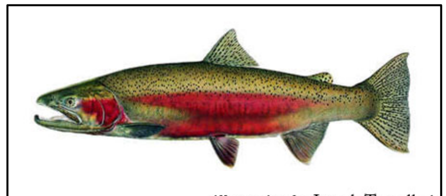
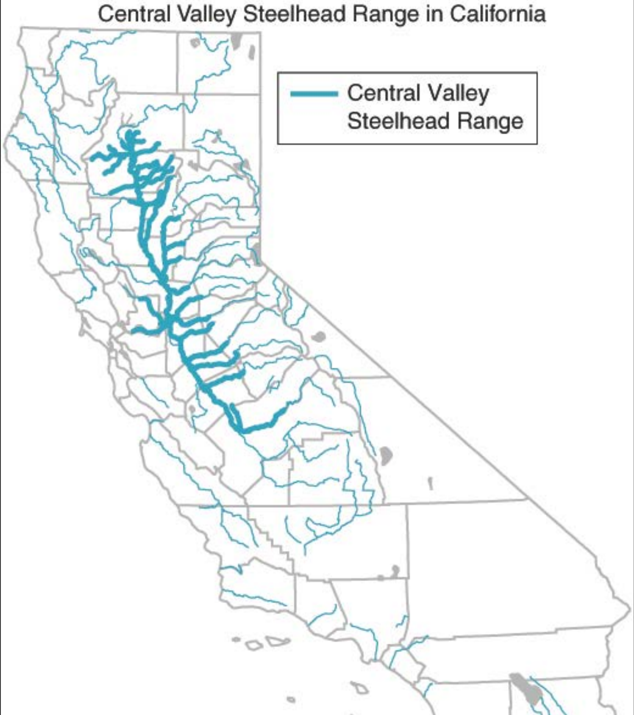
A.17 Central Valley Steelhead (*Oncorhynchus mykiss*)



A.17.1 Legal and Other Status

The Central Valley steelhead evolutionarily significant unit (ESU)1 was federally listed as threatened on March 19, 1998 (63 FR 13347). This listing included, "only natural spawned populations of steelhead (and their progeny) residing below naturally and manmade impassable barriers (e.g., impassible waterfalls and dams)... in the Sacramento and San Joaquin Rivers and their tributaries" (63 FR 13347). Steelhead in San Pablo and San Francisco Bays and their tributaries were not included in this ESU. On June 14, 2004, the National Marine Fisheries Service (NMFS) proposed that all West Coast steelhead be reclassified from ESUs to Distinct Population Segments (DPS)2 and proposed to retain Central Valley steelhead as threatened (69 FR 33102). Threatened status of the Central Valley DPS was reaffirmed on January 5, 2006 (71 FR 834). This decision included the Coleman National Fish Hatchery and Feather River Hatchery steelhead populations. Although previously included in the ESU, these populations were not deemed essential for conservation and were, therefore, not included in the listed steelhead population.



Critical habitat for the Central Valley steelhead was designated throughout the Central Valley on September 2, 2005 (70 FR 52488). Critical habitat was further characterized in the Federal Register Final Rule for steelhead on January 5, 2006 (71 FR 834). Critical habitat for the species is divided into 22 hydrologic units by watersheds. Of these, two occur in Butte County and include the Marshville and Butte Creek Hydrologic Units. These units include the Feather River through Oroville and Little Chico, Butte, Little Butte, and Little Dry creeks near Paradise.

Central Valley steelhead are not listed under the California Endangered Species Act but are designated as a California Species of Special Concern.

[1] An ESU is defined as a population that: 1) is substantially reproductively isolated from conspecific populations and 2) represents an important component in the evolutionary legacy of the species" (Johnson et al. 1994).

[2] A DPS is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species (NOAA 2011).

A.17.2 Species Distribution and Status

A.17.2.1 Range and Status

West Coast steelhead occur in Washington, Oregon, Idaho, and throughout California as far south as San Mateo Creek in San Diego County (McEwan 2001). The Central Valley steelhead DPS was once widespread throughout the Central Valley. Historically, steelhead likely occurred from the McCloud River and other northern tributaries in the Central Valley to Tulare Lake and the Kings River in the southern San Joaquin Valley (McEwan 2001, Good et al. 2005). More than 95 percent of historical spawning habitat is currently inaccessible to steelhead; before major dam construction, between 1 and 2 million steelhead may have spawned in Central Valley waterways (McEwan 2001).

No reliable estimates of historical Central Valley steelhead population size currently exist. Based on monitoring below the confluence of the Sacramento and San Joaquin rivers at Chipps Island in 1997 to 1999 and calculations reported in Good et al. (2005) using generous assumptions, roughly 100,000–300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the 1950s, the average estimated spawning population size above the mouth of the Feather River in the Sacramento River system was 20,540 fish (McEwan and Jackson 1996). In 1991–1992, the annual run size for the total Sacramento River system was likely less than 10,000 adult fish.

The population numbers returning to the Red Bluff Diversion Dam fish ladders have decreased substantially since 1966. In the late 1960s, roughly 20,000 fish passed through the fish ladders; in 1994, only 2,000 returned (Good et al. 2005). These statistics include hatchery fish from Coleman National Fish Hatchery.

The present distribution of Central Valley steelhead is greatly reduced from their historical range, mostly due to impassible dams that block access to spawning and rearing habitat. Naturally spawning populations that support anadromy have been found in the upper Sacramento River and tributaries, Mill, Deer, and Butte creeks, and the Feather, Yuba, Mokelumne, Calaveras, and Stanislaus rivers (McEwan 2001). Incidental captures of juvenile steelhead during Chinook salmon monitoring in the Cosumnes, Tuolumne, and Merced rivers confirm a widespread distribution of steelhead in accessible streams and rivers (Good et al. 2005).

A.17.2.2 Distribution and Status in the Plan Area

Central Valley steelhead have been observed spawning in the Plan Area in the Feather River upstream of the Thermalito Afterbay outlet to the Fish Diversion Dam (DWR 1999, NMFS 2005); Big Chico Creek (DFG 1993, NMFS 2005); Butte Creek upstream of River Mile (RM) 13 to upstream of the Plan Area (USFWS 2000); Little Dry Creek throughout its length in the Plan Area (NMFS 2005); Little Chico Creek throughout its length in the Plan Area (NMFS 2005); and Mud Creek (NMFS 2005) (Figure A.17-1, *Central Valley Steelhead Modeled Habitat*). Juvenile rearing occurs in all of these waterways as well as in Rock Creek and Lindo Channel. Although the California Natural Diversity Database (CNDDB 2006) has no records of Central Valley steelhead within Butte County, critical habitat has been identified by NMFS to include the Feather River, Little Chico Creek, Butte Creek, Little Butte Creek, and Little Dry Creek (NMFS 2005).

A.17.3 Habitat Requirements and Special Considerations

Optimal habitat for steelhead throughout its range on the Pacific Coast can generally be characterized by clear, cool water with abundant instream cover, well-vegetated stream banks, relatively stable water flow, and a 50:50 pool-to-riffle ratio (Raleigh et al. 1984). Although optimal water temperatures for steelhead are considered to range from 53.8ºF to 68ºF (12ºC to 20ºC), various sources document southern steelhead as persisting in streams with water temperatures ranging from 58ºF to 80ºF (14.4ºC to 25.5ºC) during the summer and early fall months of drought years (Titus et al. in preparation). The critical thermal maximum is reported to be up to 85ºF (29.4ºC) (Lee and Rinne 1980). Maximum water temperature thresholds have been established by NMFS (2009b) for spawning and egg incubation at 56°F and for juvenile rearing and juvenile and adult migration at 65°F.

In fresh water, steelhead use freshwater habitat for spawning, rearing, and migration (65 FR 7764). Essential features of steelhead habitat include adequate substrate, water quality and quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. In general, appropriate stream flow, water temperature, and water chemistry (e.g., high dissolved oxygen and low turbidity) are necessary for adult migration to spawning areas and juvenile migration to the ocean. Suitable water depth, velocity, and substrate composition are the primary requirements for spawning, although water temperature and turbidity are also important. Dissolved oxygen, pH, and water temperature all affect survival of incubating embryos. Fine sediment particles (sand and smaller) can settle into the spaces between larger substrate particles (such as gravel and cobbles) in the redd, which reduces water flow and dissolved oxygen concentrations.

For juvenile steelhead, living space (defined by water depth and velocity), shelter from predators and adverse environmental conditions, a food supply, and suitable water quality and quantity are necessary for survival and development while in fresh water. Young-of-the-year steelhead use shallow water and constituent habitats, whereas larger, older juveniles use deeper water for ontogeny and survival (A. Spina no date). All age classes, however, may seek cover and cool water in pools during the summer (Nielsen et al. 1994), especially when flow, and consequently space, decline during the summer and fall (Kraft 1972).

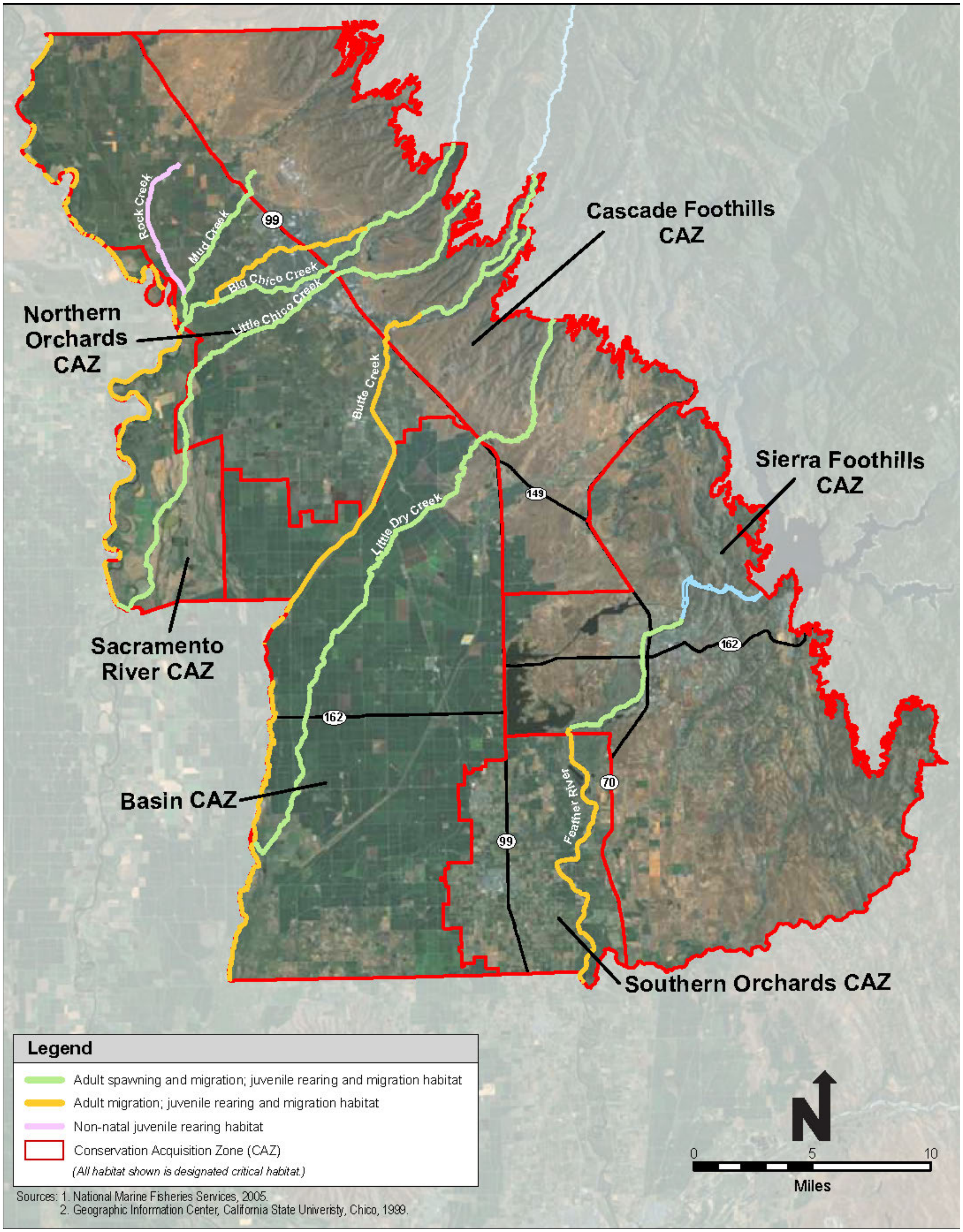


Figure A.17-1. Central Valley Steelhead Modeled Habitat

The four primary constituent elements of freshwater critical habitat for steelhead include:

- Freshwater spawning sites (i.e., providing suitable water temperatures and instream flows for successful spawning in the upstream reaches of the tributary rivers);
- Freshwater rearing sites (i.e., providing suitable water quality for juvenile rearing, instream flows to support physical habitat, connectivity with floodplains, tidal habitat, channel margin habitat, and other juvenile rearing areas, and providing suitable food resources for juvenile rearing);
- Freshwater migration corridors (i.e., reducing and avoiding passage barriers and impediments, providing suitable water quality and instream flows to support access and connectivity for migration within the tributary rivers, seasonally inundated floodplains and tidal habitats, and migration pathways through the Delta); and
- Estuarine areas (i.e., providing unobstructed migration and rearing opportunities, suitable water quality with salinity conditions that support juvenile and adult physiological transitions between freshwater and saltwater, and providing food resources to support juvenile growth and survival) (70 FR 52488, 71 FR 834).

A.17.4 Life History

Steelhead are the anadromous form of rainbow trout, migrating from the Pacific Ocean to upstream rivers and streams to spawning grounds. Adult steelhead enter creeks in the winter (September through March), usually after the first substantial rainfall, and move upstream to suitable spawning areas. Spawning can occur in winter to spring (January through March, or April in some years), generally in riffle areas or the tails of pools. Suitable spawning gravels generally are 0.5 to 3 inches in diameter, are not heavily compacted, and have low amounts of sand or silt in them; however, steelhead can successfully spawn in gravels not meeting these characteristics. Females dig a nest, or redd, in the gravel and deposit their eggs, the males fertilize the eggs, and the female covers the nest with gravel.

After eggs hatch (three and one-half to five weeks), fry emerge from the gravel in two to six weeks in late May to early June, and disperse throughout the creek, typically occupying shallow areas along stream margins. Juvenile steelhead often move to deeper water as they grow and will remain in freshwater for an average of two years before migrating to the ocean (62 FR 43937). Downstream movement of kelts[3] generally occurs from January through April. Downstream juvenile migration usually occurs from October to May. Photoperiod, stream flow, and temperature appear to influence emigration timing (Shapovalov and Taft 1954, Bjornn and Reiser 1991, Holubetz and Leth 1997). Juvenile steelhead may spend several weeks in the coastal lagoon or estuary of a stream before entering the ocean. They reside in the ocean for two to three years before returning to their natal stream to spawn (62 FR 43937), although in wet

[3] "Kelt" is the name given to adult salmon and steelhead after they have spawned.

years steelhead may return to spawn after only one year in the ocean (Moyle et al. 1995). Adults can spawn more than once, although most do not spawn more than twice (62 FR 43937).

A.17.5 Threats

Steelhead populations have been most significantly impacted by the construction of dams that block access to headwaters of the main stem Sacramento and San Joaquin rivers and all the major tributaries (McEwan and Jackson 1996). The construction of barrier dams along the migratory streams has blocked steelhead passage to many natal tributaries, resulting in the loss of spawning and holding habitat. Compared to historical extent, the spawning and rearing habitat accessible to steelhead has been substantially reduced. Dam-regulated low flow periods and alterations in river flows are other limiting factors for steelhead migration and reproduction. During low flows, fish are unable to reach natal spawning habitat or become disconnected and isolated from flowing water. In dry years, some individuals may be blocked from their streams and forced to remain in main rivers where breeding habitat is marginal.

Elevated water temperatures are the result of inadequate carryover storage in Shasta and other reservoirs and warm agricultural runoff (McEwan and Jackson 1996). Steelhead require cool water temperatures, and increases in water temperatures negatively impact the rate of survival. Land use activities associated with logging, road construction, urban development, mining, livestock grazing, agriculture, and recreation are causing a decline in quantity and quality of fish habitat by changing streambank and channel morphology, altering water temperatures, degrading water quality, and blocking access to spawning areas (McEwan and Jackson 1996).

Artificial propagation of steelhead at multiple Central Valley hatcheries presents threats to the wild steelhead population (NMFS 2009b). A major concern is genetic introgression by hatchery origin fish that spawn naturally and interbreed with wild fish (McEwan and Jackson 1996). Genetic introgression is thought to introduce maladaptive traits to wild stocks that can reduce their survival and fitness (Araki et al. 2007). Straying of hatchery fish is also a significant problem within the DPS that reduced the genetic integrity of local populations (Hallock 1989). There is thought to be significant local genetic structure of steelhead populations in the Central Valley (NMFS 2009b).

A.17.6 Relevant Conservation Efforts

Several efforts have been established by DFG to conserve and restore steelhead throughout California, including 100 percent marking of hatchery-produced steelhead, zero bag limit for unmarked steelhead, gear restrictions, harvest closures, and size limits.

Biological opinions for State Water Project (SWP) and Central Valley Project (CVP) operations (e.g., NMFS 2009a) and other federal projects involving irrigation, water diversion, and fish passage have improved or minimized adverse impacts on steelhead in the Central Valley. In 1992, an amendment to the authority of the CVP through the Central Valley Project

Improvement Act (CVPIA) was enacted to give protection of fish and wildlife equal priority with other Central Valley Project objectives. From this Act arose several programs that have benefited listed salmonids. The USFWS's Anadromous Fish Restoration Program is engaged in monitoring, education, and restoration projects designed to contribute toward doubling the natural populations of select anadromous fish species residing in the Central Valley, including steelhead. Restoration projects funded through the program include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment.

The CALFED Ecosystem Restoration Program (ERP) has conducted restoration actions that include installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. A major CALFED ERP action currently underway is the Battle Creek Salmon and Steelhead Restoration Project. This project will restore 77 kilometers (km) (48 miles) of habitat in Battle Creek to support steelhead and Chinook salmon spawning and juvenile rearing at a cost of more than $130 million. The project includes removal of five small hydropower diversion dams, construction of new fish screens and ladders on another three dams, and construction of several hydropower facility modifications to ensure continued hydropower operations. This restoration effort, which began in 2009 and is expected to be completed in 2015, is believed to be the largest cold water restoration project to date in North America.

Since about 1992, state and federal resource agencies, including CALFED, DFG, and AFRP, in cooperation with various environmental groups and water agencies have conducted numerous restoration activities in Butte Creek primarily focusing on anadromous fish. Restoration activities have included removing six dams that blocked passage, screening several water diversions to reduce the risk of entrainment, and installing fish ladders and water control structures to aid in migration.

Oroville Dam Federal Energy Regulatory Commission (FERC) relicensing efforts on the Feather River have considered instream flows and temperature management for steelhead spawning and juvenile rearing downstream of the dam.

In August 2011, the Red Bluff Diversion Dam's gates were raised for the final time as part of the Fish Passage Improvement Project. A new pumping facility is being built to provide reliable water supply for high-valued crops in Tehama, Glenn, Colusa, and northern Yolo counties while providing year-round unimpeded fish passage. Gate closures at the dam have historically interrupted the passage of steelhead and other migratory species.

The Bay Delta Conservation Plan is under development to contribute to the recovery of Central Valley steelhead and other fish species. Proposed conservation measures under the plan that would benefit steelhead include restoration of up to 65,000 acres of tidal wetland, 10,000 acres of floodplain, and 10 linear miles of channel margin habitat; reductions in predation; improvements in dissolved oxygen levels in the Stockton Deep Water Ship Channel; reductions in illegal harvest; improvements in fisheries in the Yolo Bypass; and contributions to hatchery and genetic management plans at Central Valley hatcheries.

Mitigation under the Delta Fish Agreement has increased the number of wardens enforcing harvest regulations for steelhead and other fish in the Bay-Delta and upstream tributaries by creating the Delta Bay Enhanced Enforcement Program (DBEEP). Initiated in 1994, DBEEP currently consists of nine wardens and a supervisor.

Many smaller tributaries to the Sacramento and San Joaquin rivers have local watershed conservancies with master plans to contribute to conservation and recovery of steelhead and other salmonids.

A.17.7 Species Habitat Suitability Model

Steelhead migration, spawning, and rearing habitats are defined as migration, spawning, and rearing habitats delineated by NMFS (2005) and GIC (1999) (Figure A.17-1).

A.17.7.1 Spawning Habitat

Spawning habitat of Central Valley steelhead exists in multiple waterways throughout the Plan Area. Spawning occurs in the Plan Area throughout Mud Creek, Little Chico Creek, Big Chico Creek, and Little Dry Creek, in Butte Creek upstream of river mile (RM) 13 to outside the Plan Area, and in the Feather River upstream of the Thermalito Afterbay Outlet to the Fish Diversion Dam.

A.17.7.2 Adult Migration Habitat

Adult migration habitat occurs in and downstream of all spawning habitat locations in the Plan Area.

A.17.7.3 Juvenile Rearing and Migration Habitat

Juvenile rearing and migration habitat occurs throughout adult spawning and migration habitat. Some nonnatal juvenile steelhead rearing has also been observed in Rock Creek, a tributary to Big Chico Creek.

A.17.7.4 Assumptions

Data from NMFS were used for this model because NMFS is the federal agency responsible for managing steelhead and, as such, is considered to be the authority on the distribution of the species and its habitat. Data gaps in the NMFS (2005) GIS database were augmented with information from Chico State University's Geographic Information Center (1999).

A.17.8 Recovery Plan Goals

The Public Draft Recovery Plan for Central Valley salmonids, including steelhead, was released by NMFS on October 19, 2009. Although not final, the overarching goal in the public draft is the removal of, among other listed salmonids, the Central Valley steelhead DPS from the Federal List of Endangered and Threatened Wildlife (NMFS 2009b). Several objectives and related criteria represent the components of the recovery goal, including the establishment of at least two viable populations within each historical diversity group, as well as other measurable biological criteria.

A.17.9 References

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