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Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead

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B.2.8 SOUTH-CENTRAL CALIFORNIA STEELHEAD

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B.2.8.1 Summary of Previous BRT Conclusions

The geographic range of the ESU was determined to extend from the Pajaro River basin in Monterey Bay south to, but not including, the Santa Maria River Basin near the town of Santa Maria. The ESU was separated from steelhead populations to the north on the basis of genetic data (mitochondrial DNA and allozymes), and from steelhead populations to the south on the basis of a general faunal transition in the vicinity of Point Conception. The genetic differentiation of steelhead populations within the same ESU, and the genetic differentiation between ESUs, appears to be greater in the south than in Northern California or the Pacific Northwest; however the conclusion is based on genetic data from a small number of populations.

Summary of major risks and status indicators

Risks and limiting factors—Numerous minor habitat blockages were considered likely throughout the region; other typical problems were thought to be dewatering from irrigation and urban water diversions, and habitat degradation in the form of logging on steep erosive slopes, agricultural and urban development on floodplains and riparian areas, and artificial breaching of estuaries during periods when they are normally closed off from the ocean by a sandbar.

Status indicators—Historical data on this ESU are sparse. In the mid 1960s, the CDFG (1965) estimated that the ESU-wide run size was about 17,750 adults. No comparable recent estimate exists; however, recent estimates exist for five river systems (Pajaro, Salinas, Carmel, Little Sur, and Big Sur), indicating runs of fewer than 500 adults where previously runs had been on the order of 4,750 adults (CDFG 1965). Time-series data only existed for one basin (the Carmel River), and indicated a decline of 22% per year over the interval 1963 to 1993 (see below for a review of this conclusion).

Many of the streams were thought to have somewhat to highly impassable barriers, both natural and anthropogenic, and in their upper reaches to harbor populations of resident trout. The relationship between anadromous and resident *O. mykiss* is poorly understood in this ESU, but was thought to play an important role in its population dynamics and evolutionary potential. A status review update conducted in 1997 (NMFS 1997) listed numerous reports of juvenile *O. mykiss* in many coastal basins; but noted that the implications for adult numbers were unclear. They also discussed the fact that certain inland basins (the Salinas and Pajaro systems) are rather different ecologically from coastal basins.

Previous BRT Conclusions

The original BRT (Busby et al. 1996) concluded that the ESU was in danger of extinction, due to 1) low total abundance; and 2) downward trends in abundance in those stocks for which data existed. The negative effects of poor land-use practices and trout stocking were also noted. The major area of uncertainty was the lack of data on steelhead run sizes, past and present. The status review update (NMFS 1997) concluded that abundance had slightly increased in the years immediately preceding, but that overall abundance was still low relative to historical numbers. They also expressed a concern that high juvenile abundance and low adult abundance observed in some datasets suggested that many or most juveniles were potentially resident fish (i.e. rainbow trout). The BRT convened for the update was nearly split on whether the fish were in danger of extinction, or currently not endangered but likely to become so in the foreseeable future, with the latter view holding a slight majority.

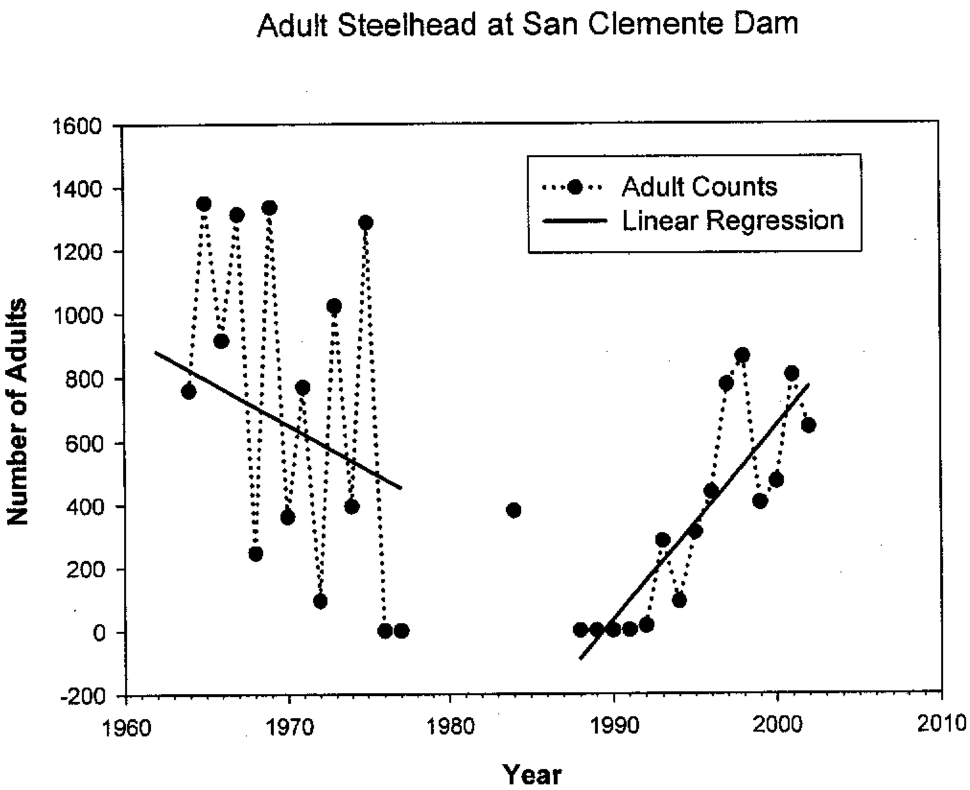

Figure B.2.8.1. Adult counts at San Clemente Dam, Carmel River. Data from the Monterey Peninsula Water Management District. See Snider (1983) for methods of counting fish before 1980; these early data are subject to substantial observation error (*N.B.* the regression line is not significantly different from flat). The increase during the 1990s followed a severe drought (and concurrent dewatering of the mainstem by a water district) in the late 1980s and early '90s.

Listing Status

The ESU was listed as threatened in 1997.

B.2.8.2 New Data and Updated Analyses

There are three new significant pieces of information: 1) updated time-series data concerning dam counts made on the Carmel River (MPWMD 2002) (See analyses section below for further discussion); 2) a comprehensive assessment of the current geographic distribution of *O. mykiss* within the ESU's historical range (Boughton & Fish MS; see next paragraph); and (3) changes in harvest regulations since the last status review (see next section).

Table B.2.8.1. Estimates of historical run sizes from the previous status review (Busby 1996).

River Basin	Run size estimate	Year	Reference
Pajaro R.	1,500	1964	McEwan and Jackson 1996
	1,000	1965	McEwan and Jackson 1996
	2,000	1966	McEwan and Jackson 1996
Carmel R.	20,000	1928	CACSS (1988)
	3,177	1964 – 1975	Snider (1983)
	2,000	1988	CACSS (1988)
	<4,000	1988	Meyer Resources (1988)

Current distribution vs. historical distribution—In 2002, an extensive study was made of steelhead occurrence in most of the coastal drainages between the northern and southern geographic boundaries of the ESU (Boughton and Fish MS). Steelhead were considered to be present in a basin if adult or juvenile *O. mykiss* were observed in any stream reach that had access to the ocean (i.e. no impassable barriers between the ocean and the survey site), in any of the years 2000-2002 (i.e. within one steelhead generation). Of 36 drainages in which steelhead were known to have occurred historically, between 86% and 94% were currently occupied by *O. mykiss*. The range in the estimate of occupancy occurs because three basins could not be assessed due to restricted access. Of the vacant basins, two were considered to be vacant because they were dry in 2002, and one was found to be watered but a snorkel survey revealed no *O. mykiss*. One of the "dry" basins—Old Creek—is dry because no releases were made from Whale Rock Reservoir; however, a land-locked population of steelhead is known to occur in the reservoir above the dam.

Occupancy was also determined for 18 basins with no historical record of steelhead occurrence. Three of these basins—Los Osos, Vicente, and Villa Creeks—were found to be occupied by *O. mykiss*. It is somewhat surprising that no previous record of steelhead seems to exist for Los Osos Creek, near Morro Bay and San Luis Obispo.

The distribution of steelhead among the basins of the region is not much less than what occurred historically, so despite the widespread declines in habitat quality and population sizes, regional extirpations have not yet occurred. This conclusion rests on the assumption that juveniles inhabiting stream reaches with access to the ocean will undergo smoltification and thus are truly steelhead.

Three analyses are made below: 1) A critical review of the historical run sizes cited in the previous status review, 2) an assessment of recent trends observed in the adult counts being made on the Carmel River; and 3) a summary of new sport-fishing regulations in the region.

Review of historical run sizes—Estimates of historical sizes for a few runs were described in the previous status review (Busby et al. 1996), and are here reproduced in Table B.2.8.1.

The recent estimates for the Pajaro River (1,500, 1,000, 2,000) were reported in McEwan and Jackson (1996), but the methodology and dataset used to produce the estimates were not described. CACCS (1988) suggested an annual run size of 20,000 adults in the Carmel River of the 1920s, but gave no supporting evidence for the estimate. Their 1988 estimate of 2,000 adults also lacked supporting evidence. Meyer Resources (1988) provides an estimate of run size, but was not available for review at the time of this writing.

Snider (1983) examined the Carmel River and produced many useful data. In the abstract of his report he gave an estimate of 3,177 fish as the mean annual smolt production for 1964 through 1975; Busby et al. (1996) mistakenly cited this estimate as an estimate of run size. Snider's "3,177" figure may itself be a mistake, as it disagrees with the information in the body of the report, which estimates annual smolt production in the year 1973 as 2,708 smolts, and in the year 1974 as 2,043 smolts. Snider (1983) also gives adult counts for fish migrating upstream through the fish ladder at San Clemente Dam, for the years 1964 through 1975 (data were not reported in Busby et al. 1996; but were apparently the basis for the 22% decline reported by them. See Figure B.2.8.1 for the actual counts.). The mean run size from these data is 821 adults. To make these estimates, visual counts were made twice a day by reducing the flow through the ladder and counting the fish in each step; thus they may underestimate the run size by some unknown amount if fish moved completely through the ladder between counts (an electronic counter was used in 1974 and 1975 and presumably is more accurate). In addition, San Clemente Dam occurs 19.2 miles from the mouth of the river and a fraction of the run spawns below the dam (CDFG biologists estimate the fraction to be one third of the run, based on redd surveys).

Thus, much of the historical data used in the previous status review are highly uncertain. The most reliable data are the Carmel River dam counts, which were not reported in the previous status review. Further analysis of these data are described below.

Abundance in the Carmel River—The Carmel River data are the only time-series for the ESU. The data suggest that the abundance of adult spawners in the Carmel River has increased since the last status review (Figure B.2.8.1.). A continuous series of data exists for 1964 through 1977, although the data are probably incomplete to various degrees for each year (i.e. the counts are probably incomplete, and the year-to-year fluctuations may be mostly due to observation error rather than population variability). A regression line drawn through the data indicates a downward trend, but the trend is not statistically significant (slope = -28.45; $R^2 = 0.075$; $F = 1.137$; $p = 0.304$;). The 22% decline reported by Busby et al. (1996) is apparently based on these data in comparison with the low numbers of the early 1990s.

Continuous data have also been collected for the period 1988 through 2002. The beginning of this time series has counts of zero adults for three consecutive years, then shows a rapid increase in abundance. The trend is strongly upward (see Table B.2.6.3). The time series is too short to make a reliable estimate of mean lambda. The observed positive trend could conceivably be due either to improved conditions (i.e. mean lambda greater than one), substantial immigration or transplantation, or the transient effects of age structure. Improved conditions seem by far the most likely explanation, as the basin has been the subject of intensive fisheries management since the early 1990s. According to the Monterey Peninsula Water Management

District, the entity conducting much of the restoration of the basin's steelhead fishery, the likely reasons for the positive trend are due to improved conditions, namely

> "Improvements in streamflow patterns, due to favorable natural fluctuations…since 1995; …actively manag[ing] the rate and distribution of groundwater extractions and direct surface diversions within the basin; changes to Cal-Am's [dam] operations … providing increased streamflow below San Clemente Dam; improved conditions for fish passage at Los Padres and San Clemente Dams …; recovery of riparian habitats, tree cover along the stream, and increases in woody debris…; extensive rescues … of juvenile steelhead over the last ten years … ; transplantation of the younger juveniles to viable habitat upstream and of older smolts to the lagoon or ocean; and implementation of a captive broodstock program by Carmel River Steelhead Association and California Department of Fish & Game (CDFG), [including] planting … from 1991 to1994." (MPWMD 2001).

Even so, the rapid increase in adult abundance from 1991 (one adult) to 1997 (775 adults) seems too great to attribute simply to improved reproduction and survival of the local steelhead. There are a number of possibilities: substantial immigration or transplantation may have boosted abundance, or perhaps there was a large population of resident trout that has begun producing smolts at a higher rate under improved freshwater conditions. The transplantation hypothesis is thought unlikely: although transplantation of juveniles occurred (in the form of rescues from the lower mainstem during periods in which it was dewatered), CDFG biologists consider the scale of these efforts to be too small to effect the large increase in run size that has been observed. The scale of immigration (i.e. straying) is not known but may be a significant factor. As for the role of resident trout in producing smolts, the phenomenon is known to occur but the environmental triggers have not yet been worked out. One hypothesis, congruent with the Carmel River situation, is that environmental conditions affect growth rate of juveniles, which affects propensity to smolt into the anadromous form.

The rapid increase in adult abundance in the Carmel River system is thus very interesting. At this point two conclusions seem warranted: 1) Upon improvement of freshwater conditions such as those described above, the adult runs are capable of rapid increase in this ESU, due either to resilience of steelhead populations, high stray rates, or ability of resident trout to produce smolts. Either mechanism might allow the fish to rapidly take advantage of improved conditions, suggesting a high potential for rapid recovery in this ESU if the proper actions were taken. 2) Although some component of the increase is probably due to improved ocean conditions, it would be a mistake to assume comparable increases have occurred in other basins of the ESU, as they have not been the focus of such intensive management efforts.

Possible changes in harvest impacts

Since the original status review of Busby et al. (1996), regulations concerning sport fishing have been changed in a way that probably reduces extinction risk for the ESU.

Sport harvest of steelhead in the ocean is prohibited by the California Department of Fish and Game (CDFG 2002a), and ocean harvest is a rare event (M. Mohr, NMFS, pers. comm.), so effects on extinction risk are probably negligible. For freshwaters, CDFG (2002) describes the current regulations. Summer trout fishing is allowed in some systems, often with a two- or five-bag limit. These include significant parts of the Salinas system (upper Arroyo Seco and Nacimiento above barriers; the upper Salinas; Salmon Creek; and the San Benito River in the Pajaro system (All: bag limit five trout). Also included in the summer fisheries is the Carmel River above Los Padres Dam (bag limit two trout, between 10" and 16"). A few other creeks have summer catch-and-release regulations. The original draft of the Fishery Management and Evaluation Plan (CDFG 2000) recommended complete closure of the Salinas system to protect the steelhead there, but the final regulations did not implement this recommendation, allowing both summer trout angling and winter-run catch-and-release steelhead angling in selected parts of the system (CDFG 2002).

The regulations allow catch-and-release winter-run steelhead angling in many of the river basins occupied by the ESU, specifying that all wild steelhead must be released unharmed. There are significant restrictions on timing, location, and gear used for angling. A recent draft Fisheries Evaluation and Management Plan (CDFG 2001b) has been prepared, and argues that the only mortality expected from a no-harvest fishery is from hooking and handling injury or stress. They estimate this mortality rate to be about 0.25% - 1.4%. This estimate is based on angler capture rates measured in other river systems throughout California (range: 5% - 28%), multiplied by an estimated mortality rate of 5% once a fish is hooked. The latter mortality estimate is consistent with a published meta-analysis of hooking mortality (Schill and Scarpella 1997), but experimental studies on the subject—from which the estimates are made—tend to measure mortality only for a period of a few days or a week after capture (e.g. Titus and Vanicek 1988).

The Fishery Management and Evaluation Plan contains no extensive plans for monitoring fish abundance. Although the closure of many areas, and institution of catch-and-release elsewhere, is expected to reduce extinction risk for the ESU, this risk reduction cannot be estimated quantitatively from the existing data, due to the fact that natural abundance is not being measured.

Resident *O. mykiss* considerations

Resident (non-anadromous) populations of *O. mykiss* were assigned to one of three categories for the purpose of provisionally determining ESU membership (See "Resident Fish" in the introduction for a description of the three categories and default assumptions about ESU membership). The third category consists of resident populations that are separated from anadromous conspecifics by recent human-made barriers such as dams without fish ladders. No default assumption about ESU membership was possible for Category 3 populations, so they are here considered case-by-case according to available information.

As of this writing there are few data on occurrence of resident populations and even fewer on genetic relationships. A provisional survey of the occurrence of Category 3 populations in the ESU (see Appendix B.5.2) revealed the following; There are four significant Category 3 populations within the original geographic range of the ESU (Appendix B.5.2)—two in the Salinas system, one behind Whale Rock Dam near Cayucos, and one behind the Lopez reservoir on Arroyo Grande Creek. The two in the Salinas system occur behind the dams on the Nacimiento and San Antonio Rivers, which currently block what were reported to be two of the three principal steelhead spawning areas in the basin (the other being in Arroyo Seco; Titus et al.

2003). Resident populations occur above these dams and stocking is ongoing (Appendix B.5.2). A third major barrier occurs in the headwaters of the Salinas itself; stocking currently occurs above this dam. Steelhead reportedly spawned in these streams before the dam was built, but the runs were probably relatively small and sporadic.

The Whale Rock Reservoir has a resident population that is reported to make steelhead-like runs up several tributaries for spawning. The reservoir has an associated hatchery program; see the previous section above for details on genetic studies, stocking records, *etc.*

According to David Starr Jordan, the area now blocked by the Lopez dam on Arroyo Grande Creek was originally well known as a significant steelhead area (cited in Titus et al. 2003). A resident population currently exists above this dam, and stocking is ongoing (Table B.5.1.1). We are not aware of any studies of the population's genetic affinities.

Minor barriers—defined here as blocking less than 100 sq. mi. of watershed—are numerous within the geographic range of the ESU. A nonzero number of Category 3 populations undoubtedly exist above these barriers but there are insufficient data at the present time to make a comprehensive assessment.

B.2.8.3. New Hatchery Information

The only hatchery stock being considered in this ESU is the one at Whale Rock Hatchery. This stock was assigned to one of three categories for the purpose of determining ESU membership at some future date (See "Artificial Propagation" in the introduction for a description of the three categories and related issues regarding ESU membership). To make the assignment, data about broodstock origin, size, management and genetics were gathered from fisheries biologists and are summarized below.

Whale Rock Hatchery (Whale Rock Steelhead [CDFG])

Whale Rock Reservoir was created in 1961 by placing a dam on Old Creek, 2 km upstream from the coast. Old Creek had supported a large steelhead run previous to construction of the dam and these fish were presumably trapped behind the dam (the creek is usually dewatered below the dam so no population occurs there at all). Whale Rock Hatchery was established in 1992 as an effort to improve the sport fishery in the reservoir after anglers reported a decline in fishing success. The original Whale Rock broodstock (40 fish) were collected at a temporary weir placed in the reservoir at the mouth of Old Creek Cove (Nielsen et al. 1997). Adult fish were trapped in the shallows of the reservoir using nets that are set during late winter and spring as the fish begin their migration upstream from the reservoir into Old Creek. The fish are held in an enclosure while they are monitored for ripeness. Eggs and sperm are collected from fish using non-lethal techniques, and then the adult fish are returned to the reservoir. Fish were originally hatched and raised at the Whale Rock Hatchery located below the dam at the maintenance facility, but are now raised at the Fillmore Hatchery in Ventura County. The fry are cared for until September or November at which time they are released back into the reservoir as 3-5" fingerling trout.

Broodstock origin and history—Hatchery operations began in 1992 and have been sporadic since. The project is a cooperative venture between CDFG and private parties. Fish were raised in 1992, 1994, 2000, and 2002 (John Bell, personal communication). All broodstock are taken from the reservoir.

Broodstock size/natural population size—An average of 121 fish were spawned. Spawning success has been poor. There are no population estimates for the reservoir and the hatchery fish are not marked.

Management—The current program goal is to increase angling success in Whale Rock Reservoir.

Population genetics—Neilsen et al. (1997) found that significant genetic relatedness occurs between the Whale Rock Hatchery stock and wild steelhead in the Santa Ynez River and Malibu creeks, two basins to the south. She reported a loss of genetic diversity within the hatchery stock.

Category—The hatchery was determined to belong to Category 2 (SSHAG 2003; Appendix B.5.3). Broodstock are taken from the source population, but the small population could easily lead to significant genetic bottlenecks.