not negative.	Slope of regression of the geometric mean of natural spawners over the time series ≥ zero[2]	Unmet	Trends are negative, where data is available.
Spatial Structure	Core and Non-Core independent	Ensure populations are not narrowly distributed	Annual within- population distribution ≥ 50% of accessible IP habitat[4] (outside of a temperature mask)	Unmet	Many independent populations do not have or are not known to currently have ≥ 50% occupancy of IP habitat
	Dependent	Habitat can support all life stages	Habitat is available to support all life stages	Unmet	Not all dependent populations are currently known to have habitat to support all life stages, though many do.
Diversity	Core and Non-Core independent[4]	Ensure hatchery impacts on wild fish are acceptably low.	Complete a hatchery genetics management plan (HGMP) for all hatcheries in the ESU and meet criteria specified in the HGMP.	Unmet	A majority of hatcheries in ESU do not have an approved HGMP.
	Core and Non-Core independent	Achieve population resiliency.	Abundance criteria have been met across all diversity strata.	Unmet	Spawner abundance extremely low for most core populations, where data is available.

1 Please see Table 4.3.2 for specific spawner requirements
2 During generally low marine survival (≤ 4.4%; Sharr et al. 2000) conditions in at least 8 out of the 12 year period.
3 Assess for at least 12 years, striving for a coefficient of variation (CV) of 15% or less at the population level with 80% certainty.
4 The average for each of the three year classes over the 12 year period used for delisting evaluation must each meet this criterion.

Table 6. Draft threats abatement criteria by Listing Factor for SONCC coho salmon ESU (from draft recovery plan - NMFS 2011).

Listing Factor	Threat	Recovery Criterion	Status of Criterion	Status Information
A. Habitat Destruction, Modification or Curtailment	Lack of floodplain and channel structure	Floodplain and channel structure must have at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas[2].	Unmet	Many independent populations do not currently have suitable floodplain and channel structures to support all life stages of coho salmon.
	Altered sediment supply	Sediment supply must have at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas (to be determined) of core and non-core independent populations[2].	Unmet	Many independent populations currently have degraded habitat conditions resulting from altered sediment supplies, and therefore do not support all life stages of coho salmon.
	Altered hydrologic function	The timing of peak and low flows and the magnitude of base flows must be adequate to support all life stages of coho salmon. Hydrologic function must meet the best available instream flow recommendations in targeted areas (to be determined) of core populations and non-core independent populations.	Unmet	Many independent populations currently have altered hydrologic regimes that result in conditions that do not support all life stages of coho salmon.
	Impaired water quality	Water quality must have at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas[2].	Unmet	Many independent populations currently have impaired water quality, resulting in unsuitable habitat conditions for various life stages of coho salmon.
	Degraded riparian forest	Riparian forest conditions will have at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas[2].	Unmet	Many independent populations currently lack suitable riparian forest conditions, resulting in conditions that do not support all life stages of coho salmon.
	Barriers	Barriers must not limit access to habitat	Unmet	Many barriers still block

Listing Factor	**Threat**	**Recovery Criterion**	**Status of Criterion**	**Status Information**
A. Habitat Destruction, Modification or Curtailment		necessary to meet demographic criteria.		historical coho habitat.
	Impaired Estuary Function	All estuaries in the ESU must contain estuarine wetland habitat and connected off-channel habitat (e.g., back and side channels, sloughs, tidal channels, alcoves, wetlands, beaver ponds) suitable for supporting rearing coho salmon.	Unmet	Availability of estuarine, wetland, and off-channel habitat remains limited and does not support needed population sizes.
B. Over-utilization for commercial, recreational, scientific or educational purposes	Fisheries Bycatch	The incidental bycatch rate must remain below the limits established through ESA consultations for Federal, State, and Tribal fisheries.	Unmet	The VSP criteria have not been met; therefore, the standard of 4 successful generations of bycatch limits cannot be evaluated at this time.
Factor C: Disease and predation	Disease	Mean mortality and infection from diseases must not be higher than natural background levels for coho salmon juveniles and adults in populations where disease is identified as a high or very high stress.	Unmet	Impaired water quality continues to support a heightened level of infection and disease in many populations.
	Predation	Predation and competition rates from introduced species and hatchery-origin salmonids must not be higher than from native fishes.	Unmet	Hatchery fish predation remains a significant problem and introduced predator species are significantly reducing juvenile coho salmon in some basins.
Factor D: The inadequacy of existing regulatory mechanisms	Land and resource management	None		
Factor E: Other natural or man-	Hatchery	The management practices described in the HGMPs are carried out, and the effects of the	Unmet	Many of the hatcheries in the ESU (e.g., Iron Gate, Trinity

Listing Factor	Threat	Recovery Criterion	Status of Criterion	Status Information
made factors affecting continued existence		hatchery are as expected as described in the HGMPs.		River, and Mad River) still do not have a NMFS approved HGMP.
	Climate change	None		
	Invasive species	Regulatory measures to prevent additional or minimize spread of existing exotic species must be implemented. The effects of invasive species must not be higher than natural background levels for coho salmon in independent populations where invasive species is a high or very high threat to coho salmon.	Unmet	Invasive species continue to spread

1 Based on all of the available, applicable indicators for the threat

2 Specific targeted areas where stress reduction and threat abatement must occur will be identified through the habitat assessment identified as the first step of the habitat monitoring protocol. Until then, the targeted areas will be 50% of the IP habitat in each basin or sub-basin.

2.3 Updated Information and Current Species Status

2.3.1 Analysis of Viable Salmonid Population (VSP) Criteria

The following summary is primarily taken from the SWFSC's status review update for Pacific salmon and steelhead in California (Williams et al. 2011). Additional information was included in this section and is cited where appropriate.

Summary of Previous Biological Review Team (BRT) Conclusions

Good et al. (2005) concluded that the SONCC Coho Salmon ESU was likely to become endangered. The BRT found that data did not suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONCC ESU. They stated that coho salmon populations continued to be depressed relative to historical numbers, and there were strong indications that breeding groups had been lost from a significant percentage of streams within their historical range (Good et al. 2005). The BRT did note that the 2001 broodyear appeared to be one of the strongest perhaps of the last decade, following a number of relatively weak years (the exception being the numbers of fish in the Rogue River that had an average increase in spawners in early 2000 despite low years in 1998 and 1999 [Good et al. 2005]). Risk factors identified in previous status reviews such as severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that were clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continued to be a concern to the BRT. The BRT did note several risk factors that had been reduced, including termination of hatchery production of coho salmon at the Mad River and Rowdy Creek and restrictions on recreational and commercial harvest of coho salmon since 1994 (Good et al. 2005). An additional risk identified by the BRT was the illegal introduction of nonnative Sacramento pikeminnow (*Ptychocheilus grandis*) to the Eel River (Good et al. 2005).

Brief Review of TRT Documents and Findings

The Technical Recovery Team (TRT) for the SONCC Coho Salmon ESU prepared two documents intended to guide recovery planning efforts for the ESA-listed coho salmon. The first of these reports described the historical population structure of the ESU (Williams et al. 2006). In general, the historical population structure of coho salmon in the SONCC ESU was characterized by small-to-moderate-sized coastal basins where high quality habitat is in the lower portions of the basin and by three large basins where high quality habitat was located in the lower portions, middle portions of the basins provided little habitat, and the largest amount of habitat was located in the upper portions of the sub-basins. The SONCC TRT categorized populations into one of four distinct types based on its posited historical functional role in the ESU: (1) Nineteen *functionally independent populations*, defined as populations with a high likelihood of persisting over 100-year time scales and that conform to the definition of independent "viable salmonid populations" offered by McElhany et al. (2000); (2) Twelve *potentially independent populations*, defined as populations with a high likelihood of persisting over 100-year time scales, but that were too strongly influenced by immigration from other populations to be demographically independent; (3) Seventeen small *dependent populations* of coho salmon, which are believed to have had a low likelihood of sustaining themselves over a

100-year time period in isolation and that received sufficient immigration to alter their dynamics and extinction risk; and (4) Two *ephemeral populations*, defined as populations that were both small enough and isolated enough that they were only intermittently present.In addition to categorizing individual populations, the population structure report also placed populations into *diversity strata*, which are groups of populations that likely exhibit genotypic and phenotypic similarity due to exposure to similar environmental conditions or common evolutionary history (Williams et al. 2006). This effort was a prerequisite for development of viability criteria that consider processes and risks operating at spatial scales larger than those of individual populations.

The second TRT report proposed a framework for assessing viability of coho populations in the SONCC Coho Salmon ESU (Williams et al. 2008). This report established biological viability criteria, from which delisting criteria are currently being developed. These criteria consist of both population-level viability criteria and ESU-level criteria. Application of these criteria requires time series of adult spawner abundance spanning a minimum of four generations for independent populations. The population viability criteria represent an extension of an approach developed by Allendorf et al. (1997) and include criteria related to population abundance (effective population size), population decline, catastrophic decline, spawner density, and hatchery influence (see Table 3 in Williams et al. 2008). In general, the spawner density low-risk criterion, which seeks to ensure a population's viability in terms its ability to fulfill its historical functional role within the ESU, is the most conservative. Preliminary viability targets for each population are determined by the spawner density low-risk criterion (see Table 4 in Williams et al. 2008). The ESU-level criteria are intended to ensure representation of the diversity within and ESU across much of its historical range, to buffer the ESU against potential catastrophic risks, and to provide sufficient connectivity among populations to maintain long-term demographic and genetic processes.

The lack of time series of adult abundance at the appropriate spatial scale or temporal scale (i.e., enough years of data from present back 9 to 12 years) precluded rigorous application of the criteria proposed by Williams et al. (2008). Although the appropriate data were lacking for the TRT to assess population viability using the framework proposed, data available to the TRT and used by Good et al. (2005) were in agreement with earlier assessments (Weitkamp et al. 1995; California Department of Fish and Game 2002) that component populations were in decline and that SONCC coho salmon were likely to become endangered in the foreseeable future.

New and Updated Analysis

Quantitative population-level estimates of adult spawner abundance spanning more than 9 –12 years are scarce for independent or dependent populations of the SONCC coho salmon ESU. New data since the last status review (Good et al. 2005) consist of the continuation of a limited number of adult abundance time series (some of which had only a few years of data at the time of the last status review), expansion of sampling efforts in coastal basins of Oregon to collect data on SONCC coho salmon populations, and the continuation and addition of several "population unit" scale monitoring efforts in California.

The Oregon Department of Fish and Wildlife (ODFW) has initiated monitoring and reporting of time series of adult coho salmon estimates for five of the seven independent populations of SONCC coho salmon in Oregon. These estimates are based on spawning habitat distribution as sampling frames and the Environmental Monitoring and Assessment Program (EMAP) site selection process to provide random, spatially balanced set of sites. These estimates are of wild spawners derived through application of carcass fin-mark observations. Sampling did not occur in 2005 and 2009 due to reported budget constraints.

Other than the Shasta River and Scott River adult counts, reliable time series of naturally produced adult migrant or spawners are not available for the California portion of the SONCC ESU at the "population unit" scale. As discussed by Good et al. (2005), the CDFG has conducted annual spawner surveys on 4.5 miles of Sprowl Creek, a tributary to the Eel River, since 1974 (except of 1976-1977) and on 2 miles of Canon Creek, a tributary to the Mad River, since 1981 (PFMC 2010). These counts are conducted primarily to generate minimum Chinook salmon counts and the detection of coho salmon is problematic due to conditions during those surveys (Good et al. 2005). The number of adult coho salmon observed over the past 29 years has never exceeded 29 fish.

Spawning surveys have been conducted on tributaries of the Smith River to generate minimum coho salmon escapement estimates (McLeod and Howard 2010). On the West Branch of Mill Creek, four survey reaches totaling 4.75 miles and on the East Branch five survey reaches totaling 5.4 miles were included, although occasional exclusion or inclusion of specific reaches within each stream varied. The Smith River population unit has approximately 386 IP-km, so this partial count cannot be used to determine current status of this population and the trends of the estimates over the past nine years at each site are not significantly different than zero.

Although long-term data on coho abundance in this ESU are scarce, the available evidence from shorter-term research and monitoring efforts indicate that populations in this ESU have declined since the last formal status review (Good et al. 2005). For all available time series (except the counts from the West Branch and East Fork of Mill Creek), recent population trends have been downward. The longest existing time series at the "population unit" scale is for the past ten years in the Shasta River (Figure 1). This series has a significant negative trend. The two extensive time series from the Rogue Basin also show recent negative trends, although neither is statistically significant.

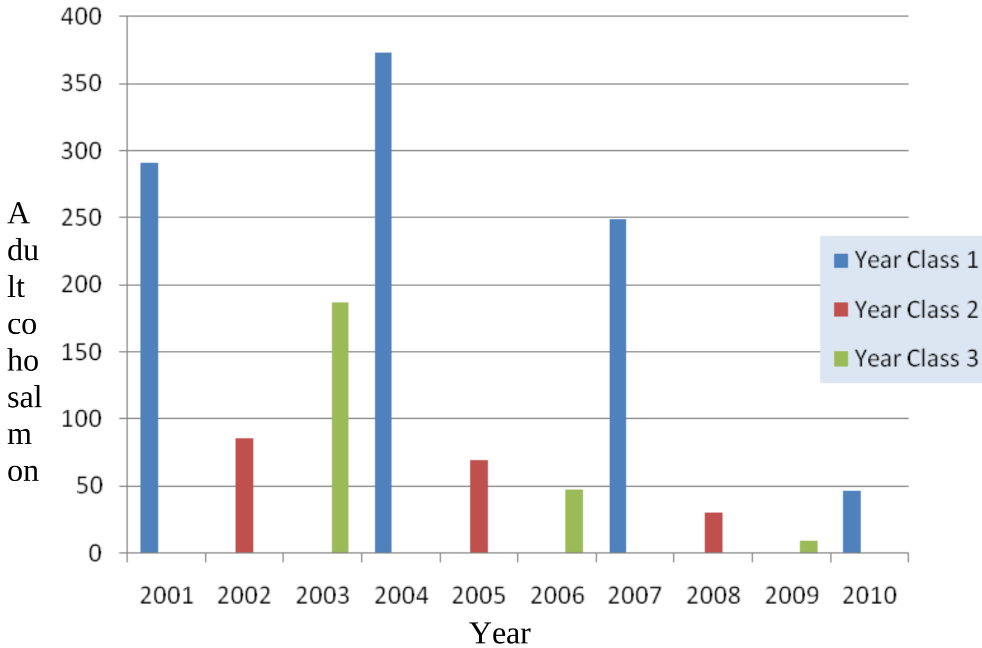

Figure 1. Video weir estimates of adult coho salmon abundance in the Shasta River independent population, 2001 – 2010 (data from M. Knechtle, CDFG).

NMFS received little new data to determine if the spatial distribution of SONCC coho salmon has changed since the last status review (Good et al. 2005). In their review, Good et al. (2005) noted that there were strong indications that breeding groups have been lost from a significant percentage of streams within the historical range of the ESU. Good et al. (2005) also noted that the 2001 brood year appeared to be the strongest of the last decade and that the Rogue River stock had an average increase in spawners over the last several years (as of the Good et al. 2005 review). For this status update, none of the time series examined (other than West Branch and East Fork Mill Creek) had a positive short-term trend and examination of these time series indicates that the strong 2001 brood year was followed by a decline across the entire ESU. The exception being the Rogue Basin estimate from Huntley Park that exhibited a strong return year in 2004, stronger than 2001, followed by a decline to 394 fish in 2008, the lowest estimate since 1993 and the second lowest going back to 1980 in the time series.

These short-term declines across the ESU are of concern, but should be considered in the context of the estimate of marine survival for coded wide tagged (CWT) hatchery fish produced at Cole Rivers Hatchery that indicate marine survival was extraordinarily low for the 2005 and 2006 broodyears (i.e., <0.08%). The estimate for 2004 broodyear was also low at 0.97%. These estimates are in contrast to the much higher marine survival rates of Cole Rivers Hatchery fish that were 4.35%, 7.81%, and 4.89%, respectively, for broodyears 1997, 1998, and 1999 which were the three most recent considered in the Good et al. (2005) review. The negative short-term trends in abundance observed in the limited number of time series are not surprising given the apparent low marine survival in recent years. Of concern, however, is the lack of information suggesting freshwater conditions are improving, the low numbers of fish that have been observed in the few "population unit" scale time series (e.g., Shasta River – 30 adults 2008, 9 adults 2009), and the second lowest number of fish from Huntley Park since 1980.

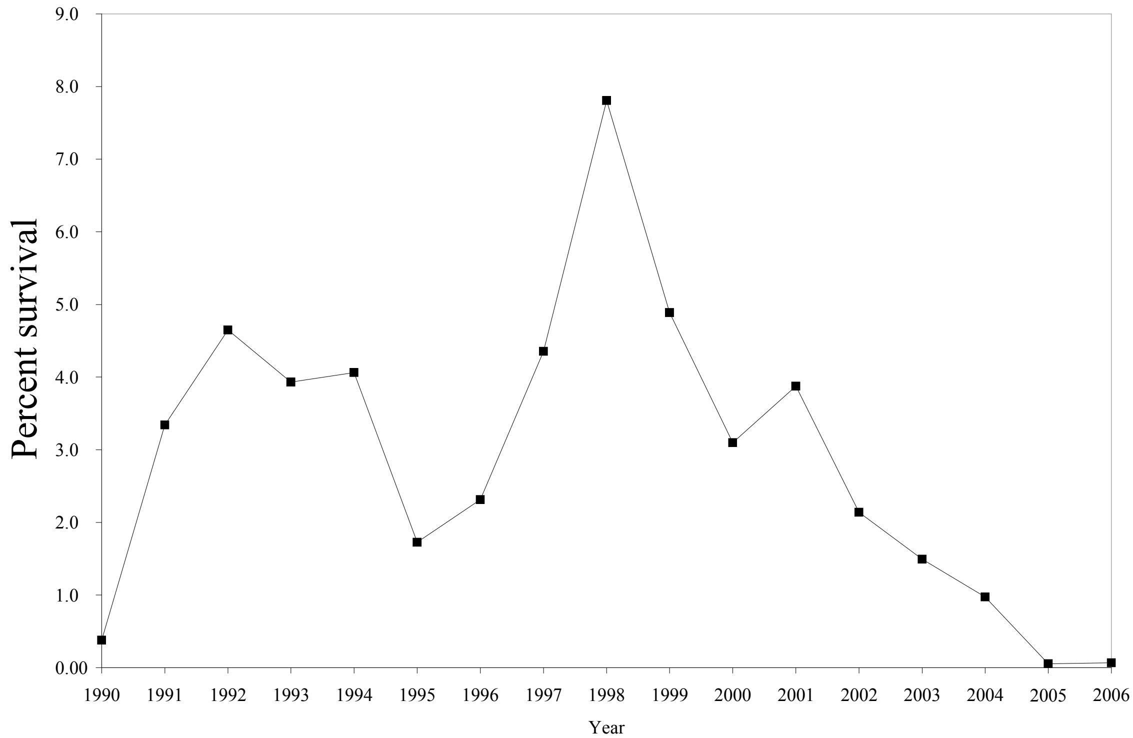

Figure 2. Survival of hatchery fish returning to Cole Rivers Hatchery (Rogue River) based on coded-wire-tag returns: broodyears 1990 – 2006 (data from ODFW).

Additionally, it is evident that many independent populations appear to be well below low-risk abundance targets, and several are likely below the high-risk depensation thresholds specified by the TRT. Though population-level estimates of abundance for most independent populations are lacking, none of the seven diversity strata appears to currently support a single viable population as defined by the TRT's viability criteria, although all diversity strata are occupied (Williams et al. 2011).

The Good et al. (2005) review concluded that the SONCC coho salmon ESU was likely to become endangered. Since that review, the apparent negative trends across the ESU are of great concern as is the lack of information necessary to determine if there has been a substantial improvement in freshwater habitat and survival. However, these recent negative trends must be considered in the context of the apparent extremely low marine survival rates over the past five years that most likely contributed to the observed declines. Overall, this new information, while cause for concern, does not appear to indicate there has been a change in biological extinction risk since the last status review. However, careful monitoring and evaluation of biological extinction of this ESU is warranted.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range

Timber Harvest

At the time of the original listing in 1997 (62 FR 24588), timber harvest was identified as a significant threat to coho salmon in this ESU. In July 2000, the California Department of Forestry (CDF) began imposing stricter guidelines to protect and restore watersheds with threatened or impaired values (T/I rules). The T/I rules were intended to minimize impacts to salmonid habitat resulting from timber harvest by requiring management actions in watersheds with State and Federally listed (threatened or endangered) or candidate populations of anadromous salmonids. The T/I rules were never permanently adopted, but instead were re-authorized by the Board of Forestry (BOF) numerous times following their original inception in 2000. The T/I rules were replaced by the Anadromous Salmonid Protection (ASP) rules in 2010. The BOF's primary objectives in adopting the ASP rules were to: (1) ensure rule adequacy in protecting listed anadromous salmonid species and their habitat, (2) further opportunities for restoring the species' habitat, (3) ensure the rules are based on credible science, and (4) meet Public Resources Code (PRC) § 4553 for review and periodic revisions to the forest practice rules (FPRs).

The effects of past and present timber harvest operations still represent a threat to this ESU. However, within the last decade two large scale habitat conservation plans (HCPs) have been developed and implemented within the range of this ESU. The Humboldt Redwoods Company (HRC and formerly PALCo) HCP was finalized in 1999 and is valid through 2049. The HCP covers approximately 210,000 acres of industrial timberlands in northern California and includes mitigation strategies related to timber management, forest road construction and maintenance, and rock quarrying. The HCP covers five major rivers within the ESU including: Freshwater Creek, Elk River, Eel River, Van Duzen River, and Mattole River. The goals of the HCP are to achieve and move towards properly functioning aquatic conditions with the range of the ESU. To ensure habitat goals are met, the HCP relies heavily on watershed analysis, monitoring, and adaptive management tools. The most recent HRC monitoring report (HRC 2009) indicated that approximately 44% of habitat objectives in the HCP are being met, a 3% improvement since 2008 and a 4% improvement since 2002. The Green Diamond Resource Company (GDRC) HCP was finalized in 2006 and is valid through 2056. The HCP covers approximately 410,000 acres in coastal northern California and affects all coastal coho salmon populations from the Oregon border south to, and including, the Eel and Van Duzen Rivers. One of the major mitigation activities of this HCP includes removing 50% of high and moderate priority road sites within the first 15 years of plan implementation. These measures, coupled with provisions for riparian protection, mass wasting prevention, and adaptive management ensure that adverse impacts to coho salmon rearing, migration, and spawning habitats are minimized or avoided. The first biennial report for the GDRC HCP was submitted to NMFS in 2009 (GDRC 2009). The report focused primarily on laying a foundation for future monitoring efforts, and reported baseline environmental conditions (e.g., turbidity levels, stream temperatures) for future comparison. Both of these HCPs are expected to improve management of private timberlands in northern California over the coming decades. At this time, however, it is not possible to evaluate changes in coho salmon habitat conditions resulting from implementation of the HCPs.

Despite the benefits from the HRC and GDRC HCPs, timber harvest within the range of this ESU continues to be a threat. NMFS staff have actively engaged and participated in BOF meetings and expressed concern to the BOF that the ASP rules, while resulting in some improvements to riparian protections, will not adequately protect anadromous salmonids until several inadequacies in the FPRs are addressed. Specifically, NMFS believes that take of listed salmonids associated with timber harvest operations in California could be minimized (but not entirely avoided) if the following additional protections were added to the existing ASP rules: 1) provide Class II-S (standard) streams with the same protections afforded Class II-L (large) streams, 2) include provisions to ensure hydrologic disconnection between logging roads and streams, and 3) include provisions to avoid hauling logs on hydrologically connected roads during winter periods. In addition NMFS believes the use of scientific guidance will provide additional limitations in the rate of timber harvest in watersheds to avoid cumulative impacts of multiple harvests, and provide greater protections to ensure the integrity of high gradient slopes and unstable areas. This may include limiting the areal extent of harvest in such areas.

In summary, NMFS is working collaboratively with the BOF to limit the effects of forestry operations on threatened and endangered salmonid populations in California, including the SONCC coho salmon ESU. At this time, however, the effects of past and present timber harvest activities continue to be an ongoing threat to this ESU.

Roads

At the time of the original listing in 1997 (62 FR 24588), roads were identified as a threat to the SONCC coho salmon ESU. Roads, especially unpaved roads, are a pervasive feature throughout the ESU and reflect a legacy of land use activities. Road construction, whether associated with timber harvest or other activities, has caused widespread impacts to salmonids, including coho salmon (Furniss et al. 1991). Nearly all populations are affected by high road density, with some areas having greater than 3 miles of road per square mile of watershed. Armentrout et al. (1999) used a reference of 2.5 mi/mi^2 of roads as a watershed management objective to maintain hydrologic integrity in Lassen National Forest watersheds harboring anadromous fish. Cederholm et al. (1980) found that fine sediment in salmon spawning gravels increased by 2.6 - 4.3 times in watersheds with more than 4.1 mi/mi^2 of unpaved roads. Although some roads have been decommissioned in timbered areas, in many instances, maintenance of existing roads is lacking, leading to chronic impacts to salmonid habitat. Where roads cross salmonid-bearing streams, improperly placed culverts have blocked access to many stream reaches. Roads intercept natural drainage patterns, potentially increasing peak flows (Ziemer 1998) with consequent effects on the stability of stream substrates and banks (Chamberlin et al. 1991, McIntosh et al. 1994). Excessive sediment decreases emergence survival (Phillips et al. 1975; McHenry et al. 1994; Kondolf 2000), reduces carrying capacity for juvenile salmonids due to pool filling, and reduces feeding and growth due to high turbidity levels (Sigler et al. 1984). In addition to increased sediment loading, water quality can also be impaired by heavy metal, gas, oil and other pollutants deposited on roads and washed into streams (Sandahl et al. 2007).

In 2007, NMFS approved Humboldt, Del Norte, Trinity, Siskiyou and Mendocino Counties' (Five Counties) "Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California Watersheds" (Manual; Five Counties 2002) under the existing salmon and steelhead 4(d) rule for threatened salmonids in California. To qualify their road programs, the Five Counties collaboratively developed the Manual to address county road maintenance impacts on coho salmon. Despite recent efforts to address impacts associated with county roads, there still remains inadequate funding for road projects, inadequate regulations for maintenance and building on private roads, and a large number of existing problems associated with private and public roads throughout the ESU.

Besides the Five Counties' efforts, no significant changes to roads and road impacts have occurred since the last review and roads remain an ongoing threat to the SONCC coho salmon ESU.

Agricultural Operations and Grazing

At the time of the original listing in 1997 (62 FR 24588), agricultural practices were identified as a threat to the SONCC coho salmon ESU. Since the listing, a number of agricultural water quality management plans (AWQMPs) have been completed in southern Oregon. NMFS hoped that implementation of AWQMPs would achieve state water quality standards. However, despite completion of numerous AWQMPs, state water quality standards are still unmet. In California, Regional Water Quality Control Boards regulate water quality through their Total Maximum

Daily Load (TMDL) program and permit waiver programs for agricultural runoff. TMDLs have been completed for many northern California watersheds, but the water quality impairments remain on the Clean Water Act's (CWA) 303d list.

In 2003, the Environmental Protection Agency (EPA) revised their CWA permitting requirements and effluent limits for concentrated animal feeding operations (CAFOs). The 2003 revision required all CAFOs seek coverage under a national pollutant discharge elimination system (NPDES) permit unless they demonstrated no potential to discharge pollutants to waters of the U.S. These more stringent revisions extended requirements to facilities that had not been previously regulated. However, in 2005, an appellate court directed the EPA to only require NPDES permits from CAFOs that discharge or proposes to discharge pollutants, and to require nutrient management plans from CAFOs seeking NPDES permits. In response to the court decision, the EPA issued the 2008 final CAFO rule which required states, as necessary, to revise their NPDES regulations within one year to adopt the requirements of EPA's 2008 rule, or two years if statutory changes are needed, as provided in 40 CFR 123.62.

In northern California, the North Coast Regional Water Quality Control Board (NCRWQCB) administers the NPDES program, and is currently drafting a general NPDES permit for CAFOs that will comply with the EPA rule. The general NPDES permit will improve on the existing conditional waiver that is not sufficiently protective of all water resources (NCRWQCB 2010). Because the final federal CAFO rule has been in place for only 2 years and the NCRWQCB is still in the process of implementing the new federal rule, the federal CAFO rule has not yet improved coho salmon habitat in northern California. Improvements to water quality downstream of CAFOs in northern California are likely once the NCRWQCB finalizes their NPDES regulations.

In 2009, the Oregon Department of Agriculture incorporated all of the EPA 2008 CAFO Rule into the most current Oregon CAFO General Permit #01-2009 (permit). The permit and Oregon Statute, ORS 468B.050, require NPDES CAFO Permit registrations for livestock facilities much smaller than what is required by the EPA 2008 CAFO Rule (Matthews 2011). Therefore, water quality downstream of CAFOs and smaller livestock facilities should be protected by the most current Oregon CAFO permit.

In summary, agricultural operations and grazing continue to be a threat to the SONCC coho salmon ESU, although some improvements to CAFO regulations have been made in recent years.

Mining

At the time of the original listing in 1997 (62 FR 24588), mining was identified as a threat to the SONCC coho salmon ESU. Since the listing, instream gravel mining practices have improved in Northern California and Southern Oregon. Mining operations are permitted by the U.S Army Corps of Engineers (Corps) and the permits in place contain numerous impact minimization measures to reduce the effects of gravel extraction on coho salmon and their habitat. However, even with minimization measures, gravel extraction reduces overall habitat complexity and reduces the quality and quantity of available pool habitat (Simon and Hupp 1992). Given the sensitivity of channels to disturbance (i.e., current lack of floodplain and channel structure; low levels of instream wood), and the use of gravel extraction reaches by juvenile coho salmon for summer rearing, gravel extraction is a significant threat to rearing juveniles and a moderate threat to adults who require resting habitat in pools during upstream migration. In recent years, NMFS has worked with the Corps and others, pursuant to section 7 of the ESA, to minimize the effects of several gravel mining operations in Humboldt County and southern Oregon, and the measures included in the resulting biological opinions provide increased protections for coho salmon and their habitat. Beginning in 2010, the intensity of gravel mining operations in the Mad River will be correlated with annual water yields and annual estimates of sediment recruitment (NMFS 2009), which is expected to significantly reduce impacts to coho salmon in the Mad River.

Since the listing of the SONCC coho salmon ESU, California has developed new regulations including special closed areas, closed seasons, and restrictions on gravel mining methods and operations to minimize and prevent disturbance of aquatic habitat (Cal. Code Regs., tit. 14, Sections 228 and 228.5). These new regulations in place are to help protect habitat, but careful monitoring of mining activity is necessary to ensure compliance.

On August 6, 2009, the California governor signed into law (SB 670) placing a moratorium on suction dredge mining permits due to the potentially detrimental effects the practice has on salmonid spawning and rearing habitat. As a result of the moratorium, suction dredging does not presently affect coho salmon and its habitat. The moratorium will remain in effect until the CDFG completes a court-ordered environmental review of its permitting program and implements any necessary updates to the existing regulations. The court-ordered environmental review addressing the effects of suction dredging is expected to be completed in the summer of 2011.

In summary, the threat from gravel mining on SONCC coho salmon has been reduced in northern California and Southern Oregon since the last review in 2005, and the threat from suction dredging has been temporarily eliminated.

Urbanization

At the time of the original listing in 1997 (62 FR 24588), urbanization was identified as a threat to the SONCC coho salmon ESU. Urbanization impacts SONCC coho salmon habitat mostly through development and associated road construction and land clearing in and adjacent to floodplains. Development induces changes in the hydrologic regime because of the increased impermeable surfaces, often resulting in increased runoff during winter storm events and reduced infiltration essential to replenish the aquifer. Reduced aquifer replenishment results in lower stream flows in the summer and early fall. Sediments washed from the urban areas contain trace metals such as copper, cadmium, zinc, and lead (Davis et al. 2001; Barrett et al. 1998). These, together with pesticides, herbicides, fertilizers, gasoline, and other petroleum products, contaminate drainage waters and harm aquatic life necessary for coho salmon survival. Other habitat impacts include rock slope protection (riprap) along river banks and the construction of levees along rivers and around estuaries for flood protection. Levees have reduced the size of floodplains and estuaries essential for providing rearing habitats for salmonids.

Roads, buildings, riprap, and levees continue to be present in floodplains throughout northern California and southern Oregon, and therefore, urbanization remains a threat to the SONCC coho salmon ESU and its habitat.

Water withdrawal and unscreened diversions

At the time of the original listing in 1997 (62 FR 24588), water withdrawal and unscreened diversions were identified as threats to the SONCC coho salmon ESU. Since 2005, no significant reductions in water withdrawals have occurred, but some diversions have been properly screened to protect juvenile coho salmon from entrainment and other impacts.

While water withdrawals have remained relatively unchanged since 2005, efforts have been made to address the impacts of water withdrawals on anadromous fish which should improve habitat conditions in the future. In 2005, California amended its Water Code §1259.4 to require the State Water Resources Control Board (SWRCB) to adopt by January 1, 2008, a policy for maintaining instream flows in coastal streams from the Mattole River to San Francisco, and in coastal streams entering northern San Pablo Bay. Though delayed, the SWRCB adopted an instream flow policy in 2010 for central coastal California streams. The instream flow policy calls for limiting new water diversions to only the winter period from December 15 to March 31, establishing bypass flows for new dams, establishing a cumulative maximum rate of withdrawal, and restricting construction of new on-stream dams (SWRCB 2010). Although applicable only to the central coast, this instream flow policy at least provides some measures to protect flows in the Mattole River watershed and could be used as a template for other other watersheds in the SONCC coho salmon ESU in the future.

In November of 2009, the California State Legislature passed a series of bills that require groundwater monitoring and enforcement of illegal diversions, more ambitious water conservation policy, and water recycling and conservation programs. Implementation of these new measures may help reduce less efficient or illegal use of diversions in SONCC coho watersheds, but there is still no comprehensive strategy for providing instream flow for coho salmon in both California and Oregon. If effectively implemented, these California water bills should contribute to improved instream habitat in the future.

In summary, important efforts have been implemented to reduce the impacts of water withdrawal and unscreened water diversions, but these activities continue to represent a threat to the SONCC coho salmon ESU.

Stream Channelization

At the time of the original listing in 1997 (62 FR 24588), stream channelization was identified as a threat to the SONCC coho salmon ESU. In nearly all the estuaries within the ESU, the majority of historic estuarine habitat has been diked off from the channel for agriculture and flood protection (Seliskar and Gallagher 1983). The remaining areas lack rearing potential and natural estuarine function. Channelization often occurs in association with agriculture and development and leads to the simplification and degradation of habitat. Channelized reaches often lack floodplain connectivity and riparian vegetation, rarely contain complex habitat features such as pools, and experience high flows and degraded water quality. These areas provide little if any rearing or spawning habitat and can contribute to degraded water quality and hydrologic function within the watershed. Since the last status review, there has been no significant removal or set back of dikes within the range of this ESU.

In summary, stream channelization and the diking of stream and river channels still occurs within the range of the SONNC coho salmon ESU, and therefore, continues to be a threat to the specie and its habitat.

Beaver trapping

At the time of the 1997 listing, beaver trapping was identified as a threat to the SONCC coho salmon ESU (60 FR 38011). Beavers create dams, which impound water and provide rearing habitat for coho salmon. The lower velocities and the large edge-to-surface-area of beaver ponds support a highly productive environment for both vegetation and aquatic invertebrates. The enhanced cover and prey abundance provide coho salmon with foraging opportunities not found in unimpounded stream habitats (Keast and Fox 1990). During the winter, juvenile coho salmon rearing in side channels impounded by beaver dams are consistently larger and have a higher overwinter survival rate than juveniles that use side channels without beaver dams (Bustard and Narver 1975a; Swales et al. 1986). Similarly, juvenile coho salmon rearing upstream of beaver dams during the summer were found in higher densities and larger than in other habitat types (Murphy et al. 1989).

Regulations on beaver trapping in both California and Oregon have not significantly changed since the last status review and still allow for the trapping or killing of beavers. Therefore, beaver trapping remains an ongoing threat to the SONCC coho salmon ESU and its habitat.

Barriers

At the time of the 1997 listing, barriers were identified as a threat to the SONCC coho salmon ESU (60 FR 38011). Approximately 450 manmade barriers remain throughout the California portion of the ESU (Koller 2010) which block access to historic spawning and rearing areas. Since the last review, several significant fish passage improvements have occurred throughout the ESU. In the Rogue River, three dams have been recently removed (i.e., Savage Rapids Dam in 2009, Gold Hill Dam in 2008, and Gold Ray Dam in 2010) and one notched (i.e., Elk Creek Dam in 2008) to restore natural flow and fish passage. The Rogue River now flows unimpeded for 157 miles from the Cascade foothills to the ocean, increasing salmon returns by an estimated 22% (NMFS 2010b). Since 2005, 75 barriers in the California portion of the ESU have been remediated with funding from the CDFG Fisheries Restoration Grant Program (Carpio 2010).

Overall, coho salmon passage has improved since the last review, barriers to migration remain a major threat to the SONCC coho salmon ESU because many have yet to be remediated and they continue to block passage to historic habitat.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational

purposes

Tribal harvest

At the time of the 1997 listing, tribal harvest was not considered to be a major threat to the SONCC coho salmon ESU (62 FR 24588). Klamath basin tribes (Yurok, Hoopa, and Karuk) harvest a relatively small number of coho salmon for subsistence and ceremonial purposes (CDFG 2002). Coho salmon harvested by Native American tribes is primarily incidental to larger Chinook salmon subsistence fisheries in the Klamath and Trinity Rivers. Estimates of the harvest rate for the Yurok fishery are available since 1992, and averaged 4% from 1992–2005 and 5% from 2006–2009 (Williams 2010). Harvest rate estimates for the other two tribal fisheries were not available at the time of this review. The available information indicates that tribal fisheries continue to take SONCC coho, but that the impacts have not changed since the last review.

Non-tribal commercial fishery

At the time of the 1997 listing the non-tribal commercial fishery was identified as a major factor in the decline of the SONCC coho salmon ESU (62 FR 24588). SONCC coho salmon are primarily distributed off the coast of California and southern Oregon. Because coho salmon-directed fisheries and coho salmon retention have been prohibited off the coast of California since 1996, the SONCC coho salmon ocean exploitation rate is likely very low and attributable to non-retention impacts in California and Oregon Chinook-directed fisheries and in Oregon's mark-selective coho fisheries. The Rogue/Klamath coho salmon ocean exploitation rate forecast time series from 2000 to 2010 (Figure 3) is the best available measure of ocean exploitation rate for the SONCC coho salmon ESU. This exploitation rate was stable and averaged 6% from 2000–2007 before declining to 1% and 3% in 2008 and 2009, respectively, due to closure of nearly all salmon fisheries south of Cape Falcon, Oregon. For 2010, the forecasted rate was 10% (Pacific Fisheries Management Council [PFMC] 2010) primarily due to the resumption of recreational fishing off California and Oregon in 2010. However, preliminary post-season estimates show the marine exploitation rate was only 2.2% in 2010 (PFMC 2011). Because of restrictions on the ocean salmon fishery since 2005, impacts of the commercial fishery on the SONCC coho salmon ESU have been reduced since the last review.

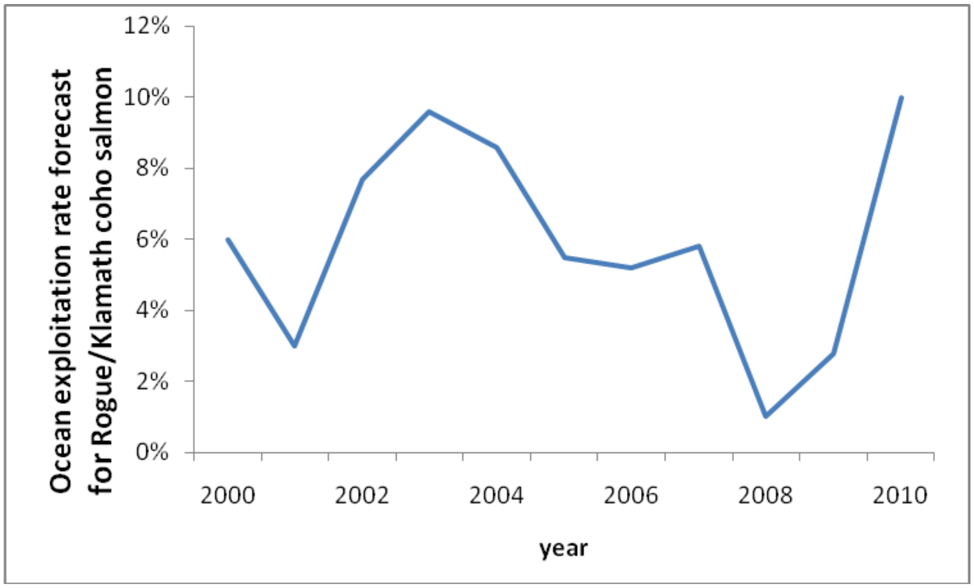

Figure 3. Rogue/Klamath coho salmon ocean exploitation rate forecast for years 2000-2010 (PFMC 2010b).

Recreational fishing

At the time of the 1997 listing, recreational fishing was considered a potential threat to the SONCC coho salmon ESU (62 FR 24588). Recreational harvest of SONCC coho salmon has not been allowed since 1994, with the lone exception being a mark-selective recreational coho salmon fishery that has taken place in recent years in the Rogue River and Oregon coastal waters. The PFMC (2007) estimated that 3.3% of Rogue/Klamath coho salmon accidentally caught in this mark-selective fishery would die on release. To date, no assessments of coho salmon bycatch have occurred in Oregon or California. Overall, the threat to the SONCC coho salmon ESU from recreational fishing is unknown, but is likely unchanged since the last status review.

Scientific Research

At the time of the 1997 listing, collection for scientific research was considered a minor threat to the SONCC coho salmon ESU (62 FR 24588). Since the last review (70 FR 37160), NMFS believes that the ESA section 10(a)(1)(A) research and enhancement permit program has continued to be a minor threat to the ESU because the issuance criteria [50 CFR§ 222.308 (c)] are designed to insure that the permit (1) will not operate to the disadvantage of the endangered species; and (2) will further a bona fide and necessary or desirable scientific purpose. To insure that authorizing the take of fish for scientific research would not jeopardize the continued existence of the ESU, NMFS completed an ESA section 7 consultation on each permit prior to its issuance. The majority of juvenile and adult SONCC coho salmon take authorized in section 10 research permits is non-lethal (harass or harm). Potential unintentional mortality of juveniles, analyzed in the section 7 consultation, generally ranges from 1 to 3 percent of the total number of juveniles captured; however, this percentage is rarely realized. Based on the available information, it is unlikely that the take and associated threat from scientific research has changed since the last status review.

2.3.2.3 Disease or predation

Disease

Ceratomyxosis, which is caused by *Ceratomyxa shasta*, has recently been identified as one of the most significant diseases for juvenile salmon due to its prevalence and impacts in the Klamath Basin (Nichols et al. 2003). Severe infection of juvenile coho salmon by *C. shasta* may be contributing to declining adult coho salmon returns in the Klamath basin (Foott et al. 2010). Mortality rates from temporary and longer term exposures at various locations in the Klamath River vary between location, months and years, but are consistently high (10-90%) (Bartholomew 2008). In addition, parasitic infections by *Parvicapsula minibicornis* have been detected in 65% of young of the year and 71% of yearling coho salmon in the mainstem Klamath River (Nichols et al. 2008). Although the prognosis of juvenile coho salmon infected with *P. minibicornis* is unknown, infections contribute to additional stresses to juveniles, which cumulatively decrease growth and survival. Adults in the Klamath basin are also impacted by disease, primarily from the common pathogens *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* (columnaris) (NRC 2003). These pathogens were responsible for the 2002 adult fish die-off on the Klamath River (Guillen 2003; CDFG 2003; Belchik et al. 2004). Adult mortality from ich and columnaris are not as common as juvenile mortality from *C. shasta* or *P. minibicornis*. Although a large-scale fish kill has not occurred since the last status review, the potential for such an event still exists and is believed to remain a threat for this ESU. In summary, the prevalence of infection and disease generally has not changed since the last status review, but continues to be an ongoing threat to the SONCC coho salmon ESU.

Sacramento Pike minnow predation

At the time of the 1997 listing, Sacramento pike minnow predation was considered a threat to coho salmon populations in the Eel River basin (62 FR 24588). The non-native Sacramento pikeminnow is still observed throughout the Eel River basin and is a predator that impedes coho salmon recovery (Yoshima and Moyle 2010). No significant eradication efforts have been undertaken since the last status review. Based on recent data collected in the Upper Eel River (PG&E 2010), the pikeminnow population has decreased from its peak in the 1980s and 1990s and has continued to vary in size since new monitoring began in 2005. The decline in pikeminnow abundance in the upper mainstem Eel River is believed to be a result of increased flows from the Potter Valley Project that began in 2005 (Jahn 2010); however, thousands of Sacramento pikeminnow still threaten juvenile coho salmon survival on the mainstem and tributaries of the Eel River. In summary, predation from the Sacramento pikeminnow continues to be a threat to the SONCC coho salmon ESU and in unlikely to have diminished significantly since the last status review.

Sea lions and harbor seals

At the time of the 1997 listing, marine mammal predation was identified as a potential threat to the SONCC coho salmon ESU (62 FR 24588). California sea lions and Pacific harbor seals (which occur in most estuaries and rivers where coho salmon are present) are known predators of salmonids, and their numbers are increasing. Predation by these marine mammals may significantly influence salmonid abundance in some local populations when other prey species are absent and physical conditions lead to the concentration of salmonid adults and juveniles (Cooper and Johnson 1992). Although fishes form the principal food sources of many marine mammals, coho salmon appear to be a minor component of their diet (Roffe and Mate 1984; Brown and Mate 1983; Graybill 1981; Jameson and Kenyon 1977; Scheffer and Sperry 1931). Although there are likely more seals and sea lions than existed at the time of the last status review, there is no evidence the threat of predation has increased threat for SONCC coho salmon.

Hatchery fish predation

At the time of the 1997 listing, predation from hatchery fish was not identified as a threat to SONCC coho salmon (62 FR 24588). Recent studies have raised concerns about the potential impacts of hatchery fish predation on natural coho salmon populations. Hatchery fish can exert predation pressure on juvenile coho salmon in certain watersheds. Released at larger sizes than naturally produced juveniles and in great quantity, hatchery-reared salmonids will often prey on naturally-produced juvenile coho (Kostow 2009). There is evidence that predation by hatchery fish may result in the loss of tens of thousands of naturally produced coho salmon fry annually in some areas of the Trinity River (Naman 2008). Because hatchery production has not significantly changed, the threat from hatchery fish predation likely remains unchanged since the last status review.

Predatory Non-native species

At the time of the 1997 listing, NMFS did not identify predation from non-native species as a threat to the SONCC coho salmon ESU (62 FR 24588). The invasive American bullfrog (*Rana catesbeiana*) is known to occur throughout the range of this ESU and it competes for food resources and/or preys on juvenile coho salmon (Garwood et al. 2010). Bullfrogs are highly predatory and are found in seasonal habitats where juvenile coho salmon rear, such as off-channel ponds, side channels, and alcoves. Brown trout (*Salmo trutta*) and striped bass (*Morone saxatilis*) are common non-native predators in many watersheds occupied by the ESU. In the Trinity River, for example, brown trout compose a substantial proportion of the fish observed by biologists during juvenile salmonid habitat use surveys (Martin 2009). Brown trout and striped bass, both piscivorous, likely consume naturally produced fry and juvenile coho salmon, but the amount is not known. Based on the available information, predatory invasive species have likely increased as a threat to the SONCC coho salmon ESU since the last status review.

2.3.2.4 Inadequacy of existing regulatory mechanisms

Northwest Forest Plan

At the time of the 1997 listing, the Northwest Forest Plan (NFP) was recognized as a benefit to coho salmon, but was limited to only federally managed lands administered by the U. S. Forest Service (USFS) and Bureau of Land Management (BLM) in the range of the northern spotted owl (which overlaps with a majority of the SONCC coho ESU). The essential component of the NFP is the Aquatic Conservation Strategy (ACS) that conserves and protects aquatic and riparian dependent species, specifically anadromous salmonids and their habitats. While the NFP covers a very large area, the overall effectiveness of the NFP in conserving Oregon and California coho salmon is limited by the extent of USFS and BLM Federal lands. Federal land ownership is not uniformly distributed in some areas within the ESU or tends to be located in the upper reaches of watersheds or river basins, upstream of the highest quality coho salmon habitat. In other areas, federal lands are distributed in a checkerboard fashion. These federal land distribution factors continue to constrain the ability of the NFP to achieve its aquatic habitat restoration objectives at watershed and river basin scales and highlight the importance of complementary salmon habitat conservation measures on non-federal lands within the ESU. Although the NFP itself is an improvement over past management practices, its limitations regarding protection of coho salmon habitat in this ESU remain unchanged since the last status review.

State Forest Practices

At the time of the 1997 listing, forest practice rules (FPRs) in both Oregon and California were identified as needing improvements to protect coho salmon and their habitats (62 FR 24588). These FPRs apply to all non-Federal forestland, including private, state-owned and local government-owned forestlands. Due to the amount of private timber land and timber harvest activity in the range of this ESU, careful consideration of state forest practices rules and regulations is necessary. At the time of listing, most reviews of the FPRs indicated that implementation and enforcement of these rules did not adequately protect coho salmon or their habitats (CDFG 1994; Murphy 1995). Although the FPRs in both Oregon and California have recently been reviewed and recommendations have been made for improving aquatic habitat protection, neither State has fully adopted these recommendations.

State Agricultural Regulations

At the time of the 1997 listing, NMFS identified the need to regulate impacts to salmon habitat from agricultural practices (62 FR 24588). The Oregon Department of Agriculture completed guidance for development of agricultural water quality management plans (AWQMPs) (as enacted by State Senate Bill 1010) at the time of federal listing. Plans that were consistent with this guidance were assumed to achieve state water quality standards. However, despite completion of numerous AWQMPs, state water quality standards are still unmet. For example, monitoring in the Rogue River Basin has revealed unsuitable levels of *E. coli*, turbidity, and dissolved oxygen in recent years (ODA 2009). Accordingly, it appears that AWQMPs are not likely to be improving habitat conditions for coho salmon. The Oregon Department of Environmental Quality reported that the AWQMPs are not effective due to a lack of awareness that the plans exist, and resistance from municipalities to take the plans and rules seriously when developing land use laws (ODEQ 2009). The ability of AWQMPs to improve water quality will depend on public outreach efforts and the manner in which the plans are implemented. The State of California does not have regulations that directly manage agricultural practices, but relies on TMDLs developed under the CWA to improve water quality from all sources and parties. Numerous streams throughout the range of this ESU that are currently impacted by agricultural practices do not have TMDLs (NCRWQCB 2010a) and many are not scheduled for completion until 2019. Overall, the threat from inadequate agricultural regulations continues for the SONCC coho salmon ESU is believed to be relatively unchanged since the last status review.

Permitting of Dredge, Fill, and In-water Construction Programs

At the time of the 1997 listing, NMFS identified limitations in the Federal and state regulations pertaining to dredging and filling of aquatic resources (62 FR 24588). The Corps regulates removal/fill activities under section 404 of the CWA. The regulations under section 404 are inadequate for protecting coho salmon habitat because they are restricted to activities that result in direct filling or dredging of waters (e.g., upland activities are generally excluded) and because they do not adequately prevent cumulative impacts from multiple projects. Upland activities, such as timber harvesting or road construction, although not regulated under section 404, can result in a reduction of riparian shade or an eventual increase in sediment delivery to streams. The Corps requires an evaluation of cumulative impacts from these permits; however, the effectiveness of such evaluations in minimizing cumulative impacts is unknown.

Similarly, the section 401 water quality certification program, which is regulated by the states of California and Oregon, applies only to activities that require a federal permit or license (i.e., 404 permit or FERC license). Because the 401 certification requirements depend on the initiation of the 404 permitting or FERC licensing process, the 401 program does not address exclusively upland activities that may have downslope effects on aquatic habitats. Therefore, the lack of review and jurisdiction for upland activities limits the ability of the 404 and 401 regulatory programs to provide protection to coho salmon and its habitat.

State agencies responsible for dredge and fill permits include the Oregon Department of State Lands (DSL) and Department of Environmental Quality (DEQ) along with the California Water Quality Control Board and in some cases the California Department of Fish and Game. The states attempt to minimize or prevent habitat degradation through the development of standardized permit conditions incorporating best management practices for removal and fill activities and through strengthening interagency coordination in removal and fill permitting.

Overall, the existing limitations of programs to permit dredge, fill, and in-water construction activities are believed to be relatively unchanged since the last status review, and therefore, remain an ongoing threat to SONCC coho salmon ESU.

Water Quality Programs

At the time of the 1997 listing, NMFS identified limitations regarding the development of TMDLs for many 303(d) listed water bodies (62 FR 24588). The State water quality agencies and the EPA administers the CWA and are required to develop TMDLs for water bodies that are identified as impaired on the 303(d) list. Since the last status review, seven watersheds within the SONCC ESU have had TMDLs developed to limit the pollutants that are impairing the water bodies. A total of twenty-four TMDLs have been completed in the range of the SONCC ESU. The potential for these TMDLs to protect coho salmon in Oregon and California is expected to be significant in the long term; however, they are difficult to implement quickly and their efficacy in protecting coho salmon habitat will be unknown for years to come. Although progress is being made, effective regulation of water quality throughout the range of the SONCC coho salmon ESU has remained relatively unchanged since the last status review, and therefore, remains a threat.

Harvest Management

At the time of the 1997 listing, NMFS identified harvest management, particularly CDFG’s sport fishing regulations that allowed fishing for coho salmon in inland waters, as a threat to the SONCC coho salmon ESU (62 FR 24588). Since 1998, however, CDFG has prohibited retention of coho incidentally taken in California’s inland waters (CDFG 2002). Historically, ocean harvest of coho from this ESU occurred in coho and Chinook directed commercial and recreational fisheries off the coasts of California and Oregon. Significant changes in harvest management have occurred since the late 1980s, resulting in substantial reductions the harvest of SONCC coho salmon.

Current regulations include time and area closures, seasonal quotas, minimum sizes, gear restrictions, and allowable take. SONCC coho salmon experience incidental morality due to hooking and handling in other fisheries, especially the Chinook salmon fishery north of Humbug Mountain (Good et al. 2005). Modeled impacts from regulations for non-retention and mark-selective coho salmon fisheries, which take into account incidental mortality and non-compliance, project that Rogue and Klamath hatchery stocks (a surrogate for SONCC coho salmon ESU stock) sustain exploitation rates of 6-10 %, which is below the exploitation rate of 13% for low spawner abundance or low marine survival conditions (PFMC 1999). Harvest management of this ESU is considered effective and is relatively unchanged since the last status review.

2.3.2.5 Other natural or manmade factors affecting its continued existence

Hatcheries

At the time of the 1997 listing, NMFS identified hatcheries and hatchery fish as a threat to the SONCC coho salmon ESU (62 FR 24588). Three artificial propagation programs for coho salmon are included in the listed ESU: Cole Rivers Hatchery on the Rogue River, Trinity River Hatchery on the Trinity River, and Iron Gate Hatchery on the Klamath River (70 FR 37160). Annual coho salmon production goals at these hatcheries are 200,000, 500,000, and 75,000 fish, respectively. Management of these hatchery programs, including the broodstock that is used, has not changed substantially since the last status review. These three programs also produce Chinook salmon and steelhead for release into the wild as do the Mad River and Rowdy Creek hatcheries in California and the Elk River Hatchery in Oregon. The Chinook salmon and steelhead produced by these programs likely prey on, or compete with, the naturally produced coho salmon in this ESU.

Natural populations of coho salmon in this ESU are heavily influenced by hatchery programs through genetic and ecological interactions (Weitkamp et al. 1995; Good et al. 2005). Genetic risks associated with out-of-basin and out-of-ESU stock transfers have largely been eliminated.

However, two significant genetic concerns remain: (1) the potential for domestication selection in hatchery populations such as in the Trinity River Hatchery where there is little or no infusion of genes from natural fish, and (2) out-of-basin straying by large numbers of hatchery coho salmon. Spawning by hatchery salmonids in rivers and streams is often not controlled (ISAB 2002) and hatchery fish may stray into non-natal rivers and streams where they can transfer genes into naturally spawning populations (Pearse et al. 2007). CDFG (2002a) found that 29 percent of the coho salmon carcasses recovered at the Shasta River fish counting facility (SRFCF) in 2001 had left maxillary clips indicating that they were progeny from Iron Gate Hatchery. The average percentage of hatchery coho salmon carcasses recovered at the SRFCF from 2001, 2003, and 2004 was 16 percent (Ackerman and Cramer 2006). Although the actual percentage of hatchery fish in the river changes from year to year, and depends largely on natural returns, these data indicate that substantial straying of Iron Gate Hatchery fish may be occurring to important tributaries of the Klamath River. Such straying has the potential to reduce the reproductive success of the naturally spawning populations (Mclean et al. 2003; Chilcote 2003; Araki et al. 2007) and negatively affect the diversity of the interior Klamath populations throughout breeding depression (Reisenbichler and Rubin 1999; HSRG 2004). More information is needed to determine the stray rate and its impact on natural populations. This can be problematic because hatchery programs have the potential to significantly alter the genetic composition (Reisenbichler and Rubin 1999; Ford 2002), phenotypic traits (Hard et al. 2000; Kostow 2004), and behavior (Berejikian et al. 1996; Jonsson 1997) of reared fish.

Genetic interactions between hatchery and naturally produced fish can decrease the amount of genetic and phenotypic diversity within populations and even an ESU as a whole by homogenizing once disparate traits of hatchery and natural fish. The result can be progeny with lower survival (McGinnity et al. 2003; Kostow 2004) and ultimately, a reduction in the reproductive success of the natural populations (Reisenbichler and McIntyre 1977; Chilcote 2003; Araki et al. 2007) which can potentially compromise the viability of natural stocks due to out breeding depression (Reisenbichler and Rubin 1999; HSRG 2004). Williams et al. (2008) considers a population to be at least at moderate risk of extinction if the proportion of naturally spawning fish that are of hatchery origin exceeds 5 percent.

Flagg et al. (2000) found that, depending on the carrying capacity of the system, the release of increasing numbers of hatchery fish often negatively impacts naturally-produced fish because these fish can be displaced from portions of their habitat. Competition between hatchery and naturally-produced salmonids can also lead to reduced growth of naturally produced fish (McMichael et al. 1997). Kostow et al. (2003) and Kostow and Zhou (2006) found that over the duration of the steelhead hatchery program on the Clackamas River in Oregon, the number of hatchery steelhead in the upper basin regularly caused the total number of steelhead to exceed carrying capacity which triggered density-dependent mechanisms that impacted the natural population. Competition between hatchery and natural salmonids in the ocean can also lead to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish et al. 1997; Levin et al. 2001; Sweeting et al. 2003).

NMFS and CDFG are currently developing hatchery and genetic management plans (HGMPs) for the Iron Gate, Trinity River, and Mad River hatcheries that will improve hatchery management and reduce impacts on naturally spawning populations of coho salmon. Overall, however, management of these hatcheries has been relatively unchanged since the last status review, and therefore, they still remain a threat to the genetic integrity and diversity of the SONCC coho salmon ESU.

Invasive Species

At the time of the 1997 listing, invasive species, such as the New Zealand mud snail (*Potamopyrgus antipodarum*), reed canary grass (*Phalaris arundinacea*), were not identified as threats to the SONCC coho salmon ESU (62 FR 24588). Since the last status review, the invasive New Zealand mud snail has been documented to occur in several watersheds within the range of this ESU. New Zealand mud snail colonies disrupt the base of the food chain by consuming algae and competing with native macroinvertebrates. A population decline of macroinvertebrates may result from the invasion of New Zealand mud snail, which may in turn reduce the abundance of preferred prey available to coho salmon. Further research on *P. antipodarum* is needed to assess the impacts to coho salmon in this ESU.

Reed canary grass is an invasive non-native perennial grass that was not identified as a threat at the time the SONCC coho salmon ESU was listed. This grass has been found to prohibit native riparian growth, choke stream channels, provide poor to non-existent habitat for fish and other native aquatic wildlife, inhibit the mobility of fish at lower flows, increase sedimentation, contribute to low levels of dissolved oxygen, and cause overbank flooding during winter and spring base flow conditions (Miller et al. 2008). Over 150 adult unspawned coho salmon were found dead in a field dominated by reed canary grass, likely stranded by the dense reed canary grass when high flows receded quickly in an ill-defined channel (Carrasco 2000). Although the mortality occurred outside of the SONCC coho salmon range, the invasive grass is found throughout southern Oregon and northern California and is a threat to this ESU and its habitat. Overall, reed canary grass is considered a new and growing threat to the SONCC coho salmon ESU.

Droughts and Floods

At the time of the 1997 listing, drought and flooding were identified as threats to the SONCC coho salmon ESU (62 FR 24588). The drought conditions in the decade prior to listing were specifically mentioned as a factor for listing and since that time droughts have continued to produce poor spawning and rearing conditions which may have adversely affected coho salmon. The spring of 2008 was the driest on record for some areas of northern California, and the entire ESU also experienced drought conditions the previous year. In addition, 2009 was also a drought year. Three consecutive years of drought in California have resulted in reduced instream flows and habitat conditions for rearing coho salmon which may affect future spawner abundance. Drought conditions may become more severe and frequent based on predicted changes in temperature associated with climate change (see discussion below). Since the last status review, several years of drought have occurred which have increased threats to this ESU. The impacts to coho habitat resulting from floods are believed to be reduced because of improved land management practices; however, flooding (including their frequency, timing and magnitude) is likely to become less predictable in the future as a result of climate change.

Fire

At the time of the 1997 listing, fire was not identified as a threat to the SONCC coho salmon ESU (62 FR 24588). Fire risks will continue to increase in the future as conditions become drier and hotter with changes in climate. Higher temperatures, reduced snowpack, and earlier spring snowmelt all contribute to the frequency, intensity, and extent of fires. The fire season has already begun to stretch longer into the spring and fall with an increase of 78 days over the last three decades across the western United States (IPCC 2007). Fires seasons will continue to increase and conditions will continue to favor large-scale, high intensity fires. Studies have shown that the probability of large fires (more than 500 acres) will increase by more than 75% in areas within the Klamath and Smith basins with increases of 50% seen throughout inland areas of northern California and southern Oregon (Luers et al. 2006). Elevated fire frequency and intensity will continue to degrade stream conditions through sedimentation and loss of riparian vegetation, and therefore, represents a growing threat to this ESU.

Ocean Condition and Marine Survival

At the time of the 1997 listing, marine survival conditions and El Nino conditions were identified as threats to the SONCC coho salmon ESU (62 FR 24588). Marine survival of coho salmon is correlated with periods of alternating cold and warm ocean conditions. Cold marine water temperatures are generally good for coho salmon, while warm conditions are not (Peterson et al. 2010). Unusually warm ocean surface temperatures and associated changes in coastal currents and upwelling, known as El Niño conditions, result in ecosystem alterations such as reductions in primary and secondary productivity and changes in prey and predator species distributions. Coho salmon along the Oregon and California coast may be especially sensitive to changes in upwelling patterns because these regions lack extensive bays and estuaries which could provide a buffer against adverse oceanographic effects in the marine environment. The paucity of high quality near-shore habitat, coupled with variable ocean conditions, makes freshwater rearing habitat essential for the survival and persistence of many coho salmon populations.

Data from coho salmon produced at the Cole Rivers Hatchery in Oregon indicate that marine survival was extremely low for the 2005 and 2006 broodyears (i.e., 0.05 and 0.07 %, respectively) compared with an average of approximately 2.2% between 2000 and 2004 (Figure 2; Williams et al. 2011). Strong upwelling in the spring of 2007 resulted in better ocean conditions (MacFarlane et al. 2008; Peterson et al. 2010) and marine conditions in 2008 and 2009 have also been favorable (Figure 4), with 2008 being the best in the last 13 years (Northwest Fisheries Science Center 2011). Because salmon productivity and survival are correlated with ocean conditions (Peterson et al. 2010; Pearcy 1992 in Zabel et al. 2006; Beamish & Bouillon 1993), favorable marine conditions usually corresponds with increased marine survival. However, despite favorable marine conditions in 2007 and 2008, data on hatchery fish returns at Cole Rivers Hatchery show extremely poor marine survival for those respective year classes (i.e., the 2005 and 2006 broodyears; Williams et al. 2011). While poor ocean conditions are likely to result in poor marine survival, improved ocean conditions have not resulted in improved marine survival and higher adult returns for SONCC coho salmon. In 2008, adult spawner populations (fish resulting from the 2005 broodyear) within the Oregon Coast coho salmon ESU rebounded from recent declines (Lewis et al. 2009), while many SONCC coho salmon populations, including those in the Rogue River, declined to near record low numbers. On average, coastal coho salmon populations are unable to replace themselves when marine survival falls below about 3% (Bradford et al. 2000). NMFS is concerned that the ocean conditions in 2010 will result in marine survival rates for coho salmon that are similar to recent lows of 0.05 and 0.07%, both of which were significantly below the 3% identified by Bradford et al. (2000) as generally unsustainable for populations. Overall, NMFS believes that poor marine survival has contributed to recent population declines and continues to pose a significant threat to the SONCC coho salmon ESU.

	Year of Samples												
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pacific Decadal Oscillation													
Dec-Mar	12	4	2	8	5	13	7	11	9	6	3	1	10
May-Sep	10	2	4	5	7	12	11	13	9	8	1	6	3
Multivariate El Niño Southern Oscillation Index													
MEI Annual	13	1	3	6	12	11	9	10	7	5	2	8	4
MEI Jan-Jun	13	2	3	4	9	10	7	11	5	8	1	6	12
Mean sea surface temperature (°C)													
Buoy 46050 (May-Sep)	11	8	3	4	1	7	13	10	5	12	2	9	6
NH 05 (May-Sep)	8	4	1	6	2	5	13	10	7	12	3	11	9
Winter prior to ocean entry (Nov-Mar)	13	10	3	5	6	9	11	8	7	2	1	4	12
Coastal upwelling													
Physical transition (upwelling index)	3	6	12	11	4	8	10	13	8	1	5	2	7
Anomalies (April-May)	7	1	12	3	6	10	9	13	7	2	4	5	11
Season length (upwelling index)	6	2	12	9	1	10	8	13	5	3	7	3	11
Deep water at NH 05 (May-Sep)													
Temperature (°C)	13	4	6	3	1	9	10	11	12	5	2	8	7
Salinity	13	3	6	2	5	11	12	8	7	1	4	9	10
Copepod indicators													
Biodiversity (species richness)	13	2	1	5	3	9	8	12	10	6	4	7	11
Anomalies	13	10	3	7	2	11	8	12	9	6	1	5	4
Community structure	13	3	4	6	1	9	10	12	11	7	2	5	8
Biological transition	13	7	5	3	6	11	9	12	10	4	1	2	8
Trawl survey catch													
Winter ichthyoplankton	13	6	2	4	5	9	12	8	11	10	1	7	3
Spring Chinook (June)	12	2	3	10	7	9	11	13	8	6	1	4	5
Coho (Sep)	9	2	1	4	3	5	10	12	7	8	6	13	11
Overall Ranking													
Mean rank	10.9	4.2	4.5	5.5	4.5	9.4	9.9	11.2	8.1	5.9	2.7	6.1	8.0
Rank of mean ranks	12	2	3	5	3	10	11	13	9	6	1	7	8

Figure 4. Rank scores of ocean ecosystem indicators. Lower numbers indicate better ocean ecosystem conditions, or "green lights" for salmon growth and survival, with ranks 1–4 green, 5–9 yellow, and 10–13 red. To arrive at these rank scores, 13 years of sampling data were compared across years (within each row), and each year received a rank between 1 and 13. Source: Northwest Fisheries Science Center 2011.

Climate Change

New information since this ESU was originally listed and since the last status review suggests that the earth's climate is warming, and that this change could significantly impact ocean and freshwater habitat conditions which affect coho salmon survival. In the coming years, climate change will influence the ability to recover some salmon species in most or all of their watersheds. Of all the Pacific salmon species, coho salmon are likely one of the most sensitive to climate change due to their extended freshwater rearing phase. Additionally, this ESU is near the southern end of the species' distribution and many populations occupy degraded streams that have water temperatures near the upper limits of thermal tolerance for the species. For these reasons, climate change poses a new threat to the long term viability and recovery of the SONCC coho salmon ESU.

Future climate change is expected to alter freshwater temperature regimes in several ways including an overall increase in temperature levels, an increase in high temperature extremes, and an increase in low temperature levels. The increase in winter temperatures will be especially dramatic. A recent study in the Rogue River basin determined that annual average temperatures are likely to increase from 1 to 3° F (0.5 to 1.6° C) by around 2040 and 4 to 8° F (2.2 to 4.4° C) by around 2080. Summer temperatures may increase dramatically reaching 7 to 15° F (3.8 to 8.3° C) above baseline by 2080, while winter temperatures may increase 3 to 8°F (1.6 to 3.3° C) (Doppelt et al. 2008). Changes in temperature throughout the range of the SONCC coho salmon ESU are likely to be similar. The individual increases in temperature that we are likely to see within a specific stream or stream reach will depend on factors such as riparian condition, groundwater and spring influence, the presence of upstream impoundments, and stream flow (Bartholow 2005). Increases in winter and spring temperature regimes may cause eggs to develop more quickly, leading to early emergence. Early fry may be disoriented or displaced downstream during high spring flows, which increase their exposure to predators or the ocean prematurely. Higher spring temperatures will increase the growth rates of fry; however, increases in summer temperatures will lead to thermal stress and decreased growth and mortality of juveniles.

The increase in winter water temperatures will be especially dramatic since flows in many streams are expected to continue decreasing as a result of decreasing snowpack (Crozier et al. 2008; Doppelt et al. 2008; Luers et al. 2006). Recent projections indicate that snowpack in northern California and southern Oregon will decrease by 60-75% by 2040 and will disappear almost completely by 2080. Levels will be less than 10 inches snow water equivalent (SWE) in the few areas where snowpack remains (Doppelt et al. 2008; Luers et al. 2006). This loss of snowpack will continue to create lower spring and summertime flows while additional warming will cause earlier onset of runoff in streams. Changes in the timing of runoff will shift downstream migration timing to be earlier and may ultimately influence the survival of smolts depending on the timing of upwelling and favorable ocean conditions.

Annual precipitation could increase by up to 20% over northern California. Most precipitation will occur during the mid-winter months as intense rain and rain-on-snow events that will be linked to higher numbers of landslides and greater and more severe floods (Doppelt et al. 2008; Luers et al. 2006). Overall, there will be earlier and lower low-flows and earlier and higher high-flows. Increased flooding may cause eggs to be scoured from their nests; displace overwintering juveniles; and contribute to higher summer water temperatures.

In coastal and estuarine ecosystems, where coho salmon reside as juveniles, the threats from climate change largely come in the form of sea level rise and the loss of coastal wetlands. Sea is likely to rise exponentially over the next 100 years, with possibly a 50-80 cm rise by the end of the 21st century (USGCRP 2002). This rise in sea level will alter the habitat in estuaries and either provide increased opportunity for feeding and growth of coho salmon or in some cases will lead to the loss of estuarine habitat and a decreased potential for estuarine rearing.

Marine ecosystems face an entirely unique set of stressors related to global climate change, all of which may have deleterious impacts on coho salmon growth and survival while in the ocean. In general, the effects of changing climate on marine ecosystems are not well understood given the high degree of complexity and overlapping climatic shifts that already occur (e.g., El Niño, La Niña, Pacific Decadal Oscillation) and uncertainties about how climate change will interact with these existing processes. Current and projected changes in the North Pacific include rising sea surface temperatures that increase the stratification of the upper ocean; changes in surface wind patterns that impact the timing and intensity of upwelling of nutrient-rich subsurface water; and increasing ocean acidification which will change plankton community compositions with potential bottom-up impacts on marine food webs (ISAB 2007). Ocean acidification also has the potential to dramatically change the phytoplankton community due to the likely loss of most calcareous shell-forming species such as pteropods. Recent surveys show that ocean acidification is increasing in surface waters off the west coast, and particularly off northern California, even more rapidly than previously estimated (Feely et al. 2008). For coho salmon, shifts in prey abundance, composition, and distribution are the indirect effects of these changes.

Direct effects are decreased growth rates due to ocean acidification and increased metabolic costs due to the rise in sea surface temperature (Portner and Knust 2007). Another consequence is that salmon must travel further from their home streams to find satisfactory marine habitat, which will increase energy demands, slow growth and delay maturity (ISAB 2007). Coho salmon typically do well when ocean conditions are cool and upwelling occurs. Because conditions may be warmer and upwelling may be delayed, salmon may encounter less food or may have to travel further from their home ranges to find satisfactory habitat, increasing energy demands, slowing growth and delaying maturity.

Since the original listing and last status review much more information has become available regarding the impacts of predicted shifts in climate. Global average surface temperature has increased by approximately 0.7°C during the 20th Century (IPCC 2007) and appears to be accelerating with the global trend over the past 50 years increasing at a faster rate. Regional trends in temperature show even greater warming tendencies. In general, conditions in the climate and within the ecosystems on which coho salmon rely will change dramatically and at an ever-increasing rate. In the near future, climate change will likely surpass habitat loss as the primary threat to the conservation of most species (Thomas et al. 2004). Climate change is having, and will continue to have, an impact on salmonids throughout the Pacific Northwest and California (Battin et al. 2007). Overall, climate change is believed to represent a growing threat to the SONCC coho salmon ESU.

Depensation

Depensation occurs when populations are reduced to very low densities and their per capita growth rates decrease as a result of a variety of mechanisms (e.g., failure to find mates and therefore reduced probability of fertilization, failure to saturate predator populations [Liermann and Hilborn 2001]). Populations that are below their depensation threshold are also at a higher risk of extinction because of these mechanisms (Williams et al. 2008).

Sharr et al. (2000) modeled the probability of extinction of most Oregon Coast Natural populations and found that as spawner density dropped below 4 fish per mile (2.4 spawners/km), the risk of extinction rises rapidly (Figure 5). When Chilcote et al. (1999) tracked the collapse of four populations in the Lower Columbia River, they found the depensation threshold was 2.4 spawners/km. Barrowman et al. (2003) found evidence of depensatory effects when spawner densities are less than 1 female per km. Small-population demographic risks are very likely to be significant when spawner density is below 0.6 spawner per km (1 spawner/IP-km; Wainwright et al. 2008).

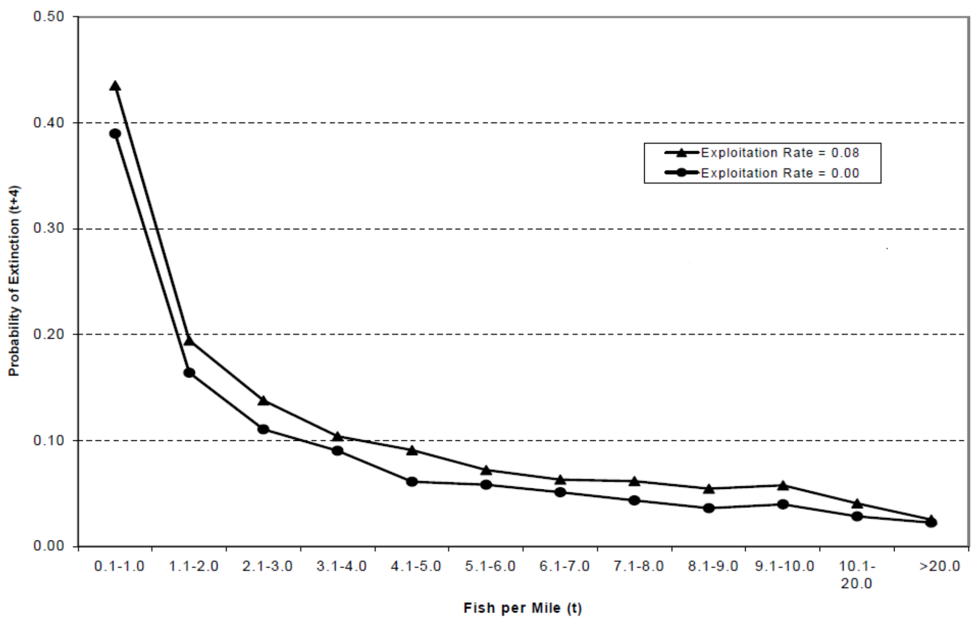

Figure 5. Probability of basin-level extinction in four generations as a function of spawner density for exploitation rates of 0.00 and 0.08. All Oregon coastal basins are combined. Figure from Sharr et al. 2000.

Although long term spawner data are not available for many populations within the range of the SONCC coho salmon ESU, recent information for some populations suggests that they are below depensation thresholds and may be facing an increased risk of extinction. For example, recent spawner surveys in the Mattole River found only 3 and 9 coho salmon, respectively in 2009 and 2010. These numbers are well below the depensation threshold for this population. Similarly; the Scott River and Shasta River populations have declined substantially in recent years. Available time series data on the Shasta River show low adult returns with abundance having declined by almost 50% from one generation to the next (Williams et al. 2011). In addition, two out of three cohorts are considered to be nearly extirpated (Figure 1; Chesney et al. 2009). Available data show that the Scott River population has also declined over the most recent three years and is below its depensation threshold. This and other qualitative information suggests that at least some coho salmon populations within this ESU are likely at an increased risk of extinction, particularly at the southern end of the ESUs range and in the inland portions of the Klamath basin. Overall, it appears that the threat of depensation impacts has increased since the last review as a result of population declines caused at least in part by poor ocean conditions and drought.

Stochastic Pressure from Small Population Size

At the time of listing, the risk of stochastic processes affecting small population size was not identified as a specific threat to the SONCC coho salmon ESU. Small populations have a significantly increased risk of extinction (Schaffer 1981; McElhany et al. 2000; Fagan and Holmes 2006). In fact, time-to-extinction decreases logarithmically with population size (Lande 1993; Fagan and Holmes 2006). Population declines are likely to beget further declines, especially for small populations because stochastic factors exert more influence (Fagan and Holmes 2006). Small populations can be affected by multiple forms of stochasticity, not all of which affect large populations (Lande 1993). The fact that small populations can be affected by different types of stochasticity results in extinction probabilities substantially greater than the extinction probabilities that would occur from of a single form of stochasticity (Melbourne and Hastings 2008).

Random events in small populations may have a large impact on population dynamics and the ability of a population to persist. The risks small populations face may be either deterministic, the result of systematic forces that cause population decline (e.g., overexploitation, development, deforestation, loss of pollinators, inability to find mates, inability to defend against predators) or stochastic (the result of random fluctuations that have no systematic direction). If the rate of population growth varies from one generation to the next, a series of generations in which there are successive declines in population size can lead to extinction even if the population size is growing on long-term average. As natural populations get smaller, stochastic processes may cause alterations in genetics, breeding structure, and population dynamics that may interfere with the success of recovery efforts and need to be considered when evaluating how populations respond to recovery actions. This stochastic pressure can express itself in three ways: genetic, demographic and environmental.

Genetic stochasticity refers to changes in the genetic composition of a population unrelated to systematic forces (selection, inbreeding, or migration). It can have a large impact on the genetic diversity of populations, both by reducing the amount of diversity retained within populations and by increasing the chance that deleterious recessive alleles may be expressed. The loss of diversity could limit a population's ability to respond adaptively to future environmental changes. The increased frequency with which deleterious recessive alleles are expressed (because of increased homozygosity) could reduce the viability and reproductive capacity of individuals. Demographic stochasticity refers to the variability in population growth rates arising from random differences among individuals in survival and reproduction within a season. This variability will occur even if all individuals have the same expected ability to survive and reproduce and if the expected rates of survival and reproduction do not change from one generation to the next. Even though it will occur in all populations, it is generally important only in populations that are already fairly small. Environmental stochasticity is the type of variability in population growth rates that refers to variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, or other factors external to the population. For example, the 1964 flood in northern California significantly degraded many watersheds and reduced the abundance of many SONCC coho salmon populations.

Many populations in the SONCC coho salmon ESU have declined in recent years such that they may be influenced by natural stochastic processes (e.g., Shasta River, Mattole River and possibly others), in addition to deterministic threats. In the Shasta River, for example, the number of spawners returning in 2008, 2009, and 2010 was estimated at 30, 9 (all males) and 46 fish, respectively. In the Mattole River, recent spawner surveys found only 3 and 9 adults in 2009 and 2010, respectively. Stochastic events may well have contributed to the instability and decline of SONCC coho salmon populations in recent years, and it may also explain why recent adult returns have remained low despite improvements in ocean conditions since 2007 and the reduction of fishery impacts in recent years due to ocean fishery closures.

2.4 Synthesis

NMFS listed the SONCC coho salmon ESU, which includes populations spawning from the Elk River (Oregon) in the north to the Mattole River (California) in the south, as a threatened species in 1997 (62 FR 24588). In 2005, NMFS reaffirmed its status as a threatened species and also listed three hatchery stocks as part of the ESU (70 FR 37160). Analysis of recent genetic data from coho salmon in this and adjacent ESUs (Oregon Coast ESU to the north and Central California Coast ESU to the south) supports the existing boundaries of the SONCC coho salmon ESU boundary (Stout et al. 2010; Williams et al. 2011).

The Southern Oregon/Northern California Technical Recovery Team (TRT) evaluated the population structure of the SONCC Coho Salmon ESU (Williams et al. 2006). In general, the historical population structure of this ESU was characterized by small-to-moderate-sized coastal basins where high quality habitat is in the lower portions of the basin and by three large basins where high quality habitat was located in the lower portions, middle portions of the basins provided little habitat, and the largest amount of habitat was located in the upper portions of the sub-basins. Based on its review, the TRT concluded the ESU was historically comprised of: 1) 19 functionally independent populations, 2) 12 potentially independent populations, 3) 17 small dependent populations of coho salmon, and 4) 2 ephemeral populations. In addition to categorizing individual populations, the TRT's analysis defined seven diversity strata within the ESU which comprised groups of populations that likely exhibit genotypic and phenotypic similarity due to exposure to similar environmental conditions or common evolutionary history (Williams et al. 2006).

Short-term research and monitoring indicate that abundance of coho salmon has decreased for many populations in this ESU since the last status review. Available time series of recent population trends have been downward. The longest existing time series from the past nine years for Shasta River exhibited a significant negative trend. The two extensive time series from the

Rogue River Basin also have recent negative trends. Additionally, a majority of independent populations are well below low-risk abundance targets, and many may also be below the high-risk depensation thresholds identified in Williams et al. (2008). None of the seven diversity strata appears to support a single viable population; however, all of the diversity strata are occupied by coho salmon. There is insufficient data available to determine if occupancy throughout the ESU has changed since the last status review.

We are concerned about these recent declines in abundance of coho salmon across the ESU, regardless of what the contributing factor(s) may have been (e.g., marine survival conditions and drought). The negative short-term trends observed in the limited number of time series are not unexpected given the apparent low marine survival in recent years (<1% for the 2004 to 2006 year classes). However, as population sizes have decreased other factors (e.g., small population dynamics) may be adversely affecting coho salmon populations in spite of the improved ocean conditions that occurred from 2007 to 2009. The declining abundance trends and low spawner abundance for most populations in the ESU underscore the importance of addressing freshwater habitat conditions across the ESU so that all populations are sufficiently resilient to withstand fluctuations in marine survival.

The threats discussed in the five factor analysis are largely unchanged since the last status review with the exception of those associated with natural or manmade factors. In particular, threats from poor ocean conditions, drought, climate change, and small population size (depensation and stochastic processes) have or are likely to have increased and may be responsible for the observed declines in abundance. Data for the survival of hatchery fish from the Cole Rivers Hatchery suggest that marine survival was extremely low for the 2005 and 2006 brood years (i.e., 0.05% and 0.07, respectively) and the average ocean conditions in 2010 (NWFSC 2011) suggest there may be poor marine survival for the 2011 spawning season. Drought conditions occurred for three consecutive years (2007-2009) that decreased instream flows and habitat conditions for juvenile coho salmon and very likely reduced their freshwater survival. Although it's unclear if significant habitat changes are occurring from climate change, we now expect a wide range of future changes to coho salmon habitat including decreased stream flows as a result of decreasing snowpack, warmer instream water temperatures, warmer stream and coastal ocean temperatures, more frequent wildfires, delays in the onset of coastal upwelling and associated delays in ocean spring bloom, and declining ocean conditions. Lastly, because many coho salmon populations in this ESU are low in abundance, and may well be below their depensation thresholds, their risk of extinction may also be increasing.

In summary, the best available updated information on the biological status of this ESU and the threats facing this ESU indicate that it continues to remain threatened although there is cause for concern. The new information indicates that the current ESU boundaries do not need to be changed and that the hatchery populations that are part of the listed ESU should remain part of the ESU.

3.0 RESULTS

3.1 Recommended Classification:

Based on the best available information, we recommend that the SONCC coho salmon ESU remain classified as a threatened species. However, this review indicates that the biological status of this ESU has worsened since the last status review and factors such as ocean survival conditions, drought effects, and small population size are continuing sources of concern. Accordingly, we recommend that the ESU and relevant environmental conditions be carefully monitored and that the status of the ESU be re-assessed in 2-3 years if it does not respond positively to improvements in environmental conditions and management actions.

3.2 New Recovery Priority Number

No change is recommended in the recovery priority number for this DPS.

3.3 ESU Boundary and Hatchery Stocks

No change is recommended in the ESU boundary or hatchery stock membership.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

We recommend the following restoration, research and monitoring actions for the SONCC coho salmon ESU:

Restoration actions should include, but are not limited to:

- Re-establishing off-channel rearing areas in both freshwater and the estuary.
- Improving habitat conditions in areas where coho salmon have been recently found.
- Returning water to the river in sufficient quantities and at the right times to support all life stages of coho salmon.
- Investigating the feasibility of establishing temporary conservation hatcheries in the Mattole, Shasta, and Eel Rivers to preserve the very low numbers of coho salmon found there.
- Reducing the adverse impacts of current mitigation hatcheries on the Klamath and Trinity Rivers.
- Improving agricultural and forestry practices, in particular riparian protections, road construction and road maintenance.

Research and monitoring should include, but are not limited to:

- Monitoring and assessment of the status of SONCC coho salmon populations in the next few years.
- An interim review of the status of SONCC coho salmon within the next 2 to 3 years, particularly if ocean conditions improve and populations continue to decline.

- Annual monitoring of spawner abundance and juvenile distribution for all independent populations.
- Establishing/maintaining seven life-cycle monitoring stations, one in each diversity stratum, to track abundance and evaluate the effects of marine residence on SONCC coho salmon recovery.
- Assessing habitat conditions of all populations every 5-10 years.
- Investigating climate change effects to SONCC coho salmon survival and recovery.
- Implementing limiting factors analysis for all core populations, where none exists.

To support future status reviews of this and other ESUs, we recommend the Southwest and Northwest Regions form an inter-regional team to evaluate whether and how NMFS should develop criteria for: (1) ranking data quality and conditions for data use in assessing biological status of salmon and steelhead ESUs, including how to weigh short-term and non-systematic monitoring data in assessing ESU status; and (2) considering small population size, the risks associated with small population size, and the risks associated with population sizes below high-risk depensation levels, in the biological assessment of salmon and steelhead ESUs. Although evaluated as a threat in this review, small population size and its relationship to depensation thresholds may warrant more rigorous consideration in status assessments when long-term data sets are lacking.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW

Southern Oregon Northern California Coast Recovery Domain

Southern Oregon-Northern California Coast Coho Salmon

Current Classification: Threatened

Recommendation resulting from the 5-Year Review: Retain current ESA classification as threatened and current ESU boundary. Continue to include hatchery stocks in the listed ESU.

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries

Approve: ____ Date: ________

Cooperating Regional Administrator, NOAA Fisheries

_____Concur _____ Do Not Concur

Signature____ Date_______

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

_____Concur _____ Do Not Concur

Signature____ Date_______