NORTH-CENTRAL CALIFORNIA COAST RECOVERY DOMAIN
5-Year Review:
Summary and Evaluation of

California Coastal Chinook Salmon ESU
Central California Coast Coho Salmon ESU

National Marine Fisheries Service
Southwest Region
Long Beach, CA

5-YEAR REVIEW
North Central California Coast Recovery Domain

Species Reviewed	Evolutionarily Significant Unit or Distinct Population Segment
Chinook Salmon ***(Oncorhynchus tshawytscha)***	**California Coastal Chinook Salmon ESU**
Coho Salmon ***(O. kisutch)***	**Central California Coast Coho Salmon ESU**

1.0 GENERAL INFORMATION

1.1 Reviewers

1.1.1. Southwest Region (SWR)

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1.1.2. Southwest Fisheries Science Center (SWFSC)

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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 west coast salmon and steelhead occurred in 2005 and 2006. This document summarizes NMFS's 5-year reviews for the threatened California Coastal (CC) Chinook salmon and endangered Central California Coast (CCC) coho salmon Evolutionarily Significant Units (ESUs).

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 salmon we use 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 distinct population segment (DPS) policy (61 FR 4722) rather than our agency's ESU policy for the delineation of West Coast steelhead (*O. mykiss*) DPSs under the ESA. 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 or DPS to be included in any listing of those units; (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 evaluated all hatchery stocks and programs and divided them into 4 categories (SHAGG 2003) as follows:

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 were included in ESUs and DPSs (70 FR 37204) although hatchery programs in other categories were occasionally also included in an ESU or DPS.

Because the new hatchery listing policy changed the way NMFS considered hatchery fish in ESA listing determinations, we conducted new status reviews and ESA-listing determinations for all West Coast salmon ESUs and steelhead DPSs using this policy. On June 28, 2005, we issued final listing determinations for 16 ESUs of Pacific salmon (including the CC Chinook salmon CCC coho salmon ESUs) 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 FR 13082). Overall, we received very limited comments during the public comment period; however, Friends of the Eel River (FOER 2010) did submit comments regarding the status of and factors affecting the CC Chinook salmon ESU.

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.

Second, salmon management biologists from the Southwest Region's 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.

Key information sources used for the review of CC Chinook salmon and CCC coho salmon included:

- draft recovery plans and related technical information for both ESUs;
- the Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Southwest Region (Williams et al. 2011);
- the Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Central California Coast Coho Salmon ESU (Spence and Williams 2011);
- peer-reviewed scientific publications;
- the final listing notices for the CC Chinook salmon (64 FR 50394 and 70 FR 37160) and CCC coho salmon ESUs (61 FR 56138);
- the final listing notice reclassifying the CC coho salmon ESU as endangered and reaffirming the threatened listing of CC Chinook salmon (70 FR 37160);
- the final rules designating critical habitat for the CC Chinook salmon (70 FR 52488) and CCC coho salmon ESUs (64 FR 24049);
- the 2005 status update for the CC Chinook salmon and CCC coho salmon ESUs (Good et al. 2005); and
- updated information compiled on hatchery stocks and programs since 2005.

All literature and documents used for this review are on file at the NMFS North Central Coast Office and can also be obtained from the SWR Regional office in Long Beach, California.

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

1.3.1 FR Notice citation announcing initiation of this review

75 FR 13082; March 18, 2010

1.3.2 Listing history

The CC Chinook salmon ESU was originally listed as a threatened species in 1999 (64 FR 50394). In 2005 following a reassessment of its status and after applying NMFS hatchery listing policy, we reaffirmed that the ESU continued to be threatened and also listed several small hatchery stocks that were associated with the ESU (70 FR 37160).

The CCC coho salmon ESU was originally listed as threatened in 1996 (61 FR 56138). In 2005 following a reassessment of its status and after applying NMFS' hatchery listing policy, we reclassified the ESU as endangered and listed several conservation hatchery programs that were associated with the ESU (70 FR 37160). See Table 1 for details.

Table 1. Summary of the listing history under the ESA for ESUs in the NCCC Recovery Domain.

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Chinook Salmon *(O. tshawytscha)*	**California Coastal Chinook Salmon ESU**	**FR notice:** 64 FR 50394 **Date:** 9/16/1999 **Classification**: Threatened	**FR notice:** 70 FR 37160 **Date:** 6/28/2005 **Classification**: Threatened including hatchery stocks
Coho Salmon *(O. kisutch)*	**Central California Coast Coho Salmon ESU**	**FR notice:** 61 FR 56138 **Date:** 10/31/1996 **Classification**: Threatened	**FR notice:** 70 FR 37160 **Date:** 6/28/2005 **Re-classification**: Endangered including hatchery stocks

1.3.3 Associated rulemakings

The ESA requires NMFS to 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, if they contain physical or biological features essential to conservation, and those features may require special management considerations 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 the CCC coho salmon ESU in 1999 and the original designation for the CC Chinook salmon ESU was promulgated in 2000. We subsequently withdrew our designation for CC Chinook salmon in 2002 and later issued a new designation in 2005 (70 FR 52488). See Table 2 for details.

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. In 2002, NMFS promulgated 4(d) protective regulations for both ESUs

(67 FR 1116). In 2005, the 4(d) rule the CC Chinook salmon ESU was revised and the CCC coho salmon ESU was reclassified as endangered which superseded the 4(d) rule established in 2002 (70 FR 37160).   See Table 2 for details.

Table 2. Summary of rulemaking for 4(d) protective regulations and critical habitat for ESUs in the NCCC Recovery Domain.

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Chinook Salmon *(O. tshawytscha)*	**California Coastal Chinook Salmon ESU**	**FR notice:** 67 FR 1116 **Date:** 1/9/2002; revised 6/28/2005 (70 FR 37160)	**FR notice:** 70 FR 52488 **Date:** 9/2/2005
Coho Salmon *(O. kisutch)*	**Central California Coast Coho Salmon**	**FR notice:** 67 FR 1116 **Date:** 1/9/2002; removed with re-classification as endangered 6/28/2005 (70 FR 37160)	**FR notice:** 64 FR 24049 **Date:** 5/5/1999

1.3.4 Review History

Numerous scientific assessments have been conducted to assess the biological status of these ESUs. A list of those assessments is provided in Table 3.

Table 3. Summary of previous scientific assessments for the ESUs in the NCCC Recovery Domain.

Salmonid Species	ESU/DPS Name	Document Citation
Chinook Salmon *(O. tshawytscha)*	**California Coastal Chinook Salmon ESU**	Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R,S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35,443 pp.
		Busby, P., S. Grant, R. Iwamoto, R. Kope, C. Mahnken, G. Matthews, J. Myers, M. Ruckleshaus, M. Schiewe, D. Teel, T. Wainwright, F. W. Waknitz, R. Waples, J. Williams, G. Bryant, C. Wingert, S. Lindley, P. Adams, A. Wertheimer & R. Reisenbichler. 1999. Status review update for deferred ESUs of West Coast Chinook salmon (*Oncorhynchus tshawytscha*) from Washington, Oregon, California, and Idaho. National Marine Fisheries Service. 100 pp.
		Good, T. P., R. S. Waples & P. B. Adams. 2005. Updated status of federally listed ESUs of West

		Coast salmon and steelhead. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NMFS-NWFSC-66. 598 pp.
		Bjorkstedt, E. P., B. C. Spence, J. C. Garza, D. G. Hankin, D. Fuller, W. E. Jones, J. J. Smith & R. Macedo. 2005. An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the north-central California coast recovery domain. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-382. 210 pp.
		Spence, B. C., E. P. Bjorkstedt, J. C. Garza, J.J. smith, D.G. Hankin, D. Fuller, W. E. Jones, & R. Macedo, T.H. Williams, and E. Mora. 2008. A framework for assessing the viability of threatened and endangered salmon and steelhead in the north-central California coast recovery domain. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-423. 173 pp.
		Williams, T.H, S.T. Lindley, B.C. Spence, and D.A. Boughton. 2011. Status review update for Pacific salmon and steelhead Listed Under the Endangered Species Act: Southwest. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center NOAA-TM-NMFS-SWFSC-XXX. XX pp.
Coho Salmon *(O. kisutch)*	**Central California Coast Coho Salmon ESU**	Weitkamp, L., A., T. C. Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope & R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. United States Department Of Commerce; National Oceanic and Atmospheric Administration; National Marine Fisheries Service, Seattle, NMFS-NWFSC-24.
		NMFS. 2001. Status review update for coho salmon (Oncorhynchus kistuch) from the central California coast and the California portion of the Southern

		Oregon/Northern California coasts evolutionarily significant units (revision). National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, CA. 40 pp.
		Good, T. P., R. S. Waples & P. B. Adams. 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NMFS-NWFSC-66. 598 pp.
		Bjorkstedt, E. P., B. C. Spence, J. C. Garza, D. G. Hankin, D. Fuller, W. E. Jones, J. J. Smith & R. Macedo. 2005. An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the north-central California coast recovery domain. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-382. 210 pp.
		Spence, B. C., E. P. Bjorkstedt, J. C. Garza, J.J. smith, D.G. Hankin, D. Fuller, W. E. Jones, & R. Macedo, T.H. Williams, and E. Mora. 2008. A framework for assessing the viability of threatened and endangered salmon and steelhead in the north-central California coast recovery domain. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-423. 173 pp.
		Williams, T.H, S.T. Lindley, B.C. Spence, and D.A. Boughton. 2011. Status review update for Pacific salmon and steelhead Listed under the Endangered Species Act: Southwest. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center NOAA-TM-NMFS-SWFSC-XXX. XX pp.
		Spence, B and T. Williams 2011. Status review update for Pacific Salmon and Steelhead Listed Under the ESA: Central California Coast Coho Salmon ESU. U.S. Department of Commerce, National Oceanic and Atmospheric Administration,

		National Marine Fisheries Service, Southwest Fisheries Science Center NOAA-TM-NMFS-SWFSC-475. 15 pp.

1.3.5 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 current recovery priority numbers for the two ESUs, 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)*, are listed in Table 4 below.

1.3.6 Recovery Plan or Outline

Recovery outlines were developed for the ESUs in 2005 (CCC coho) and 2007 (CC chinook), respectively (see Table 4). A public draft recovery plan was issued for the CCC coho salmon ESU in 2010 and NMFS anticipates it will be finalized and released in late 2011. A draft multi-species recovery plan is also under development that will address the CC chinook ESU as well as two coastal steelhead DPSs (see Table 4).

Table 4. Recovery Priority Number and Endangered Species Act Recovery Plans for the ESUs in the NCCC Recovery Domain.

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plans/Outline
Chinook Salmon *(O. tshawytscha)*	**California Coastal Chinook Salmon ESU**	**3**	**2007 Federal Recovery Plan Outline for the Evolutionarily Significant Unit of California Coastal Chinook Salmon (issued July 16, 2007). Available at: http://swr.nmfs.noaa.gov/recovery/FINAL-2007_Recovery_Outline_for_the_ESU_of_CC_Chinook_Salmon_071607.pdf** **Plan Status:** Draft recovery plan under development
Coho Salmon *(O. kisutch)*	**Central California Coast Coho Salmon ESU**	**1**	**2005 Recovery outline for the Evolutionarily significant unit of Central California Coast Coho Salmon (issued October 19, 2005)** **Draft Recovery plan for the Evolutionarily Significant unit of Central California coast Coho Salmon. Available at: http://swr.nmfs.noaa.gov/recovery/Coho_Recovery_Plan_031810.htm** **Plan Status:** Public Draft recovery plan issued March 18, 2010

2.0 REVIEW ANALYSIS

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**
California Coastal Chinook salmon ESU	**X**	
Central California Coast 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**
California Coastal Chinook salmon ESU	**X**	
Central California Coast coho salmon ESU	**X**	

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

NOTE: Under the joint NMFS-FWS DPS policy, ESUs developed under NMFS' ESU policy are considered DPSs

2.1.3 Was the DPS listed prior to 1996?

ESU/DPS Name	YES*	NO**	Date Listed if Prior to 1996
California Coastal Chinook salmon ESU		**X**	
Central California Coast coho salmon ESU		**X**	

** 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 CC Chinook salmon and CCC coho salmon ESUs under the ESU policy in 1996 and 1999, respectively, NMFS treated the ESUs as DPSs under the ESA. NMFS considers its ESU policy to be a detailed extension of the joint DPS policy and consequently will continue to use its 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 ESUs/DPSs under review

As part of this five year review process, the SWFSC compiled and evaluated new information relevant to the geographic boundaries of all listed ESUs and DPSs in California to determine if potential boundary changes were warranted (Williams et al. 2011). There have been significant amounts of new genetic information and analyses produced for anadromous salmonids in California since the Good et al. (2005) status review. In particular, the SWFSC's Molecular Ecology and Genetic Analysis Team has produced substantial amounts of new population genetic data that have contributed to improving our understanding of the population structure of ESA-listed salmonids in California. The new genetic information, which is taken from Williams et al. (2011), is summarized below by species. In addition to the new genetic information, a Technical Recovery Team (TRT) that was established to provide scientific support for the development of ESA recovery plans for listed salmonids in this recovery domain examined all relevant historical and recently acquired ecological and environmental information to describe the historical population structure (Bjorkkstedt et al. 2005) and develop population and ESU/DPS viability criteria for listed salmonids in this domain (Spence et al. 2008). For four coastal steelhead DPSs in California, the new data led NMFS to convene a BRT to re-evaluate DPS boundaries in the context of all available information including the recently developed genetic information.

CC Chinook salmon ESU

Since the previous status review large amounts of genetic data have been collected using microsatellite and single nucleotide polymorphism (SNP) markers for California populations of Chinook salmon and, through collaboration, for other populations broadly distributed throughout the entire range of the species (Garza et al. 2008; Seeb et al. 2007; Narum et al. 2008). There are no new genetic data that we are aware of that suggests ESU boundary changes are necessary for the Southern Oregon Northern California Coast (SONCC) or Upper Klamath/Trinity Chinook Salmon ESUs, nor the ESUs in the Central Valley. However, new genetic data are now available for Chinook salmon returning to coastal basins south of the Russian River which is the current southern boundary of the CC Chinook ESU and in the San Francisco Bay complex west of the current boundary of the Central Valley Fall/Late Run ESU. In particular, new genetic data are available from adult Chinook found in Lagunitas Creek (Garza, unpublished data A) and the Napa and Guadalupe rivers (Garza, unpublished data B; Garza and Pearse 2008) which enter into San Pablo and San Francisco Bays, respectively. The SWFSC has evaluated these data to determine which ESUs these populations belong to (Williams et al. 2011).

Genetic data from tissues samples collected from adult Chinook salmon in the Napa and Guadalupe Rivers indicate that these fish have a strong affinity to Central Valley fall run Chinook salmon (Garza et al., unpublished data B; Garza and Pearse 2008). Although there are similarities in the genetic make-up of the non-listed Central Valley fall run Chinook salmon and the listed Central Valley spring-run Chinook salmon, the genetic analysis assigned the vast majority of fish from these two watersheds (all 41 fish from the Napa River and 25 of 28 fish from the Guadalupe River) to the Central Valley fall run Chinook ESU. In addition, the adults sampled in the Napa River were observed during the period of late November through early January which is consistent with the fall run life history type. The SWFSC concluded that populations recently identified in the Napa and Guadalupe rivers, along with future populations found in basins inclusive of the San Francisco/San Pablo Bay complex that express a fall-run timing should be included in the Central Valley fall/late fall Run Chinook salmon ESU (Williams et al. 2011).

Analytical results of tissue samples from relatively small numbers (N=17) of adult Chinook salmon collected in Lagunitas Creek were more equivocal, with equal numbers of fish being assigned to both the CC Chinook and Central Valley fall run Chinook ESUs and three fish also identified as being from the Oregon Coast (Garza, unpublished data A). The SWFSC recommended that the Lagunitas Creek population and other populations identified between the Russian River and the Golden Gate should be placed in the CC Chinook salmon ESU due to the geographic proximity and ecological similarities of the Lagunitas Creek watershed to other coastal basins within the range of the CC Chinook salmon ESU as well as this recently collected genetic information (Williams et al. 2011). The SWFSC also recommended that this conclusion should be revisited as new information becomes available.

CCC coho salmon ESU

Coho salmon are distributed in coastal California basins from the Oregon border in the north to Monterey Bay in the south and historically were present in the San Francisco/San Pablo Bay system, where they are now extirpated. Populations to the north of Punta Gorda, from the Mattole River north, are considered to be in the SONCC coho Salmon ESU, whereas populations from Punta Gorda southward to the San Lorenzo River are part of the CCC coho Salmon ESU. Abundant new genetic data are available for California populations of coho salmon, including microsatellite genotypes from over 8,000 fish from nearly every extant population in the state (Garza, Unpublished data C; Garza and Gilbert-Horvath Unpublished data – as cited in Williams et al. 2011). These new genetic data continue to show a clear separation between populations north and south of Punta Gorda and no evidence of populations at the southern end of the species range having been derived from an out-of-ESU hatchery stock. Juvenile coho salmon were recently found in Soquel Creek which is south of the San Lorenzo River indicating that coho salmon naturally recolonized that watershed during the 2007-8 spawning season. The southern boundary of the CCC coho salmon ESU was reviewed recently by a Biological Review Team (BRT) in response to an ESA petition to redefine the southern boundary of this ESU (Spence et al. 2011). In its report, the BRT considered the recent colonization of Soquel Creek by coho salmon, new genetic analysis of tissue samples from the Soquel Creek fish indicating they were closely related to coho populations south of San Francisco, and the habitat characteristics of the Soquel and Aptos creeks. Based on this information, the BRT recommended that the southern boundary of the CCC coho salmon ESU be moved southward to include both Soquel and Aptos creeks (Spence et al. 2011). Based on this recommendation and the updated status review for this ESU which was prepared by the SWFSC (Spence and Williams 2011), NMFS proposed to this range extension on February 4, 2011 (76 FR 6383).

Hatchery Stocks

CC Chinook salmon ESU

In conjunction with the most recent status review for the CC Chinook salmon ESU (Good et al. 2005), NMFS reviewed available information on hatchery stocks and programs within the range of the ESU. This review and analysis concluded that seven artificially propagated hatchery stocks (Freshwater Creek, Yager Creek/Van Duzen, Redwood Creek, Hollow Tree Creek, Van

Arsdale fish station, Mattole River, and Mad River hatchery) were closely related to naturally spawning populations in the ESU (Salmon and Steelhead Assessment Group 2003) based on genetic information, the source of the broodstock and the hatchery management practices. In accordance with NMFS' 2005 hatchery listing policy, these seven hatchery stocks were found to be part of this ESU and subsequently evaluated as part of the listing process. Based on this review and evaluation, these seven hatchery stocks were ultimately included in the listed ESU in 2005 (70 FR 37160). As part of this 5-year review, we have re-evaluated the status of these hatchery stocks and programs to determine whether they are still operational and if so, whether they have been substantially modified. Based on a review of the available information, including discussions with the California Department of Fish and Game (CDFG), we have determined that all seven programs have been terminated.

CCC coho salmon ESU

In conjunction with the most recent status review for the CCC coho salmon ESU (Good et al. 2005), NMFS also reviewed available information on hatchery stocks and programs within the range of this ESU. This review and analysis concluded that four artificially propagated hatchery stocks (Don Clausen Fish Hatchery Captive Broodstock Program, Scott Creek/King Fisher Flats Conservation Program, the Scott Creek Captive Broodstock Program, and Noyo River Fish Station egg-take Program) were closely related to naturally spawning coho populations in the ESU (Salmon and Steelhead Assessment Group 2003). In accordance with NMFS' 2005 hatchery listing policy, these hatchery stocks were found to be part of the ESU and subsequently evaluated as part of the listing process. Based on this review and evaluation, these four hatchery stocks were included in the listed ESU when it was reclassified as endangered in 2005 (70 FR 37160). As part of this 5-year review, we have re-evaluated the status of these hatchery stocks and programs to determine whether they are still operational and if so, whether they have been substantially modified. Based on a review of the available information, including discussions with the CDFG, we have determined that the Noyo Egg Taking station program has been terminated. The other three hatchery programs continue to be operational and propagate stocks that are part of this ESU.

2.2 Recovery Criteria

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

ESU/DPS Name	YES	NO
California Coastal Chinook salmon ESU		**X**
Central California Coast coho salmon ESU		**X**

The ESA requires recovery plans to incorporate (to the maximum extent practicable) objective, measurable 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). Although not finalized or approved, the draft recovery plan for the CCC coho salmon ESU includes the following general types of recovery criteria: (1) population based biological criteria that consider future commercial, recreational and tribal fish harvest; (2) criteria that measure watershed health, (3) criteria that address the abatement and amelioration of threats to the species, and (4) criteria that address the five listing factors (NMFS 2010). These criteria reflect the best available and most up-to-date information on the biology of the species and its habitat and require clear evidence that: (1) the status of populations comprising the ESU have improved in response to the reduction of threats, and (2) the threats leading to the species decline and listing have been controlled. The draft plan also proposes criteria for reclassifying the ESU from endangered to threatened, as well as delisting criteria. The specific criteria related to the status of populations, improvement in watershed conditions, and abatement of threats across the ESU must be met prior to down-listing or delisting.

A multi-species recovery plan is under development for the three other listed salmonids in this domain, including the CC Chinook salmon ESU, Central California Coast steelhead DPS, and Northern California steelhead DPS. This multi-species plan will include recovery criteria comparable to those for the CCC coho salmon ESU that are objective and measurable, and that utilize the best available and most up-to-date information on the biology of the species and their habitat.

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
California Coastal Chinook salmon ESU	**N/A**	
Central California Coast coho salmon ESU	**N/A**	

The recovery criteria under development for these ESUs will reflect the best available and most up to date information on their biology and habitat requirements. See discussion in section 2.2.1.

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
California Coastal Chinook salmon ESU	**N/A**	
Central California Coast coho salmon ESU	**N/A**	

The recovery criteria under development will address all of the 5 listing factors. See discussion in section 2.2.1.

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

Final or interim recovery plans have not been issued and recovery criteria have not been finalized. See discussion above in section 2.2.1.

2.3 Updated Information and Current Species Status

2.3.1 Analysis of Viable Salmonid Population (VSP) Criteria

The following discussion for the CC Chinook salmon ESU is taken primarily from the updated status review of Williams et al. (2011) while the discussion for the CCC coho salmon ESU is taken from Spence and Williams (2011).

<u>CC Chinook salmon ESU</u>

Summary of Previous Biological Review Team (BRT) Conclusions

Myers et al. (1998) and Good et al. (2005) concluded that CC Chinook salmon ESU was likely to become endangered. Good et al. (2005) cited continued evidence of low population sizes relative to historical abundance, mixed trends in the few available time series of abundance indices available, and low abundance and extirpation of populations in the southern part of the ESU. Good et al. (2005) also cited the apparent loss of the spring-run life history type throughout the entire ESU as a significant diversity concern and expressed concern about the paucity of information and resultant uncertainty associated with the few estimates of abundance, natural productivity, and distribution of Chinook salmon in the ESU.

Review of Technical Review Team (TRT) Documents and Findings

Bjorkstedt et al. (2005) concluded that the CC Chinook salmon ESU historically comprised 15 independent populations (i.e., 10 functionally independent and 5 potentially independent) of fall-run Chinook salmon and 6 independent populations (all functionally independent) of spring-run Chinook salmon. Notable in the TRT’s structure is the division of Eel River Chinook salmon into two populations: the Lower Eel River population, which includes fish spawning in the South Fork Eel River as well as all mainstem and tributary spawners downstream of the South Fork confluence, and the Upper Eel River population, which includes all fish spawning upstream of the South Fork Eel River confluence, including major tributaries such as the Middle Fork Eel River. The lack of historical data on Chinook salmon in smaller watersheds within this ESU, none of which currently support persistent populations of Chinook salmon, confounded efforts to identify dependent populations. The TRT tentatively identified 17 watersheds as possibly supporting dependent populations, but suggested that perhaps only two of these were consistently occupied by Chinook salmon. Populations were assigned to four geographically based strata, with two of these strata further subdivided into fall-run and spring-run life history types (Bjorkstedt et al. 2005; modified in Spence et al. 2008). For fall-run populations, viability targets based on density criteria developed by Spence et al. (2008) are shown in Table NCC6. Such targets were not developed for spring-run populations because availability of over-summering habitat for adults was considered more likely to limit abundance than availability of spawning or juvenile rearing habitat.

The lack of time series of adult abundance estimates spanning 3-4 generations for any of the 15 independent Chinook populations precluded the TRT from rigorously applying the viability criteria for this ESU (Spence et al. 2008). However, based on the limited ancillary data that was available, the TRT concluded that six independent populations of fall Chinook salmon in this ESU were at high risk of extinction or possibly extinct, including the Ten Mile, Noyo, Big, Navarro, Garcia, and Gualala river populations. One population of fall-run Chinook was determined to be at moderate or high risk (Mattole River), and the remaining populations were deemed to be data deficient. All six putative historical populations of spring-run Chinook salmon were believed extinct (Spence et al. 2008).

New Data and Updated Analyses

Information from public comments

Comments on the status of the CC Chinook salmon ESU were received from Friends of the Eel River (FOER 2010) who concluded that the status of this ESU should be changed from threatened to endangered. Concerns expressed by FOER included: (1) the apparent loss of several Chinook populations in the southern half of the ESU, including the Ten Mile, Noyo, Big, Little, Navarro, Gualala, and Garcia rivers, as well as the spring-run life history; (2) general degradation of freshwater habitats; (3) potential impacts of harvest, including incidental take in ocean salmon fisheries, bycatch in Pacific Whiting fisheries, and recreational catch-and-release fishing; and (4) potential effects of past and current artificial propagation.

Biological information provided by FOER relevant to the status of Chinook salmon in this ESU included plots representing spawner survey data collected by CDFG for various sampling reaches in the Eel River, and summary statistics derived from these data. These data included spawner index data from two sites in the Eel River basin, Sproul and Tomki creeks, which have been compiled by CDFG since the mid-1970s. These data have been considered in previous status reviews, and are addressed in the section "Abundance and Trends" below. FOER (2010) also presented plots of live fish counts from spawner surveys conducted in a number of tributaries of the South Fork Eel River (e.g., Redwood Creek, China Creek, Pollock Creek, Bull Creek, Cow Creek, and Squaw Creek), the Van Duzen River (Lawrence Creek, Grizzly Creek), and mainstem Eel River (Chadd Creek, Bear Creek) between 2002 and 2008. We acquired these data from CDFG. However, interpretation of this information is difficult. Unlike for Sproul, Tomki, and Cannon creeks, standardized indices have not been developed by CDFG for these other Eel River sites (M. Gilroy, California Department of Fish and Game, Eureka, personal communication with Brian Spence, 2 September 2010). This is in part because these surveys have generally been opportunistic and, as a consequence, the level of survey effort for these sites has been both lower and far more variable among years than for the Tomki, Sproul, and Cannon creek surveys. Some sites have been sampled only sporadically, and in the years they have been surveyed, the number of site visits has varied from as few as one to as many as eight. FOER (2010) plotted the total number of live fish observed at each site over all surveys in a given year. However, this analysis is problematic since individual live fish may be counted more than once on successive surveys and because year-to-year differences in total counts may be entirely a function of sampling intensity rather than trend in population abundance. As a result, we do not consider these numbers to be reliable indicators of either status or trend.

Abundance and Trends

New data available since the publication of the last status review (Good et al. 2005) consist primarily of continued time series for: (1) spawner indices (maximum live/dead counts) at three sites in the Eel and Mad river basins where data have been collected since the 1970s, (2) weir counts at Freshwater Creek that began in 1994, (3) dam counts at Van Arsdale Fish Station in the upper Eel River, (4) spawner estimates (AUC method) for Prairie Creek, a tributary to Redwood Creek (Humboldt County); and (5) video counts of adults at Mirabel in the Russian River that began in 2000. Only the Russian River video counts likely provide some sense of total population abundance, though these counts do not include fish spawning below the counting facility. The remaining sampling efforts either provide only indices of relative abundance and not population estimates (e.g., Mad and Eel river sites), or sample only a portion of a population (e.g., Prairie Creek, Freshwater Creek, and Van Arsdale Station).

Population estimates for Chinook salmon adults in Prairie Creek (part of the Redwood Creek population) have been made annually since 1998. During that time, estimates have averaged 212 adults (range 27 to 531) and the population has experienced a significant ($p < 0.001$) decline over the 12-year period of record (Figure NCC2a and Table NCC7 in Williams et al. 2011). Spawner surveys had been performed on Cannon Creek, tributary to the Mad River, since 1981, with data expressed as maximum live/dead counts (Figure 2b in Williams et al. 2011). Both the 16-yr and 29-yr trend are slightly positive, though not significantly so. There has also been a downward trend since 2005. Chinook salmon have been counted at the Freshwater Creek weir since 1994 (Figure 2c in Williams et al. 2011). These counts are partial counts, as fish can fish pass over the weir during high flows and smaller jacks may pass through the weir. Additionally, Freshwater Creek represents only one of several Chinook-bearing streams that make up the Humboldt Bay population defined by the TRT. Counts at the weir indicate the wild population has declined over the 16 years of record (Table NCC7 in Williams et al. 2011), a trend that is largely driven by the fact that only two adults were counted at the weir in both 2008 and 2009.

For the Lower Eel River population, spawner surveys have been conducted annually since the mid-1970s at Sproul Creek, a tributary to the South Fork Eel River, with data expressed as maximum live/dead counts. Over the past 16 years, Sproul Creek shows a slight positive trend, though it is not significant; the longer-term trend, however, remains negative, though again the trend is not significant (Figure NCC2d; Table NCC7 in Williams et al. 2011). As Sproul Creek represents only a small fraction of the total spawning habitat available to the Lower Eel River population, these patterns may not necessarily reflect overall trends in the population.

For the Upper Eel River population, two time series of abundance are available: maximum live-dead counts from Tomki Creek, and counts at the Van Arsdale fish station. Returns to both Tomki Creek and Van Arsdale Station appear influenced by stream flows in the mainstem, which in turn are affected by water releases from Cape Horn and Scott dams upriver. In years of lower flow, fish may be less inclined to enter Tomki Creek or to ascend the mainstem Eel River as far as Van Arsdale Station, instead spawning in areas downstream; thus, there is some uncertainty as to the reliability of these data sets for inferring population trends (S. Harris, California Department of Fish and Game, personal communication). Beginning in 2004, mandated increases in minimum flow releases from Cape Horn Dam have been implemented (NMFS 2002; J. Jahn, NMFS Southwest Region, Santa Rosa, personal communication to Brian Spence, 1 September 2010), resulting in a general increase in the amount of water available in the mainstem Eel River below the dam. The increase in flow has likely influenced the distribution of spawners in the Eel River, possibly drawing more fish as far as the Van Arsdale Station. With that caveat in mind, Tomki Creek Chinook maximum live/dead counts have trended downward, though only the long-term trend is significant, primarily because of high numbers that prevailed from the late 1970s to mid-1980s (Figure 2e; Table NCC7 in Williams et al. 2011). Counts at Van Arsdale Station have shown considerable variation (Figure 2f in Williams et al. 2011). Over the last 14 years, during which wild fish were counted separately from hatchery fish, the number of wild fish has trended upward ($p = 0.016$). However, interpretation of these data is complicated by the fact that an average of 38,822 hatchery Chinook salmon were released annually between the 1996-1997 and 2003-2004 seasons. Although hatchery fish are not included in the trend analysis, an unknown proportion of wild fish returning are likely progeny of hatchery parents that spawned on natural spawning grounds. The potential influence of hatchery plantings, coupled with the changed in flow regime discussed above, makes it difficult to determine if the recent increase in numbers of fish reaching Van Arsdale Station represents an increase in wild population size or the combined effect of hatchery activities and redistribution of spawners.

Spawner surveys have also been conduction on the Mattole River since the 1994-1995 spawning season by the Mattole Salmon Group (MSG 2010). Because the number of stream kilometers and the frequency of surveys has gradually increased over time, MSG has developed a redd index, which is the total number of Chinook redds observed, divided by the accumulated distance surveyed over all surveys (this includes repeated surveys of the same reach in some instances). Since 1994, the redd index has shown a slight downward trend (Figure NCC2g in Williams et al. 2010).

Finally, video counts of adult Chinook salmon in the Russian River indicate that an average of just over 3000 adults have passed upstream in the last 10 years (range 1125-6103) (Figure NCC2h). The trend in numbers during this time has been negative but not significant ($p = 0.56$) (Table NCC7).

Discussion

The lack of population-level estimates of abundance for Chinook salmon populations in this ESU continues to hinder assessment of its status. The available data, a mixture of partial population estimates and spawner/redd indices show somewhat mixed patterns, with some showing slight increases and others slight decreases, and few of the trends being statistically significant (Table NCC7 in Williams et al. 2011). Further, it is difficult to interpret the available numbers in the context of population viability criteria developed by the TRT. For example, the only available time series from the Upper Eel River are from Tomki Creek and Van Arsdale Station, which together represent only a fraction of the total habitat available to Chinook salmon in this population. These data indicate a minimum combined spawner abundance averaging 469 individuals over the past 16 years. However, the Upper Eel River population is likely substantially larger. For example, in the 2009-2010 spawning season, spawner surveys were conducted on the mainstem Eel River from Dos Rios to Van Arsdale Station, as well as in Outlet

Creek and one of its major tributaries, Long Valley Creek. These surveys covered about 40% of the available spawning habitat in these reaches and resulted in a population estimate of just over 3,000 fish (Harris 2010c). Adding to this number the Tomki Creek maximum live/dead count and the Van Arsdale Chinook count (534 fish) and the total exceeds 3,500 for those portions of the Upper Eel River that were surveyed this year, which does not include the Middle Fork Eel River, or the mainstem Eel River and its tributaries from Dos Rios downstream to the confluence of the South Fork of the Eel River. This example highlights the difficulty in interpreting index reach counts that cover only a small fraction of the available spawning habitat. Until more exhaustive and spatially representative surveys of the available habitat are done on a consistent basis, the status of Chinook salmon in these watersheds will remain highly uncertain.

At the ESU level, Williams et al. (2011) expressed several areas of concern. Within the North-Coastal and North Mountain Interior strata, all independent populations continue to persist, though there is high uncertainty about current abundance in all of these populations. The loss of the spring Chinook life-history type from these two strata represents a significant loss of diversity within the ESU. Additionally, the apparent extirpation of all populations south of the Mattole River to the Russian River (exclusive) means that one diversity stratum (North-Central Coastal) does not currently support any populations of Chinook salmon, and a second stratum (Central Coastal Stratum) contains only one extant population (Russian River) that, while it remains relatively abundant, has shown a declining trend since 2003. The significant gap in distribution diminishes connectivity among strata across the ESU.

In summary, Williams et al. (2011) concluded it is difficult to characterize the status of this ESU based on the available data. Williams et al. (2011) did not find evidence of a substantial change in conditions since the last status review (Good et al. 2005), but were concerned about the loss of representation from one diversity stratum, the loss of the spring-run life history type (two diversity substrata), and the diminished connectivity between populations in the northern and southern half of the ESU when viewed in the context of TRT's viability criteria for this ESU. Complicating the assessment is the fact that the historical occurrence of persistence populations in the region from Cape Mendocino to Point Arena, which includes the two southern-most diversity strata, is also highly uncertain (Bjorkstedt et al. 2005).

Based on a consideration of this new and updated information, Williams et al. (2011) concluded that the extinction risk of the CC Chinook salmon ESU has not changed since the Good et al. (2005) review. Good et al. (2005) concluded that this ESU was likely to become endangered in the foreseeable future.

CCC coho salmon ESU

Summary of Previous Biological Review Team (BRT) Conclusions

Status reviews by Weitkamp et al. (1995) and Good et al. (2005) both concluded that the CCC coho salmon ESU was in danger of extinction. NMFS initially listed this ESU as threatened in

1996, but changed its ESA listing to endangered in 2005. In their status reviews, the BRTs cited concerns over low abundance and long-term downward trends in abundance throughout the ESU, as well as extirpation or near extirpation of populations across most of the southern two-thirds of the ESUs historical range, including several major river basins. They further cited as risk factors the potential loss of genetic diversity associated with range reductions or loss of one or more brood lineages, coupled with historical influence of hatchery fish (Good et al. 2005)

Review of Technical Review Team (TRT) Documents and Findings

Bjorkstedt et al. (2005) proposed that the CCC coho salmon ESU historically comprised 12 independent populations (11 functionally independent and 1 potentially independent) as well as at least 63 dependent populations. These populations were assigned to five diversity strata, one of which (San Francisco Bay) contained only dependent populations. Spence et al. (2008) proposed viability criteria for each independent population.

The lack of time series of adult abundance estimates for any of the 12 independent populations precluded rigorous application of the criteria (Spence et al. 2008); however, based on ancillary data the TRT concluded that coho salmon were at a high risk of extinction or extinct in the Garcia River, Gualala River, Russian River, Walker Creek, Pescadero Creek, and the San Lorenzo watersheds. The Noyo River population was deemed to be at moderate/high risk. The remaining independent populations (Ten Mile River, Big River, Albion River, Navarro River, and Lagunitas Creek) were considered data deficient. The lack of demonstrably viable populations in any of the diversity strata, the lack of redundancy in viable populations, and substantial spatial gaps in the distribution of coho salmon led the TRT to conclude that the CCC coho salmon ESU was in danger of extinction.

New Data and Updated Analyses

Consideration of information from the public

No public input on the status of the CCC coho salmon ESU was received during the public comment for the 5-year review.

Abundance and Trends

Quantitative population-level estimates of adult spawner abundance spanning more than 10-12 years are extremely rare for independent or dependent populations of coho salmon in this ESU. New data since publication of the previous status review (Good et al. 2005) consist of continuations of a few time series of adult abundance, some of which had only a few years of data at the time of the last status review, and most of which are for dependent populations (see Appendix 1 of Spence and Williams 2011). The best available data for an independent population are from Lagunitas Creek. Since the 1997-1998 season, redd surveys have been conducted annually in Lagunitas Creek and its major tributaries (San Geronimo, Devils Gulch, Nicasio Creek and Olema Creek) through the combined efforts of the Marin Municipal Water District, the National Park Service, and the Salmon Protection and Watershed Network (Ettlinger et al. 2010; M. Reichmuth, National Park Service, Point Reyes National Seashore, unpublished data). Although these redd counts have not been calibrated to estimate adult population abundance, a rough estimate of spawner abundance can be made by doubling the redd count, which assumes an average of one redd per female and a 1:1 male/female sex ratio. Based on these assumptions, the redd counts indicate that coho populations within the watershed have averaged about 527 fish over the past 12 years, but have declined from a peak observed in 2004 and 2005 (see Figure 1a in Spence and Williams 2011). The negative 12 year trend in redd counts is not statistically significant, but was nearly so (see Table 5 in Spence and Williams 2011).

The only other independent population for which information is available is from Noyo River for which two separate time series of abundance data are available. Counts of coho salmon have been made annually at the Noyo Egg Collecting Station on the South Fork of the Noyo River since the 1960s (Grass 1999-2009; Harris 2010). These data represent only a portion of the Noyo River population (approximately 30% of the watershed lies upstream of the collecting station) and interpretation of the data is confounded by several factors. First, counts from 1963-1998 were a mix of hatchery and wild fish which were not separately identified during counting. Second, the collecting station was not operated continuously during most years prior to 1998 so the counts underestimate the total number of fish passing upstream. Third, some fish are able to pass over the counting weir without being counted thereby leading to an underestimation of the population above the weir. Beginning in 1997-98 all hatchery fish were marked allowing hatchery fish to be separately counted; however, hatchery releases ended in the early 2000s and the last hatchery-origin fish returned in 2006. Despite these limitations, it is clear that adult returns to the SF Noyo River have declined substantially since the 1960s and 1970s and have continued to decline in recent years with fewer than 80 fish counted at the weir in each of the past 5 years (see Figure 1b in Spence and Williams 2011). The 12-year trend in number of returning wild fish is negative, but not statistically so. A shorter time series of adult abundance for the entire Noyo River basin, which combines several methods of estimation and includes hatchery fish indicates that the average abundance declined from an estimated 668 fish/year between 2001-03 to 513 fish/year from 2006-10 (S. Gallagher, CDFG, unpublished data as cited in Spence and Williams 2011). No meaningful trend was calculated for this time series as there were two years without population estimates.

Monitoring of coho salmon has also been ongoing for five dependent populations in the ESU. For three of these populations (Pudding Creek, Caspar Creek, and Little River), the estimates of adult abundance have been made since 2000 or 2001 (S. Gallagher, CDFG, unpublished data). In all three cases, the population trends have been downward (see Figure 1 in Spence and Williams 2011) with the declines in Pudding Creek and Little River statistically significant. Pudding Creek is the largest of these populations with an estimated average of 495 spawners annually over this period. Caspar Creek averaged 155 spawners over the last 11 years and Little River approximately 40 spawners (see Table 6 in Spence and Williams 2011). Coho redd counts have been made by the National Park Service (NPS) in Redwood Creek (Marin County) annually since 1999 (M. Reichmuth, NPS, Point Reyes National Seashore, unpublished data). Counts have ranged from 0 to 93 during this 12-year period and trended downward though the decline is not statistically significant (Spence and Williams 2011). Lastly, counts of adult coho salmon have been made at the Scott Creek weir in Santa Cruz County since 2003 (Sean Hayes, NMFS, SWFSC, unpublished data). In several of years, counts have been too low to produce reliable estimates of abundance, but the population has declined precipitously since the 2003-04 and 2004-05 spawning seasons when an estimated 272 and 329 adults returned, respectively (Figure 1 in Spence and Williams 2011). During those two spawning seasons approximately half the returning fish were of hatchery origin and in the last five years only 5 wild adults have been captured.

Other Data

From 2006-08, scientists from the SWFSC investigated the distribution and abundance of juvenile coho salmon in coastal streams in Santa Cruz and San Mateo counties which are at the southern end of the ESU's range. In 2006, juvenile fish were found at only 2 of 46 sampling sites (San Vicente and Scott creeks); in 2007, juvenile fish were not found at any of the 47 sampling sites; and in 2008, juveniles were found at 5 of 46 sampling sites including San Gregorio, Waddell, Scott, San Vicente, and Soquel creeks. In all cases, the number of juveniles observed was small with fewer than 180 fish observed in any single stream (B. Spence, NMFS, SWFSC, unpublished data). Genetic data from fish at three of the sites with the largest number of fish in 2008 indicated that the observed juveniles resulted from no more than one or two successful spawning pairs in each case (Spence et al. 2011). These and other observations since 2005 suggest that natural spawning populations south of San Francisco are near extinction (Spence and Williams 2011).

Discussion

Although long term data on coho salmon abundance in this ESU are scarce, all available evidence from short-term research and monitoring efforts indicate that the status of populations in this ESU have worsened since the 2005 (Good et al. 2005) status review (Spence and Williams 2011). For all available time series, recent population trends have been downward with particularly poor adult returns from 2006 to 2010. In addition, many independent populations are well below low-risk abundance targets and several are either extinct or below the high-risk dispensation thresholds (San Lorenzo River, Pescadero Creek, Russian River, Gualala River, and Garcia River) that were specified by Spence et al. (2008). Finally, even though population level estimates of abundance are lacking for most independent populations, it appears that none of the five diversity strata defined by Bjorkstedt et al. (2005) currently support viable populations based on the criteria established by Spence et al. (2008). In summary, the risk of extinction for this ESU appears to have increased since the last formal review when Good et al. (2005) concluded that the ESU was in danger of extinction.

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

Section 4(a)(1) of the ESA and the listing regulations (50 CFR Part 424) set forth procedures for listing species. NMFS must determine, through the regulatory process, if a species is endangered or threatened based upon any one or a combination of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or education purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence. New information relating to each of these five listing factors is discussed below including discussion of important conservation efforts being made to protect the ESUs where appropriate.

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

CC Chinook salmon ESU

At the time of listing, Chinook salmon and their habitat within the range of this ESU were adversely affected by logging, road construction, urban development, mining activities, agriculture, ranching and recreation (NMFS 1998; 64 FR 50394; 70 FR 37160). These activities resulted in the loss, degradation, simplification, and fragmentation of Chinook salmon habitat. A wide range of impacts resulted from these activities including: alteration of steam banks and channel morphology, alteration of ambient water temperatures, degradation of water quality, elimination of spawning and rearing habitat, elimination of spawning gravels and large woody debris (LWD), removal of riparian vegetation and increased stream sedimentation. The effects of periodic flood events exacerbate the adverse effects of these activities.

Additionally, the distribution of the Chinook salmon in this ESU has been curtailed by dam construction. The spring-run life history form, which historically spawned and reared in upstream portions of certain watersheds, was heavily impacted by construction of dams and has been completely extirpated from this ESU. Warm Springs and Coyote Dams in the Russian watershed and Scott Dam on the Eel were cited at the time of listing as curtailing or blocking access to spawning and rearing habitat within this ESU. Peters Dam on Lagunitas Creek was also cited as a migration barrier even though the watershed was not included in originally defined ESU.

No significant changes have occurred in this factor since listing or the most recent status review and the identified threats continue to adversely impact this ESU. Land use activities associated with logging, road construction, urban development, mining, agriculture, ranching, and recreation, and their associated impacts continue to result in the loss, degradation, simplification, and fragmentation of Chinook salmon habitat within this ESU, thereby resulting in declining salmon populations. The distribution of Chinook salmon in this ESU continues to be curtailed or blocked by dams in the Eel and Russian River basins. As noted above, Peters Dam in the Lagunitas Creek watershed curtailed or blocked access to historic Chinook salmon spawning and rearing habitat (NMFS 1998); however, it was not part of the listed ESU because it is south of the current ESU boundary at the Russian River. New information on the presence of Chinook salmon in the Lagunitas Creek watershed and genetic data suggesting these fish are most likely part of the CC Chinook salmon ESU led to the SWFSC's recommendation that the southern boundary of this ESU be extended southward to include all coastal watersheds north of the Golden Gate, including Lagunitas Creek (see section 2.1.3 in this report). If this boundary change is implemented through formal rulemaking, Peters Dam on Lagunitas Creek will be identified as further curtailing Chinook salmon habitat in this ESU.

CCC coho salmon ESU

At the time of listing, logging, agriculture, mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals and unscreened diversions for irrigation were identified as factors contributing to the degradation of coho salmon habitat and populations within this ESU (61 FR 56138). Land use activities associated with logging, road construction, urban development, mining, agriculture, and recreation have significantly altered the quantity and quality of coho salmon habitat. Impacts associated with these activities include: alteration of streambank and channel morphology, alteration of ambient stream water temperatures, elimination of spawning and rearing habitat, fragmentation of available habitats, elimination of downstream recruitment of spawning gravels and LWD, removal of riparian vegetation resulting in increased stream bank erosion, and degradation of water quality (61 FR 56138). Of particular concern is the increased sediment input into spawning and rearing areas resulting from the loss of channel complexity, pool habitat, suitable gravel substrate, and LWD (61 FR 56138). Decreased large woody material in streams also reduces habitat complexity and contributes to the loss of cover, shade, and pools which are required by juvenile coho salmon (60 FR 38011). Logging activities have also altered the natural hydrograph.

Agricultural practices have contributed to the degradation of coho salmon habitat in the ESU through irrigation diversions, overgrazing in riparian areas, and compaction of soils in upland areas from livestock. Habitat degradation resulting from the adverse impacts of livestock grazing on riparian vegetation are described in 61 FR 56138 (at 56141). Urbanization has degraded coho salmon habitat through stream channelization, changes to the hydrologic regime (including floodplain drainage), riparian damage, and point source and non-point pollution (including sediments with trace metals, pesticides, herbicides, fertilizers, gasoline, and other petroleum products). Depletion and storage of natural flows have altered natural hydrological cycles in many central California rivers and streams within the range of this ESU. Alteration of stream flows has increased juvenile salmonid mortality for a variety of reasons described in 61 FR 56138 (at 56141). Reduced flows degrade or diminish fish habitats via increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravels, encroachment of riparian and invasive vegetation into spawning and rearing areas, and increased water temperatures (60 FR 38011; 61 FR 56138). The destruction or modification of estuarine areas has resulted in the loss of important rearing and migrations habitats.

No significant changes have occurred to this factor since listing and the threats remain. Land use activities associated with logging, road construction, urban development, mining, agriculture, ranching, and recreation, and their associated impacts continue to result in the loss, degradation, simplification, and fragmentation of coho salmon habitat in this ESU and continue to contribute to the declining abundance of coho salmon populations. Many fish passage barriers, including Warm Springs Dam located in the Russian River watershed, continue to curtail access to historic coho salmon habitat within this ESU.

Conservation Efforts

NMFS reviewed conservation efforts undertaken since the last review that we aimed at reducing the destruction, modification or curtailment of habitat or range for both ESUs. Important efforts have been taken by Federal, State and local entities. For example, in September 2008, NMFS completed the Russian River biological opinion that addressed water operations managed by the U.S. Army Corps of Engineers (COE) and the Sonoma County Water Agency (SCWA) in that watershed. The reasonable and prudent alternative (RPA) included in the biological opinion focused on addressing three areas impacted by SCWA and the COE water operations within the Russian River basin: habitat degradation within the Russian River estuary, habitat conditions in Dry Creek, and habitat conditions in the mainstem of the Russian River. Implementation of actions identified in the RPA are expected to substantially improve habitat conditions in these areas over time.

An example of a conservation program led and organized by a non-governmental organization is the Fish Friendly Farming Program. The Fish Friendly Farming Program was started by the Sotoyome Resource Conservation District and is now organized and led by the California Land Stewardship Institute. It is a cooperative program involving private landowners that want to implement environmental improvements in vineyard systems. The program is currently operating in Sonoma, Napa, Solano and Mendocino counties and is targeted at improving conditions for Chinook salmon, coho salmon and steelhead. Landowners enroll their property into the program, attend a series of educational workshops on environmentally-friendly land management practices, and complete a detailed farm conservation plan for their property which describes best management practices and specific conservation projects. Best management practices may include road repair and erosion management, use of cover crops, proper water diversion pump screening, planning considerations for vineyard expansions or replants, and low impact pesticide selection and application recommendations. Projects encouraged by the program include creek and river corridor re-vegetation and restoration, erosion repairs on sites such as gullies and old roads, eradication of invasive, non-native plants, and fish passage barrier removal or modification projects.

NMFS has provided over $300,000 in funding for both operational costs (through contracts) and project implementation (through competitive grant processes) since the Fish Friendly Farming Program was initiated which has allowed the program to leverage an even larger amount of funding. Over 60,000 acres have been enrolled in the program since 2001 resulting in numerous improvement projects and the program is continuing to expand. Funding has been secured through the State of California and other competitive grants for additional educational classes and project implementation and the program is still operating.

In 2004, NMFS began implementing procedures for reviewing, approving, and monitoring gravel mining activities in Humboldt and Del Norte counties, substantially improving protections for anadromous salmonids, including Chinook and coho salmon, and their habitat. The process is used to permit in-stream gravel mining in Humboldt County as well as batched individual permits for gravel mining on the Mad River. Since that time, the methods used to extract gravel from all streams in Humboldt County have been modified to better protect Chinook salmon, coho salmon and steelhead as well as designated critical habitat for all three species. These conservation efforts improve salmonid habitat by avoiding stream channel braiding, increasing overall gravel bar heights, and improving fish passage. Overall, these management efforts are anticipated to maintain, or gradually improve, spawning, rearing, and migration habitat. These efforts are expected to continue until at least 2014. In addition, NMFS has provided extensive technical assistance to both Mendocino and Sonoma counties to assist in developing improvements to gravel mining operations in those counties.

In spite of these and many other conservation efforts aimed at reducing the destruction, modification or curtailment of habitat for these two ESUs, they have not fully ameliorated the threats associated with this listing factor.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

CC Chinook salmon ESU

Prior to listing, Chinook salmon populations in this ESU supported tribal, commercial, and recreational fisheries. Overfishing in the early days of European settlement depleted many Chinook salmon stocks prior to the impact of more recent habitat degradation (NMFS 1998). In the 1990's ocean harvest rates for Chinook populations in this ESU were estimated at 21% (PFMC 1996a, as cited in NMFS 1998), and freshwater and estuarine harvest rates were estimated at between 25-30% (PFMC 1996b, as cited in NMFS 1998). At the time of listing, the collection of Chinook salmon for scientific research and education programs were thought to have little or no impact on the ESU as a whole.

Chinook salmon in this ESU are currently harvested incidentally in tribal, commercial, and recreational salmon fisheries that target other non-listed Chinook stocks. Harvest impacts to Chinook salmon in this ESU occur primarily from ocean fisheries that are driven by hatchery production of Chinook salmon from outside the ESU (i.e. the Klamath basin and Central Valley). Limited data is available on the harvest of Chinook salmon in this ESU. However, available data do suggest that Chinook salmon from this ESU and Klamath River (i.e. Klamath River fall Chinook [KRFC]) share a similar ocean distribution which is concentrated between central California and central Oregon. For this reason, the KRFC age-4 (fully vulnerable) ocean harvest rate is used as a proxy for the ocean harvest rate on the CC Chinook salmon ESU. The KRFC age-4 ocean harvest rate has fallen sharply from 45% during the years from 1983-1990 to 12% and 15%, respectively, during the years from 1991–1999 and 2000–2007 (Figure 1). The 2008 and 2009 harvest rates were 10% and 0%, respectively, due to the closure of nearly all Chinook fisheries south of Cape Falcon, Oregon. Ocean fisheries resumed in 2010, but commercial fishing opportunity was severely constrained, particularly off California, resulting in a forecasted harvest rate of 12% for 2010. Freshwater fishery impacts on Chinook salmon in this ESU are relatively minor because retention of Chinook is either prohibited, or fishing regulations are structured to ensure non-retention of Chinook (e.g., by closures during the spawning migration period or maximum size limits smaller than spawning Chinook). Overall, the available information indicates that fishery impacts on the CC Chinook ESU has not appreciably changed since the most recent review (Good et al. 2005), except for the exceptionally low rates in 2008 and 2009.

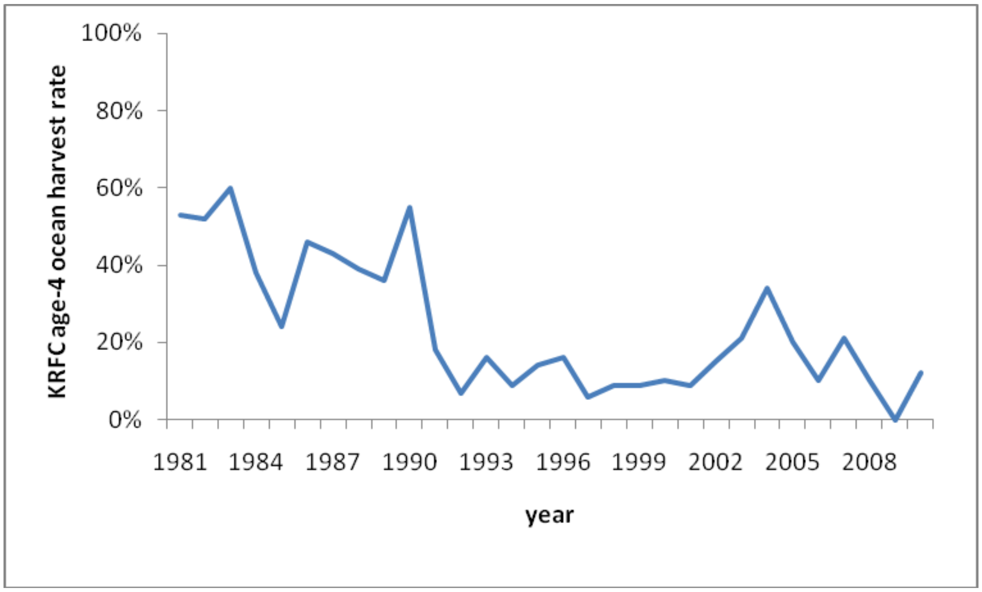

Figure 1. Klamath River fall Chinook (KRFC) age-4 ocean harvest rate for years 1981–2010 (PFMC 2010a, PFMC 2010b). 2010 rate value is forecast.

Since the listing of this ESU the take of fish for scientific research and other purposes has been closely controlled by CDFG and NMFS through the issuance and conditioning of collection permits. Most of the permits are issued to environmental consultants, Federal resource agencies, and educational institutions. There is no information indicating that impacts from scientific research have changed since the last review. Artificial production, supplementation, and broodstock collection activities have also been terminated since the last review, and therefore, no fish are being collected for these purpose at present.

CCC coho salmon ESU

Coho salmon were historically harvested in tribal fisheries, and were also targeted in recreational and commercial fisheries. Overfishing in the early days of European settlement led to the depletion of many stocks of salmonids, prior to the extensive modification and degradation of natural habitats (69 FR 33102). Marine harvest of coho salmon also occurred in the coastal waters off British Columbia, Washington, Oregon, and California. Recreational fishing for coho salmon was pursued in numerous streams throughout the central California coast as adults returned on their fall spawning migration.

Coho salmon stocks are managed by NMFS in conjunction the PFMC, the States, and certain tribes. The central California coast falls within the Federal salmon fishery management zone stretching from Horse Mountain, south of Eureka, California, to the Mexico border. Coho salmon ocean harvests were historically managed by setting escapement goals for Oregon Coastal Natural coho salmon which constituted the largest portion of naturally produced coho salmon caught in ocean salmon fisheries off California and Oregon. Use of this index resulted in pre-1994 exploitation rates higher than central California populations could sustain. The confounding impacts to coho salmon from habitat degradation, drought, and poor ocean conditions make it difficult to assess the extent to which recreational and commercial harvest contributed to the overall decline of coho salmon populations on the West Coast rivers, including those that are part of the CCC coho salmon ESU (61 FR 56138).

No direct information is available regarding the harvest of coho salmon in this ESU. However, it is reasonable to expect that they have a similar or even a more southerly distribution than SONCC coho salmon which 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 ocean exploitation rate for coho salmon in this ESU is thought to be very low and attributable to by-catch in California and Oregon fisheries that target Chinook salmon and Oregon's mark-selective coho salmon fisheries. The SONCC coho salmon (Rogue/Klamath coho hatchery stocks) ocean exploitation rate forecast time series for 2000–2010 provides the best available proxy for recent trends in the ocean exploitation rate of this ESU. This harvest rate was stable and averaged 6% from 2000–2007 prior to falling to 1% and 3% in 2008 and 2009, respectively, due to closure of nearly all salmon fisheries south of Cape Falcon, Oregon (Figure 2). For 2010, the forecasted harvest rate was 10% due primarily to the resumption of recreational fishing off California and Oregon. Freshwater fishery impacts on coho salmon from this ESU are likely relatively minor because California has prohibited the retention of coho salmon statewide since the 1990's. Overall, the available information indicates that harvest impacts on this ESU have not changed appreciably since the most recent status review, except for the exceptionally low rates in 2008 and 2009.

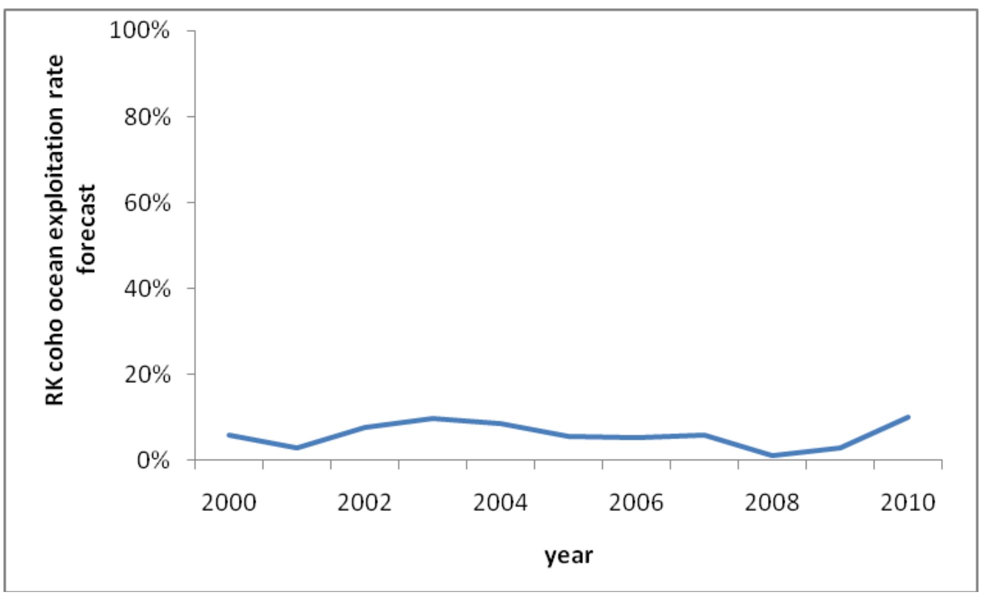

Figure 2. Rogue/Klamath (R/K) coho ocean exploitation rate forecast for years 2000-2010 (PFMC 2010b).

Collection of coho salmon for scientific research and educational programs is thought to have had little or no historic impact on California coho salmon populations. NMFS did not consider impacts from scientific research programs to a significant factor at the time this ESU was listed in 1996 (61 FR 56138). In California, most of the scientific collection permits are issued to environmental consultants, Federal resource agencies, and educational institutions by CDFG and

NMFS and take is regulated by issuing and conditioning individual permits. The CDFG and NMFS also require reporting of any coho salmon taken incidental to other monitoring activities.

No significant changes have occurred to this listing factor since the most recent status review. Ocean harvest impacts remain low as described above and freshwater fishing impacts are minimized by California sport fishing regulations that do not allow retention of coho salmon in inland or nearshore waters. Collection for scientific research, education programs and artificial propagation broodstock is tightly controlled and monitored through the issuance of collection permits by NMFS and CDFG.

Conservation Efforts

NMFS reviewed conservation efforts aimed at reducing overutilization of these two ESUs since the last status review. Freshwater and ocean harvest impacts to both ESUs have remained low as a result on ongoing management efforts. During 2008 and 2009, the closure of nearly all salmon fisheries south of Cape Falcon, Oregon eliminated or severely curtailed commercial and recreational salmon fisheries to allow salmon stocks to recover. Because coho salmon-directed fisheries and retention have been prohibited off the coast of California since 1996, the CCC coho salmon ocean exploitation rate is likely very low and the result of by-catch in Chinook fisheries supported by stocks from the Klamath River and Central Valley. Several hatchery stocks are considered part of the CCC coho salmon ESU (Don Clausen Fish Hatchery Captive Broodstock Program, Scott Creek/King Fisher Flats Conservation Program, and Scott Creek Captive Broodstock Program) and they are managed as conservation facilities to supplement wild populations rather than to support fisheries. Broodstock collection is closely monitored and constrained to minimize impacts to this ESU. Although conservation efforts aimed at reducing impacts of fishing and other forms of take have been implemented for both ESUs, these activities and particularly fishing, continue to impact both ESUs.

2.3.2.3 Disease or predation

CC Chinook salmon ESU

Infectious diseases can influence adult and juvenile salmon survival. Fish are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. Specific diseases known to affect Chinook salmon are bacterial kidney disease (BKD), ceratomyxosis shasta, columnaris, furunculosis, infectious hematopoietic necrosis, redmouth and black spot disease, and erythrocytic inclusion body syndrome (NMFS 1998; 69 FR 33102). Very little information existed to quantify infection levels and mortality rates attributable to these diseases at the time of listing. However, studies have shown that naturally spawned fish tended to be less susceptible to pathogens than hatchery-reared fish and so hatchery programs were considered possible sources of infectious diseases. Chinook salmon co-evolved with specific communities of these organisms, but the widespread use of artificial propagation introduced exotic organisms not historically present in particular watersheds. Habitat conditions such as low water flows and high temperatures can exacerbate susceptibility to infectious diseases. Since the last status review, all of the Chinook salmon hatchery programs within this ESU have been terminated, and therefore, the risk of pathogen transfer from these programs has been eliminated.

At the time of listing, introductions of non-native species and habitat modifications were documented as sources of increased predation on Chinook salmon and other salmonids (64 FR 50394). For example, introduced Sacramento pikeminnow, whose populations have flourished with warmer water conditions, were known to consume juvenile Chinook salmon throughout the Eel River Basin. Numerous avian species also prey upon juvenile salmonids, and their success is often increased as a result of water development activities. Predation by marine mammals (e.g. harbor seals and California sea lions) was also a concern at the time of listing due to the increased numbers of pinnipeds along the Pacific Coast and dwindling run sizes Chinook salmon in this and other ESUs. In many of the small coastal rivers and streams in southern Oregon and northern California, returning adult salmon and steelhead were considered more vulnerable to pinniped predation than fish in larger systems (NMFS 1997). In low rainfall years or when rain arrives late in the winter season, small coastal rivers do not flow with sufficient volume to open the beach crest and flow into the sea. Low-tide periods also create or confound this condition in small, low-flowing rivers and streams. During such periods, adult fish arrive and accumulate in nearshore waters just offshore of the closed-off river mouth. The adult salmonids are then exposed to days or weeks of pinniped predation at these sites until sufficient rainfall occurs or higher tides allow access to the river or stream. During successive years of drought, the situation can be exacerbated because the river mouths are open only intermittently during the salmonid spawning season. Downstream migrating smolts also become more vulnerable to pinniped and bird predation in these conditions, as the fish congregate in the lagoons formed near the river mouth until it opens up to the sea. Despite these concerns, most studies indicated salmonids were a minor dietary component of marine mammals. For example, Hanson (1993) reported that predation on anadromous salmonids was minimal by harbor seals and California sea lions at the mouth of the Russian River.

The threats associated with this listing factor remain largely unchanged since the last status review. Predation may significantly influence salmonid abundance in some populations when other prey are absent and physical habitat conditions lead to the concentration of adult and juvenile salmonids in small areas where they can be preyed upon. Sacramento pikeminnow continue to be a significant source of mortality to Chinook salmon in this ESU, although changes in water operations in the Eel and Russian rivers may reduce this threat over time. In most cases, salmonids continue to be a minor component of the diet of marine mammals, although they may be locally significant in some circumstances. Habitat conditions such as low water flows and high temperatures still exist throughout the ESU and can exacerbate susceptibility to infectious diseases.

CCC coho salmon ESU

At the time of listing, disease and predation were not considered to be major factors contributing to the decline of this ESU; however, both factors were thought to have the potential to be locally significant for some populations. As with Chinook salmon, coho salmon are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. Specific diseases known to be present in the environment and to effect salmonids are listed in 69 FR 33102, but little information was available indicating these infectious diseases directly impacted coho salmon. However, studies have shown native fish tend to be less susceptible to such pathogens than hatchery-reared fish (Buchanan et al., 1983; Sanders et al., 1992) and so hatchery programs were considered potential sources of these diseases. In California, many natural and hatchery coho salmon populations tested positive for the bacterium Renibacterium salmoninarum which is the causative agent of BKD. For example, the incidence of BKD infection for coho salmon in Scott and Waddell Creeks was estimated to be 100 percent (61 FR 56138). Due to BKD outbreaks in the Russian River and Scott Creek, the CDFG implemented treatment protocols in an attempt to control the disease (61 FR 56138). At the time of listing, the presence of Sacramento pikeminnow and freshwater habitat modifications were known to cause increased predation on coho salmon and other salmonids in central California streams. Predation by marine mammals (primarily harbor seals and California sea lions) was also of concern in areas experiencing dwindling run sizes of coho salmon. There were also concerns about predation by seabirds, including ring-billed gulls, common merganser, herons, cormorants, and alcids.

There is no new information indicating that threats associated with this factor have substantially changed for this ESU since the last status review. Disease and predation continue to be potential threats to this ESU, but neither factor is considered to be an important contributor to the decline of coho salmon populations in this ESU.

Conservation Efforts

NMFS reviewed conservation efforts addressing the reduction of disease and predation since the last status review of these ESUs. Actions to restore and enhance aquatic habitats and reduce effects from water withdrawals (as summarized in section 2.3.2.1) are expected to help ameliorate conditions conducive to disease organisms and non-native predators over time. In particular, recent changes to water operations in the Eel and Russian River are expected to reduce pikeminnow predation over time. Overall, however, conservation efforts have not eliminated threats from this factor for either ESU.

2.3.2.4 Inadequacy of existing regulatory mechanisms

CC Chinook salmon ESU

In conjunction with the original listing determinations for west coast Chinook salmon, NMFS reviewed a wide range of Federal, State, local, tribal and other regulatory and/or protective mechanisms affecting the abundance and survival of Chinook salmon and the quality of their habitat (NMFS 1998). The following sections provide an overview of some of the key regulatory mechanisms and their effects on Chinook salmon and its habitat within this ESU.

Federal and State Land Management

The Northwest Forest Plan (NFP) is a coordinated ecosystem management strategy for 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 (Strix occidentalis) (which overlaps with portions of the CC Chinook 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 CC Chinook salmon is limited because of the limited extent of USFS and BLM Federal lands within the range of the ESU, and the fact that Federal land ownership is not uniformly distributed in watersheds within the ESU. In some areas, Federal lands tend to be located in the upper reaches of watersheds or river basins, upstream of the highest quality salmon habitat. In other areas, particularly Bureau of Land Management (BLM) ownership, Federal lands are distributed in a checkerboard fashion, resulting in fragmented landscapes. Both of these Federal land distribution factors limit the ability of the NFP to achieve its aquatic habitat restoration objectives and protect Chinook salmon habitat at watershed and river basin scales and highlight the importance of complementary salmon habitat conservation measures on non-Federal lands within the ESU. Limitations of the NFP continue since the last status review of this ESU and represent an ongoing “regulatory” threat to this ESU.

The California Department of Forestry and Fire Protection enforces the State of California's forest practice rules (FPRs) which are promulgated through the Board of Forestry (BOF) and regulate management of non-Federal timberlands in California. The FPRs contain provisions that could provide significant protection for Chinook salmon if fully implemented. NMFS believes the FPRs do not ensure protection of Chinook salmon and other salmonid habitats and populations because they do not adequately address LWD recruitment, streamside tree retention to maintain bank stability, and canopy retention standards that assure stream temperatures are suitable for all life stages of Chinook salmon. There have been some limited improvements in the FPRs over time, but they still do not fully protect salmonid habitat and continue to represent an ongoing regulatory threat to the CC Chinook salmon ESU.

Federal and State Water Management

The Federal Clean Water Act (CWA), administered by the Environmental Protection Agency (EPA), is intended to protect beneficial uses of water, including consideration of habitat for anadromous salmonids and other fishery resources. In practice, implementation has not provided the desired level of protection of fishery resources, particularly with respect to non-point sources of pollution. Section 303(d)(1)(C) and (D) of the CWA requires states to prepare Total Maximum Daily Loads (TMDLs) for all water bodies that do not meet State water quality standards. TMDLs are a method for quantitative assessment of environmental problems in a watershed and identifying pollution reductions needed to protect drinking water, aquatic life, recreation, and other use of rivers, lakes, and streams. TMDLs may address all pollution sources including point sources such as sewage or industrial plant discharges, and non-point discharges such as runoff from roads, farm fields, and forests. TMDLs have the potential to provide long term benefits to listed salmonids and their habitat, but it will take time to develop and implement the standards and to determine the magnitude of the benefits.

Historically, the impacts to fish habitat from agricultural practices have not been closely regulated. The State of California does not have regulations that directly manage agricultural practices, but instead relies on the TMDLs under the CWA to improve water quality from all sources and parties, including agricultural sources. Numerous streams within the range of the CC Chinook ESU are currently impacted by agricultural practices, but do not have established TMDLs (SWRCB 2010). In many instances, TMDLs are not scheduled for completion until 2019. Agricultural activities continue with minimal regulation, and represent a threat to Chinook salmon survival and recovery in this ESU.

As described in section 2.3.2.1, NMFS recently issued a biological opinion which addressed water operations managed by the COE and by the Sonoma County Water Agency (SCWA) on the Russian River. The jeopardy Biological Opinion contained a Reasonable and Prudent Alternative that addressed three areas impacted by SCWA and the COE water operations within the Russian River basin: habitat degradation within the Russian River estuary, Dry Creek, and the mainstem Russian River. The actions required by the RPA are expected to substantially improve habitat conditions over time for Chinook salmon in the basin.

The State Water Resources Control Board (SWRCB) Division of Water Rights administers a water rights permitting system which controls utilization of waters for beneficial uses throughout the State. This system, while it contains provisions (including public trust provisions) for the protection of instream aquatic resources, does not provide an explicit regulatory mechanism to implement CDFG Code Section 5937 requirements to protect anadromous fish populations such as Chinook or coho salmon below impoundments. Additionally, SWRCB generally lacks the oversight and regulatory authority over groundwater development comparable to surface water developments for out-of-stream beneficial uses.

In early 2009, NMFS requested that the SWRCB take action to address concerns that diversions for frost protection of crops in the Russian River basin cause mortality of listed salmonids. In late 2010, the SWRCB announced it would develop regulations to ensure that the instantaneous cumulative diversion rate does not result in a reduction in stream stage that is harmful to salmonids and would be required to include stream and diversion monitoring and reporting requirements. Such regulations have not yet been implemented. In addition, NMFS has protested permitting of certain new water rights, and has urged the SWRCB to address unpermitted diversions in the basin.

Overall, most Federal and State water management regulatory mechanisms are limited in their ability to provide robust protections for listed Chinook salmon populations or their habitat and are relatively unchanged since the last status review. Consequently, they remain a continuing threat to the CC Chinook salmon ESU.

Dredge, Fill, and In-stream Construction Programs

The COE regulates removal/fill activities in waters of the U.S. under section 404 of the CWA. The regulations under section 404 do not fully protect Chinook habitat because the regulations are limited in scope and authority 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. Currently the COE requires an evaluation of cumulative impacts from these projects, the effectiveness of such evaluations on minimizing cumulative impacts is unknown. For instance, the number of permits being denied or modified based on the cumulative effects evaluations is unknown, but likely to be very small.

Similarly, the section 401 water quality certification program, which is regulated by the states of California and Oregon, apply only to activities that require a federal permit or license (i.e., 404 permit or Federal Energy Regulatory Commission (FERC) license, respectively). Because the 401 certification requirements depend on the initiation of the 404 permitting or FERC licensing process, the 401 program also does not address upland activities. Therefore, the lack of review and jurisdiction for upland activities limits the ability of the 404 and 401 regulatory programs to provide protection to Chinook salmon and their habitat.

State agencies responsible for dredge and fill permits include the Regional Water Quality Control Boards and, in some cases, the CDFG. The State attempts 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 regulatory limitations of dredge, fill, and instream construction programs are believed to be relatively unchanged since the last status review, and therefore, remain a threat to this ESU.

CCC coho salmon ESU

At the time of listing, inadequate State and Federal regulatory mechanisms were considered a threat to this ESU. Although many regulatory programs were in place at the time of listing, they were not considered fully effective or had not been adequately implemented for a variety of reasons (e.g. funding, implementation uncertainties, voluntary nature, etc.). The following discussion provides an overview of some of the key regulatory mechanisms and their effects on coho salmon and its habitat within this ESU.

Federal and State Land Management

As noted above, The NFP's Aquatic Conservation Strategy (ACS) 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 habitat in this ESU is extremely limited. Federal lands comprise only about 5 percent of the lands in the CCC coho salmon ESU which represents insufficient habitat to secure coho recovery even with the strictest of Federal forest management practices. These limitations highlight the need for 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 salmon habitat remain unchanged since the last status review.

The State of California listed coho salmon as endangered in streams south of Punta Gorda pursuant to the California Endangered Species Act and released a strategy for their recovery (CDFG 2004). Within this geographic area, timber harvest was identified as a major threat to coho salmon and therefore CDFG proposed designating coho salmon as a sensitive species. AS discussed above, California's FPRs contain provisions that could be protective of coho salmon and its habitat if fully implemented, including a provision allowing a species to be designated as sensitive thereby allowing the BOF to adopt special management practices for the species and its habitat. In this case, however, the BOF chose not to adopt CDFG's proposal to designate coho salmon as a sensitive species. Other limitations of the FPRs include the current process for approving Timber Harvest Plans which receive imperfect environmental review, and insufficient monitoring of impacts of timber harvest operations to determine whether a particular operation damages habitat and, if so, how it might be mitigated. There are also exceptions to the rules that allow timber harvest to occur without any requirement for environmental review or monitoring. Overall, NMFS believes the FPRs do not adequately protect coho salmon habitat and still represent an ongoing regulatory threat to this ESU.

Federal and State Water Management

The CWA provides for the protection of beneficial uses, including the protection of fishery resources. However, implementation of this statute has been imperfect to protect coho habitat. For example, of 88 water bodies identified as impaired within the range of this ESU pursuant to Section 303(d), only 10 have completed TMDLs (SWRCB 2010). The State Water Quality Control Board is required to develop and implement water quality standards for these water bodies, and, if they do not, the EPA is required to do so.

As described above, in late 2010, the SWRCB announced it would develop regulations to ensure that the instantaneous cumulative diversion rate does not result in a reduction in stream stage that is harmful to salmonids and would be required to include stream and diversion monitoring and reporting requirements. In addition, NMFS has protested permitting of certain new water rights, and has urged the SWRCB to address unpermitted diversions that affect listed salmonids. To date the SWRCB has not developed these new regulations nor sufficiently addressed the problem of unpermitted water diversions.

Overall, the regulatory limitations of Federal and state water management programs are relatively unchanged since the last status review, and therefore, continue to be a threat to this ESU.

Dredge, Fill, and Instream Construction Programs

As described above, the COE regulates removal/fill activities under section 404 of the CWA. The regulations under section 404 are limited in 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 address cumulative impacts from multiple projects.

Similarly, the section 401 water quality certification program applies only to activities that require a federal permit or license (i.e., 404 permit or FERC license, respectively). Because the 401 certification requirements depend on the initiation of the 404 permitting or FERC licensing process, the 401 program also does not address exclusively upland activities. 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 their habitat.

State agencies responsible for dredge and fill permits includes the Regional Water Quality Control Boards and, in some cases, the CDFG. 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.

The Federal Emergency Management Agency (FEMA) administers a Flood Insurance Program which influences development in waterways and floodplains. Regulations allow for development in the margins of active waterways if they are protected against 100-year flood events, and do not raise the water elevations within the active channel (floodway) more than one foot during such flood events. This standard does not consider the dynamic, mobile nature of watercourses and the critical role that margins of active waterways (riparian areas) play in the maintenance of aquatic habitats within the range of this coho salmon ESU. FEMA programs for repairing flood related damages (Public Assistance Program, Individual and Households Program, and Hazard Mitigation Grant Program) promote the replacement of damaged facilities and structures in their original locations, which are prone to repeated damage from future flooding, and thus lead to repeated disturbance of riparian and aquatic habitats important to coho salmon and other listed salmonids.

Overall, the regulatory limitations of dredge, fill, and instream construction programs are relatively unchanged since the last status review, and therefore, continue to be a threat to this ESU.

2.3.2.5 Other natural or manmade factors affecting its continued existence

CC Chinook salmon ESU

At the time of listing, several natural factors were identified that could adversely affect Chinook salmon populations in this ESU including variability in ocean habitat conditions, drought, flooding, fire, and landslides. Although Chinook salmon and other salmonids clearly survived such natural events over the millennia, there was concern that these types of factors could threaten Chinook populations if coupled with deteriorating freshwater habitat conditions. Cyclic ocean conditions, for example, could affect food supply, predator distribution and abundance, migratory patterns, and overall survival (NMFS 1998). Droughts and floods might reduce Chinook salmon spawning, rearing, and migration habitat, particularly in conjunction with previously described land and water use activities that modify or degrade habitat conditions. Similarly, fire events, particularly if coupled with modified or degraded habitat conditions, could affect woody debris recruitment, shade, and soil stability. Landslides could affect riparian vegetation and sedimentation. These natural factors continue to represent a significant threat, in large part because freshwater habitat conditions have not sufficiently improved since the time of listing and last status review.

Artificial Propagation

Artificial propagation of Chinook salmon and other salmonids was also identified as a potential threat to this and other ESUs at the time of their listing. Artificial propagation of salmonids can have a wide range of beneficial or detrimental effects on salmon populations (64 FR 50394, 70 FR 37160). At the time of the last review in 2005, seven artificial propagation programs were considered part of this ESU and eventually listed. Most of these artificial propagation programs were small, cooperative programs authorized by the CDFG. In making its 2005 listing finding for this ESU, we considered the effects of these hatchery programs on the viability of the naturally spawning populations of Chinook salmon in this ESU. In general, our assessment concluded that these programs slightly increased the abundance of Chinook salmon in the ESU, but did not have any beneficial (or adverse) impacts on productivity, spatial structure or diversity of Chinook salmon populations, in large part because the programs were very small and broadly distributed over the ESU. Overall, we concluded that hatchery programs in this ESU did not provide significant benefits to the ESU and could have potential adverse impacts. Since the last status review in 2005, all seven artificial propagation programs have been terminated and they no longer have any impacts on naturally spawning Chinook salmon populations within the ESU.

Climate Change

New information since this listing of this ESU suggests that the Earth's climate may be warming, driven by the accumulation of greenhouse gasses in the atmosphere, and that these changes could alter freshwater habitat conditions and affect survival of Chinook salmon in the future. In coming years, climate change may affect our ability to recover salmon species, including Chinook in this ESU. Specific characteristics of a population or its habitat that could influence its vulnerability to climate change include its reliance on snowpack, its current temperature requirements, suitability of available habitat and the genetic diversity of the ESU.

The range of water temperatures is likely to shift resulting in higher high temperatures as well as higher low temperatures in streams. A recent study in of 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 NCCC Domain 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 streamflow (Bartholow 2005). Increases in winter and spring temperature regimes will cause eggs to develop more quickly, leading to early emergence and lower survival. Higher spring temperatures will increase the growth rates of fry. Increases in summer temperatures will lead to thermal stress, decreased growth and affect survival of outmigrating juveniles.

The increase in winter water temperatures may be intensified since streamflow in many streams is expected to decrease as a result of decreasing snowpack. 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 SWE (snow water equivalent) in the few areas where snowpack remains (Doppelt et al. 2008; Luers et al. 2006).

This loss of snowpack will likely lower spring and summertime flows while additional warming may cause earlier onset of runoff in streams. Changes in runoff patterns may ultimately influence the survival of smolts.

Annual precipitation could increase by up to 20% in 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 will likely cause eggs to be scoured from their nests; displace overwintering juveniles; and contribute to higher summer water temperatures.

Sea level is expected 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 salmon or in some cases will lead to the loss of estuarine habitat and a decreased potential for estuarine rearing.

Marine ecosystems will change as a result of global climate change and many of these changes will likely have deleterious impacts on salmon growth and survival while at sea. In general, the effects of changing climate on marine ecosystems are not well understood given the high degree of complexity and the overlapping climatic shifts that already exist (e.g. El Niño, La Niña, and Pacific Decadal Oscillation) and will interact with global climate changes in unknown and unpredictable ways. 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 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). 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). Salmon typically do well when ocean 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 last status review much more information regarding the impacts of predicted shifts in climate has become available. Global average surface temperature has increased by approximately 0.7°C during the 20th Century (IPCC 2007) and appears to be accelerating, and the global trend over the past 50 years is nearly twice that rate. Regional trends in temperature show even greater warming tendencies. In general, conditions for salmon in California will change dramatically and at an ever-increasing rate. In the future, climate change will likely surpass habitat loss as the primary threat to the conservation of most salmonid 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 CC Chinook salmon ESU.

CCC coho salmon ESU

Long-term trends in rainfall and marine productivity associated with oceanic and atmospheric conditions in the North Pacific Ocean have had a major influence on coho salmon production. On the west coast, variations in climatic conditions may have exacerbated or mitigated problems associated with degraded and altered riverine and estuarine habitats (69 FR 33102). Coho salmon have evolved behaviors and life history traits allowing them to survive a variety of environmental conditions; however, when populations are fragmented or reduced in size and range they are more vulnerable to extinction. At the time of listing, the effects of extended drought on water supplies and water temperatures were a major concern for coho salmon populations in California including for this ESU. Drought conditions were known to reduce the amount of water available, resulting in reductions (or elimination) of flows needed for adult coho salmon passage, egg incubation, and juvenile rearing and migration.

Flood events increase sedimentation into streams, particularly in areas with underlying erosive soil risk, urban encroachment, intensive timber management, and land disturbances resulting from logging, road construction, mining, urbanization, livestock grazing, agriculture, and fire. Sedimentation of stream beds was implicated as a principal cause of declining coho salmon and other salmonid populations on the west coast. Coastal watersheds in central California have some of the most erodible soils in the world and catastrophic erosion and subsequent stream sedimentation (such as during the 1955 and 1964 floods) has occurred as a result of timber harvest and road construction on unstable soils (61 FR 56138).

Poor ocean survival conditions are believed to have been a key factor in the decline of coho salmon populations in California. Unusually warm ocean surface temperatures and associated changes in coastal currents and upwelling, known as El Niño conditions, have periodically occurred causing reductions in primary and secondary productivity and resultant changes in prey and predator species distributions. These ecosystem changes can significantly impact ocean survival of juvenile salmonids including coho salmon. Near-shore conditions during the spring and summer months along the California coast may have dramatically affected year-class strength of salmonids (Kruzic et al. 2001).

Artificial Propagation

The use of artificial salmon propagation had a significant impact on the production of West Coast coho salmon and was a factor of concern for this ESU at the time of listing. Non-native coho salmon stocks were introduced as broodstock in some hatcheries and widely transplanted in many coastal rivers and streams in central California (Bryant 1994; Weitkamp et al. 1995). Potential problems associated with hatchery programs include genetic impacts on indigenous, naturally-reproducing populations (Waples 1991), disease transmission, predation of wild fish by hatchery stocks, difficulty in determining wild stock status due to incomplete marking of hatchery fish, depletions of wild stock to increase brood stock, and replacement rather than supplementation of wild stocks through competition and continued annual introduction of hatchery fish (61 FR 56138).

At the time of the last status review in 2005, NMFS determined that four hatchery stocks or programs were part of this ESU. In making the 2005 listing determination for this ESU, we considered the effects of these hatchery programs on the viability of the naturally spawning populations of coho salmon in this ESU. In general, our assessment concluded that these programs slightly increased the abundance of coho salmon in the ESU, but did not have any beneficial impacts on productivity, spatial structure or diversity of coho salmon populations. Overall, we concluded that hatchery programs in this ESU did not provide significant benefits to the ESU and could have potential adverse impacts. Three of the four artificial propagation programs listed in 2005 continue to be operated and their management practices remain largely unchanged since that time.

Climate Change

Of all the Pacific salmon species, coho salmon are thought to be one of the most sensitive to climate change due to their extended freshwater rearing. Additionally, coho salmon in this ESU occur at the southern end of the species range in North America and, therefore, often reside in streams near the upper limits of their thermal tolerance. For these reasons, climate change poses a serious threat to this ESU. Across the entire range of this ESU, there are likely to be dramatic changes in the spatial structure, diversity, abundance, and productivity of populations due to climate change. Together these changes will determine the future viability of individual populations as well as the overall viability of the ESU.

As described in detail above, climate change is projected to have profound effects for salmon in California, including increased water temperatures, decreased snowpack, increased annual precipitation, a rise in sea level, the loss of coastal wetlands, and altered estuarine habitats. Marine ecosystems face an entirely unique set of stressors related to global climate change, which will likely have deleterious impacts on coho salmon growth and survival while at sea. 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 bottom-up impacts on marine food webs (ISAB 2007). For coho salmon, shifts in prey abundance, composition, and distribution may be the indirect effects of these changes.

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, including coho salmon (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 coho salmon populations in this ESU.

Stochastic Processes with Small Population Sizes

Random events in small populations may have a large impact on the population dynamics and ability of a population to persist. The peril 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 noted in section 2.3.1, many populations of coho salmon in this ESU have declined in abundance to levels that are well below low-risk abundance targets, and several are, if not extirpated, likely below the high-risk depensation thresholds specified by Spence et al. (2008). These small populations are at risk from natural stochastic processes, in addition to deterministic threats, that may make recovery of this ESU difficult to achieve. 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 may 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), i.e., genetic drift. 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 don't 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.

Two important changes have occurred with regard to this listing factor since the last status review and reclassification of this ESU as endangered in 2005. First, we now recognize climate change to be a more serious risk to this and other salmon and steelhead ESUs in California. The best available scientific information indicates that the Earth’s climate is warming, driven by the accumulation of greenhouse gasses in the atmosphere (Oreskes 2004; Battin et al. 2007; Lindley et al. 2007). Because coho salmon in this ESU depend upon freshwater streams and the ocean during different stages of their life history cycle, populations throughout the ESU, but particularly at the southern end of its range, are likely to be significantly impacted by climate change in the future. Second, the effects of stochastic processes associated with small population size are believed to have increased over the past five years thereby likely placing populations in this ESU at a higher risk of extinction.

2.4 Synthesis

CC Chinook salmon ESU

The CC Chinook salmon ESU was listed as a threatened species in 1999 (64 FR 50394) and included all Chinook populations from streams immediately south of the Klamath River in northern California to and including the Russian River. The threatened status of this ESU was reaffirmed in 2005 and seven small artificial propagation programs were also added to the listed ESU (70 FR 37160). Since 2005, all seven artificial programs have been terminated and all hatchery fish from these programs have returned to spawn. Genetic data from Chinook salmon populations spawning in streams south of the Russian River and in several tributaries to San Francisco Bay suggest that populations spawning between the Russian River and Golden Gate are part of the CC Chinook salmon ESU (Williams et al. 2011) and that the southern boundary of the ESU should be moved southward to the Golden Gate.

A multi-species recovery plan is under development which will address the CC Chinook salmon ESU, as well as the CCC and NC steelhead DPSs. This plan will include recovery criteria for each listed species that are objective, measureable, and based on the best available and most up to date information on the biology of Chinook salmon and its habitat. A co-manager draft of the plan is expected to be released in late 2011.

A status review update by the SWFSC concluded that the lack of population-level estimates of abundance for Chinook salmon populations in this ESU continues to hinder assessment of its status (Williams et al. 2011). However, based on a consideration of all new information since the last status review, the SWFSC did not find evidence of a substantial change in the biological status of the ESU (Good et al. 2005). The updated status review did, however, cite several concerns about the ESU including the apparent loss of populations from one diversity stratum, the loss of the spring-run life history type from two diversity strata, and the diminished connectivity between populations in the northern and southern halves of the ESU. These concerns were generally recognized at the time of the previous status review, but were considered more significant in this review given the recently developed population viability criteria for this ESU. Overall, the SWFSC update concluded that the biological status of this ESU is unchanged from that described by Good et al. (2005) who considered it likely to become endangered in the foreseeable future.

Although conservation efforts for Chinook salmon have reduced some threats for this ESU, the threats described in the five listing factor discussion in section 2.3.2 have with few exceptions, remained unchanged since the last review (Good et al. 2005 and 70 FR 37160). Poor ocean conditions and drought, in particular, have likely impacted Chinook salmon populations in this ESU since the last review and contributed to declining abundance. Climate change related impacts are also now recognized as a new and more serious threat to this ESU.

In summary, the best available information on the biological status of this ESU and the threats facing this ESU indicate that it continues to remain threatened. The new information indicates that two changes should be made to the listed ESU: (1) the seven previously listed hatchery stocks should be removed from the ESU because they have been terminated, and (2) the southern boundary of the ESU should be moved from its current location at the Russian River southward to the entrance to San Francisco Bay. Lastly, special attention should be given in the future to the potential threats related to climate change because this factor may surpass habitat loss as the primary threat to the conservation of most salmonid species, including this ESU (Thomas et al. 2004).

CCC coho salmon ESU

The CCC coho salmon ESU was listed originally at threatened in 1996 (61 FR 56138) and subsequently reclassified as endangered in 2005 (70 FR 37160). The ESU includes all coho salmon populations in watersheds ranging from Punta Gorda in northern California south to and including the San Lorenzo River in central California, as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system. Four artificial propagation stocks of coho salmon were also included in the ESU when it was reclassified in 2005 (70 FR 37160). Since 2005 one of these programs has been terminated and it therefore is no longer part of the ESU. The SWFSC has reviewed recent information on the presence of coho salmon in Soquel Creek, genetic data for this population, and habitat conditions in watersheds south of the San Lorenzo River and now recommends that the range of this ESU be extended southward to include Soquel and Aptos creeks (Spence et al. 2011 and Spence and Williams 2011).

A public review draft recovery plan for this ESU was released in March 2010. The draft recovery plan, although not finalized or approved, includes: (1) population based biological criteria that take into consideration future commercial, recreational and tribal harvest; (2) criteria that measure watershed health, and (3) criteria that address the abatement and amelioration of threats to the species (NMFS 2010). In addition, the draft plan includes criteria addressing each of the five listing factors. These criteria reflect the best available and most up to date information on the biology of coho salmon and its habitat.

According to an updated biological status review conducted by the SWFSC (Spence and Williams 2011), long-term data on coho population abundance in this ESU are scarce, but all available evidence from shorter-term research and monitoring efforts indicate that the status of populations in this ESU has worsened since the last review (Good et al. 2005). For all available time series, recent population trends have been downward, and it is evident that many independent populations are, if not extirpated, likely below the high-risk depensation thresholds specified by Spence et al. (2008). The most recent status review (Good et al. 2005) concluded that this ESU is currently in danger of extinction. Based on a consideration of all new substantive information on the biological status of this ESU, the SWFSC concluded that this ESU continues to be in danger of extinction and that its overall extinction risk has worsened (Spence and Williams 2011). According to Spence and Williams (2011) this ESU will continue to be in danger of extinction if the southern boundary of the ESU is expanded southward to include Soquel and Aptos creeks.

Although conservation efforts for coho salmon have reduced some threats to this ESU, the threats described in the five listing factor discussion in section 2.3.2 have with few exceptions, remained unchanged since the last review (Good et al. 2005 and 70 FR 37160). At least two new, significant factors now threaten this ESU including climate change impacts to coho salmon habitat, and increased stochastic threats to coho salmon populations because of their small size.

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 endangered. New information indicates that two changes should be made to the ESU: (1) one of the four previously listed hatchery stocks should be removed from the ESU because it has been terminated and fish from that program have all returned to spawn, and (2) the southern boundary of the ESU should be moved from its current location at the San Lorenzo River to Aptos Creek.

3.0 RESULTS

3.1 Recommended Classification

CC Chinook salmon ESU

Based upon a review of the best available information, we recommend the CC Chinook salmon ESU remain listed as a threatened species.

CCC coho salmon ESU

Based upon a review of the best available information, we recommend the CCC coho salmon ESU remain listed as an endangered species.

3.2 New Recovery Priority Number

CC Chinook salmon ESU

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

CCC coho salmon ESU

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

3.3 ESU Boundaries and Hatchery Stocks

CC Chinook salmon ESU

Based upon the best available new information, we recommend: (1) the southern boundary of this ESU be moved southward to include Chinook salmon populations in all coastal watersheds between the Russian River and the entrance to San Francisco Bay, and (2) the seven currently listed hatchery stocks be removed from the listed ESU.

CCC coho salmon ESU

Based upon the best available new information, we recommend: 1) the southern boundary of the ESU be moved southward to include coho salmon populations in Soquel and Aptos creeks, and (2) one of the four currently listed hatchery stocks be removed from the ESU. In response to a previously accepted petition, NMFS published a proposed rule implementing these recommended changes to the ESU on February 4, 2011 (76 FR 6383).

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Recovery actions in the draft CCC coho salmon recovery plan, and under development for the multi-species recovery plan addressing CC Chinook salmon, address major threats to all listed salmonid species across the NCCC Recovery Domain. Prompt and effective implementation of these actions will affect a large geographic area and benefit both the CC Chinook and CCC coho salmon ESUs. Successful implementation will have positive long term effects and promote their recovery. As such, the following recovery actions are the highest priority across both ESUs and within individual watersheds.

Due to its critically endangered status, the highest priority recommendations focus on intervention, support and recovery for the CCC coho salmon ESU. These actions include:

- Ensure extant populations of CCC coho salmon are protected from harm or take and protect habitat from further degradation.
- Finalize the NMFS Recovery Plan for the CCC coho salmon ESU.
- Promote captive broodstock programs, and monitoring for these programs. Captive broodstock and conservation rearing facilities may be the best opportunity to preserve year classes and genetic diversity, particularly at the southern extent of the range.
- Pacific Coastal Salmon Recovery Funding should be appropriately allocated to prevent the extinction of CCC coho salmon, and adequate funding should include monies for monitoring as recommended in the draft recovery plan (NMFS 2010).
- Promote restoration projects in habitats most limiting for CCC coho salmon - critical over-wintering habitats (such as alcoves, backchannels, off channel areas, and estuaries), and critical summer rearing habitat (such as complex pool habitat and unimpeded summer flows).
- Work with Federal and State agencies to coordinate and develop programmatic permits for incidental take authorization for actions that contribute to the recovery of CCC coho salmon and their habitats, including streamlined permitting for non-PCSRF funded restoration projects.

Additional recommendations likely to benefit both CC Chinook and CCC coho salmon include actions by NMFS or other Agencies, research and monitoring, restoration, and threat abatement. These actions are detailed below.

Agency Actions

- Continue the combined CDFG and NMFS efforts to complete development of and implement the California Coastal Salmonid Monitoring Program. Funding and implementation of a coordinated Program are necessary to enable ESU and statewide tracking of population trends for listed species and tracking effectiveness of efforts towards recovery.
- The Mendocino Redwood Company owns portions of six high priority recovery watersheds in Mendocino and Sonoma counties; watersheds currently supporting extant Chinook and coho populations. Finalize the HCP with NMFS, and its implementation, are expected to facilitate recovery of CCC coho salmon ESU as well as prevent its extinction.
- Conduct extensive outreach to improve education and awareness for agencies, professional organizations, landowners, and the public regarding the importance and imperative need for immediate and direct actions to prevent extinction and/or increase regulatory oversight on projects that may impair habitats or result in direct harm to salmon.
- Implement and enforce AB 2121, which codified (in sections 1259.2 and 1259.4 of the California Water Code) CDFG and NMFS' Water Diversion Guidelines to ensure protective flows for all life stages of salmon.
- Work with CDFG to develop protective regulations to minimize impacts from fishing during migratory periods (e.g., until sandbars open naturally) within one mile of the river mouths of the focus watersheds, and to improve freshwater sport fishing regulations to minimize take, and incidental mortality, of listed salmon. Considerations may include low-flow closure thresholds, seasonal fishing closures, and angler outreach programs.
- Improve coordination between the agencies, particularly the SWRCB, to effectively address illegal water diversion, off-stream reservoirs, and bypass flows fully protective of listed species.
- Encourage amendments to COE 404 Clean Water Act exemptions for farming, logging, and ranching activities to terminate Section 404(f) exemptions for discharges of dredged or fill material into US waters (channelization) associated with agriculture, logging, ranching and farming.
- Work with the California Board of Forestry, CalFire, CDFG, professional organizations, and landowners to secure forest lands from conversion, promote sustainable forestry practices, and provide incentives for growing large trees and conducting restoration actions. For example, modify the timber harvest permitting process to provide opportunities and incentives for LWD placement in streams during timber harvest operations.
- Promote programs that purchase land or develop conservation easements encouraging the protection, re-establishment and/or enhancement of natural riparian communities.
- Support and engage CalTrans, FishNet, counties and others with oversight on road practices to reduce sediment delivery to streams from road networks and channelization from poorly situated roads. This should be accomplished through education, laws and policies designed to educate staff and road engineers and improve construction, maintenance, and decommissioning practices.

Research and Monitoring Recommendations

- Conduct population research and monitoring focusing on life stage survival (e.g., life cycle stations) within each Diversity Stratum including survival and fitness in wetland, estuaries and lagoons.
- Utilize existing population models and genetic information for each watershed and associated Diversity Stratum to identify minimum redd or adult counts that would trigger the need for augmentation or intervention.
- Implement monitoring programs to assess spawner abundance, population viability and key habitat attributes in all independent populations. These programs will require consistent methods, reporting, databases and adaptive management across the NCCC Domain to evaluate population and habitat responses to recovery actions.

Restoration and Threat Reduction Recommendations

- Aggressively promote installation of instream large woody debris and projects to improve off-channel/floodplain habitats to benefit freshwater survival in areas with extant populations.
- Implement recovery actions identified in draft recovery plans to address poor habitat conditions and abate threats in independent populations.
- Develop water conservation measures at local and State levels to include a drought management plan for each watershed that is triggered by minimum flow requirements.
- Work with the agricultural community to develop water conservation strategies protective of salmonids.
- Collaborate and support the SWRCB to increase oversight and responsibility for regulating groundwater hydrologically connected to surface flows.
- Participate in land and water use planning with local, county, and State agencies that have direct control and responsibilities over non-Federal practices.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
NCCC Recovery Domain
CC Chinook salmon ESU and CCC coho salmon ESU

Current Classification:

CC Chinook salmon ESU – threatened
CCC coho salmon ESU - endangered

Recommendation resulting from the 5-Year Review

CC Chinook salmon ESU: Retain current ESA classification as threatened, remove 7 hatchery populations from ESU due to their termination; extend southern boundary of ESU to entrance of San Francisco Bay.

CCC coho salmon ESU: Retain current ESA classification as endangered, remove 1 hatchery population from the ESU because of its termination; extend southern boundary of ESU to include Aptos and Soquel Creeks at the southern end of the range.

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NMFS

Approve: ____ Date: ________

Cooperating Regional Administrator, NMFS

_____Concur _____ Do Not Concur

Signature____ Date_______

HEADQUARTERS APPROVAL:

Assistant Administrator, NMFS

_____Concur _____ Do Not Concur

Signature____ Date_______