

Recovering Endangered Steelhead Rainbow Trout (*Oncorhynchus mykiss*) in Southern California Coastal Watersheds¹

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On August 11, 1997, the National Marine Fisheries Service identified fifteen distinct populations, or Evolutionarily Significant Units (ESUs), of steelhead rainbow trout under the U.S. Endangered Species Act. Of the five populations identified in California, only the Southern California ESU was designated as endangered. This designation was adopted for the Southern California ESU because habitat modifications have caused the annual steelhead runs in southern California to decline from historic estimates of 55,000 to less than 500 returning adult fish per year, a decline of over 90% in less than 50 years since the end of the Second World War.

Steelhead are the anadromous form of rainbow trout native to the coastal drainages of western North America and parts of the northwest Pacific Rim. Adults spend most of their life in the ocean, but return to spawn in freshwater streams, generally to the stream of their birth. Unlike the five related species of Pacific salmon, steelhead do not necessarily die after spawning, but may return to their natal stream to spawn a second, and possibly a third or a fourth time. In completing the reproductive phase of their life-cycle, steelhead use all major elements of the freshwater stream system (estuaries, mainstem and tributaries). Coastal estuaries are used by migrating adults and emigrating juvenile (smolts) to acclimate to fresh and salt water during their movement between marine and freshwater environments; they also provide important rearing habitat where the estuary may constitute the largest areal extent of aquatic habitat in smaller coastal stream systems. The mainstem of southern California coastal rivers and streams frequently do not maintain perennial flows, but provide critically important transportation corridors for adults migrating upstream during the winter seeking spawning areas, and for smolts emigrating to the ocean during the spring. The numerous small tributaries in the headwaters of coastal watersheds generally exhibit more constant surface flow and cooler water temperatures and provide the principal steelhead spawning and rearing areas in the larger coastal river systems.

Steelhead are vulnerable to a variety of habitat disturbances during their reproductive phase and are a sensitive indicator of the overall health of coastal watersheds. In southern California over 90% of the original estuarine habitat has been filled since the turn of the century, or degraded as a result of point and non-point waste discharges. Mainstem river segments have been impacted by encroachment onto the floodplains for agricultural and urban developments, and disruptive infrastructure (e.g., sewer lines, roads, and bridges), which have led to extensive flood control measures (e.g., levying, concrete channelization, and periodic vegetation removal). While significant portions of the tributaries of coastal watershed are located within the National Forests, they have been impacted by road construction on steep slopes and within riparian corridors, and by the construction of dams on tributaries, or lower down in the watershed, which prevent steelhead from accessing historic spawning and rearing habitats within the National Forests. Developments throughout the coastal watersheds have led to elevated levels of fine sediments in all major elements of the freshwater stream systems. These sediments have reduced the suitability of spawning gravels as well as reduced benthic invertebrate production, thus adversely affecting rearing juvenile steelhead.

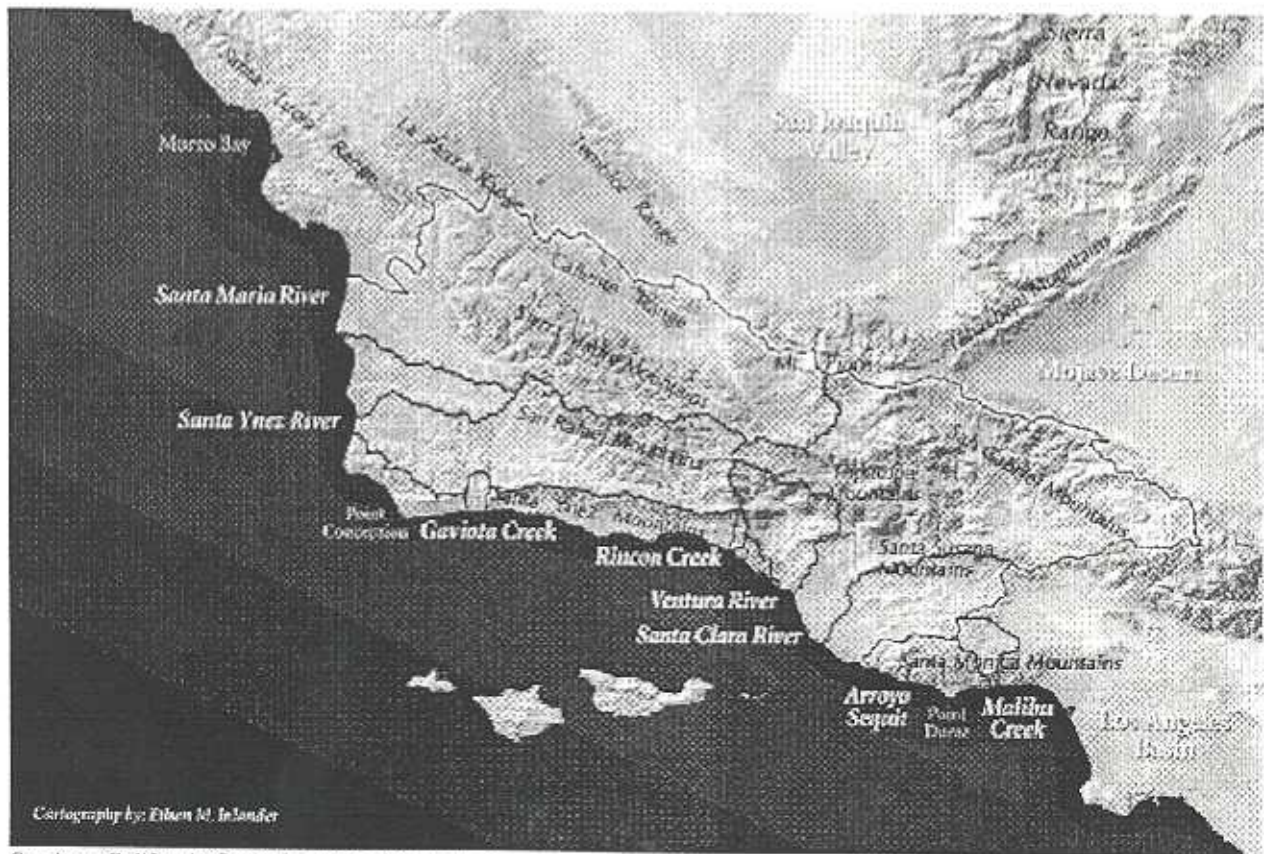
The coastal region of southern California is drained by four major river systems which continue to support remnant steelhead runs: the Santa Maria and Santa Ynez Rivers in Santa Barbara County, and the Ventura and Santa Clara Rivers in Ventura County. Three rivers in particular supported substantial annual runs of anadromous steelhead in southern California until the development of major water supply facilities after the Second World War: the Santa Ynez in Santa Ynez is estimated to have supported 20,000 adult fish per year. The Ventura River is reported to have supported 5,000, and the Santa Clara River 9,000 adult fish per year. Several large river systems further south (e.g., Los Angeles, San Gabriel, and Santa Margarita Rivers) also supported anadromous runs which are now thought to be extirpated, though there are reports of adults ascending these systems during unusually wet years, and sightings of young-of-the-year produced by these

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irregular runs. Additionally, there are over a hundred small coastal streams with watersheds of only a few square miles that drain the south facing coastal ranges and provide additional habitats, which can be used by southern California steelhead when water conditions are suitable. The southernmost stream which continues to support an annual remnant run of steelhead in southern California is Malibu Creek, in Los Angeles County. The size of all these runs varied considerably from year to year, controlled largely by winter rains associated with short-duration cyclonic storms generated over the Pacific Ocean.

The explosive growth of the human population in southern California after the Second World War (estimated today at over 15 million people) has spurred the development of major water supply facilities in southern California watersheds (e.g., dams, diversions, and groundwater wells) that have reduced flushing flows, diminished recruitment of spawning gravels, and depressed or eliminated base flows in most southern California watersheds. The

Santa Maria River is controlled by Twitchell Dam on the Cuyama River which blocks access to the historic steelhead spawning tributaries of the Cuyama River, and impedes access to Sisquoc Creek, which historically provided the principal spawning and rearing habitat in the Santa Maria system. The Santa Ynez River is controlled by Bradbury, Gibraltar, and Juncal Dams on the mainstem of the river, which block access to all major steelhead spawning and rearing tributaries, except Salsipuedes Creek. The Ventura River is controlled by Casitas Dam on Coyote Creek and the Robles Diversion on the mainstem, and by Matilija Dam on Matilija Creek, the principal spawning and rearing tributary of the Ventura River system. The Santa Clara River is controlled by the Vern Freeman Diversion on the mainstem and by Piru, Pyramid, Castaic, and Bouquet Dams on several upper watershed tributaries; these facilities impede access to Sespe Creek, the principal steelhead spawning and rearing tributary in the Santa Clara River system.



Southern California Coastal Steelhead Watersheds

Together, these water supply facilities block access to over 85% of the historic steelhead spawning and rearing habitat in the Southern California ESU, as

well as reduce the level and duration of flows to the ocean in the lower reaches of these rivers and streams. Additionally, wastewater discharges from

municipal sewer treatment facilities have created artificially fluctuating flows, as well as degraded water quality through the introduction of nutrients and other waste products into the lower reaches of some watersheds (e.g., Santa Ynez and Ventura River and Malibu Creek). The recent listing of southern California steelhead as an endangered species, and the mandate to recover this species, has raised a number of fundamental questions regarding recovery strategies. One basic question is where to focus limited funds and recovery efforts, and the related question of the relationship between the populations in the larger river systems and the smaller coastal streams. Steelhead exhibit a high degree of viability in their life-cycles. Some individuals use non-natal streams for reproduction, when natal stream conditions are unsuitable, or may never return to the ocean to sexually mature, or delay their return for a number of years following their initial instream growth. Individual stream populations are consequently thought to form part of a larger metapopulation of interacting populations within the Southern California ESU.

Little is known about the historic or current interactions between steelhead populations from the larger river systems and the smaller coastal streams. However, one model suggests a fundamental relationship: that between source and sink populations. This model suggests that there are two classes of steelhead populations within the Southern California ESU, those associated with larger river systems with extensive and relatively stable habits (source populations) and those associated with smaller stream systems, with less extensive and less stable habitats (sink populations). This model suggests that the larger river systems contribute and support the numerous smaller coastal streams, and that the recovery of the former is necessary for recovery of the metapopulation, and therefore of the Southern California ESU. The relative historic contribution of the three major river systems to the total estimated historic steelhead production in the Southern California ESU (approximately 66%) further underscores the importance of these larger river systems for recovery efforts.

Significantly, the source populations of the Southern California ESU (Santa Ynez, Ventura, Santa Clara Rivers) have been subjected to the most extensive modifications as a result of water supply developments. Recovery efforts are consequently being focused on removing major obstructions to upstream migration, and examining opportunities to restore flow regimes, or create artificial regimes to create spawning and rearing habitats. Restoring

access to historic spawning and rearing tributaries would allow returning fish to use significant portions of the coastal watersheds which are within either the Los Padres or Angeles National Forests and therefore afforded a basic level of protection against most (though not all) of the potential adverse effects of urbanization and agricultural development.

Two notable efforts to restore access to historic steelhead spawning and rearing habitat involve the Matilija Dam on Matilija Creek, and the Rindge Dam on Malibu Creek. Matilija Dam is a concrete arched dam 150 feet in height. Because of sedimentation and the dam's notched spillway, Matilija Dam has no significant flood control capacity, and only limited water storage capacity. Matilija Dam blocks the principal historic spawning and rearing habitat in the Ventura River system; its removal would double the current amount of spawning and rearing habitat. (A related effort to provide fish passage at the Robles Diversion on the mainstem is also being actively pursued.) Rindge Dam is a concrete arched dam 100 feet in height. Rindge dam is completely filled in with sediments and provides no flood control or water supply benefits. Rindge Dam blocks over three-quarters of the historic spawning and rearing habitat in Malibu Creek, leaving only two miles of stream habitat accessible to steelhead; its removal would triple the amount of spawning and rearing habitat accessible steelhead in Malibu Creek.

A major issue in both dam removal proposals is the disposal of sediments stored behind the dams. Matilija Dam is estimated to store over four million cubic yards of material, while Ridge Dam is estimated to hold approximately one million cubic yards of material. This material is composed of a mixture of sediments ranging in size from fine silts to larger sandstone boulders. The sudden release of this material into the downstream channels would effect the remaining habitat within the lower stream sections and coastal lagoons, possible filling in remaining holding pools and spawning areas used by adult steelhead, as well as the shallow coastal lagoons used by both adults and juveniles to acclimate to marine and freshwater.

Several alternatives to managing this sediment have been identified: (1) phased lowering of the dam structure to allow sediments to be metered into the lower reaches; (2) excavating the sediments and hauling them to construction sites or nearby coastal beaches; (3) conveying the sediments through a slurry-pipe to downstream coastal beaches. Because the sediments stored behind these dams are generally suitable for placement on coastal beaches (where they

would have naturally been deposited) the removal of Matilija and Rindge Dams are being viewed as multi-purpose restoration projects, involving recovery of southern Californian steelhead and the re-establishment of coastal beaches eroded as a result of sediments trapped behind these facilities.

The quality of the freshwater and marine habitats used by southern California steelhead is influenced by a wide variety of landuse practices in coastal watersheds that are not regulated by State or Federal resource agencies. Consequently, recovery and

management of steelhead resources in southern California will require the active involvement and cooperation of private landowners, municipalities, and county governments that have important regulatory and planning responsibilities for all non-federal and non-state lands, as well as the more traditional public resource agencies such as the California Department of Fish and Game, the U.S. Fish and Wildlife Service, the U.S. Forest Service, and the National Marine Fisheries Service.

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