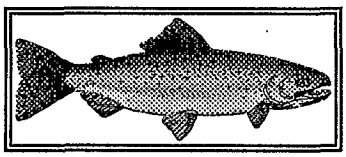
CALFED Vision for Steelhead Trout



The CALFED vision for Central Valley steelhead trout is to achieve naturally spawning population levels that support inland recreational fishing opportunities and which fully use existing and restored habitat. This is consistent with CALFED's vision of restoring populations of steelhead to levels that eliminate the need for any future protection under the Endangered Species Act. In attaining this vision, CALFED needs to maintain and restore important ecological functions and processes that create and maintain steelhead habitats and to reduce or eliminate stressors and known sources of mortality.

Overall, CALFED envisions restoring degraded habitat, restoring access to historic habitat that is presently blocked, supporting angling regulations consistent with restoring ecosystem processes and functions, supporting additional research to address large deficiencies in information regarding steelhead fresh water and ocean life history, behavior, habitat requirements, and other aspects of steelhead biology, and in providing opportunities for angling and non-consumptive uses.

CALFED envision that Central Valley hatcheries will be operated to protect and maintain the existing genetic diversity of naturally spawning populations, and that hatchery produced fish will provide for a healthy recreational fishery.

Ecological Health of Steelhead Trout Populations

Main stem Sacramento River	*F*
Upper Sacramento River Tributary Streams	*C*
Feather River	*C*
Yuba River	*C*
San Joaquin River	*?*
Hatchery stocks	*B*

Background

Rainbow trout exhibit one of the most complex life histories of any salmonid species. Those that exhibit anadromy (meaning that they migrate as juveniles from fresh water to the ocean, and then return to spawn in fresh water as adults) are called steelhead, and those that reside their entire life in fresh water are referred to as rainbow trout. Steelhead typically migrate to marine waters after spending 1 or 3 years in fresh water. They then reside in marine waters for typically 2 or 3 years prior to returning to their natal stream to spawn as 3-5 year old fish. Unlike Pacific salmon, steelhead are iteroparous, meaning that they are capable of spawning more than once before they die. However, post-spawning survival rates are generally low. It is likely that steelhead and resident forms interbreed, thus forming a single population in streams where they coexist.

Biologically, steelhead can be divided into two reproductive ecotypes which is based on their state of sexual maturity at the time or river entry, the duration of their spawning migration, and behavior. These two ecotypes are termed "stream maturing" and "ocean maturing". Stream maturing steelhead enter fresh water in a sexually immature condition and require several months to mature and spawn. Ocean maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of fresh water entry (e.g., summer and winter steelhead). Central Valley steelhead stocks are typically of the ocean maturing type and are called winter steelhead. There is some evidence that summer steelhead

were once present, but the construction of large dams on the major tributaries, which blocked adults from reaching the deep pools which they need to oversummer, likely eliminated these populations.

The National Marine Fisheries Service has identified steelhead populations in the Central Valley as composing a single evolutionarily significant unit (ESU) based on a variety of criteria physical and biological data including: (1) the physical environment -- geology, soil type, air temperature, precipitation, river flow patterns, water temperature, and vegetation, (2) biogeography -- marine, estuarine, and freshwater fish distributions, (3) life history traits -- age at smolting, age at spawning, river entry timing, and spawning timing, and genetic uniqueness.

The Central Valley steelhead ESU is comprised the Sacramento and San Joaquin rivers and their tributaries. Recent allozyme data show that samples of steelhead from Deer and Mills creeks and Coleman National Fish Hatchery on Battle Creek are well differentiated from all other samples of steelhead from California.

The National Marine Fisheries Service, in reviewing the status of Central Valley steelhead, concluded that the ESU is presently in danger of extinction due to widespread degradation, destruction, and blockage of freshwater habitats and the potential results of continuing habitat destruction, water allocation problems, and interactions between introduced and native stocks.

The National Marine Fisheries Service has recommended general conservation measures for steelhead throughout their range along the Pacific Coast. These conservation measures when applied to the Central Valley include the following:

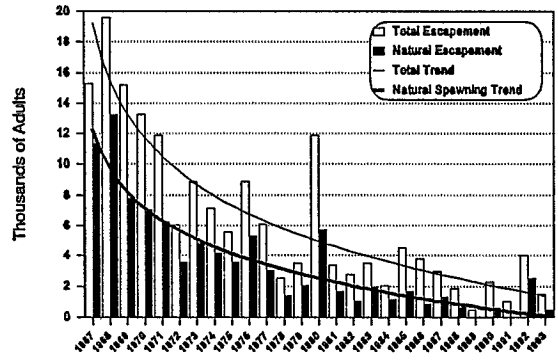
- Implement land management practices that protect and restore habitat. Existing practices that may affect steelhead include timber harvest, road building, agriculture, livestock grazing, and urban development.
- Existing harvest regulation should be reviewed to identify any changes that would further protect Central Valley steelhead.
- Hatchery program should incorporate practices to minimize impacts upon native populations of steelhead.
- Existing dams should have provisions to allow the upstream passage of adult steelhead.
- Water diversion should have adequate headgate and staff gauge structures to control and effectively monitor water usage, and that water rights should be enforced.
- Irrigation diversions affecting downstream migrating steelhead should be screened.

Identification and Status of Key Habitats, Ecosystem Processes, and Stressors

Steelhead are somewhat unique in that they are dependent on essentially all habitats of a river system: the estuary for rearing and acclimation to salt water; the main channel for migration between the ocean and upstream spawning and rearing areas; and the tributaries for spawning and rearing. Because of this, the are found in virtually all Ecological Zones and many of their respective ecological units. Overall, the decline of the steelhead trout population resulted from the cumulative effects of

degradation and loss of spawning, rearing and migration habitats in the Sacramento and San Joaquin basins and the Sacramento-San Joaquin Delta. Specifically, the decline was most likely precipitated by a combination of factors that reduced or eliminated important ecological processes and functions such as: 1) construction of dams on the larger rivers and streams which eliminated access to critical habitat for adults and juveniles, 2) excessively warm water temperatures during the pre-spawning, incubation and early rearing period of juvenile steelhead, 3) the interruption or blockage of the free passage of juveniles and adults at diversion dams, 4) loss of natural emigration cues do to altered flow regimes resulting from the export of water from large diversions in the South Delta, 5) entrainment to a large number of unscreened and poorly screened diversions, and 6) degradation and loss of woody debris, shaded riverine aquatic, riparian corridors and forests, and floodplain functions and habitats due to such factors such as channelization, levee construction, and land use.

FIGURE 1. Sacramento River Steelhead Adjusted Counts at Red Bluff Diversion Dam



A host of other factors has also contributed to the decline of the steelhead trout but perhaps to a lesser degree. These include the various smaller water manipulation facilities and dams; extensive loss of rearing habitats in the lower Sacramento River, San Joaquin River and Sacramento-San Joaquin estuary through levee construction and marshland reclamation; and the interaction and predation by introduced species.

Ecosystem Processes

Within the broad context of ecosystem restoration, salmon restoration will include a wide variety of efforts, many of which are being implemented for other ecological purposes or which are nonspecific to steelhead trout. For example, restoration of riparian woodlands along the Sacramento River between Keswick Dam and Verona will focus on natural stream meander, flow, and natural revegetational/successional processes. These will be extremely important in providing shaded riverine aquatic habitat, woody debris, and other necessary habitats required by lower trophic organisms and juvenile and adult salmon populations.

Operation of the water storage and conveyance systems throughout the Central Valley for their potential ecological benefits can be one of the more important elements in restoring a wide spectrum of ecological resources including steelhead trout.

Stressors

Inadequate connectivity between upstream holding, spawning, and rearing habitat in certain tributary streams has impaired or reduced the reproductive potential of some steelhead stocks. These issues are discussed in greater detail in the CALFED visions for the 14 ecological zones.

Unscreened diversions are ubiquitous throughout the Central Valley. They are a known source of mortality and are discussed in greater detail in the CALFED Vision for Water Diversion.

Ecosystem Restoration Needs and Opportunities

Rebuilding steelhead trout populations to a healthy state will require a coordinated approach to restoring ecosystem processes and functions, restoring habitat, reducing or eliminating stressors, and wise, ecologically benign management and operations of the four hatcheries in the Central Valley that propagate steelhead. One of the critical efforts is to conduct the necessary evaluations and analyses to determine the potential benefits and consequences of reintroducing certain steelhead stocks above major dams in order to provide access to historic spawning and rearing areas. The potential transfer of adult fish above the dams may be straight forward, but insuring that juveniles successfully emigrate downstream is very uncertain. There has been limited success in the passage of juvenile salmonids at large dams in the Columbia River basin, but whether this will be a viable option to protect and restore naturally spawning steelhead trout in the Central Valley is unknown.

In addition, there is a strong need to mark all artificially produced steelhead in order to allow better estimation of the success and contributions from naturally spawning stocks.

Linkage to Other Restoration Programs

Two major programs to restore steelhead trout populations exist within the Central Valley. The U.S. Fish and Wildlife Service is required by the Central Valley Project Improvement Act (Public Law 102-575) to double the natural production of Central Valley anadromous fish stocks by the year 2002. The California Department of Fish and Game is required under state legislation (The Salmon, Steelhead Trout and Anadromous Fisheries Program Act of 1988) to double the numbers of steelhead present in the Central Valley in 1988.

Each of these steelhead trout restoration programs has developed specific restoration goals for Central Valley steelhead trout stocks (Table 1). Although CALFED embraces each of the restoration goals, CALFED will contribute to each agency's program through the restoration of critical ecological processes and functions, habitats, and reduction or elimination of stressors. CALFED's approach is to contribute to the management and restoration of each stock with the purpose of maintaining cohort replacement rates of much greater than 1.0 while the individual stocks are rebuilding to desired levels. When the stocks approach the desired population goals, CALFED will contribute to maintaining cohort replacement rates a 1.0.

Selected References

McEwan, D. And T.A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California Department of Fish and Game. 234p.

McEwan, D., J. Nelson. 1991. Steelhead restoration plan for the American River. Department of Fish and Game. 40 p.

Mills, T.J., D.R. McEwan, and M.R. Jennings. 1996. California salmon and steelhead: beyond the crossroads, p. 91-111. *In* D. Stouder, P. Bisson, and R. Naiman, (eds.), Pacific salmon and their ecosystems: status and future options. Chapman and Hall, New York.

Mills, T.J. and F. Fisher. 1993. Central Valley anadromous sport fish annual run-size, harvest, and population estimates, 1967 through 1991. California Department of Fish and Game, Inland Fisheries Technical Report, June 1993. 70p.

Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley Streams: A Plan for Action. California Department of Fish and Game.