2007 Federal Recovery Outline for the Distinct Population Segment of South-Central California Coast Steelhead

San Carpoforo Creek, San Luis Obispo County, CA 2007

Prepared by

The National Marine Fisheries Service
Southwest Regional Office

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Disclaimer

This recovery outline is meant to serve as an interim guidance document to outline recovery efforts, including recovery planning for the South-Central California Coast Steelhead Distinct Population Segment (DPS), until a full recovery plan is developed and approved. A preliminary strategy for recovery of the species is presented here, as are recommended high priority actions to stabilize and recover the species. The recovery outline is intended primarily for internal use by National Marine Fisheries Service (NMFS) as a pre-planning document. Formal public participation will be invited upon the release of the draft recovery plan for this species. However, any new information or comments that members of the public may wish to offer as a result of this recovery outline will be taken into consideration during the recovery planning process. Recovery planning has been initiated and a recovery plan is targeted for completion in 2008. NMFS invites public participation in the planning process. Interested parties may contact Mark H. Capelli, South-Central/Southern California Coast Steelhead Domain Recovery Coordinator, at 735 State Street, Suite 616, Santa Barbara, California 93101.

PURPOSE AND OVERVIEW

The Federal Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*) requires that the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) develop and implement recovery plans for the conservation and survival of NMFS listed species. According to the NMFS Interim Recovery Planning Guidance (NMFS 2006a):

> Recovery is the process by which listed species and their ecosystems are restored and their future safeguarded to the point that protections under the Federal ESA are no longer needed. A variety of actions may be necessary to achieve the goal of recovery, such as the ecological restoration of habitat or implementation of conservation measures with stakeholders. However, without a plan to organize, coordinate and prioritize the many possible recovery actions, the effort may be inefficient or even ineffective. The recovery plan serves as a road map for species recovery – it lays out where we need to go and how best to get there. According to the ESA §4(f), recovery plans must contain: (1) objective measurable criteria for delisting the species; (2) site-specific actions; and (3) estimates of the time and cost for implementing the recovery plan.

Recovery plans are guidance documents, not regulatory documents. The ESA clearly envisions recovery plans as the central organizing tool for guiding each species' recovery process. They should also guide Federal agencies in fulfilling their obligations under Section 7(a)(1) of the ESA, which calls on all Federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species . . ." In addition to outlining strictly proactive measures to achieve the species' recovery, recovery plans provide context and a framework for implementation of other provisions of the ESA with respect to a particular species, such as Section 7(a)(2) consultations on Federal agency activities or the development of Habitat Conservation Plans in accordance with Section 10(a)(1)(B) of the ESA.

In the interim between listing and recovery plan approval, NMFS Interim Recovery Planning Guidance requires the development of a Recovery Outline for listed species. A Recovery Outline provides a preliminary strategy for conservation that conforms to the mandates of the ESA. The Recovery Outline is intended to guide initial recovery actions and ensure that future recovery options are not precluded due to a lack of interim guidance. Actions that are urgently needed at the time the species is listed, as well as actions that constitute the initial steps of long-term recovery efforts, can be implemented more effectively and efficiently if they are treated as integral parts of a comprehensive recovery strategy. By providing a consistent view of the species' status and recovery needs, the Recovery Outline can also provide a basis for conducting individual project reviews under ESA Sections 7 and 10. It can also be used by biologists and resource managers to assist project proponents to avoid narrowing or precluding future recovery options, such as the loss of a portion of the habitat that might later be determined to be important to the recovery of the species. (See Allendorf *et al.* 1997 for a general discussion of prioritizing Pacific salmon stocks for conservation.)

The NMFS Southwest Region (SWR) Protected Resources Division (PRD) in Long Beach and Santa Barbara, California, is responsible for the development of recovery plans for the threatened South-Central California Coast Steelhead DPS. The NMFS Strategic Plan for 2005 establishes a high priority focus on recovery plan development over the next five years. The SWR will proceed with recovery planning by developing a draft recovery plan for this DPS during 2008.

This Recovery Outline has been developed to guide the recovery planning process for the endangered South-Central California Coast Steelhead DPS.

I. INTRODUCTION

A. South-Central California Coast Steelhead Recovery Planning Area

The South-Central California Coast Steelhead DPS extends from the Pajaro River south to (but excluding) the Santa Maria River and includes those portions of coastal watersheds which are at least seasonally accessible to steelhead entering from the ocean (Figure. 1). The topography of the area is dominated in the north by the southern end of the Santa Cruz Mountains, along the coast by the Santa Lucia Mountains, and in the inland areas by the Diablo, Gabilan, and Cholame/Temblor Mountains. The South-Central California Coast Steelhead Recovery Planning Area is encompassed by the Californian floristic province (Barbour *et al.* 2007; Munz 1974; California Department of Fish and Game 2003). The watersheds within this province fall within two basic groups: those characterized by short coastal streams draining the several coastal mountain ranges (*e.g.*, Santa Lucia Mountains), and those containing larger river systems (*e.g.*, Pajaro, Salinas, Nacimiento, and San Antonio Rivers) that extend inland through gaps in the coastal ranges (Holland 2001; Jacobs 1993; Kreissman 1991).

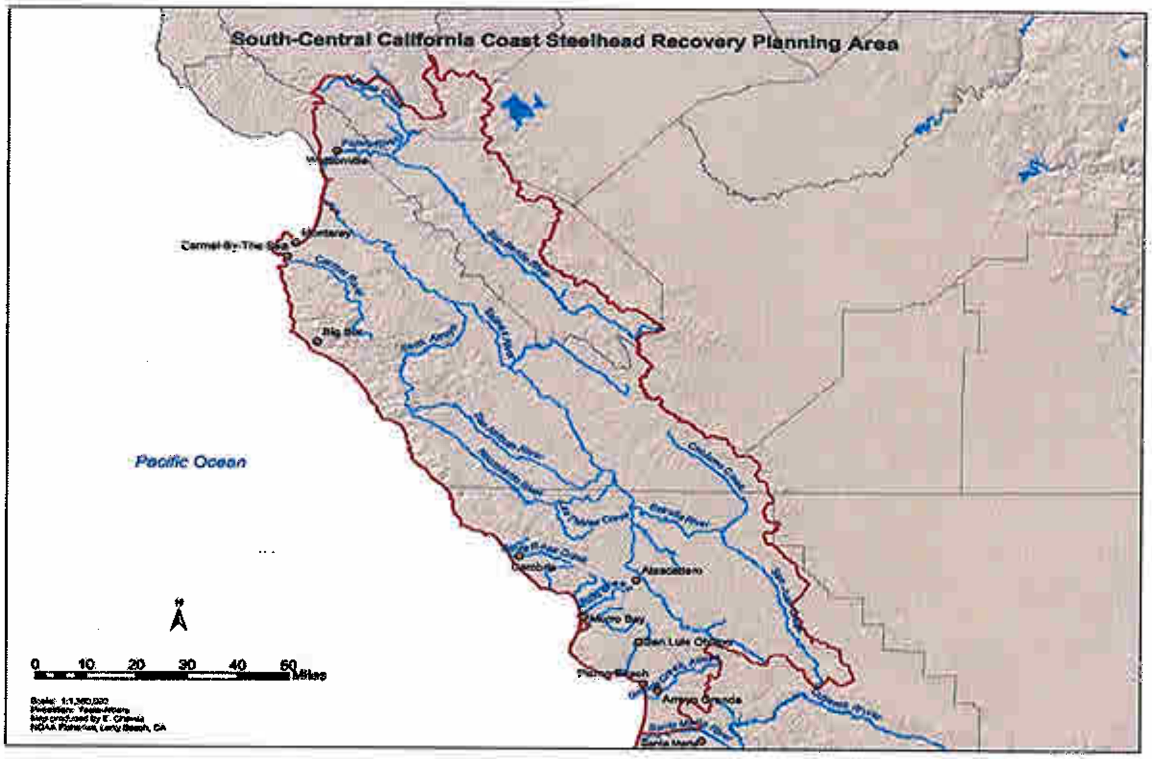

Figure 1. South-Central California Coast Steelhead Recovery Planning Area.

The major inland steelhead watersheds in the South-Central California Coast Steelhead Recovery Planning Area (which encompasses all portions of coastal drainage occupied by *O. mykiss* in an unimpaired state) include the Pajaro, Salinas (Arroyo Seco, San Antonio, Nacimiento), and Carmel Rivers. Along the Big Sur coast, major steelhead watersheds include Big Sur River, Little Sur River, San Carpoforo and Arroyo de la Cruz Creeks. South of the Big Sur coast, steelhead watersheds include, San Simeon, Santa Rosa, San Luis Obispo, Pismo, and Arroyo Grande Creeks (Busby *et al.* 1996, 1997; Good *et al.* 2005; Titus *et al.* 2006).

The South-Central California Coast Steelhead DPS is characterized by geologically young mountainous topography with a number of inland valleys and coastal terraces. Major topographic features include moderate to steeply sloping mountains, with intermittent valleys. Coastal area are characterized by marine terraces and coastal dunes fronted by sand beaches. Valley landforms include floodplains, alluvial fans at the base of adjoining mountains and canyon mouths, and stream terraces. The geomorphology is strongly influenced by tectonic activity, with highly folded and faulted rocks of varying types, including metamorphic formations in the northern portion of the Central Coast Ranges, and sedimentary rocks in the southern and inland Central Coast Ranges. Soils are derived from alluvium, colluvium, and residual Cenozoic marine and non-marine sedimentary rock formations (*e.g.*, mudstone, shale, and sandstone). Steep slopes and unconsolidated rock formations, combined with an active fire-cycle and intense winter cyclonic storms, create highly unstable river and stream habitats for anadromous and other aquatic species (Bailey 1966; Barbour 2007; Faber *et al.* 1989; Felton 1965; Norris and Webb 1990; Norris 2003; Sugihara *et al.* 2006).

Significant portions of the upper watersheds within the southern half of the South-Central California Coast Steelhead Recovery Planning Area are contained within the Los Padres National Forest. This forest is managed primarily for water production and recreation (with limited grazing, oil, gas, and mineral production). Urban development is centered in coastal areas and inland valleys, with the most expansive and dense agricultural and urban development located within the Pajaro, Salinas, and Carmel River Valleys. Coastal marine terraces, and some foothills, are also extensively developed with agriculture, principally row-crops, and some vineyards (Hornbeck 1983; Keeley1993; Lantis *et al.* 1981; Lockmann 1981; Stephenson and Calcarone 1999; U.S. Forest Service 2006).

Within the Californian floristic province there are ten broad native terrestrial plant communities which characterize the South-Central California Coast Steelhead Recovery Planning Area: Estuarine Wetlands, Beach and Dunes, Riparian Forests, Coastal Prairie, Coastal Sage Scrub, Oak Woodlands, Chaparral, Valley Grasslands, Vernal Pools, and Closed-Cone Pine and Cypress Conifer Forests. (Barbour, *et al.* 2007; Ferren *et al.* 1995; Hickman 1993; Munz 1974; Sawyer and Keeler-Wolf 1995). The upland areas of the South-Central California Coast Steelhead Recovery Planning Area are dominated by a mix of Oak Woodlands, Chaparral, Valley Grasslands, and in two disjunct areas, Closed-Cone Pine and Cypress Conifer Forests. These upland areas are subject to catastrophic wildfires (Sugihara *et al.* 2006). The Big Sur coast supports the southernmost stands of Coast Redwoods. Riparian forests consist of deciduous species, with some conifers along the Big Sur coast. Much of the foothill grassland and floodplain riparian areas within the northern and southern portions of the South-Central California Coast Steelhead Recovery Planning Area have been converted to agricultural, residential, and a variety of commercial land-uses (California Department of Fish and Game 2003; Holland 1996; Kreissman 1991; Mayer and Laundenslayer 1988; Stephenson and Calcarone 1999; Warner and Hendrix 1984). However, the interior uplands within the Los Padres National Forest are largely undeveloped, as are the coastal terraces and uplands of large, privately held lands such as the Hearst Ranch, along the Big Sur coast.

The climate in the Californian floristic province is Mediterranean, with long, dry summers and short, sometimes intense cyclonic winter storms. Rainfall is restricted almost exclusively to the winter months (December through March). The California floristic province is also subject to an El Niño/La Niña weather cycle which can significantly affect winter rainfall, causing highly variable rainfall between years. Additionally, there is a disparity between winter rainfall from north to south, as well as between coastal plains and inland mountainous areas. Annual precipitation along the coast (north to south) ranges from 50 – 32 centimeters (cm), with similar variations (48 – 54 cm) due to orographic effects of the various mountain ranges. Fog along the coastal areas is typical in late spring and summer, extending inland along coastal reaches with valleys extending into the interior and moderating conditions for rearing steelhead in the lower reaches near the coast (Barbour *et al.* 2007; Bailey 1966; Hornbeck 1999; Karl 1979).

River flows vary greatly between seasons, and can be highly flashy during the winter season, changing by several orders of magnitude over a few hours. Snow accumulation is generally small and of short duration, and does not contribute significantly to peak run-off. Base flows in some rivers reaches can be influenced significantly by groundwater stored and transported through faults and fractured rock formations. Many rivers and streams exhibit interrupted base flow patterns (alternating channel reaches with surface and no surface flow) controlled by geologic formations. Water temperatures are generally highest during summer months, but can be locally controlled by springs, seeps, and rising groundwater, creating micro-aquatic conditions suitable for salmonids (Faber *et al.* 1999; Harrison *et al.* 2005; Jacobs 1993; Mount 1995; Reid and Wood 1976).

B. Species Name: South-Central California Coast Steelhead (*Oncorhynchus mykiss*)

C. Listing Status: Threatened

D. Date Listed: August 18, 1997 (62 FR 43937); listing reconfirmed January 5, 2006 (71 FR 834)

E. Lead Field Office/Contact Biologist: South-Central/Southern California Coast Steelhead Recovery Domain, Mark H. Capelli, Recovery Coordinator, National Marine Fisheries Service, 735 State Street, Suite 616, Santa Barbara, CA 93101. Phone: (805) 963-6478

II. BIOLOGICAL ASSESSMENT

A. Species Range

The South-Central California Coast Steelhead DPS includes all naturally spawned anadromous populations of *O. mykiss* in coastal river basins from the Pajaro River in Monterey County southward to but not including the Santa Maria River in San Luis Obispo County. Major inland watersheds currently occupied by naturally spawning steelhead in this DPS include the Pajaro, Salinas (Arroyo Seco, San Antonio, Nacimiento), and Carmel Rivers. Along the Big Sur coast, major steelhead watersheds include Big Sur River, Little Sur River, and San Carpoforo and Arroyo de la Cruz Creeks. South of the Big Sur coast, steelhead watersheds include, San Simeon, Santa Rosa, San Luis Obispo, Pismo, and Arroyo Grande Creeks (62 FR 43937; 71 FR 834).

Table 1. South-Central California Coastal basins historically and currently occupied by populations of *O. mykiss* (N to S)[1].

	Extant		Extant
Pajaro River	Y		
Salinas River	Y	Arroyo de la Cruz	Not determined
Carmel River	Y	Little Pico Creek	Not determined
San Jose Creek	Y	Pico Creek	Y
Malpaso Creek[2]	Y	San Simeon Creek	Not determined
Garrapata Creek	Y	Santa Rosa Creek	Y
Rocky Creek	Y	Villa Creek - SLO	Y
Bixby Creek	Y	Cayucos Creek	Y
Little Sur River	Y	Old Creek	Negative obs.[3]
Partington Creek	Y	Toro Creek	Dry[3]
Big Creek	Y	Morro Creek	Y
Vicente Creek[2]	Y	Chorro Creek	Y
Vicente Creek[2]	Y	Los Osos Creek[2]	
Mill Creek	Y	Islay Creek	Y
Prewitt Creek	Y	Coon Creek	Y
Plaskett Creek	Y	Diablo Canyon	Y
Willow Creek - Monterey	Y	San Luis Obispo Creek	Y
Alder Creek	Y	Pismo Creek	Y
Villa Creek Monterey	Y	Arroyo Grande Creek	Y
Salmon Creek	Y		
San Carpoforo Creek	Y		

[1] Historical data: Becker *et al.* 2007; Titus *et al.* (2003); Franklin (1999). Recent data: Boughton *et al.* (2005).
[2] No data on historical occurrence, but recent occurrence documented by Boughton *et al.* (2005).
[3] "Negative obs." means juveniles were not observed during a spot-check of best-occurring summer habitat in 2002. "Dry" indicates the stream had no discharge in anadromous reaches during the summer of 2002. See Boughton *et al.* (2005).

B. Designated Critical Habitat

The ESA requires NMFS to designate critical habitat for all species listed under the ESA. Critical habitat is defined as specific areas in which are found physical or biological features essential to the conservation of the species, and which may require special management considerations or protection. In designating critical habitat, NMFS considers the following requirements of the species: 1) space required for population growth and normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for breeding, reproduction, or rearing offspring; and 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of the listed species. Additionally, when designating critical habitat NMFS considers certain habitat features called "primary constituent elements" (PCEs) that are essential to support one or more life-history stage(s) of the listed species (50 CFR. 424.12(b)).

Section 4 of the ESA requires that economic impact, impact on national security, and any other relevant impacts be taken into account when designating critical habitat. Additionally, Section 7 of the ESA requires that Federal agencies through the consultation process ensure that any action which they may authorize, fund, or carry out will not result in the destruction or adverse modification of designated critical habitat.

The final critical habitat designation for the South-Central California Coast Steelhead DPS was issued on September 2, 2005 (70 FR 52488). There are 30 occupied watersheds within this DPS, of which 1,250 miles of stream habitat and 3 square miles of estuarine habitat were designated as critical habitat. See Appendix A for a tabulation of the designated watersheds and river/stream reaches.

C. Species Life History

Steelhead (*Oncorhynchus mykiss*) is a species native to the North Pacific Ocean, and in North America, to coastal streams extending from Alaska south to northwestern Mexico (Busby *et al.* 1996, 1997; Good *et al.* 2005; Miller 2005; Moyle 2002; Quinn 2005; Xanthippe 2005). The ocean phase of steelhead has not been studied extensively, but the species does not generally congregate in large schools of fish as do other Pacific salmon of the genus *Oncorhynchus*. Their pattern of movement at sea is also poorly understood and some fish may remain in coastal waters relatively close to their natal rivers, while others may range widely in the North Pacific (Burgner *et al.* 1992; Quinn 2005)

Adult steelhead spawn in coastal watersheds and the progeny rear in freshwater or estuary habitats prior to emigrating to the ocean. Adults reach maturity in the ocean before returning to reproduce, generally to their natal stream. Within this basic life-history cycle pattern steelhead exhibit a greater variation in the time and location spent at each life-history cycle stage than the other five Pacific salmonids within the genus *Oncorhynchus*.

The life history of anadromous steelhead generally involves rearing in freshwater for one to three years before migrating to the ocean, usually in the winter and spring, where they may remain for up to four years. The timing of emigration is influenced by a variety of factors such as photoperiod, streamflow, and temperature. In some watersheds, immature steelhead may rear in a lagoon or estuary for several weeks or months prior to entering the ocean.

Returning adults may migrate from several miles, to hundreds of miles upstream in some watersheds, to reach their spawning grounds. Although spawning may occur in late winter and early spring, the specific timing of spawning may vary by a month or more among streams within a region. Female steelhead use their caudal fin to excavate a nest in the streambed gravels where they deposit their eggs. After fertilization by the male, the female covers the nest (often during construction of additional upstream redds) with a layer of gravel, and the embryos (alevins) incubate within this gravel nest. Hatching time varies from about three weeks to two months depending on water temperature. The young fish emerge from the nest two to six weeks after hatching. Adult steelhead do not necessarily die after spawning and may return to the ocean, sometimes repeating their spawning migration one or more years. Additional details regarding steelhead life-history can be found in Shapovalov and Taft (1954), Barnhart (1986, 1991), Bjornn and Reiser (1991), and Quinn (2005).

It has been common practice to refer to individuals completing their entire life-history cycle (hatching, rearing, maturing, reproducing, and dying) in freshwater as rainbow trout, while referring to those emigrating to and maturing in the ocean before returning to reproduce in freshwater as steelhead. However, it has become clear in recent years that this terminology does not capture the complexity of the life-history cycles of native *O. mykiss*. Native *O. mykiss* exhibit a variety of life-history patterns: individuals can complete their life-history cycle completely in freshwater, or they can migrate to the ocean after one to three years, and spend two to four years in the marine environment before returning to freshwater rivers and streams to spawn (Boughton *et al.* 2006).

Additionally, rainbow trout (*O. mykiss* which have completed their life-history cycle entirely in freshwater) sometimes produce steelhead as progeny, and vice versa. This switching in life-cycle patterns has been demonstrated by studying the otolith (small ear bone) microchemistry of *O. mykiss*, which records time spent in fresh and marine waters. Zimmerman and Reeves (2000) used techniques such as this to uncover occasional life-history cycle switching in *O. mykiss* populations in Oregon. The steelhead in the South-Central California Coast Steelhead DPS have not yet been examined in this way, but various lines of evidence (*e.g.*, inland resident fish exhibiting smolting characteristics, river systems producing smolts with no regular ingress of adult steelhead) indicate that switching between freshwater and an anadromous life-history cycle is probably widespread, though the cues triggering this are unknown (Boughton *et al.* 2006, 2007).

Finally, there is a third type of life-history cycle that is referred to as "lagoon-anadromous". Bond (2006), working at a study site in northern Santa Cruz County, has recently shown that each summer a fraction of juvenile steelhead over-summered in the estuary of their natal creek. As with other central California estuaries, this estuary was cut off from the ocean during the summer by the formation of a sandbar spit, forming a seasonal lagoon. Bond (2006) showed that many juvenile steelhead grow fast enough after their first year of lagoon rearing to migrate to the ocean, and most enter the ocean at a larger size than fish rearing in the freshwater habitats of the stream system. Larger size enhances survival in the ocean, and the lagoon-reared fish represented a large majority in the adult steelhead spawning population (Bond 2006).

Within each of the three basic life-history cycle groups (fluvial-anadromous, freshwater-resident, and lagoon-anadromous), there is additional variation, including examples of finer-scale habitat switching, such as multiple movements between lagoon and freshwater habitats in the course of a single summer; and also so-called "adfluvial" populations that inhabit reservoirs but spawn in tributary creeks (*e.g.*, Lopez Reservoir on upper Arroyo Grande Creek). A graphic overview of this life-history cycle diversity, along with some of the specialized terminology, is given in Figure 2.

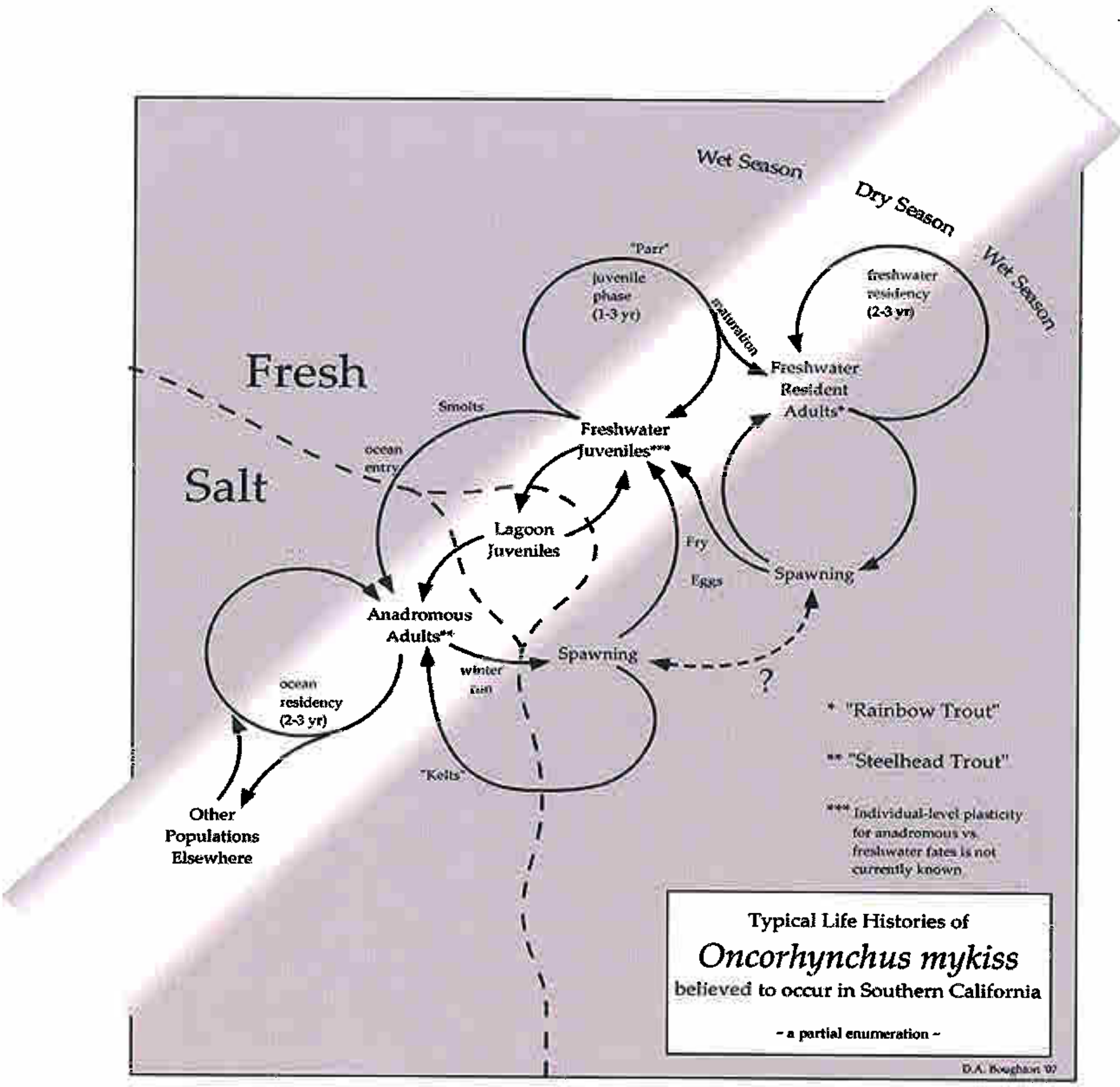

Figure 2. A synopsis of life-history cycle trajectories believed to occur in the South-Central California Coast Steelhead Recovery Planning Area (from Boughton *et al.* 2006).

D. Species Status

The South-Central California Coast Steelhead DPS is near the southern limit of the anadromous form of *O. mykiss* in North America. The status of South-Central California Coast Steelhead populations was assessed by NMFS' Biological Review Team (BRT) in 1996 (Busby *et al.* 1996); the status review of the DPS was subsequently updated in 1997 (Busby *et al.* 1997), and 2005 (Good *et al.* 2005). The following summarizes the findings from these status reviews.

The original BRT noted that quantitative historical information on the South-Central California Coast Steelhead DPS is available for only a few watersheds. No long term (20+ years) time-series data are available for any of the steelhead populations in the South-Central California Coast Steelhead Recovery Planning Area (Busby *et al.* 1996, 1997).

Steelhead populations within the South-Central California Coast Steelhead DPS have declined dramatically from annual runs totaling 27,000 adults. Estimates for the five historically highest producing steelhead watersheds (Pajaro, Salinas, Carmel, Little Sur and Big Sur Rivers), dropped from 4,740 adults in 1965, to less than 500 returning adult fish in 1996. Adult escapement information was available to compute a trend for only one stock within the South-Central California Coast Steelhead DPS: the Carmel River above San Clemente Dam. The Carmel River data indicate a significant decline of 22% per year from 1963 to1993, with the most recent average 5-year adult count of only 16 steelhead spawners recorded at San Clemente Dam. The BRT believed that general trends in the South-Central California Coast Steelhead DPS could be inferred from the early-1960 to early-1990 data. The BRT also noted that the relationship between anadromous and non-anadromous *O. mykiss*, including possibly residualized fish upstream of impassible dams, while unclear was likely to be important in the management of the species. The BRT concluded that the South-Central California Coast Steelhead DPS "is presently endanger of extinction."

In 2002 NMFS conducted an extensive survey of the geographic distribution of *O. mykiss* within the South-Central California Coast Steelhead Recovery Planning Area (Boughton and Fish 2003). Of the 36 watersheds historically supporting steelhead runs between 86% and 94% continue to be occupied by native *O. mykiss* (the range of occupancy occurred because several basins could not be accessed). Occupancy was also determined for 18 basins with no historical record of steelhead: three of these basins - Los Osos, Vicente, and Villa Creeks - were found to be currently occupied by *O. mykiss*.

An up-dated status review completed by the BRT in 2005 reported three new significant pieces information for the South-Central California Coast Steelhead Recovery Planning Area: 1) up-dated-time series data for adult steelhead counts at San Clemente Dam on the Carmel River; 2) NMFS' 2002 assessment of the geographic distribution of *O. mykiss* within its historic range (see discussion above); and 3) changes in harvest regulations for *O. mykiss* (Good, *et al.* 2005).

The Carmel River data are the only time series for the South-Central California Coast Steelhead Recovery Planning Area. The data collected since the last BRT status review indicates that the abundance of adult steelhead spawners in the Carmel River has increased. Continuous data have been collected for the period 1988 through 2002 (though the counts are incomplete because fish spawning below San Clemente Dam are not included). The steelhead counts at the start of the 1988-2002 time-series included three consecutive years with no fish reported. Fish counts have increased from a single adult reported in 1991, to 775 adults reported in 1997, with a maximum of 881 reported in 2002. The BRT noted that the rapid increase in the number of returning adult steelhead spawners to the Carmel River could be attributed to a combination of factors, including improved freshwater conditions, resilience of steelhead populations, high stray rates, or ability of resident *O. mykiss* to produce smolts. The BRT also noted that while some component of the increase is probably due to improved ocean conditions during the period of this latest time-series, it should not be assumed that comparable increases have occurred in other watersheds of the South-Central California Coast Steelhead Recovery Planning Area.

Finally, the BRT reported that the California Department of Fish and Game (CDFG) has prohibited sport harvest in the ocean (and incidental ocean harvest is rare), and imposes significant angling restrictions within the anadromous waters of the South-Central California Coast Steelhead Recovery Planning Area; these include restrictions on timing, location, and gear used for angling. However, CDFG continues to allow summer trout fishing in significant parts of the Salinas River system (*i.e.*, upper Arroyo Seco, Nacimiento above barriers, upper Salinas, Salmon Creek, and the San Benito River in the Pajaro River system), with minimum size bag limits. Additionally, a few other creeks have summer catch-and-release regulations. While there is indirect evidence that these fisheries have resulted in minimal or no mortality to *O. mykiss*, the reduction in risk to listed *O. mykiss* cannot be estimated quantitatively from the existing data because the natural abundance of *O. mykiss* is unknown quantitatively.

In summary, while a majority of watersheds historically supporting *O. mykiss* are still occupied, steelhead run-sizes have been sharply reduced in most watersheds. All four of the largest watersheds (Pajaro, Salinas, Nacimiento/Arroyo Seco, and Carmel Rivers) have experienced declines in run-sizes of 90% or more. Present population trends within individual watersheds continuing to support steelhead runs is generally unknown, but may vary widely between watersheds. Available run-size estimates for all watersheds, except the recent Carmel River time-series, represent only average annual estimates, and not the wide annual variation in run-size expected in a region with a highly variable climate. The consensus of the BRT was that the South-Central California Coast Steelhead DPS was "currently not endangered but likely to become so in the foreseeable future" (Good *et al.* 2005).

E. Historical Demographic and Genetic Structure

NMFS Technical Recovery Team (TRT) described the historical populations of the South-Central California Coast Steelhead DPS (Boughton *et al.* 2005; Boughton and Goslin 2006; Boughton *et al.* 2006, 2007). Based on a suite of distinguishing geologic, climatic, and hydrographic characteristics, the TRT identified four Biogeographic Population Groups for the South-Central Coast Steelhead DPS: Interior Coast Range, Carmel River Basin, Big Sur Coast, and San Luis Obispo Terrace (Figure 3).

In characterizing the population structure of the South-Central California Coast Steelhead DPS, the TRT: 1) identified the original steelhead populations and determined which ones were still extant; 2) delineated the potential unimpaired geographic extent of each population on a watershed scale; 3) estimated the relative potential viability of each population in its (hypothetical) unimpaired state; and 4) assessed the potential demographic independence of each population in its unimpaired state.

This analysis entailed a consideration of available data on the distribution and abundance of *O. mykiss*, genetic data, landscape data, climate data, and stream discharge data. However, insufficient data, particularly long-term run-size data, prevented the TRT from providing definitive characterizations of pre-European or current steelhead populations, including the geographic extent of individual populations, their intrinsic viability, or demographic independence. For a discussion of the constraints imposed by the absence of relevant data see Boughton *et al.* (2006). (See Appendix B for relative viability ranking of populations, and Appendix C for populations grouped by Biogeographic Population Groups.)

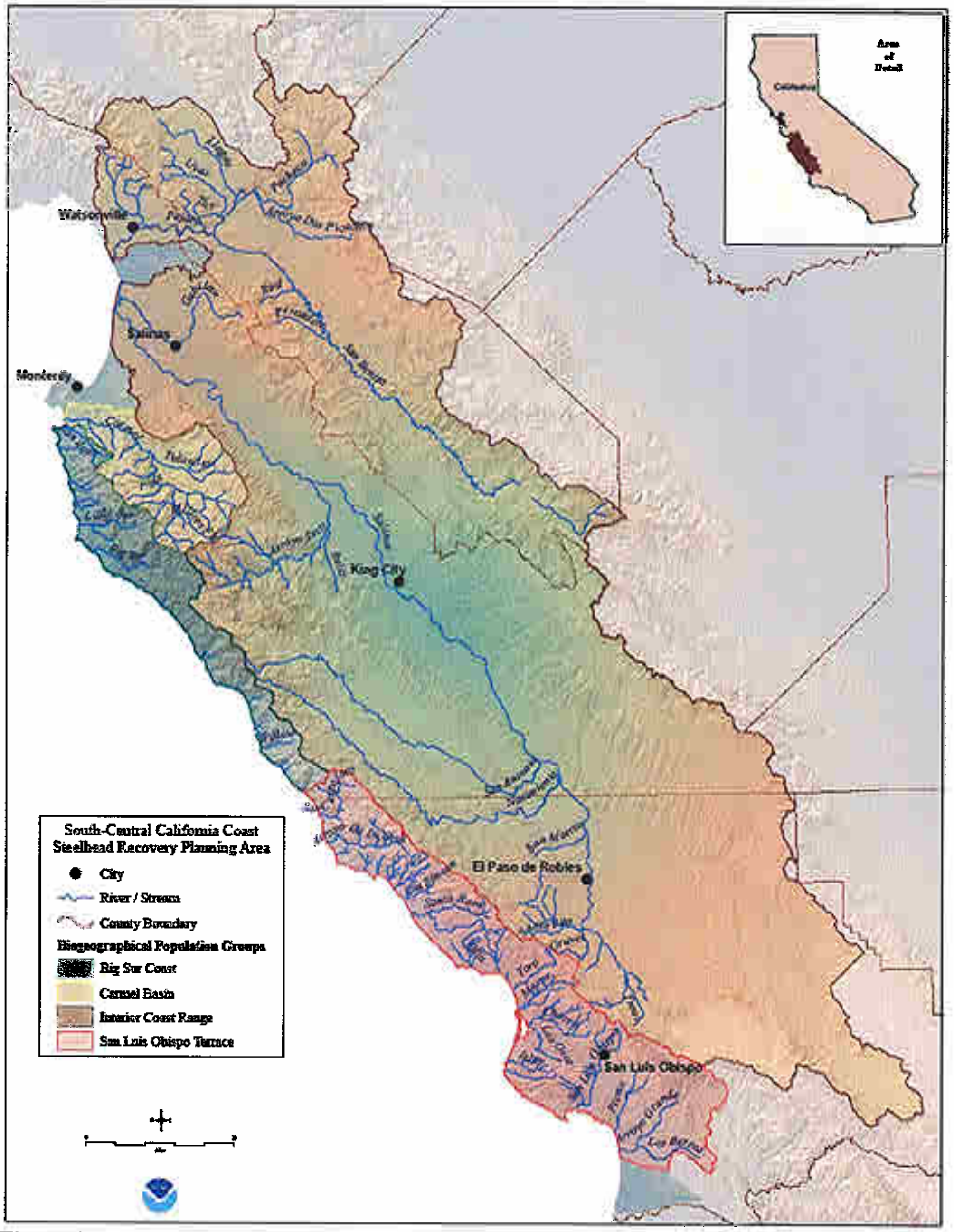

Figure 3. Biogeographical Population Groups in the South-Central California Coast Steel-Head Recovery Planning Area (after Boughton *et al.* 2007).

Because of the lack of sufficient run-size information for any of the steelhead populations within the South-Central California Coast Steelhead DPS the potential viability of individual populations could not be assessed, but only their relative potential viability in relation to other populations within the DPS. This relative ranking was based largely on the amount of potential habitat in an unimpaired condition in each watershed. Additionally, the TRT attempted to assess how potential viability might be influenced by the dispersal between populations using several different dispersal models (*i.e.*, dispersal pool, nearest neighbor, and reliable flow), none of which have been empirically tested to date. For a discussion of this issue see Boughton *et al.* (2006).

Since the late 1980s, a number of genetic studies have been conducted to elucidate the structure of steelhead populations within the South-Central California Coast Steelhead DPS. These studies have been useful in providing insights into the historic distribution of the species, as well as the potential influence of past (and current) stocking practices within the watersheds historically occupied by native *O. mykiss*. Early studies used electrophoretically detectable protein differences (allozymes). More recently, studies have employed molecular genetic analyses, assaying variation in mitochondrial DNA (mtDNA) sequences, and variations in tandem-repeat copies of microsatellite loci.

Berg and Gall (1988) surveyed 24 polymorphic allozyme loci from populations throughout California, including a small number of populations from the South-Central California Coast Steelhead Recovery Planning Area. They discovered considerable variability among California populations, but did not discern a clear geographic pattern to the variation. Busby *et al.* (1996, 1997) reported a large-scale study of 51 allozyme loci in 113 populations, including 22 from California, four of which were specifically from the South-Central California Coast Steelhead Recovery Planning Area. A high level of genetic variability was found in the California coastal populations. Busby *et al.* (1996, 1997) noted that finding an allozyme allele fixed in some populations, but entirely absent in others, is unprecedented in anadromous salmonids, except when comparing populations at the extreme ends of their ranges.

In the 1990s, a series of investigations into the molecular genetic diversity and biogeography of steelhead in coastal California was conducted by Nielsen, *et al.* (1994) Genetic variation in mtDNA and a single microsatellite locus was assayed in 468 coastal *O. mykiss* sampled from 31 populations throughout California. Allele frequencies differed enough between populations to reject the hypothesis that steelhead throughout southern California are freely interbreeding. Nielsen *et al.* (1994) offered two explanations for this: 1) genetic drift has caused populations in southern California to differ from one another and from the rest of the California populations, or 2) the southern steelhead are descended from an ancient lineage that survived the Pleistocene in a refugium in the Gulf of California. The authors noted that the data were insufficient to reject either explanation, but predicted that if explanation 2 were true, then a high degree of genetic diversity should be observed in the South-Central California Coast Steelhead Recovery Planning Domain.

Nielsen *et al.* (1997) compared genetic diversity in mtDNA and three microsatellite loci in *O. mykiss* from five habitats with varying degrees of hatchery influence and accessibility to the ocean. Samples were drawn from streams with and without access to the ocean, reservoirs, and hatcheries, and from sea-run adults and outmigrating smolts (the anadromous group). Based on the presence of rare haplotypes, mtDNA diversity was found to be highest among the anadromous fish (however, this result may be an artifact of the small number of anadromous fish sampled), and lowest among the hatchery trout. Additionally, certain "uniquely southern" haplotypes absent in rainbow trout hatchery strains occurred at moderate frequency in rainbow trout from freshwater habitats–both with and without ocean access–throughout the study area. This suggested that some rainbow trout populations in southern California, despite years of stocking with hatchery strains, still possess genetic heritage from wild southern steelhead. It was pointed out, however, that rainbow trout from streams with open access to the ocean were more closely related to the anadromous fish than were fish from closed habitats or reservoirs, suggesting that trout still having access to the ocean may retain a greater degree of southern steelhead heritage.

Nielsen (1999) deemed it unlikely that wider allele size ranges would occur in California if steelhead survived the late Pleistocene in a single northern refugium, and then colonized rivers to the south in California. Thus, she argued that "we are left with one alternative to explain the unique genetic diversity observed . . . the vicariance model of genetic variation," and that "Perhaps some of the genetic diversity in southern steelhead represents lineage effects from populations that evolved from a Gulf of California refugium, rather than reflecting particular processes in a marginal population with common ancestry from a Beringia refugium."

Most recently, Girman and Garza (2006) completed a genetic survey of *O. mykiss* populations above and below impassible barriers within the South-Central/Southern California Coast Steelhead Recovery Planning Domain. The analysis found evidence for hierarchical structure similar to that found in steelhead populations further to the north. The majority of the genetic variation was at the level of individual local populations. Phylogenetic trees indicate that *O. mykiss* above and below dams in the same basin are generally closely related, and in many cases are the most genetically similar populations within the study area, though the magnitude of differentiation between above and below barrier populations was variable. There was no genetic evidence of widespread introgression of hatchery trout into breeding populations of naturally spawning rainbow trout either above or below dams, though there was some evidence of hatchery ancestry in the small number of fish sampled south of the Santa Clara River (within the Southern California Coast Steelhead Recovery Planning Area).

Girman and Garza concluded that because hatchery stocks have among the lowest levels of genetic variation observed in the study area, inbreeding depression resulting from these hatchery strains, or any population derived from them, would be of concern. Also, a change in environmental conditions or stocking practices in the future that would result in such an admixture and a consequent reduction of effective population size, would be of concern, and possibly complicate efforts to recover and retain viable populations of native *O. mykiss*.

III. THREATS - LISTING FACTORS ASSESSMENT

The ESA provides that the Secretary of Commerce must determine, through a regulatory process, if a species is endangered or threatened based upon the consideration of any one of the five listing factors discussed below. The listing factors specified in the ESA deal with those aspects of the species' biology or habitat that effect the level of threat to the species' continued persistence. The ESA requires that in developing recovery plans for listed species, each of the factors which contributed to the species' listing as threatened or endangered be addressed in the recovery actions identified in recovery plans.

A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Steelhead runs on the west coast of the United States have experienced declines in abundance, particularly following World War II, as a result of human activities such as water development, flood control programs, forestry practices, agricultural activities, mining, and urbanization that have degraded, simplified, and fragmented habitats. One indicator of the extent of steelhead habitat degradation is the loss of estuarine habitat which steelhead use for both rearing and acclimation to salt and fresh water. Notably, California has experienced a 91% loss of its estuarine wetland habitat (Dahl 1990; Ferren *et al.* 1995).

NMFS staff has identified seven principal threats which have contributed to the destruction, modification or curtailment of the habitat or range of the threatened *O. mykiss* populations in the South-Central California Coast Steelhead DPS. The threats contributing to decline of *O. mykiss* populations are associated with most of the major river systems, *e.g.*, Pajaro, Carmel, Salinas, Arroyo Seco, San Antonio, and Nacimiento Rivers, and many also apply to a number of the smaller short-run coastal streams within the Big Sur Coast and San Luis Obispo Terrace Biogeographic Population Groups. These threats, along with a short explanation of why each is a principal threat contributing to the decline of the listed species, are presented below:

- **Alteration of Natural Stream Flow Patterns:**
    - Stream flows are necessary to breach the sand bar at the mouth of coastal estuaries, and to allow for both upstream migrations of adults to spawning and rearing reaches in headwater streams, and for the downstream emigration of juvenile fish (smolts) to the ocean. Naturally variable flow regimes also perform important functions such as maintain naturally complex channel morphology, recruit spawning gravels, flush fine sediments, rejuvenate riparian habitats, and support rearing juvenile steelhead.
    - Water developments (*e.g.*, water wells, water diversions, and dams) have reduced the frequency, duration, timing, and magnitude of river and stream flows, which affect migratory behavior, and have altered the breaching patterns at the mouths of coastal estuaries, which affects steelhead rearing and migratory opportunities. Altered flow regimes have also created conditions which promote the spread of non-native invasive species, including amphibians, fishes, and plants.
    - This factor contributing to decline of the species affects mainstems and tributaries in most major drainages, *e.g.*, Pajaro, Salinas, and Carmel Rivers, and Arroyo Grande Creek.

- **Physical Impediments to Fish Passage:**

    - Structures within river and stream channels (*e.g.*, road crossings, culverts, water diversions, and dams) impede or completely block both upstream and downstream migration of adult and juvenile fish within the watershed, as well as between the ocean and freshwater habitats.

    - Dams or diversions have blocked the majority of the prime steelhead spawning and over-summering rearing habitat in mainstems and upstream tributaries in most of the major watersheds; San Corpoforo and Arroyo de la Cruz Creeks are notable exceptions of systems without anthropogenic impediments to fish passage.

    - This factor contributing to decline of the species affects mainstems and tributaries in most major drainages, *e.g.*, Pajaro, Salinas, and Carmel River and Arroyo Grande Creek systems.

- **Alteration of Floodplains and Channels:**

    - Riparian areas provide shade to maintain suitable water temperatures, filter out pollutants (including fine sediments) and provide essential habitat for food organisms to support rearing juvenile steelhead. Natural channel forming processes facilitate migration, and sustain over-summering habitat for juvenile steelhead in mainstems and tributaries.

    - Agricultural, industrial, (including aggregate extraction), and residential developments have encroached upon, fragmented, degraded or eliminated riparian habitat along most of the major river systems (particularly the lower mainstems). Encroachment has also led to the modification of river and stream channels (*e.g.*, construction of levees, concrete channelization, and periodic channel clearing) to protect development from erosion or inundation associated with periodic high flows.

    - This factor contributing to decline of the species affects mainstems and tributaries in most major drainages, *e.g.*, Pajaro, Salinas, and Carmel River systems, Santa Rosa, San Luis Obispo, and Arroyo Grande Creeks.

- **Sedimentation:**

    - Road construction, residential development, and clearing of vegetative cover (particularly on steep slopes and adjacent to the riparian stream corridor) principally for agricultural purposes, has accelerated the rate, type, and amount of erosion and sedimentation within rivers and streams.

- Steelhead have adapted to a naturally dynamic sediment regime which maintains spawning gravels and summer pool habitat while preventing too large a buildup of fine sediments.

- Elevated levels sedimentation as a result of watershed developments has degraded spawning and rearing habitat by smothering eggs, reducing the amount of bottom dwelling insects (an important food for rearing juvenile steelhead), and filling in pools that provide refugia habitat for juvenile steelhead during low flow periods.

- This factor contributing to decline of the species affects mainstems and tributaries in most major drainages, *e.g.*, Pajaro, Salinas, and Carmel River systems, and San Simeon, Santa Rosa, San Luis Obispo, Pismo, and Arroyo Grande Creeks.

- **Urban and Rural Waste Discharges:**

  - Municipal and industrial point waste discharges and urban and agricultural non-point waste run-off are widespread, and have altered the quantity and quality of flows in rivers and streams, particularly mainstems.

  - Urban and rural waste discharges have altered naturally seasonal changes in flow, and degraded water quality through the introduction of chemical contaminants, nutrients, and thermal pollution. The effects of these waste discharges include reduced living space, direct mortality, lower reproduction and growth rates, and increased habitats for non-native aquatic species which compete with native species, including juvenile steelhead.

  - This factor contributing to decline of the species affects mainstems and tributaries in most major drainages, *e.g.*, Pajaro, Salinas, and Carmel River systems, and San Simeon, Santa Rosa, and San Luis Obispo Creeks.

- **Spread and Propagation of Exotic Species:**

  - California watersheds naturally support a relatively small suite of native fish and amphibians which compete with rearing juvenile steelhead. A number of non-native species, particularly fish and amphibians such as bass and bullfrogs, have been introduced and spread widely.

  - Some non-native fish and amphibian species prey upon rearing juvenile steelhead, compete with juvenile steelhead for living space, cover, and food, and can also act as vectors for non-native diseases.

  - Invasive plants such as Giant reed *(Arundo donax)* and Tamarisk ((*Tamarix* spp.) have infested some watersheds. These plant species can displace extensive areas of native riparian vegetation and in some cases can reduce surface flows through the uptake of large amounts of groundwater. Non-native plants can also reduce the natural diversity of insects that are an important food source for rearing juvenile steelhead.

- This factor contributing to decline of the species affects mainstems and tributaries in most major drainages, *e.g.*, Pajaro, Salinas, and Carmel River systems, as well as smaller systems such as Pismo and Arroyo Grande Creeks.

- **Loss of Estuarine Habitat:**

  - Coastal estuaries are used by adult and juvenile steelhead to acclimate to the fresh and salt water phases of their life-history, and can also serve as important nursery areas for rearing juvenile steelhead.

  - Many estuaries have been lost or substantially reduced in size and physical complexity through filling and the elimination of distributary and side-bar channels to accommodate agricultural, residential, recreational, and industrial development, as well as for road crossings (particularly Highway 1). Over 90% of the coastal estuarine acreage of California has been lost or substantially degraded.

  - Remaining estuarine habitat has been further degraded as a result of alteration of natural flow regimes, point and non-point sources of pollution, and the artificial breaching of sand-bars which temporarily dewaters estuaries and unnaturally alters their salinity regimes.

  - This factor contributing to decline of the species affects most of the major estuaries, *e.g.*, Pajaro, Salinas, and Carmel River and Morro Bay Estuaries, and the San Luis Obispo, Pismo, and Arroyo Grande Creek Estuaries.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Steelhead have traditionally supported an important recreational fishery throughout their range. Recreational angling for both winter adult steelhead and summer rearing juveniles is a popular sport. Recreational angling in coastal rivers and streams for native steelhead has increased the mortality of adults (which represent the current generation of brood stock) and juveniles (which represent the future generations of brood stock).

During periods of decreased habitat availability (*e.g.*, drought conditions or naturally low summer flow when fish are concentrated in freshwater habitats), the impacts of recreational fishing on native anadromous stocks may be heightened. NMFS has reviewed and evaluated the impacts of recreational fishing on west coast steelhead populations (Busby *et al.* 1996, 1997; Good *et al.* 2005; NMFS 1996a). Steelhead are not generally targeted in commercial fisheries. High seas driftnet fisheries in the past may have contributed slightly to a decline of this species in local areas, but could not be principally responsible for the large declines in abundance observed along most of the Pacific coast over the past several decades.

Angling regulations for sport fishing have been changed to reduce extinction risk for the South-Central California Coastal Steelhead DPS. For freshwaters, the current regulations allow summer trout fishing in some systems, often with a two- or five-bag limit. These include significant parts of the Salinas system (upper Arroyo Seco and Nacimiento above barriers; the upper Salinas River; Salmon Creek; and the San Benito River in the Pajaro River system). Also included is the summer fishery in the Carmel River above Los Padres Dam. The regulations also allow catch-and-release winter-run steelhead angling in many of the river basins, specifying that all wild steelhead must be released unharmed, though the mortality associated with this fishery is unknown. There are significant restrictions on timing, location, and the gear used for angling; however, this fishery is not currently covered by a Fishery Management and Evaluation Plan.

Sport and commercial harvest of steelhead in the ocean is prohibited by the CDFG, and incidental ocean harvest is rare (California Department of Fish and Game 2007).

C. Disease or Predation

Infectious disease is one of many factors that can influence adult and juvenile steelhead survival. Specific diseases such as bacterial kidney disease, Ceratomyxosis, Columnaris, Furunculosis, infectious hematopoietic necrosis, redmouth and black spot disease, Erythrocytic Inclusion Body Syndrome, and whirling disease among others are present and are known to affect steelhead and salmon (Noga 2000; Rucker *et al.* 1953; Wood 1979). Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases for steelhead. However, studies have shown that native fish tend to be less susceptible to pathogens than hatchery cultured and reared fish (Buchanon *et al.* 1983).

Introductions of non-native aquatic species (including fishes and amphibians) and habitat modifications (*e.g.*, reservoirs, altered flow regimes, *etc.*) have resulted in increased predator populations in numerous river systems, thereby increasing the level of predation experienced by native salmonids (NMFS 1996a). Non-native species, particularly fish and amphibians such as bass and bullfrogs have been introduced and spread widely. These species can prey upon rearing juvenile, steelhead, compete with native juvenile steelhead for living space, cover, and food, and can also act as vectors for non-native diseases.

Artificially induced summer low flow conditions may also provide conditions beneficial to non-native species, exacerbate spread of diseases, and permit the increase in avian predation. However, site-specific information on the role of disease and predation impacts on steelhead is generally not available for the South-Central California Coast Steelhead DPS.

D. Inadequacy of Existing Regulatory Mechanisms

Federal Efforts

The following summarizes the principal federal regulatory and planning mechanisms affecting the conservation of steelhead populations within the South-Central California Coast Steelhead Recovery DPS (NMFS 2005).

- The Los Padres National Forest is managed through the implementation of Forest Service Plans. However, the extent and distribution of federal lands limits the ability to achieve aquatic habitat restoration objectives at river basin scales in most watersheds, and highlights the importance of complementary steelhead habitat conservation measures on non-federal lands within individual watersheds. Furthermore, the existing Forest Plans do not include adequate provisions for the protection and restoration of aquatic habitats important to migrating, spawning or rearing steelhead.

- The U.S. Army Corps of Engineers (COE) regulates dredging and filling in the waters of the United States through the Clean Water Act (CWA) Section 404 Program. The COE program is implemented through the issuance of a variety of Individual, Nation-Wide and Emergency permits. COE does not permit a discharge that would "cause or contribute to significant degradation of the waters of the United States." One of the factors that must be considered in this determination is cumulative effects. However, COE guidelines do not specify a methodology for assessing cumulative impacts or how much weight to assign them in decision-making. Furthermore, COE does not have in place any process to address the cumulative effects of the continued development of waterfront, riverine, coastal, and wetland properties. A variety of factors, including inadequate staffing, training, and in some cases policy direction, results in ineffective protection of aquatic habitats important to migrating, spawning, or rearing steelhead. The deficiencies of the current program are particularly acute during large-scale flooding events, such as those associated with El Niño conditions, which can put additional strain on the administration of the CWA Section 404 program.

- The Federal Emergency Management Agency (FEMA) administers a Flood Insurance Program which strongly influences the development in waterways and floodplains. Current 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 adequately reflect the dynamic, mobile nature of watercourses in the South-Central California Coast Steelhead DPS, and the critical role that margins of active waterways (riparian areas) play in the maintenance of aquatic habitats. FEMA also provides technical and financial assistance to pubic and private property owners who incur damages from flooding resulting from natural disasters. 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 migrating, spawning, or rearing steelhead.

- The CWA is intended to protect beneficial uses associated with aquatic habitats, including fishery resources. To date, implementation has not been fully effective in adequately protecting fishery resources, particularly with respect to non-point sources of pollution (including increased sedimentation from routine maintenance and emergency flood control activities within the active channel and floodplain).

  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.

  The CWA gives state governments the primary responsibility for establishing TMDLs. However, the Environmental Protection Agency (EPA) is required to do so if a state does not meet this responsibility. EPA has made a commitment guaranteeing that either EPA or the State of California will establish TMDLs that identify pollution reduction targets for 18 impaired river basins in California by the year 2007. The State of California has made a commitment to establish TMDLs for approximately half the 18 river basins by 2007. EPA will develop TMDLs for the remaining impaired basins in the State and has also agreed to complete all TMDLs if the State fails to meet its commitment by 2007.

  The ability of these TMDLs to protect steelhead should be significant in the long term. However, it will be difficult to develop them quickly, and their efficacy in protecting steelhead habitat will be unknown for many years to come.

Non-Federal Efforts

The following summarizes the principal regulatory and planning mechanisms affecting the conservation of steelhead populations within the South-Central California Coast Steelhead Recovery DPS (NMFS 1996b, 1997).

- California's Steelhead Restoration and Management Plan (McEwan and Jackson 1996). emphasizes ecosystem restoration and focuses on restoration of native and naturally produced steelhead stocks because of their importance in maintaining genetic and biological diversity. The Steelhead Plan identifies needed restoration measures on a broad, programmatic scale and on a stream-specific scale. CDFG has begun implementation of some of the measures identified in this plan, as well as funding site-specific projects developed by local, state, and regional groups through the Fishery Restoration Grant Program (NMFS 2006c).

- California's steelhead stocking practices have distributed non-native steelhead stocks in many coastal rivers and streams in California. Because of problems associated with the practice of transplanting non-native steelhead stocks, CDFG developed its Salmon and Steelhead Stock Management Policy. This policy recognizes that such stock mixing can be detrimental and seeks to maintain the genetic integrity of all identifiable stocks of salmon and steelhead in California, as well as minimize interactions between hatchery and natural populations. To protect the genetic integrity of salmon and steelhead stocks, this policy directs CDFG to evaluate each salmon and steelhead stream and classify it according to its probable genetic source and degree of integrity (McEwan and Jackson 1996). Additionally, CDFG has eliminated the stocking of hatchery cultured and reared fish in most coastal streams where anadromous steelhead have direct access from the ocean.

- CDFG Code Section1600 (Streambed Alteration Agreements) is the principal mechanism through which the CDFG provides protection of riparian and aquatic habitats. Inadequate funding, staffing levels, training, and administrative support have led to inconsistent implementation of this program, resulting in inadequate protection of riparian and aquatic habitats important to migrating, spawning and rearing steelhead.

- DFG and NMFS have produced a partial draft Coast-Wide Anadromous Fish Monitoring Plan for California. Monitoring of stocks (particularly annual run-sizes) is essential to assess current and future status of the listed species as well as to develop basic ecological information about listed salmon and steelhead. However, the Coast-Wide Anadromous Fish Monitoring Plan remains unfinished and funding for its implementation has not been identified or secured.

- The California State Water Resources Control Board (SWCB) 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 fish populations 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.

- Local governments have the most direct responsibility for permitting land uses on non-federal and non-state owned lands. Local efforts to control development within the floodplains and active channels is in many cases limited to the protection of public properties such as county or city roads, bridges, or other infrastructure. Local government regulation of floodplain development depends to a large extent on the standards provided by FEMA's Flood Insurance Program which does not explicitly provide for the protection of natural fluvial processes essential for the maintenance of naturally functioning riverine and riparian habitats important for steelhead migration, spawning and rearing.

E. Other Natural or Human-Made Factors Affecting Its Continued Existence

Natural climatic conditions have exacerbated the problems associated with degraded and altered riverine and estuarine habitats. These habitats have been particularly adversely affected as a result of filling, point and non-point source pollution, and alteration of stream flows or natural breaching patterns of the sand bar (which annually forms at the mouth of most coastal rivers and streams). Periodic drought conditions have reduced already limited spawning, rearing and migration habitat. Changing climatic conditions appear to have resulted in decreased ocean productivity which, during more productive periods, may help offset degraded freshwater habitat conditions (Busby, *et al.* 1996, 1997).

There are no steelhead hatcheries operating in or supplying hatchery reared steelhead to the South-Central California Coast Steelhead DPS. However, there is an extensive stocking program of hatchery cultured and reared, non-anadromous *O. mykiss* which supports a put-and-take fishery. These stockings are now generally conducted in non-anadromous waters (though other non-native game species such as small mouth bass and bullhead catfish are stocked into anadromous waters by a variety of public and private entities).

While some of these programs have succeeded in providing seasonal fishing opportunities, the impacts of these programs on native, naturally-reproducing steelhead stocks are not well understood. Competition, genetic introgression, and disease transmission resulting from hatchery introductions may significantly reduce the production and survival of native, naturally-reproducing steelhead. Collection of native steelhead for hatchery broodstock purposes can harm small or dwindling natural populations. Artificial propagation can also, in some situations, play an important role in steelhead recovery through carefully controlled supplementation programs, but are not a substitute for naturally reproducing steelhead populations.

Finally, a number of general conditions have contributed to the threats to the steelhead of the South-Central California Coast Steelhead DPS. These include: continued human population growth intensifying demands for land and water resources; an insufficient number of professionally trained biologists and natural resource managers at the local and regional governmental levels; inadequate staffing with the requisite range of pertinent professional skills (*e.g.*, hydrologic engineering, geomorphology, toxicology, and general ecology) at State and Federal governmental levels; insufficient enforcement staffing at the local, regional, State and Federal governmental levels; and inadequate public outreach and education programs aimed at informing a broad range of interests and stakeholders about the threats to and values of native steelhead populations.

IV. CONSERVATION ASSESSMENT

Two types of conservation assessments are conducted for listing and recovery planning purposes:

1) For listing determinations, conservation measures are evaluated pursuant to the "Policy for Evaluation of Conservation Efforts When Making Listing Decisions" (68 FR 15100);

2) For recovery plans, conservation assessments are conducted pursuant to the Interim Recovery Planning Guidance (NMFS 2006a).

Protective efforts assessed for listing decisions are required under Section 4(b)(1)(A) of the ESA. Federal agencies are required to review the status of the species using the best scientific and commercial data available after taking into account efforts being made to protect the species. The efficacy of existing efforts must consider the following: (1) substantive, protective and conservation elements; (2) the degree of certainty that efforts will be implemented; and (3) the presence of monitoring provisions that determine effectiveness and permit adaptive management. Protective efforts assessed for the South-Central California Coast Steelhead DPS were evaluated in 1997 with the original listing (62 FR 43937) and when the listing was re-confirmed in 2006 (71 FR 834).

Review and assessment of protective efforts for steelhead range in scope from regional strategies to local watershed initiatives. Major efforts assessed are summarized in "Steelhead Conservation Efforts: A Supplement to the Notice of Determination for West Coast Steelhead under the Endangered Species Act" (NMFS 1996b, 1997). This assessment reviewed a variety of State of California programs including:

California State Angling Regulations; Salmon, Steelhead Trout, and Anadromous Fisheries Program Act; Keen-Nielsen Fisheries Restoration Act of 1985; Bosco-Keene Renewable Resources Investment Fund; Steelhead Trout Catch Report-Restoration Card Program; California Fish and Game Commission's Steelhead Rainbow Trout Policy; Trout and Steelhead Conservation and Management Planning Act of 1979; CalTrans Environmental Enhancement and Mitigation Program; California Fish and Game Commission Water Policy; California Fish and Game Commission Cooperatively Operated Rearing Programs for Salmon and Steelhead Policies; California Department of Fish and Game Salmon and Steelhead Stock Management Policy; California Fish and Game Commission Wetlands Resources Policy; California Riparian Habitat Conservation Act; California Wildlife Protection Act of 1990; California Fish and Game Code 5931-33 (fish passage around dams); California Fish and Game Code 5937 (flow releases below dams); California Fish and Game Code 16001 and 1603 (streamed alteration agreements); California Fish and Game Code 6900 (increase natural salmon and steelhead production and offset habitat loss); California Water Code 1243 (beneficial use of water for fish and wildlife); California Water Code 1707 (appropriation of water for fish and wildlife); and the Pajaro River Watershed Management Plan). Additionally, the development of the State's Watershed Protection Program; implementation of the California Department of Fish and Game strategic management plan; implementation of the 1998 NMFS/California Memorandum of Understanding (administration of salmon and steelhead funds), and CalTrans inventory of fish barriers (SB857, 2006) also address conservation needs of the South-Central California Coast Steelhead Recovery Planning Area.

While many of these programs and policies provide some level of protection for native anadromous fishes, they have not prevented the decline of many species of Pacific salmon and steelhead, particularly steelhead populations in the South-Central California Coast Steelhead DPS, and have therefore not maintained the viability of many populations, or the DPS. The limitations of these programs and policies have resulted in the listing of a number of anadromous species as either threatened or endangered under the ESA, including the threatened South-Central California Coast Steelhead DPS.

Conservation assessments for recovery outlines and plans are conducted pursuant to the Interim Recovery Planning Guidance (NMFS 2006a). Conservation efforts undertaken since listing of the South-Central California Coast DPS as threatened include: habitat protection and restoration measures undertaken by a variety of local, State, and Federal agencies; measures implemented pursuant to Section 7 or 10 of the ESA; and recovery-related research and monitoring.

The full suite of conservation efforts will be evaluated and documented during recovery plan development. The following highlights ongoing efforts NMFS believes has contributed to the conservation of steelhead within the South-Central California Coast Steelhead DPS by eliminating or reducing threats outlined above.

NMFS has addressed activities adversely affecting the South-Central California Coast Steelhead *DPS* through Biological Opinions, participation in Habitat Conservation planning, and interagency coordination on major restoration efforts such as planning for the removal of San Clemente Dam on the Carmel River. Consultations have benefited listed steelhead and their habitats by improving habitat and fish passage conditions. Additionally, NMFS has developed guidelines for bank stabilization, road maintenance, instream gravel mining, maintenance of instream flows to protect salmonids below water diversions, fish screening, salmonid passage at stream crossings, and construction and operation of summer dams.

Several notable Federal, State and local conservation programs and initiatives providing conservation benefits to steelhead in the South-Central California Coast Steelhead DPS include (NMFS 2006b, 2006c):

- Fishery Restoration Grant Program
- Development and implementation of EPA Total Maximum Daily Load Programs
- State Steelhead Restoration and Management Plan for California
- CalFish and California Fish Passage Forum
- Modifications to CDFG rainbow trout Hatchery and Stocking Programs
- Adjustments to CDFG angling regulations for resident and anadromous *O. mykiss*
- Draft CDFG/NMFS California Coast-Wide Salmon and Steelhead Monitoring Plan
- FishNet 4C (Mendicino, Sonoma, Marin, San Mateo, Santa Cruz Counties)
- Tri-County Fish Team (San Luis Obispo, Santa Barbara, and Ventura Counties)

V. PRELIMINARY RECOVERY STRATEGY

A. Recovery Priority Number 3

Ranking for the South-Central California Coast Steelhead DPS was determined in accordance with the Recovery Priority Guidelines (55 FR 24296) and was based on a high magnitude of threat, a moderate potential for recovery, and anticipated conflict with current and future development/disturbance within the range of the DPS. The Biological Review Team (BRT) that was formed to conduct an updated status review in 2005 concluded that the South-Central California Coast California Steelhead DPS "was currently not in danger of extinction but was likely to become so in the foreseeable future". This determination was based in part on degradation of freshwater habitats resulting from agricultural, industrial, residential, and recreational developments, impediments to fish passage, and estuarine modifications, including artificial breaching of sandbars during periods when estuaries are normally separated from the ocean by the sandbar. NMFS believes that there is a moderate magnitude of threat in smaller watersheds, but a higher risk in the major watersheds, with a moderate potential of recovery and continued conflict with land disturbance and water associated impacts in both the smaller and larger watersheds.

B. Recovery Vision Statement

Recovery of the threatened South-Central California Coast Steelhead DPS will require recovery of a sufficient number of viable populations (or sets of interacting trans-basinal populations) within each of the four Biogeographic Regions to conserve the natural diversity (genetic, phenotypic, and ecological), spatial distribution, and redundancy of the populations, and thus the long-term viability of the DPS. (See Section C, Viability Criteria for the South-Central California Coast Steelhead DPS.) Achieving this goal will require a number of closely coordinated activities, including further research into the diverse life-history cycles and adaptations of southern steelhead to a semi-arid and highly dynamic environment (including the ecological relationship between resident and migratory populations); monitoring of existing populations; and the completion and implementation of a recovery plan. Strategic and threats-specific recovery actions are identified in Section D (Strategic Recovery Actions), and Section E (Priority Actions to Address Factors Currently Suppressing Potential for Recovery), respectively.

Effective implementation of recovery actions will also entail: (1) extensive public education (including the general public, local, regional, State, and Federal governmental agencies) regarding the role and value of the species within the larger watershed environment; (2) development of cooperative relationships with private land owners, special districts, and local governments with direct control over non-federal land-use practices; (3) participation in the land use and water planning and regulatory processes of local, regional, State, and Federal agencies; (4) close cooperation with other State resource agencies such as the CDFG, California Coastal Commission, CalTrans, and the California Department of Parks and Recreation, and (5) partnering with federal resource agencies, including the U.S. Forest Service, U.S. Fish and Wildlife Service, National Park Service, U.S. Bureau of Reclamation, COE, U.S. Department of Transportation, U.S. Department of Defense, and the U.S. Environmental Protection Agency.

C. Viability Criteria for the South-Central California Coast Steelhead DPS

The TRT for the South-Central/Southern California Coast Steelhead Recovery Planning Domain developed viability criteria for both individual populations and for the South-Central California Coast Steelhead DPS as a whole. Additionally, the TRT identified several general recovery objectives to guide the overall recovery efforts for the South-Central California Coast Steelhead DPS. The following discussion adheres to the analysis and recommendations provided by the South-Central/Southern California Coast Steelhead Recovery Planning Domain TRT in Boughton *et al.* (2007).

A viable population is defined as a population having a negligible risk (<5%) of extinction due to threats from demographic variation, non-catastrophic environmental variation, and genetic diversity changes over a 100-year time frame. A viable DPS is comprised of a sufficient number of viable populations sufficiently spatially dispersed but well-connected to maintain long-term (1,000-year) persistence and evolutionary potential (McElhany *et al.* 2000).

Assessments of viability of either individual populations or the DPS as a whole must account for uncertainty due to the stochastic nature of basic biological processes such as birth, death, and migration, as well as environmental stochasticity such as droughts, floods, and wildfires. Viability assessments must also account for the complexity of estimating the rates of these basic processes, and with their relationships with population density and habitat conditions. The TRT identified two different methods of dealing with viability criteria for both individual populations and the DPS as a whole: prescriptive criteria and performance-based criteria.

Prescriptive criteria are derived from the precautionary principle, *i.e.*, the idea that irreversible harm (such as permanent population extirpation) should be actively prevented even if there is significant uncertainty about its magnitude, likelihood, or costs. Viability criteria developed according to this principle are purposely set high and include a safety factor to account for uncertainties. The advantage of prescriptive criteria derived from the precautionary principle is that they are readily derived from existing general information. The disadvantages are that they can be based on inadequate information, or are biologically unachievable.

Performance criteria are based on a formal quantitative risk assessment and decision analysis. This approach differs from prescriptive criteria in two key ways: first, the criteria involve direct estimates of risk, and second, the estimate at the margin of safety is replaced by a full quantitative accounting of uncertainty. The advantages of performance criteria are scientific rigor, quantitative estimates of risk, and possibly greater scope for innovative solutions, including more efficient management strategies that avoid an unwarranted or unachievable precaution. The principle disadvantage is the stringent requirement for data-gathering and analysis which can be both time-consuming and expensive.

In situations where the data regarding basic biological processes such as the rates of birth, death, and migration are not known quantitatively, and the uncertainty is therefore high (as with the South-Central California Coast Steelhead DPS), the approach to identifying viability criteria for recovery planning within the South-Central California Coast Steelhead DPS necessarily involves identifying prescriptive criteria. Alternatively, performance-based criteria can be developed, based on quantitative information on the relevant factors and accounting for uncertainty due to the prevalence of stochastic processes. Even when the relevant data are available and rigorously analyzed, viability models (and related criteria) retain inherent limits on the accurate forecasting of absolute risk (Beissinger and Westphal 1998). Though viability models have inherent limits of interpretation on absolute risk, they are necessary in developing and using "objective measurable" recovery criteria.

Table 3 summarizes the prescriptive criteria identified for population viability and DPS viability. At the population level the TRT propose four criteria that, in principle, are objective and measurable. However, one criterion (spawner density) is too poorly understood at the moment to estimate the minimum threshold necessary for low risk. For two criteria (run-size and anadromous fraction), the TRT derived a minimum threshold given current information constraints, but believes that a more efficient threshold could be estimated using a performance-based approach.

Table 4 summarizes the standards for the performance-based approach. A performance-based approach would require long-term investment in obtaining quantitative data on environmental stochasticity, population variability, and maintenance of the stabilizing-effect of the residency-anadromy life-history cycle polymorphism.

Table 5 identifies the number of populations, by Biogeographic Population Group, that would provide for sufficient representation, spatial distribution, and redundancy of viable populations within the South-Central California Coast Steelhead DPS, and a simple criterion for spatial separation of populations. The redundancy criteria are based on a precautionary assessment of wildfire risk. A performance-based estimate of wildfire risk probably would be more efficient, but at the cost of a significant research effort. Also, there is a lack of information on how the DPS achieves resiliency to severe droughts. See Boughton *et al.* 2006, 2007.

Table 3. Prescriptive Viability Criteria (from Boughton *et al.* 2007).

Population-level Criteria

Criterion Type[1]	Viability Threshold	Notes
Mean Annual Run Size[2]	S > 4,150[3]	Requires population monitoring
Ocean Conditions	Size criterion met during poor ocean conditions	"Poor ocean conditions" determined empirically, or size criterion met for at least 6 decades
Spawner Density	*Unknown at present*	Research needed.
Anadromous Fraction	N = 100% of 4,150	Requires further research

DPS-level Criteria[4]

Criterion Type	Viability Threshold
Biogeographic diversity	1) Numbers of viable populations as in Table 5, last column 2) Viable populations inhabit watersheds with drought refugia 3) Viable populations separated from one another by at least 68 km if possible[5].
Life-history diversity	Viable populations exhibit all three life-history types (fluvial-anadromous, lagoon anadromous, freshwater resident)

[1] Population should meet all 4 criteria to be considered viable.

[2] Modified from Allendorf *et al.* (1997), Lindley *et al.* (2006).

[3] S refers to spawning *O. mykiss* per generation and corresponds to an adult population size of at least 12,500 spawners per generation, assuming a three-year generation time.

[4] The DPS should meet all three criteria for biogeographic diversity and the criteria for life-history diversity. Currently only the anadromous populations of *O. mykiss* within the South-Central California Coast Steelhead DPS are listed under the ESA as a threatened. The non-migratory, freshwater populations are not listed, but are included here for recovery planning purposes because of their role in contributing to the viability of the listed species.

[5] Minimum distance between the boundary of the pair of watersheds harboring each two populations. If meeting the criteria is geographically impossible within a biogeographic group, then the viable populations should be as widely dispersed spatially as possible.

Table 4. General Performance-Based Criteria for Population Viability (from Boughton *et al.* 2007).

One or more prescriptive criteria (see Table 3) could be replaced by a quantitative risk assessment satisfying all of the following:

1) Extinction risk < 5% in the next 100 yr
2) Addresses each risk that is addressed by the prescriptive criteria it replaces
3) Parameters are either a) estimated from data or b) precautionary
4) Quantitative methods must conform to accepted practice in the field of risk assessment, either Bayesian or frequentist[1]
5) Must pass independent scientific review

[1] For a discussion of these two approaches see Punt, A. E. and Ray Hilborn (1997); Sokal, Robert F. and James Rohlf (1995)

Table 5. Number of wildfires in each population group during a thousand-year fire event similar to the events of 2003 and 2007, and the number of viable populations necessary for DPS viability (from Boughton *et al.* 2007)

Population Group	Expected Number of Wildfires	Maximum Number of Wildfires		Sufficient Number of Populations[1]
		95% confidence	99% confidence	
Interior Coast Range	2.567	5	7	4[2]
Carmel Basin	0.359	1	2	1
Big Sur Coast	0.406	2	2	3
San Luis Obispo Terrace		3	4	5

[1] Viable and spatially separated from other viable populations by > 68 km. Estimated as 1 + the number of wildfires at 99% confidence, or the number of historic populations, whichever is less.

[2] The number of historically viable populations is unknown at this time and may be smaller than the table entry, since some historical populations may have been ephemeral and required recurrent colonization.

Many coastal basins in two of the Biogeographic Groups (Big Sur Coast and San Luis Obispo Terrace) are relatively small, and may be capable of supporting only small steelhead runs. The basis for persistence of steelhead runs in these small basins is uncertain. At least three scenarios (not necessarily mutually exclusive) are plausible:

1) Some of the populations in the coastal Biogeographic Population Groups (*e.g.*, Big Sur Coast), though small, may be exceptionally stable and thus viable, and sustain the continued presence of steelhead in neighboring watersheds via the mechanisms of dispersal. Possible mechanisms for such stability include stable stream flows (even in dry periods), reliable migration corridors, and/or a persistent resident population of *O. mykiss* that contributes to and therefore stabilizes the anadromous runs.

2) Dispersal between neighboring basins within a coastal Biogeographic Population Group may be common enough to knit together the steelhead in individual basins into a small number of "trans-basin" populations, and these trans-basinal populations may be large enough to be viable.

3) The populations in the coastal Biogeographic Populations Groups may not be generally viable, and instead rely on occasional or frequent dispersal pulses from populations in the larger inland Biogeographic Populations Groups.

It is not clear whether a satisfactory resolution of the above uncertainties is scientifically tractable, especially in the near term. This suggests that recovery planning should proceed with the assumption that any of these scenarios may apply to any of the coastal Biogeographic Population Groups. Thus, in planning for a sufficient number of populations in the coastal Biogeographic Population Groups, a strategy would be to identify basins with stable runs to address scenario (1), group with them enough neighboring basins to address scenario (2), and then develop a monitoring effort to evaluate persistence (scenario 3) as well as to refine viability goals over time.

If scenarios (1) and (2) both are true, each comprises a distinct mechanism for stabilizing steelhead runs and would thus be complimentary to some degree. They may even interact in nonlinear ways that further enhance the reliability and abundance of steelhead runs in the coastal supergroup. Also, scenario (3) implies that the continued persistence of steelhead in a particular Biogeographic Population Group depends on robust runs occurring in other Biogeographic Population Groups. If scenario (3) is correct for this area, it implies that the continued appearance of steelhead may depend on robust runs occurring in Biogeographic Population Groups in the northern portion of the South-Central California Coast Steelhead DPS.

D. Strategic Recovery Actions

In addition to the prescriptive and performance-based viability criteria, the TRT also identified the following seven strategic recovery actions which are essential, but not necessarily sufficient by themselves, to achieve viability of the South-Central California Coast Steelhead DPS (Boughton *et al.* 2007):

1. Identify and commit to a core set of populations on which to focus recovery efforts.

Core populations are intended to meet either the prescriptive or performance-based viability criteria and are selected to be the focus of recovery. The core set would be a subset of the set of all populations composing the DPS, previously discussed in Boughton *et al.* (2006).
The strategy most likely to achieve recovery and lead to de-listing would be to identify how recovery actions and monitoring of the core populations would address the population and DPS viability criteria. In general, population viability is more likely to be achieved by focusing on larger watersheds capable of sustaining larger populations, and DPS viability is more likely to be achieved by selecting the most widely-dispersed set of such core populations still capable of maintaining dispersal-connectivity (see Boughton *et al.* 2006). This should not be interpreted to suggest that non-core populations are unimportant—dispersal connectivity and genetic diversity may be aided by also including smaller non-core populations that serve as stepping stones for dispersal. However, the core populations are fundamental.

2. Secure the extant parts of the inland populations.

Inland populations comprise the Interior Coast Range (Pajaro and Salinas Rivers) and Carmel Basin (Carmel River) Groups. In of these basins there are important impediments to migration to significant spawning and rearing habitats. The original inland populations were few in number, large in spatial extent, and inhabit challenging environments. Due to low redundancy, they are necessarily core populations in the sense described above. The inland populations are frequently the most highly impacted by dams, water diversions, and flood control practices, and wildfire analysis suggests that they had marginal redundancy even before these impacts. Yet the populations of the Interior Coast Range and Carmel Basin Biogeographic Population Groups appear to have produced the largest run sizes in the South-Central California Coast Steelhead DPS during years of high rainfall and runoff (Boughton, *et al.* 2005; Good *et al.* 2005).

The extant habitat of these populations—especially the anadromous waters of the Pajaro, Arroyo Seco, and the Salinas River - merit high priority for immediate protection and restoration so that fish runs do not decline further (and should be improved whenever possible, though this is a longer-term effort). The low level of redundancy in the inland groups indicates that ongoing efforts to restore flows and fish passage in the Pajaro and Salinas Rivers are necessary steps to achieving DPS viability, as are future efforts to improve flows and passage in the Carmel River.

3. Identify and maintain sustainable refugia against severe droughts and heat waves.

Over-summering freshwater habitat for rearing juveniles is essential for the completion of the life-history cycle of *O. mykiss*. Large changes in the climate are projected by the end of the century and perhaps even mid-century (Hayhoe *et al.* 2004; Intergovernmental Panel on Climate Change 2007). A direct effect of climate forcing by greenhouse gases is higher downwelling of infrared radiation, which would be expected to increase surface temperatures and evapotranspiration (Trenberth 1999), with complex, potentially negative effects on summer habitat of *O. mykiss*. Indirect effects include changes in precipitation and temperature patterns; and attendant changes to disturbance regimes, watershed conditions, and stream hydrographs

(Snyder *et al.* 2002; Bell *et al.* 2004; Maurer *et al.* 2006). Even a brief description of these effects is beyond the scope of this outline, but it is clear that recovery of steelhead populations will rely on identifying the ecosystem, geomorphological and geologic conditions expected to buffer habitat against the evolving climatic and hydrologic conditions. Then it will be necessary to adjust recovery efforts according to what has been learned through research and monitoring.

4. Begin collecting population data.

The Carmel River steelhead population is the only one with ongoing efforts to monitor run-size, and even these are only partial counts. However, annual estimates of run-size are the single most useful dataset for assessing population status and progress toward recovery. In addition, such data would produce basin-specific estimates of environmental stochasticity, which would allow a more refined criterion for population size. A scientifically-based recovery effort will be unachievable without a serious and sustained effort to monitor run-size in many, if not all, of the core populations within each Biogeographic Population Group.

5. Secure and improve estuarine/lagoon habitat.

The work by Bond (2006) indicates that restoration activities in estuary/lagoon habitat are likely to produce disproportionate benefits for steelhead populations. However, the work of Bond (2006) and Smith (1990) were case studies in Santa Cruz County, and the robustness of their predictions for areas to the south has not yet been tested. The precautionary approach is to protect estuaries/lagoons, and the lagoon-anadromous life form, regardless of the generality of Bond's (2006) findings, but it would also be useful to evaluate this assumption empirically.

Estuaries are under serious pressure from development and declines in water quality. Smith (1990) provides a useful discussion of estuary/lagoon conditions correlating with high juvenile growth and survival, and concludes that two key elements are integrity of the sandbar barrier during the dry season and sufficient inflow of freshwater from the stream system during the dry season. Another important problem occurs when the freshwater spawning habitat is distant from the lagoon, and the intervening fluvial corridor has become unsuitable for adult or juvenile migration due to watershed management practices; this can be a significant constraint of estuary/lagoon use if the distances between the estuary/lagoon and upstream habitats is great (*e.g.*, Pajaro and Salinas Rivers). In addition, current climate trends predict a future of warmer oceans and melting glaciers and icecaps, all expected to raise mean sea levels, perhaps leading to the inundation and displacement of estuaries/lagoons. Medium greenhouse-gas scenarios project a mean sea-level rise of 0.34m – 0.38m by the year 2100 (Raper and Braithwaite 2006).

6. Decide on a strategic balance and timeline for investment in better information vs. investment in more recovery activities.

Some of the prescriptive criteria identified are subject to significant revision if quantitative data are obtained. The criteria for population size could be more efficient with basin-specific data on run-size variation and life-history cycle plasticity; and the criterion for spawner density requires basic research. Each of these constitutes a significant research effort that may pose an opportunity cost on recovery activities, but that would result in better planning that makes recovery activities more effective and efficient.

Two related issues are research questions that require "take" of the fish, and the size of anadromous fractions necessary for tractable research. Regarding the first issue, currently the only practical way to estimate life-history cycle plasticity at broad scales is via otolith microchemistry (Zimmerman and Reeves 2000). This technique allows determination of the marine-vs-freshwater history of individual fish and their mothers, but requires lethal sampling of fish. Thus, it constitutes "take" under the ESA but ultimately has useful application to recovery planning. However, in cases where the level of sampling can be shown to be not likely to jeopardize the species, NMFS can authorize this "take" through research permits under Section 10(a)(1)(A) of the ESA.

With respect to the second issue, many populations may currently be too small to address certain research questions (*e.g.*, viability, run-time or age class distribution, *etc.*). Consequently, for some populations, recovery efforts should be implemented as soon as practicable, and run-sizes increased to ensure research efforts have sufficient sample sizes to provide statistically robust results.

Regardless of how viability criteria might be adjusted in the future, run-sizes must be substantially larger than they are now if the species is to be recovered and ultimately de-listed. There is no reason to delay proximal recovery activities because of scientific uncertainty about viability. The principal uncertainty is about how far recovery must ultimately go to achieve viability.

*7. **Establish programs for ecosystem-based management of sediment regimes and hydrographic regimes.***

Sediment regime is a simple term for a complex set of processes governing sediment transport and sorting in stream networks. These processes include the wildfire regime, mass wasting, and the winter flood regime with attendant fluvial transport processes. All these are important for maintaining a dynamic system of spawning gravels and summer pool habitat while preventing too large a buildup of fine sediments (May and Lee 2004). The hydrographic regime plays a role not just in fluvial transport of sediments, but also in maintaining migration connectivity for steelhead, and in modulating the quality of oversummering habitat in the mainstem, tributaries, and estuaries/lagoons. The sediment and hydrographic regimes of many basins have been fundamentally altered by human activities in the region, and are likely to undergo further fundamental changes, both in direct response to future climate change and urban development, and as an indirect response to both these causes via their effect on the wildfire regime. This is a complex topic beyond the scope of this outline, but it is clear that the management of sediment and hydrologic regimes is not amenable to short-term or localized solutions.

E. Priority Actions to Address Factors Currently Suppressing Potential for Recovery

Priority conservation actions which would improve the species potential for recovery have been identified for the South-Central California Coast Steelhead DPS (NMFS 2006b). These priorities address two of the overarching causes of the population declines within the South-Central California Coast Steelhead DPS: reduced access to historic steelhead spawning and rearing habitats, and reduced reproductive success. The priority actions include, but are not limited to, the following:

1. *Priority Actions to Address Threats of Limited Spatial Distribution:*

- Where fish passage impediments (*e.g.*, culverts, road-crossings, bridges, diversions, dams, *etc.*) have been identified and assessed, reestablish appropriate fish passage to upper watersheds, in both small coastal streams and larger inland river systems, commensurate with habitat and life-history requirements of steelhead.

- Complete the planning and implement a program for the removal or retrofitting of San Clemente Dam on the Carmel River commensurate with habitat and life-history requirements of steelhead.

- Evaluate and provide flows in the Salinas River system (including the mainstem and the San Antonio and Nacimiento tributaries) commensurate with habitat and life-history requirements of steelhead, through regulation of groundwater extractions and surface water diversions and storage.

- Evaluate and provide appropriate fish passage opportunities commensurate with habitat and life-history requirements of steelhead at San Antonio Dam on the San Antonio River and Nacimiento Dam on the Nacimiento River.

- Resolve flood control issues (*e.g.*, channel clearance, levee maintenance) commensurate with habitat and life-history requirements of steelhead on the Pajaro River.

- Remove and/or retro-fit the barriers created by Highway 1 crossings over a number of short coastal streams along the Big Sur Coast and San Luis Obispo Terrace commensurate with habitat and life-history requirements of steelhead.

- Evaluate and provide flows and fish passage opportunities commensurate with habitat and life-history requirements of steelhead at Lopez Dam on Arroyo Grande Creek.

2. *Priority Actions to Address Threats of Low Overwinter and Summer Survival of Juveniles, Limited Smolt Production, Low Productivity, and Reduced Spawning Success:*

- Evaluate, maintain, and where appropriate, provide flows in juvenile rearing areas commensurate with habitat and life-history requirements of steelhead. This should be accomplished through watershed management and regulation of water supply and flood control facilities.

- Enhance protection of natural in-channel and riparian habitats, through adequate control of flood control activities (both routine maintenance and emergency measures), off-road vehicle use, and in-river sand and gravel mining commensurate with habitat and life-history requirements of steelhead.

- Assess the condition of and restore estuarine habitats through the control of fill, waste discharges, and establishment of buffers, commensurate with the habitat and life-history requirements of steelhead.

- Control of artificial breaching and/or draining of coastal estuaries commensurate with habitat and life-history requirements of steelhead (including rearing juveniles and migrating adults).

- Evaluate and mitigate the effects of transportation corridors and facilities on estuarine fluvial processes. When vehicular, railroad, or utility crossings over estuaries are replaced, up-graded, retrofitted, or enlarged, reduce or eliminate existing approach-fill and maximize the clear spanning of upstream active channel(s), floodways, and floodplains to accommodate natural river and estuarine fluvial processes.

- Reduce water pollutants such as fine sediment, pesticides, and other non-point source and point source waste discharges commensurate with habitat and life-history requirements of steelhead. This should be accomplished through watershed and management and regulation of public and private facilities releasing waste-discharges.

- Complete and finalize the draft Fisheries Management and Evaluation Plan (FMEP) for the anadromous waters of the South-Central California Coast Steelhead DPS. The draft FMEP recommended complete closure of the Salinas River system and angling above Los Padres Dam on the Carmel River to protect the remnant steelhead runs in these systems (California Department of Fish and Game 2001). The current angling regulations did not implement this recommendation, allowing both summer-run trout angling and winter-run catch-and-release steelhead angling in selected parts of the system, and contains no comprehensive plan for monitoring fish abundance (CDFG 2001).

- Conduct research on the relationship between resident and anadromous forms of *O. mykiss*, and their ecological relationships (*e.g.*, distribution, abundance, residualization, homing/straying, and recolonization rates).

- Monitor annual fluctuations of *O. mykiss* populations (anadromous and resident forms) in both larger inland rivers systems and short coastal streams in all Biogeographic Population Groups.

- Survey and monitor the distribution and abundance of non-native species and plants and animals which degrade natural habitats or compete with native species within larger river systems and short coastal streams. Initiate efforts to eliminate, reduce, or control non-native, invasive species of plants and animals which degrade steelhead habitats or compete with steelhead or native species important to steelhead.

VI. NMFS PRELIMINARY RECOVERY PROGRAM

To ensure NMFS is fulfilling its obligation under the ESA to conserve and recover the South-Central California Coast Steelhead DPS, NMFS shall focus primarily on linking and coordinating ESA programs to recovery planning and implementation, and developing effective and more collaborative partnerships with other entities whose decisions and actions affect steelhead recovery.

A. Coordinate ESA Programs with Recovery Planning

1. Streamline Section 7 and 10 ESA processes and provide opportunities for NMFS staff participation in recovery planning activities, and allocate staff time towards steelhead recovery implementation efforts.

2. Utilize TRT reports, the Recovery Outline, and critical habitat information in conducting consultations and incorporate priority recovery actions into consultations where appropriate.

3. Coordinate with the Southwest Fisheries Science Center (SWFSC) to incorporate geographical information related to viable steelhead population criteria (abundance, productivity, spatial structure, diversity) into recovery and consultation actions.

4. Coordinate with the NMFS Office of Law Enforcement during recovery plan development.

B. Inter-Agency Coordination and Public Outreach

1. Continue collaboration with Federal, State, and local agencies in developing South-Central California Coast Steelhead DPS recovery strategies and improve coordination with Federal, State, and local conservation actions through, but not limited to, the Fisheries Restoration Grant Program.

2. Coordinate and improve communication with Federal, State, and local agencies regarding joint management responsibilities as well as overlapping responsibilities such as water supply management and allocations, and competing species' needs.

3. Provide technical information about steelhead life-history and steelhead population and DPS viability criteria to Federal, State, regional planning organizations, local governments, special districts, and non-governmental organizations to incorporate into their project designs, operational plans, general land use and watershed plans, local coastal programs, *etc*.

4. Promote NMFS' student internship program or other types of student appointments, to recruit individuals with desired backgrounds, education, and training that would assist NMFS in achieving the tasks described herein.

VII. NMFS PRE-PLANNING DECISIONS

A. Product

Recovery Plan for the South-Central California Coast Steelhead DPS.

B. Scope of Recovery Effort

Species_X___ Recovery Unit____ Multi-Species____ Ecosystem____

C. Recovery Plan Preparation

NMFS, SWR Protected Resources Division has initiated the preparation of a draft recovery plan for the South-Central California Coast Steelhead DPS, using the most recent Recovery Planning Guidance from NMFS (2006), and the NMFS TRT Technical Memoranda and other reports. Primary authorship of the Recovery Plan will be the responsibility of NMFS staff. Outreach by NMFS to Federal, State, local, and private partners will be central to the recovery effort, as well as engaging with other interested parties through participation in public workshops, public review, and peer review.

D. Administrative Record

The administrative record will be housed in the Long Beach office.

E. Schedule and Responsibilities for Recovery Plan development for South-Central California Coast Steelhead DPS

Summer 2005
- Issued "Contraction of the Southern Range Limit for Anadromous *Oncorhynchus mykiss*" NMFS-SWFSC-Technical Memorandum-380

Spring 2006
- Issued Draft "Steelhead of the South-Central/Southern California Coast: Population Characterization for Recovery Planning" (NMFS-SWF Science Center)

Summer 2006

- Issued "Potential Steelhead Over-Summering Habitat in the South-Central California Coast Recovery Domain: Maps Based on the Envelope Method" NMFS-SWFSC Technical Memorandum-391
- Published Notice of Intent to Prepare a Recovery Plan
- Developed Salmon and Steelhead Recovery Planning Brochure
- Initiated public outreach efforts and recovery planning website

Fall 2006

- Issued "Steelhead of the South-Central/Southern California Coast: Population Characterization for Recovery Planning" NMFS-SWFSC Technical Memorandum-394

Spring 2007

- Hosted initial series of public involvement workshops, focused on threats to steelhead
- Hosted 2nd series of public involvement workshops, focused on steelhead recovery actions
- Issued Draft "Viability Criteria for Steelhead of the South-Central/Southern California Coast" (NMFS-SWF Science Center)
- Continued posting products on website

Summer 2007

- Issued "Viability Criteria for Steelhead of the South-Central/Southern California Coast" NMFS-SWFSC Technical Memorandum-407

Fall 2007

- Issued Recovery Outline

Spring 2008

- Issue Draft Recovery Plan
- Host 3rd series of public workshops, focused on Draft Recovery Plan
- Revise Draft Recovery Plan

Fall 2008

- Finalize Recovery Plan
- Initiate outreach to initiate Recovery Plan implementation

F. Public Outreach and Stakeholder Participation

Because plans will have a greater likelihood of success if they are developed in partnership with entities that have the responsibility and authority to implement recovery actions, NMFS has initiated a series of pubic workshops to ensure effective communication and interaction with the public, stakeholders, and agencies throughout the recovery planning and implementation process. NMFS conducted a series of four workshops in the Spring of 2007 to elicit public input on threats and recovery actions for the South-Central California Coast Steelhead DPS. At least two additional workshops will be held on the draft recovery plan in 2008. To foster public understanding of the recovery planning process, NMFS has also developed informational materials, and established a recovery website for the steelhead/salmon recovery planning domains within the Southwest Region: http://swr.nmfs.noaa.gov/recovery/index.

G. Initiated and Anticipated Recovery Planning Actions

1. NMFS appointed a TRT for the South-Central/Southern California Coast Steelhead Recovery Planning Domain comprised of scientists tasked with development of population characterization, viability criteria, and research and monitoring needs for the two DPSs within the South-Central/Southern California Coast Steelhead Recovery Planning Domain. The final TRT products are expected in the Winter/Spring of 2008.

2. NMFS Protected Resources Division (PRD) staff has developed a strategy for development of steelhead recovery plans in accordance with the most recent Federal guidelines to include inter- and intra-agency coordination and collaboration on regulatory functions, public input, and plan development.

3. NMFS PRD has begun to coordinate with NMFS Habitat Conservation Division, Sustainable Fisheries Division, NOAA Restoration Center, Southwest Fisheries Science Center, and other NOAA cooperators to ensure consistency and effectiveness in the recovery plan development.

4. NMFS has begun outreach efforts to ensure effective public participation in the process. Outreach will consist of website updates on the recovery planning process, public meetings, development of educational materials and public input on the draft recovery plan.

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IX. FEDERAL REGISTER NOTICES CITED

55 FR 24296. 1990. Endangered and Threatened Species: Listing and Recovery Priority Guidelines.

62 FR 43937. 1997. Final Rule: Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead.

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70 FR 52488. 2005. Final Rule: Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California.

71 FR 834. 2006. Final Rule: Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead.

Appendix A

Designated critical habitat for the South-Central California Coast Steelhead DPS includes habitat areas within the following occupied watersheds (70 CFR 52488):

Pajaro River Hydrologic Unit (#3305): Watsonville Hydrologic Sub-area (#330510): Pajaro River, Browns Creek, Casserly Creek, Corralitos Creek, Gaffey Creek, Gamecock Canyon, Green Valley Creek, Ramsey Gulch, Redwood Canyon, Salsipuedes Creek, Shingle Mill Gulch. Santa Cruz Mountains Hydrologic Sub-area (#330520): Pajaro River, Bodfish Creek, Pescadero Creek, Tar Creek, Uvas Creek, Blackhawk Canyon, Little Arthur Creek, Pescadero Creek. South Santa Clara Valley Hydrologic Sub-area (#330530): San Benito River, Pajaro River, Arroyo Dos Picachos, Bodfish Creek, Carnadero Creek, Llagas Creek Miller Canal, Pacheco Creek, San Felipe Lake, Tar Creek, Tequisquita Slough, Uvas Creek. Pacheco-Santa Ana Creek Hydrologic Sub-area (#330540): Arroyo Dos Picachos, Pacheco Creek, Arroyo Dos Picachos, Cedar Creek, North Fork Pacheco Creek, Pacheco Creek, South Fork Pacheco Creek. San Benito River Hydrologic Sub-area (#330550): San Benito River, Bird Creek, Pescadero Creek, San Benito River, Sawmill Creek.

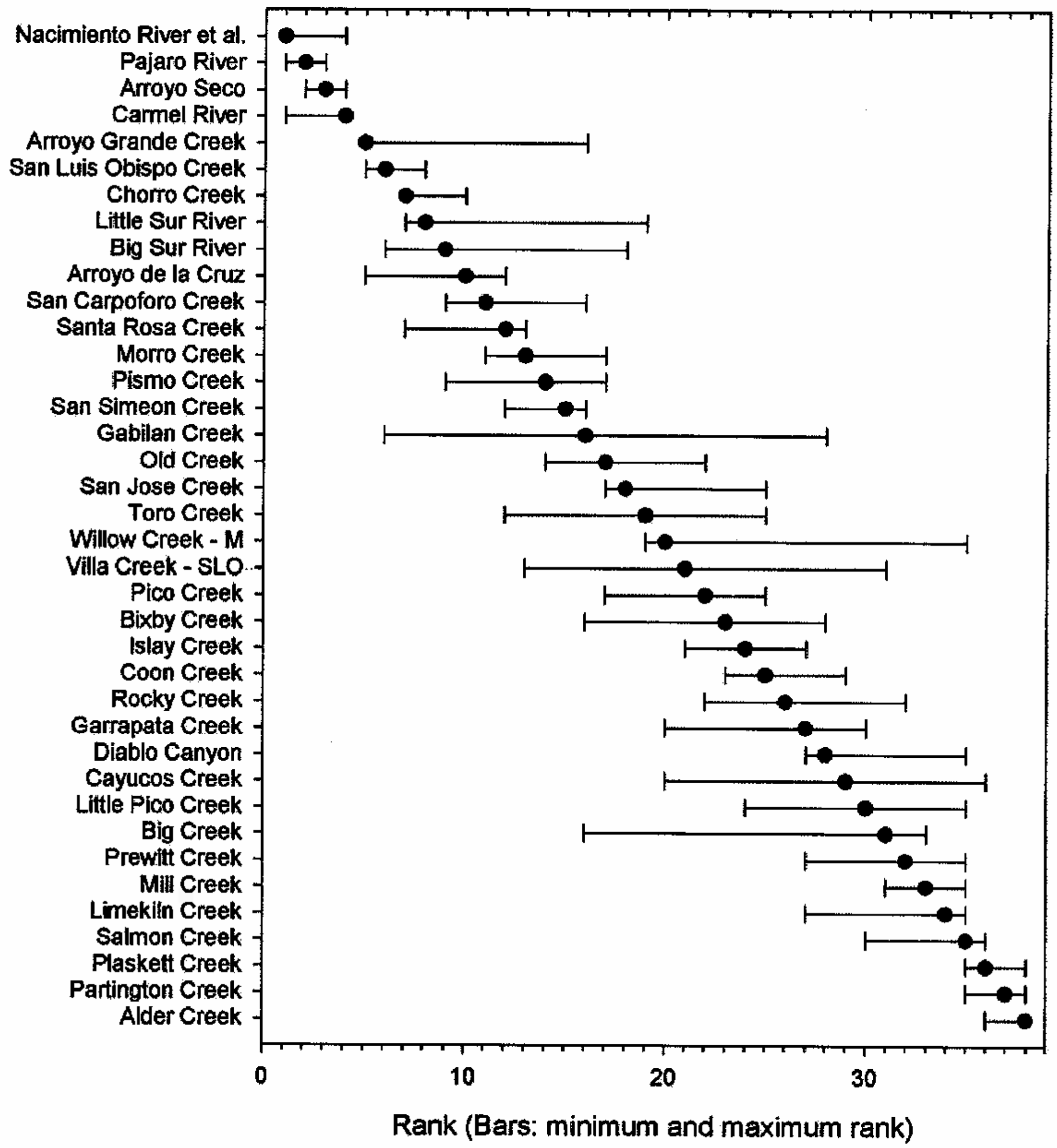
Carmel River Hydrologic Unit (#3307): Carmel River Hydrologic Sub-area (#330700): Carmel River, Aqua Mojo Creek, Big Creek, Blue Creek, Boronda Creek, Bruce Fork, Cachagua Creek, Carmel River, Danish Creek, Hitchcock, Creek Canyon, James Creek, Las Garzas Creek, Milles Fork, Pinch Creek, Pine Creek, Potrero Creek, Ran Creek, Rattlesnake Creek, Roberson Canyon, Robertson Creek, San Clemente Creek, Tularcitoas Creek, Ventana Mesa Creek.

Santa Lucia Hydrologic Unit (#3308): Santa Lucia Hydrologic Sub-area (#330800): Alder Creek, Big Creek, Big Sur River, Bixby Creek, Limekiln Creek, Little Sur River, Malpaso Creek, Mill Creek, Partington Creek, Plaskett Creek, Prewitt Creek, Rocky Creek, Salmon Creek, San Jose Creek, Vicente Creek, Vila Creek, Willow Creek, Big Creek, Devil's Canyon Creek, Garrapata Creek, Joshua Creek, North Fork Big Sur River, Redwood Creek, Rocky Creek, San Jose Creek, South Fork Little Sur River, Wildcat Canyon Creek, Williams Canyon Creek.

Salinas River Hydrologic Unit (#3309): Neponset Hydrologic Sub-area (#330911): Salinas River, Gabilan Creek, Old Salinas River, Tembladero Slough. Chualar Hydrologic Sub-area (#330920): Gabilan Creek. Soledad Hydrologic Sub-area (#330930): Salinas River, Arroyo Seco River, Reliz Creek; Upper Salinas Valley Hydrologic Sub-area (#330940): Salinas River. Arroyo Seco Hydrologic Sub-area (#330960): Arroyo Seco River, Reliz Creek, Vasqueros Creek, Arroyo Seco River, Calaboose Creek, Church Creek Horse Creek, Paloma Creek, Piney Creek, Reliz Creek, Rocky Creek, Santa Lucia Creek, Tassajara Creek, Vaqueros Creek, Willow Creek. Gabilan Range Hydrologic Sub-area (#330970): Gabilan Creek. Paso Robles Hydrologic Sub-area (#330981): Salinas River, Atascadero Creek, Graves Creek, Jack Creek, Nacimiento River, Paso Robles Creek, Salinas River, San Antonio River, San Marcos Creek, Santa Margarita Creek, Santa Rita Creek, Sheepcamp Creek, Summit Creek, Tassajera Creek, Trout Creek, Willow Creek.

Estero Bay Hydrologic Unit (#331010): San Carpoforo Hydrologic Sub-area (#331011): San Carpoforo Creek, Dutra Creek, Estrada Creek, San Carpoforo Creek, Unnamed tributary, Wagner Creek. Arroyo De La Cruz Hydrologic Sub-area (#331012): Arroyo De La Cruz Creek, Burnett Creek, Green Canyon Creek, Marmolejo Creek, Spanish Cabin Creek, Unnamed Tributary, West Fork Burnett Creek. San Simeon Hydrologic Sub-area (#331013): Arroyo del Corral, Arroyo del Puerto, Little Pico Creek, Oak Knoll Creek, Pico Creek, San Simeon Creek, Arroyo Laguna, North Fork Pico Creek, South Fork Pico Creek, Steiner Creek, Unnamed Tributaries, Van Gordon Creek. Santa Rosa Hydrologic Sub-area (#331014): Santa Rosa Creek, Green Valley Creek, Perry Creek, Santa Rosa Creek, Unnamed Tributaries. Villa Hydrologic Sub-area (#331015): Villa Creek, Unnamed Tributaries. Cayucos Hydrologic Sub-area (#331016): Cayucos Creek, Unnamed tributaries. Old Hydrologic Sub-area (#331017): Old Creek. Toro Hydrologic Sub-area (#331018): Toro Creek, Unnamed Tributary. Morro Hydrologic Sub-area (#331021): Morro Creek, East Fork Morro Creek, Little Morro Creek, Unnamed Tributaries. Chorro Hydrologic Sub-area (#331022): Chorro Creek, Dairy Creek, Pennington Creek, San Bernardo Creek, San Luisito, Unnamed Tributary. Los Osos Hydrologic Sub-area (#331023): Los Osos Creek; San Luis Obispo Creek, Brizziolari Creek, Froom Creek, Perfumo Creek, See Canyon Creek, Stenner Creek, Unnamed Tributary. Point San Luis Hydrologic Sub-area (#331025): Coon Creek, Islay Creek, Unnamed Tributaries. Pismo Hydrologic Sub-area (#331026): Pismo Creek East Corral de Piedra Creek, Unnamed Tributary. Oceano Hydrologic Sub-area (#331031): Arroyo Grande Creek, Los Burros Creek.

Appendix B



Basin-ranking in the South-Central California Coast Steelhead DPS.[1] The ranking is based on the amount of potential habitat as in indicator for potential viability. (See Boughton *et al.* 2006)

[1] Category 1 Basins are basins which experience regular winter flows to the ocean and therefore provide access to freshwater spawning areas. Category 2 Basins (all large basins within the southern portion of the Southern California Steelhead DPS, and the Santa Maria River) experience irregular winter flows to the ocean, even in an unimpaired state. Bars indicate the range of ranks (minimum and maximum) for 48 variant models (Boughton *et al.* 2006).

Appendix C

Biogeographic Group	Member Populations (ordered north to south)
Interior Coast Range	**Pajaro River, Gabilan Creek, Arroyo Seco, Southwest Salinas Basin (San Antonio and Nacimiento Rivers).**
Carmel Basin	**Carmel River.**
Big Sur Coast[1]	**San Jose Creek, Malpaso Creek, Garrapata Creek, Rocky Creek, Bixby Creek, Little Sur River, Big Sur River, Partington Creek, Big Creek, Vicente Creek, Limekiln Creek, Mill Creek, Prewitt Creek, Plaskett Creek, Willow Creek (Monterey Co.), Alder Creek, Villa Creek (Monterey Co.), Salmon Creek.**
San Luis Obispo Terrace	**San Carpoforo Creek, Arroyo de la Cruz, Little Pico Creek, Pico Creek, San Simeon Creek, Santa Rosa Creek, Villa Creek (SLO Co.), Cayucos Creek, Old Creek, Toro Creek, Morro Creek, Chorro Creek, Los Osos Creek, Islay Creek, Coon Creek, Diablo Canyon, San Luis Obispo Creek, Pismo Creek, Arroyo Grande Creek.**

Composition of South-Central California Coast Steelhead Biogeographic Population Groups (See Boughton *et al.* 2006)

[1] Population delineation in these groups may be split too finely if there is significant dispersal of fish among neighboring coastal basins. For discussion see Boughton *et al.* (2006).