2007 Federal Recovery Outline for the Distinct Population Segment of Southern California Coast Steelhead

San Juan Creek, Orange County, California 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 Southern 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 the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) to 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. However, 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 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 of the listed species 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 endangered Southern 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 in 2008.

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

I. INTRODUCTION

A. Southern California Coast Steelhead Recovery Planning Area

The Southern California Coast Steelhead DPS extends from the Santa Maria River south to the Tijuana River at the U.S.-Mexican border 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 by the San Rafael, Santa Ynez, Topatopa, and Santa Monica Mountains in the north, and the Santa Susana, San Gabriel, San Bernardino, San Jacinto, and Santa Ana Mountains in the south. The Southern California Coast Steelhead Recovery Planning Area is encompassed within 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 mountain ranges immediately adjacent to the coast (*e.g.*, Santa Ynez, Santa Monica, Santa Ana mountains), and those containing larger inland river systems (*e.g.*, Santa Maria, Santa Ynez, Ventura, Santa Clara, San Gabriel, Santa Ana, and San Diego Rivers) that extend inland through gaps in the coastal ranges (Holland 2001; Jacobs 1993; Kreissman 1991).

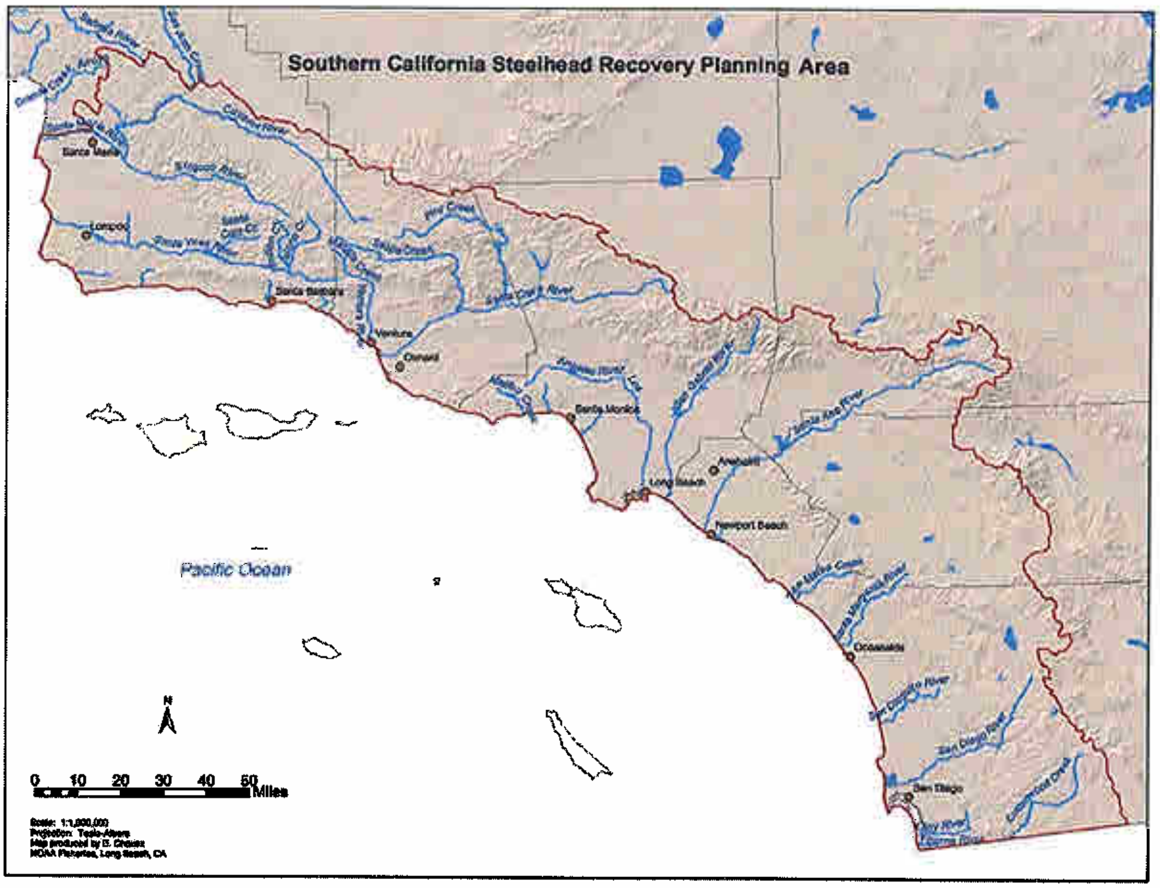

Figure 1. Southern California Coast Steelhead Recovery Planning Area.

The major steelhead watersheds in the Southern California Coast Steelhead Recovery Planning Area (which encompasses all portions of coastal drainages occupied by *O. mykiss* in an unimpaired state) include the Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers in the northern portion of the recovery planning area (Busby *et al.* 1996, 1997; Good *et al.* 2005). South of the Los Angeles Basin, several major drainages and a number of smaller streams once supported runs of steelhead (of unknown size and frequency); these include the Los Angeles, San Gabriel, Santa Ana, Santa Margarita, San Luis Rey, San Dieguito, San Diego, Sweetwater Rivers, and San Juan and San Mateo Creeks (Swift *et al.* 1993; Titus *et al.* 2006).

The Southern California Coast Steelhead Recovery Planning Area is characterized by geologically young mountainous topography with a number of inland valleys and coastal plains. The geomorphology is strongly influenced by tectonic activity, with highly folded and faulted rocks of varying types, including metamorphic formations in the Central Coast Ranges, sedimentary formations in the Transverse Ranges, and metamorphic-granitc formations in the southern Peninsular Ranges. 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; 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 California Steelhead Recovery Planning Area are contained within four national forests (Los Padres, Angeles, Cleveland, and San Bernardino National Forests). These forests are managed primarily for water production and recreation (with limited grazing and oil, gas, and mineral production). Urban development is centered in coastal areas and inland valleys, with the most expansive and densest urban development located within the Los Angeles Basin. Coastal valleys, and some foothills, are extensively developed with agriculture, principally row-crops, citrus and fruit trees, and 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 Southern 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 Southern California Conifer Forests. (Barbour, *et al.* 2007; Ferren *et al.* 1995; Hickman 1993; Munz 1974; Sawyer and Keeler-Wolf 1995). The upland areas of the northern portion of the Southern California Coast Steelhead Recovery Planning Area are dominated by a mix of Chaparral, Valley Grasslands, Oak Woodlands, and Southern California Conifer Forests. The upland areas of the southern portion of the Southern California Coast Steelhead Planning Area are dominated by Southern Coastal Scrub, Valley Grassland, Oak Woodland, and Southern California Conifer Forests. Both of these upland areas are subject to catastrophic wildfires (Sugihara, N. G. *et al.* 2006). Riparian forests consist of deciduous species. Much of the Valley Grasslands and floodplain Riparian Forests have been converted to agricultural, residential, and a variety of commercial land-uses (Barbour *et al.* 2007; 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 four National Forests are largely undeveloped, and a number of large parks, preserves, and greenbelts have been created in recent years on non-Federal lands.

The climate in the California 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), though the extreme southern portion of the Southern California Coast Steelhead Recovery Planning Area is subject to occasional summer storms originating from the Gulf of California. The California floristic province is subject to an El Niño/La Niña weather cycle which can significantly affect winter precipitation, causing highly variable rainfall between years. Additionally, there is a wide disparity between winter rainfall from north to south, as well as between coastal plains and inland mountainous areas. Annual precipitation ranges along the coast (north to south) from 32 – 24 centimeters (cm), with larger variations (24 – 90 cm) due to the 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 (Bailey 1966; Barbour *et al.* 2007; Felton 1965; Hornbeck 183; 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 river reaches can be influenced significantly by groundwater stored and transported through faults and fractured rock formations. Many rivers and streams naturally exhibit interrupted base flow patterns (alternating channel reaches with surface and no surface flow) controlled by geologic formations, and the strongly seasonal precipitation pattern characteristic of a Mediterranean climate. 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: Southern California Coast Steelhead (*Oncorhynchus mykiss*)

C. Listing Status: Endangered

D. Dates Listed: August 18, 1997 (62 FR 43937); Southern Range Extension, May 1, 2002 (67 FR 21586); 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 Southern California Coast Steelhead DPS includes all naturally spawned anadromous populations of *O. mykiss* in coastal river basins from the Santa Maria River in Santa Barbara County southward to the U.S.-Mexican Border. Major inland watersheds occupied by naturally spawning fish in this DPS include the Santa Maria, Santa Ynez, Ventura, and Santa Clara River systems. Several small coastal streams in Santa Barbara, Ventura and northern Los Angeles County also currently support naturally spawning steelhead, as do as do at least three watersheds (San Juan Creek, San Luis Rey, and San Mateo Creek) in southern Orange County and northern San Diego County. These southernmost populations are disjunct in distribution and are separated from the northernmost populations by approximately 80 miles (128 km). (62 FR 43937; 67 FR 21586; 71 FR 834)

See Tables 1 and 2 for data on historic and current steelhead occupancy of watersheds.

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

	Extant		Extant
Santa Maria River	Y	Arroyo Paredon	Y
Santa Ynez River	Y	Carpinteria Salt Marsh Complex	Barrier
Jalama Creek	Negative obs.[2]	Carpinteria Creek	Y
Cañada de Santa Anita	Y	Rincon Creek	Y
Cañada de la Gaviota	Y	Ventura River	Y
Cañada San Onofre	Negative obs.	Santa Clara River	Y
Arroyo Hondo	Y	Big Sycamore Canyon	Negative obs.
Arroyo Quemado	Barrier[2]	Arroyo Sequit	Y
Tajiguas Creek	Barrier	Malibu Creek	Y
Cañada del Refugio	Negative obs.	Topanga Canyon	Y
Cañada del Venadito	Barrier	Los Angeles River	Y
Cañada del Corral	Y	San Gabriel River	Y
Cañada del Capitan	Negative obs.	Santa Ana River	Barrier
Gato Canyon	Not determined	San Juan Creek	Y
Dos Pueblos Canyon	Y	San Mateo Creek	Y
Eagle Canyon	Not determined	San Onofre Creek	Dry[2]
Tecolote Creek	Y	Santa Margarita River	Negative obs.
Bell Canyon	Barrier	San Luis Rey River	Y
Goleta Slough Complex	Y	San Dieguito River	Y
Arroyo Burro	Y	Sweetwater River	Y
Mission Creek	Y	Otay River	Barrier
Montecito Creek	Y	Tijuana River	Not determined
Oak Creek	Barrier		
San Ysidro Creek	Y		
Romero Creek	Y		

[1] Historical data: Becker, *et al.* 2007; Titus *et al.* (2006); Sleeper (2002). Recent data: Boughton *et al.* (2005); M. Larson, California Department of Fish and Game, personal communication (2007).

[2] "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. "Barrier" indicates that all over-summering habitat was determined to be above an anthropogenic barrier, believed to be impassable. See Boughton *et al.* (2005).

Table 2. Southern California Coastal basins with no evidence[1] of historical or extant populations of *O. mykiss* in anadromous waters (N to S).

Shuman Canyon	Sycamore Creek	Corral Canyon	Cañada de Segunda
Honda Creek	Toro Canyon Creek	Trancas Canyon	Deshecha
Wood Canyon	Los Sauces Canyon	Escondido Canyon	Las Pulgas Canyon
Damsite Canyon	Hall Canyon	Ramirez Canyon	Loma Alta Creek
Cañada del Cojo	Arundell Barranca	Zuma Canyon	Buena Vista Creek
Barranca Honda	Calleguas Creek	Ballona Creek	Agua Hedionda Creek
Cañada de la Llegua	La Jolla Canyon	Dominquez Channel	Canyon de las
Arroyo San Augustin	Little Sycamore	San Diego Creek	Encincas
Arroyo El Bulito	Canyon	Los Trancos Canyon	San Marcos Creek
Cañada del Agua	Carbon Canyon	Muddy Canyon	Escondido Creek
Cañada de la Cuarta	Las Flores Canyon	Moro Canyon	San Dieguito River
Cañada de Alegria	Piedra Gorda Canyon	Emerald Canyon	Los Penasquitos Creek
Agua Calinete	Tuna Canyon	Laguna Canyon	Rose Canyon
Cañada del Molino	Santa Ynez Canyon	Aliso Creek	Tecolote Creek
Las Llagas Canyon	Santa Monica Canyon	Salt Creek	Chollas Creek
Las Varas Canyon	Solstice Canyon		Telegraph Canyon

[1] No evidence of occurrence does not imply evidence of no occurrence; the latter would require a "negative observation;" *i.e.* evidence that the species was looked for but not found. No evidence therefore means that no information of occurrence of *O. mykiss* is currently available, or has been collected for these basins.

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 Southern California Coast Steelhead DPS was issued on September 2, 2005 (70 FR 52488). There are 32 occupied watersheds within this DPS, of which 708 miles of stream habitat were designated as critical habitat. See Appendix A for a tabulation of the designated rivers and streams.

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; 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 sea where they reach maturity before returning to reproduce, generally to their natal stream. Within this basic life-history pattern steelhead exhibit a greater variation in the time and location spent at each life-history 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 (redd) in 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, where 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. Steelhead do not necessarily die after spawning and may return to the ocean, sometimes repeating their spawning migration one or more times. 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*. Populations of 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.

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-history 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 switching in *O. mykiss* populations in Oregon. The steelhead in the Southern 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 southern 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 freshwater habitats of the stream system. Larger size enhances survival in the ocean, and the lagoon-reared fish represented a large majority of the returning 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. A graphic overview of this life-history cycle diversity, along with some of the specialized terminology, is given in Figure 2.

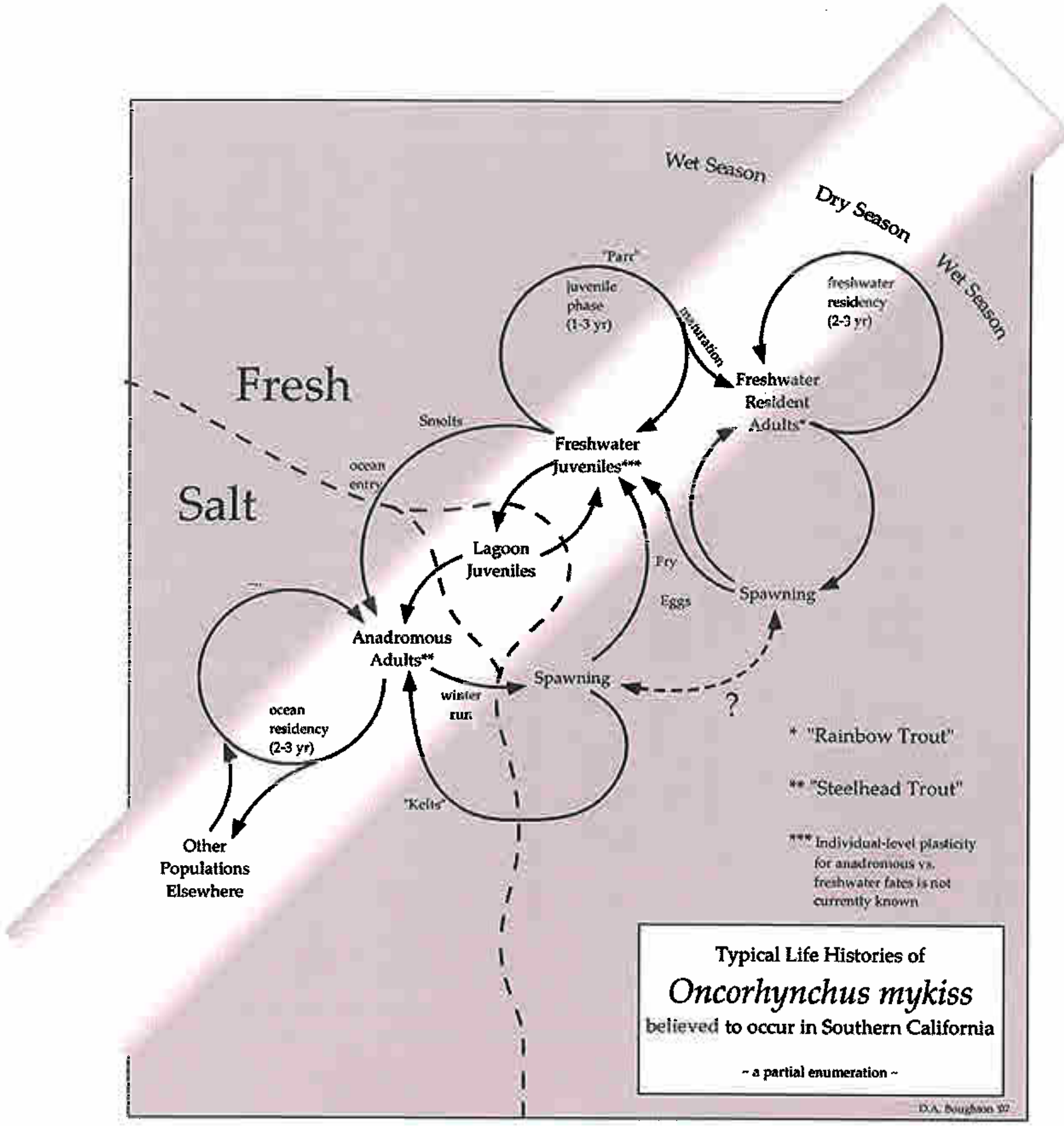

Figure 2. A synopsis of life-history cycle trajectories believed to occur in the Southern California Coast Steelhead Recovery Planning Area. (from Boughton *et al.* 2006).

D. Species Status

The Southern California Coast Steelhead DPS is at the southern limit of the anadromous form of *O. mykiss* in North America. The status of the Southern California Coast Steelhead DPS populations was originally 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.

Quantitative historical information on the Southern California Coast Steelhead DPS is based largely on observations made by California Department of Fish and Game (CDFG) personnel. No long term (20+ years) time-series data are available for any of the populations within this DPS. However, it is estimated that the steelhead populations within the Southern California Coast Steelhead DPS have declined dramatically from annual runs totaling 32,000-46,000 adults to less than 500 returning adult fish. This run-size estimate is based on and includes only four of the major steelhead-bearing watersheds (Santa Ynez River, Ventura River, Santa Clara River, and Malibu Creek) located in the northern portion of the Southern California Coast Steelhead DPS; run-size estimates from coastal and inland watersheds south of the Los Angeles Basin have generally not be recorded or estimated. Additionally, available run-size estimates represent only average annual estimates, and not the wide annual variation in run-size that would be expected in a region with a highly variable climate and related habitat conditions.

The original BRT noted extensive loss of the anadromous form of *O. mykiss* populations, especially south of Malibu Creek, Los Angeles County, due to urbanization, dewatering, channelization of creeks, man-made barriers to migration, and the introduction of exotic fish and riparian plants (Busby *et al.* 1996). Many of these southernmost watersheds may have originally supported irregular anadromous runs or intermittent resident populations, experiencing repeated local extinctions and recolonizations in dry and wet cycles, respectively. The relationship between anadromous and resident *O. mykiss* is poorly understood, but in the Southern California Coast Steelhead Recovery Planning Area likely plays an important role in population dynamics and the evolutionary potential of the species by contributing to the emigrating smolt population and recolonizing temporarily extirpated anadromous runs of steelhead (Boughton *et al.* 2006, 2007). Subsequent to the original listing of Southern California steelhead as endangered in 1997, two small populations of steelhead were documented south of Malibu Creek (Topanga and San Mateo Creek) and included in the southern range extension in 2002, thus extending the range to include all steelhead found in drainages south to the U.S.-Mexican border (67 FR 21586).

The BRT concluded that the Southern California Coast Steelhead DPS populations were in danger of extinction, noting that populations were extirpated from a significant portion of their historical range. The BRT expressed concern about the widespread degradation, destruction, and blockage of freshwater habitats by dams, diversions, road crossings, and the stocking of hatchery reared species. Additionally the BRT identified two major areas of uncertainty: 1) lack of quantitative data on past and current annual run sizes, and 2) the relationship between the anadromous and resident forms of *O. mykiss* within the Southern California Coast Steelhead Recovery Planning Area (Busby *et al.* 1996).

A second BRT convened in 1997 to update the status review for west coast steelhead found that the small amount of new data did not suggest that the situation had improved and concluded that the Southern California Coast Steelhead DPS was still in danger of extinction (Busby, *et al.* 1997).

An extensive steelhead survey in 2002 of most of the coastal drainages within the Southern California Coast Steelhead DPS was made by NMFS staff (Boughton and Fish 2003). Of the 46 drainages in which steelhead were known to have occurred historically, *O. mykiss* (either resident or anadromous) still occupied between 37% and 43%. (The range of the occupancy estimate occurred because several basins could not be surveyed.) Three basins were considered vacant because they were dry, 17 were considered vacant due to impassible barriers below all known spawning habitat, and 6 were considered vacant because the snorkel survey found no evidence of *O. mykiss*. Occupancy was also determined for 17 basins with no known historical record of steelhead occurrence; none were found to be currently occupied during the 2002 survey. The distributional study of 2002 determined that steelhead were present in two systems previously reported by Nehlsen *et al.* (1991) as extinct (Gaviota Creek and San Mateo Creek).

An updated status review completed by the BRT in 2005 reiterated the same conclusions reached from the previous status review: the Southern California Coast Steelhead DPS "was in danger of extinction" (Good *et al.* 2005). This determination was based in part on the extirpation of populations through a significant portion of their historical range, and the blockage of access to and degradation of freshwater habitats. The current distribution of steelhead among the region's basins appears to be substantially less than what occurred historically, particularly in the southern range extension (Boughton and Fish 2003; Boughton *et al.* 2005). As noted, populations from over half of the 46 watersheds historically supporting steelhead runs are believed to have been extirpated. All of the four largest watersheds (Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers) in the northern portion of the Southern California Coast Steelhead DPS have experienced declines in run-sizes of 90% or more.

In addition to the small populations identified in Topanga and San Mateo Creek since the original listing in 1997, two additional observations of adult steelhead have been made in the area of the southern range extension by California Department of Fish and Game Personnel: San Juan Creek and San Luis Rey River, in Orange and San Diego Counties, respectively (M. Larson, California Department of Fish and Game, personnel communication 2007). Present population trends within individual watersheds continuing to support anadromous runs is unknown, but may vary widely between watersheds, and are likely declining in a majority of the watersheds within the Southern California Steelhead Coast DPS because of continuing deteriorating habitat conditions, as well as natural stochastic physical and biological processes.

E. Historical Demographic and Genetic Structure

NMFS Technical Recovery Team (TRT) described the historical populations of the Southern 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 five Biogeographic Population Groups for the Southern

California Coast Steelhead DPS: Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast (Figure 3).

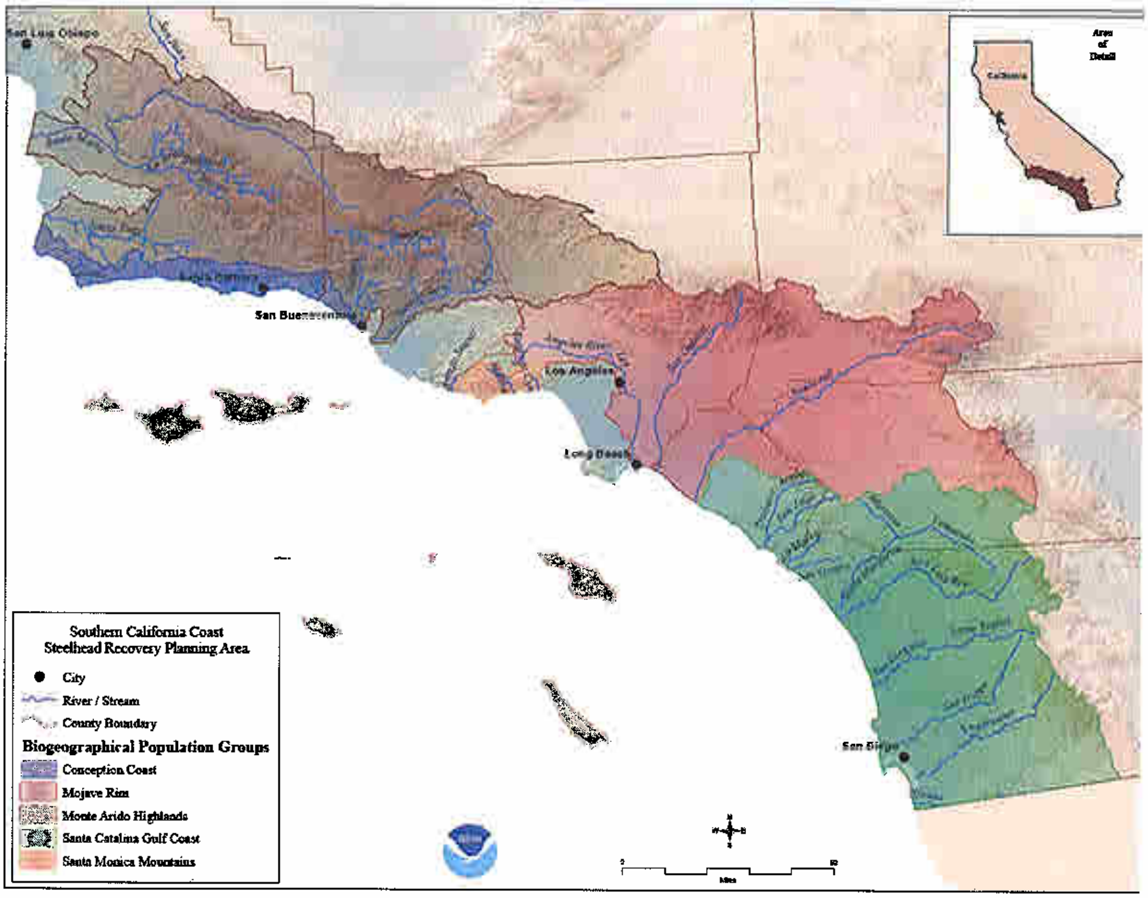

Figure 3. Biogeographic Population Groups in the Southern California Coast Steelhead Recovery Planning Area (after Boughton *et al.* 2007).

In characterizing the unimpaired population structure of the Southern California Coast Steelhead Recovery Planning Area, 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.)

Because of the lack of sufficient run-size information for any of the steelhead populations within the Southern 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 Southern 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 Southern 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) reported a large-scale study of 51 allozyme loci in 113 populations, including 22 from California, four of which were from the Southern California Coast Steelhead Recovery Planning Area. A high level of genetic variability was found in the California coastal populations. Busby *et al.* (1996) 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 Southern California Coast Steelhead Recovery Planning Area.

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 and lowest among the hatchery trout (however, this result may be an artifact of the small number of anadromous fish sampled). 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 a 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.

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. Listing factors deal with those aspects of the species' biology or habitat which affect 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 substantial 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 steelhead 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 loss of over 90% of its estuarine wetland habitat (Dahl 1990; Ferren *et al.* 1995).

NMFS staff has identified eight principal threats which have contributed to the destruction, modification or curtailment of the habitat or range of the endangered *O. mykiss* populations in the Southern California Steelhead Coast DPS. The threats contributing to decline of *O. mykiss* populations are associated with most of the larger river systems: *e.g.*, Santa Maria, Santa Ynez, Ventura, Santa Clara, Los Angeles, San Gabriel, Santa Ana, Santa Margarita, San Luis Rey, San Dieguito, and San Diego Rivers, and many also apply to the smaller coastal systems such as Malibu, San Juan and San Mateo Creeks. These threats, along with a short explanation of why each is a principal factor 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.

- **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 in southern California. The Sisquoc River, tributary to the Santa Maria River, and Sespe Creek on the Santa Clara River are two of the very few undammed major tributaries in southern California.

- **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 in some cases sustain over-summering habitat for juvenile steelhead in mainstem habitats.

    - Agricultural, industrial, (including aggregate extraction), and residential developments have encroached upon, fragmented, degraded or eliminated riparian habitat along most of the major southern California 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.

- **Sedimentation:**

    - Road construction, residential development, 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.

- **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 southern California streams, particularly mainstems.

    - Urban and rural waste discharges have altered naturally seasonal changes in flow patterns, 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 reduced growth rates, and increased habitats for non-native aquatic species which compete with native species, including juvenile steelhead.

- **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. Additionally, invasive invertebrates, such as New Zealand mud snail, have been recently introduced and pose a potential threat to benthic habitat and associated native species.

    - Invasive plants such as Giant reed *(Arundo donax)* and Tamarisk ((*Tamarix* spp.) have heavily infested many major watersheds. These plant species displaces 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.

- **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 and U.S. Interstate 5). Over 90% of the coastal estuarine acreage of southern 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.

- **Stocking of Hatchery Reared Salmonids and Other Game Fishes:**

  - Stocking of non-native strains of trout (and other game species such as small mouth bass, bullhead catfish, and carp) is widespread. Non-native species compete with native juvenile steelhead for living space, cover, and food, as well as serve as vectors for infectious diseases.

  - Stocking of non-native strains of trout has also led to reliance on hatchery cultured and reared fish to support put-and-take fisheries as a substitute for the maintenance of natural, eco-systems which support self-sustaining native fish stocks.

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 summer low 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.

Until the listing of the Southern California Coast Steelhead DPS as endangered, recreational angling for *O. mykiss* was permitted in all coastal drainages (and continues in areas above currently impassible barriers such as major dams). Angling for both adults and juveniles in those portions of coastal rivers and streams accessible to anadromous runs from the ocean (with the notable exceptions of Sisquoc, Manzana, and Davy Brown Creeks in Santa Barbara County, and upper portions of Sespe Creek in Ventura County) has been eliminated through modification of the CDFG's angling regulations following the listing of Southern California steelhead as endangered in 1997.

Sport and commercial harvest of steelhead in the ocean is prohibited by the California Department of Fish and Game (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. Site specific information on the role of disease and predation impacts on steelhead is not generally available for the Southern 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 Southern California Coast Steelhead DPS (NMFS 1996b, 1997).

- Four U.S. National Forests in southern California (Los Padres, Angeles, San Bernardino, and Cleveland) are 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. COE's 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 southern California, 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 Clean Water Act (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) standards 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 may be unknown for many years.

Non-Federal Efforts

The following summarizes the principal State regulatory and planning mechanisms affecting the conservation of steelhead populations within the Southern California Coast Steelhead 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 individual salmon and steelhead stocks, this policy directs CDFG to evaluate the stocks of 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.

- CDFG 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 (SWRCB) 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 requirement 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

Climatic changes 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 sources of 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 Southern 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 Southern 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).

Assessment of protective efforts are required when making listing decisions 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 Southern California Coast Steelhead DPS were evaluated in 1997 with the original listing (62 FR 43937), at the time of the Southern Range extension in 2002 (67 FR 21586), 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 (streambed 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 Santa Clara River Watershed Management and Enhancement 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 Southern California Coast Steelhead DPS.

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 Southern 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 endangered Southern 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 the Southern California Coast Steelhead DPS as endangered 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 have contributed to the conservation of steelhead within the Southern California Coast Steelhead DPS by eliminating or reducing threats outlined in the previous section.

NMFS has addressed Southern California Coast Steelhead DPS needs through Biological Opinions, participation in Habitat Conservation Planning, and interagency coordination on major restoration efforts such as the Matilija and Rindge Dam removal projects. 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 the Southern California Coast Steelhead DPS include (NMFS 2006b, 2006c):

- Fishery Restoration Grant Program
- Development and implementation of EPA Total Maximum Daily Loads Programs
- State Steelhead Restoration and Management Plan for California
- CalFish and California Fish Passage Forum
- Modifications to CDFG resident trout Hatchery and Stocking Programs
- Draft CDFG/NMFS Coast-Wide Salmon and Steelhead Monitoring Plan
- Tri-County Fish Team (San Luis Obispo, Santa Barbara, and Ventura Counties)

V. PRELIMNARY RECOVERY STRATEGY

A. Recovery Priority Number 3

Ranking for the Southern 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 complete an updated status review in 2005 reiterated the same conclusions reached from the previous status reviews: the Southern California Coast Steelhead DPS "was in danger of extinction". This determination was based in part on the extirpation of populations through a significant portion of their historical range, and the blockage and degradation of freshwater habitats. 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.

B. Recovery Vision Statement

Recovery of the endangered Southern 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 five Biogeographic Regions to conserve the natural diversity (genetic, phenotypic, and behavioral), spatial distribution, and redundancy of the populations, and thus the long-term viability of the DPS as a whole. (See Section C, Viability Criteria for the Southern 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 threat-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 Southern 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 DPS as a whole. Additionally, the TRT identified several general recovery objectives to guide the overall recovery efforts for the Southern California Coast Steelhead DPS. The following discussion adheres to the analysis and recommendations provided by the 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 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 Southern California Coast Steelhead DPS), the approach to identifying viability criteria for recovery planning within the Southern California Coast Steelhead DPS necessarily involves identifying prescriptive criteria. Alternatively, performance-based criteria, based on quantitative information on relevant factors and accounting for uncertainty due to the prevalence of stochastic processes, are theoretically possible. 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 (mean annual 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 as more data become available using a performance-based approach.

Table 4 summarizes the standards for the performance-based approach. A performance-based approach would require a 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, broken down by Biogeographic Population Group, for sufficient representation, spatial distribution, and redundancy of viable populations within the Southern 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 condition	"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 Southern California Coast Steelhead DPS are listed under the ESA as endangered. 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 of interest. 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. 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% within 100 yrs
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 frequintist[1]
5) Must pass independent scientific peer 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	
Monte Arido Highlands	5.624	10	12	4
Conception Coast	0.327	1	2	3
Mojave Rim	3.209	6	8	3[3]
Santa Monica Mountains	0.210	1	2	3[2,3]
Santa Catalina Gulf Coast	2.563	5	7	8[2,3]

[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.

[3] Evidence is unclear whether anadromy was a consistent feature of *O. mykiss* populations in these groups. The freshwater-resident form has always been a regular feature of these populations, and anadromous life histories were at least occasionally expressed.

Many coastal basins in several of the Biogeographic Groups (*e.g.*, Conception Coast, Santa Monica Mountains) 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 Populations Groups, though small, may be exceptionally stable and thus viable, and sustain the continued presence of steelhead in neighboring watersheds via trans-basin 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 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. In the past decade steelhead have begun to be observed (in very sparse numbers) in parts of the Santa Catalina Gulf Coast area. 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 Southern 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 Southern 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 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 restoration of core populations is fundamental.

2. Secure the extant parts of the inland populations.

Inland populations comprise the Monte Arido Highlands (Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers) and Mojave Rim (Los Angeles, San Gabriel, and Santa Ana Rivers) Groups. 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, flood control practices, and urbanization. In addition, wildfire analysis suggests that they may have had marginal redundancy even before these impacts. Yet the populations of the Monte Arido Highlands appear to have produced the largest run sizes in the Southern California Coast Steelhead DPS during years of high rainfall and runoff (Boughton *et al.* 2006, Busby *et al.* 1996).

The extant habitat of these populations—especially the anadromous waters of the Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers—merit high priority for immediate protection so that fish runs do not decline further, and should be restored to viability, though this will be a long-term effort. The low level of redundancy in the inland groups indicates that ongoing efforts to restore flows and fish passage in the Ventura River are necessary steps to achieving DPS viability, as are future efforts to restore flows and passage in the Santa Ynez River, both of which have a large majority of their steelhead spawning and rearing habitat isolated by barriers to passage from the ocean. Also, additional efforts to restore flows and passage in the Santa Clara River may be necessary to achieve DPS viability, depending on the number of steelhead that can be sustained by the currently accessible parts of the system. The role of anadromy in the inland trout populations of the Mojave Rim is less clear; steelhead ascended these rivers in the past (see appendix in Boughton *et al.* 2006) but with what regularity and numbers is unknown at this time.

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; and 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 steelhead 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 Santa Ynez River is the only river with ongoing efforts to monitor steelhead run-size (though efforts have begun on the Ventura and Santa Clara Rivers, and Topanga Creek), and even these efforts provide only partial counts. However, annual estimates of run-size are the single most useful dataset for assessing progress toward recovery. In addition, such data would produce basin-specific estimates of environmental stochasticity, which would allow a more refined criterion for viable population size. A scientifically-based recovery effort will be difficult to achieve 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 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 during the dry season. Another important factor affecting steelhead use of lagoons is the ability of adults and juveniles to migrate between the freshwater spawning habitat and the lagoon due to watershed management practices which affect the migration corridor; this can be a significant constraint of estuary/lagoon use if the distance between the estuary/lagoon and upstream habitats is great. 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, initial recovery efforts should be implemented as soon as practicable, and run-sizes increased to ensure that 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 mainstems, tributaries and 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 significant 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 Southern California Coast Steelhead DPS (NMFS 2006b). These priorities address two of the overarching causes of population declines within the Southern California Coast Steelhead DPS: reduced access to historic steelhead spawning and rearing habitats; and reduced reproductive success. These 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 small coastal streams and larger inlands river systems, commensurate with habitat and life-history requirements of steelhead.

- Within the southern range extension (Mojave Rim and Santa Catalina Gulf Coast Biogeographic Groups), inventory and assess impediments to fish passage and identify and provide appropriate fish passage opportunities in the watersheds historically supporting anadromous runs.

- Complete the Robles Diversion fish passage facilities (including downstream weirs and monitoring facilities) on the Ventura River commensurate with habitat and life-history requirements of steelhead.

- Complete COEs' Matilija Dam Ecosystem Restoration planning for and implement the removal of Matilija Dam on the Ventura River commensurate with habitat and life-history requirements of steelhead.

- Complete COEs' Rindge Dam Ecosystem Restoration planning for and implement the removal of Rindge Dam on Malibu Creek commensurate with habitat and life-history requirements of steelhead.

- Provide fish passage facilities and passage flows at the Vern Freeman Diversion on the Santa Clara River commensurate with habitat and life-history requirements of steelhead.

- Evaluate and provide appropriate fish passage opportunities at Twitchell Dam on the Cuyama River, Bradbury, Gibraltar, and Juncal Dams on the Santa Ynez River, Casitas Dam on Coyote Creek, Santa Felicia and Pyramid Dams on Piru Creek, planned water diversions on the Santa Margarita River, and Rincon/La Jolla Tribe water diversion and Henshaw Dam on the San Luis Rey River commensurate with habitat and life-history requirements of steelhead.

- Re-establish flow regimes below dams (*e.g.*, on the Santa Maria, Santa Ynez, Ventura, Santa Clara, Santa Margarita, San Luis Rey, San Diegito, Penisquitos and Sweetwater Rivers) commensurate with habitat and life-history requirements of steelhead.

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, including 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.

- Reduce water pollutants such as fine sediments, 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.

- Close remaining areas currently open to angling below impassible barriers of all anadromous waters; in anadromous watersheds, assess impacts of angling on native *O. mykiss* above barriers which are currently impassible to upstream migrating steelhead.

- Eliminate the stocking of hatchery reared fish in anadromous waters. Where stocking is otherwise appropriate, use sterile triploid fish in all waters where stocked fish may enter anadromous waters.

- 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 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.

- Conduct research on the relationship between resident and anadromous forms of *O. mykiss*, and the population dynamics (*e.g.*, distribution, abundance, residualization, homing/straying, and recolonization rates); extend genetic research and analysis to include the southern range extension (Mojave Rim and Santa Catalina Gulf Coast Biogeographic Groups).

- Monitor annual fluctuations of *O. mykiss* populations (anadromous and resident) in 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 stream identified as core populations. Initiate efforts to eliminate, reduce, or control non-native, invasive species of plants and animals which degrade steelhead habitats or compete with 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 Southern 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. Where possible, streamline Section 7 and 10 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 actions into Section 7 and 10 ESA 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 Southern California Coast Steelhead DPS recovery strategies and improve coordination with Federal, State, and local conservation actions through, but not limited to, the Fishery 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 life-history and viable steelhead population criteria to Federal, State, regional planning organizations, local governments, special interest groups, and non-governmental organizations to incorporate into their project designs, operational plans, general land use and watershed plans, local coastal program, *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 Southern 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 Southern California Coast Steelhead DPS, using the most recent Recovery Planning

Guidance (NMFS 2006a), consistent with 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 agencies, 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 the Southern 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 Steelhead 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 pubic workshops, focused on Draft Recovery Plan

- Revise Draft Recovery Plan

Fall 2008

- Finalize Recovery Plan
- Initiate outreach for 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 Southern 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 to initiate the development of the recovery plan per 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.

67 FR 21586. 2002. Final Rule: Endangered and Threatened Species: Range Extension for Endangered Steelhead in Southern California.

68. FR 15100. 2003. Policy for Evaluation of Conservation Efforts when Making Listing Decisions.

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 Southern California Coast Steelhead includes the following habitat areas within occupied watersheds (70 CFR 52488):

Santa Maria River Hydrologic Unit (#3312): Santa Maria Hydrologic Sub-area (#331210): Santa Maria River, Cuyama River, Sisquoc River; Sisquoc Hydrologic Sub-area (#331220): Sisquoc River, Abel Canyon, Davey Brown Creek, Fish Creek, Foresters Leap, La Brea Creek, Horse Creek, Judell Creek, Manzana Creek, North Fork La Brea Creek, South Fork La Brea Creek, Unnamed Tributaries, Water Canyon.

Santa Ynez Hydrologic Unit (#3314): Mouth of Santa Ynez Hydrologic Sub-area (#331410): Santa Ynez River, San Miguelito Creek. Santa Ynez; Salsipuedes Hydrologic Sub-area (#331420): Santa Ynez River, El Callejon Creek, El Jaro Creek, Llanito Creek, Salsipuedes Creek. Santa Ynez, Zaca Hydrologic Sub-area (#331430): Santa Ynez River. Santa Ynez to Bradbury Hydrologic Sub-area (#331440): Santa Ynez River, Alisal Creek, Hilton Creek, Quiota Creek, San Lucas Creek, Unnamed Tributary.

South Coast Hydrologic Unit (#3315): Arroyo Hondo Hydrologic Sub-area (#331510): Alegria Creek, Arroyo Hondo Creek, Cojo Creek, Dos Pueblos Creek, El Capitan Creek, Gato Creek, Gaviota Creek, Jalama Creek, Refugio Creek, Sacate Creek, San Augustine Creek, San Onofre Creek, Santa Anita Creek, Tecolote Creek, Dos Pueblos Creek, El Capitan Creek, Escondido Creek, La Olla Unnamed Tributaries. UCSB Slough Hydrologic Sub-area (#331531): San Pedro Creek, Tecolotito Creek, Atascadero Creek, Carneros Creek, Cieneguitas Creek, Glen Annie Creek, Maria Ygnacio Creek, San Antonio Creek, San Jose Creek, Unnamed Tributary. Mission Hydrologic Sub-area (#331532): Arroyo Burro Creek, Mission Creek, Rattlesnake Creek San Roque Creek, Sycamore Creek. San Ysidro Hydrologic Sub-area (#331533): Montecito Creek, Romero Creek, San Ysidro Creek, Cold Springs Creek, Unnamed Tributary. Carpinteria Hydrologic Sub-area (#331534): Arroyo Paredon, Carpinteria Lagoon (Carpinteria Creek) Rincon Lagoon (Rincon Creek), El Dorado Creek, Gobernador Creek, Unnamed Tributary.

Ventura River Hydrologic Unit (#4402): Ventura Hydrologic Sub-area (#440210): Ventura River Estuary (Ventura River), Canada Larga, Hammond Canyon Sulphur Canyon, Unnamed Tributaries. Ventura River Hydrologic Sub-area (#440220): Ventura River, Coyote Creek, Matilija Creek, North Fork Matilija Creek, San Antonio Creek. Lions Hydrologic Sub-area (#440231): Lion Creek; Thatcher Hydrologic Sub-area (#440232) San Antonio Creek.

Santa Clara, Calleguas Hydrologic Unit (#4403): Mouth of Santa Clara Hydrologic Sub-area (#440310): Santa Clara River. Santa Clara, Santa Paula Hydrologic Sub-area (#440321): Santa Clara River, Santa Pula Creek. Sisar Hydrologic Sub-area (#440322): Sisar Creek. Santa Clara Hydrologic Sub-area (#440331): Santa Clara River, Sespe Creek. Sespe Hydrologic Sub-area (#440332): Sespe Creek, Abadi Creek, Bear Creek, Chorro Grande Creek, Fourfork Creek, Howard Creek, Lady Bug Creek, Lion Creek, Little Sespe Creek, Munson Creek, Park Creek, Piedra Blanca Creek, Pine Canyon Creek, Portero John Creek, Red Reef Creek, Rose Valley Creek, Timber Creek, Trout Creek, Tule Creek, Unnamed Tributaries, West Forks Sespe Creek.

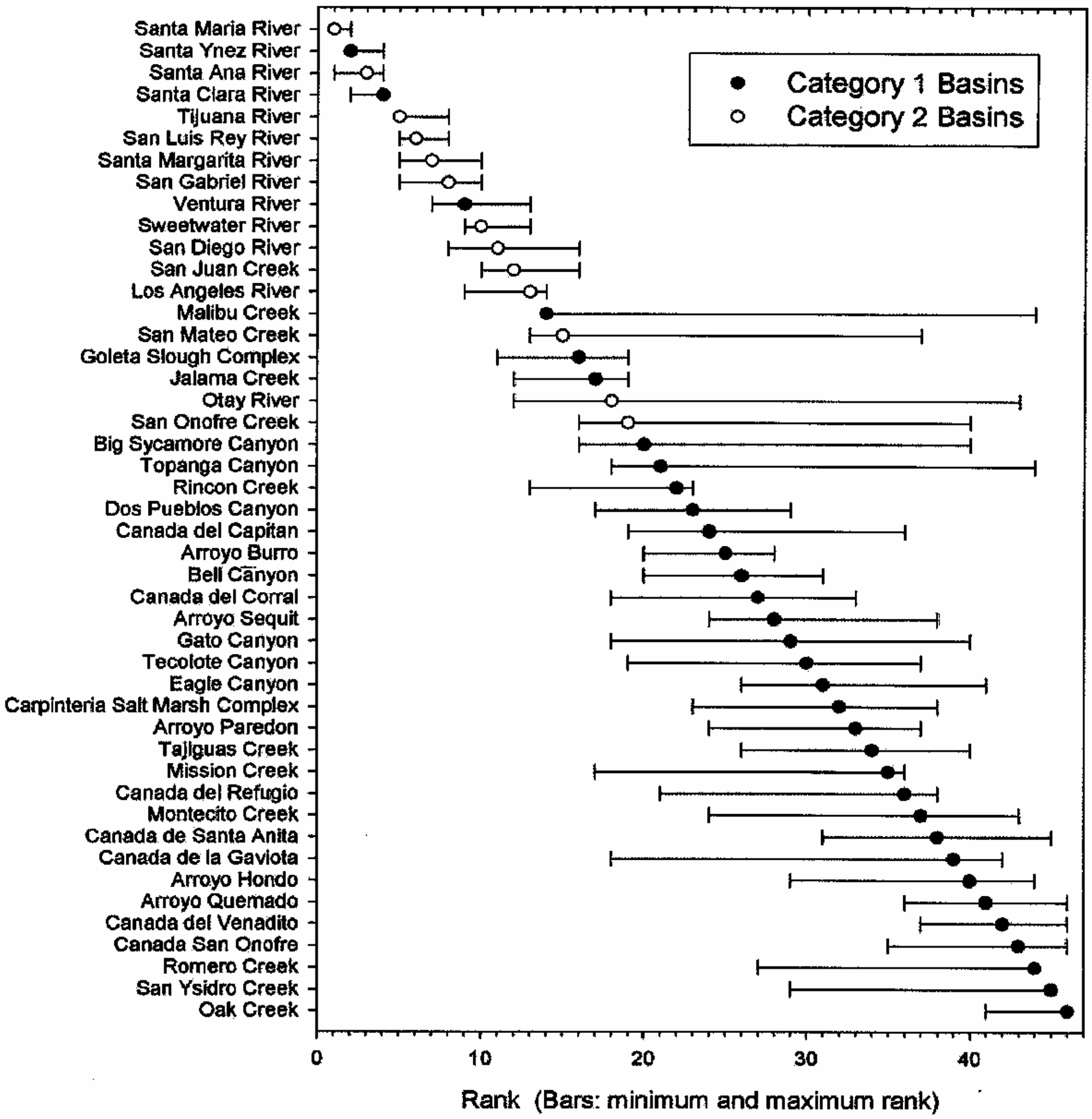
Santa Clara River, Hopper Canyon, Piru Hydrologic Sub-area (#440341): Santa Clara River, Hopper Creek, Piru Creek.

Santa Monica Bay Hydrologic Unit (#4404): Topanga Hydrologic Sub-area (#440411): Topanga Creek. Malibu Hydrologic Sub-area (#44021): Malibu Creek. Arroyo Sequit Hydrologic Sub-area (#440444): Arroyo Sequit, West Fork Arroyo Sequit.

Calleguas Hydrologic Unit (#4408): Calleguas Estuary Hydrologic Sub-area (#440813): Mugu Lagoon (Calleaguas Creek).

San Juan Hydrologic Unit (#4901): Middle Trabuco Hydrologic Sub-area (#490123): Trabuco Creek. Lower San Juan Hydrologic Sub-area (#490127): San Juan Creek, Trabuco Creek. San Mateo Hydrologic Sub-area (#490140): San Mateo Creek, San Mateo Canyon.

Appendix B



Basin-ranking in the Southern 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 (*i.e.*, 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. (See Boughton *et al.* 2006).

Appendix C

Biogeographic Group	Member Populations (ordered north to south)
Monte Arido Highlands	Santa Maria River, Santa Ynez River, Ventura River, Santa Clara River.
Conception Coast[1]	Jalama Creek, Cañada de Santa Anita, Cañada de la Gaviota, Cañada San Onofre, Arroyo Hondo, Arroyo Quemado, Tajiguas Creek, Cañada del Refugio, Cañada del Venadito, Cañada del Corral, Cañada del Capitan, Gato Canyon, Dos Pueblos Canyon, Eagle Canyon, Tecolote Canyon, Bell Canyon, Goleta Slough Complex, Arroyo Burro, Mission Creek, Montecito Creek, Oak Creek, San Ysidro Creek, Romero Creek, Arroyo Paredon, Carpinteria Salt Marsh Complex, Carpinteria Creek, Rincon Creek.
Santa Monica Mtns[1]	Big Sycamore Canyon, Arroyo Sequit, Malibu Creek, Topanga Canyon.
Mojave Rim	Los Angeles River, San Gabriel River, Santa Ana River (multiple subpopulations).
Santa Catalina Gulf Coast	San Juan Creek, San Mateo Creek, San Onofre Creek, Santa Margarita River, San Luis Rey River, San Diego River, Sweetwater River, Otay River, Tijuana River.

Composition of Southern 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).