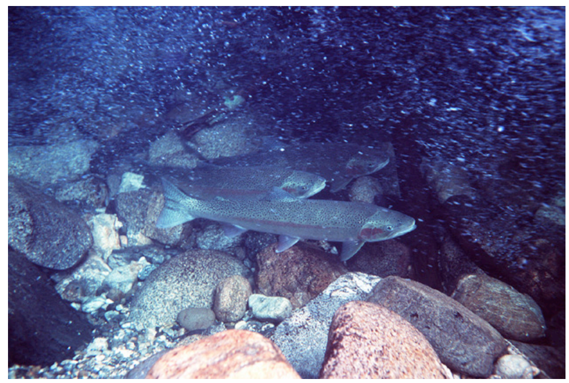
STEELHEAD – CENTRAL CALIFORNIA COAST ESU AND CENTRAL VALLEY ESU

Oncorhynchus mykiss iredeus
USFWS: Threatened
CDFG: None

Species Account



Status and Description. Steelhead are anadromous (sea-run) forms of rainbow trout. The steelhead in California are classified as the coastal subspecies, *Oncorhynchus mykiss irideus* (Behnke 1992). Steelhead and populations of other Pacific salmonids are further divided into Evolutionarily Significant Units. An Evolutionarily Significant Unit or ESU is a distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout (NOAA and NMFS 2002). Within the Solano Project Plan Area, two ESUs are present: the Central Valley ESU and Central California Coast ESU.

The Central California Coast steelhead ESU was listed as a federally threatened species on August 18, 1997 (Federal Register 1997). The Central California Coast steelhead ESU includes all naturally spawned populations of steelhead (and their progeny) in California streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), excluding the Sacramento-San Joaquin River Basin (NOAA and NMFS 2002).

The Central Valley steelhead ESU was listed as a threatened species on March 19, 1998 (63 FR 13347). This ESU includes all naturally spawned populations of steelhead (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries. Excluded are steelhead from San Francisco and San Pablo Bays and their tributaries. Steelhead from the Central Valley ESU would be expected to spawn in the streams of Solano County.

Besides their larger size at spawning, steelhead are nearly indistinguishable from the resident rainbow trout that also live in the same streams in which they spawn (Moyle 1976). Steelhead are usually silver in color with black spots on the back, adipose fin, dorsal fin, and its slightly forked tail and a pink to red lateral band (Moyle 2002). They also have pinkish colored cheeks, an iridescent blue to nearly brown back, and silver, white, or yellowish sides and belly (Moyle 2002). The mouth is large and usually has its maxillary extended to behind the eye and has teeth on the upper and lower jaws, the head and shaft of the vomer, the palatines, and on the tongue (Moyle 2002). Steelhead have a dorsal fin with 10-12 principal rays, an anal fin with 8-12 rays, two pelvic fins with 9-12 rays each, and two pectoral fins with 11-17 rays each (Moyle 2002). Approximately 16-22 gill rakers are on each arch and 9-13 branchiostegal rays. The scales have 110-160 pored scales along the lateral line, 18-35 scale rows above the lateral line, and 14-29 scale rows below the lateral line (Moyle 2002). Adults that have returned from the ocean can reach a length of approximately 23 inches (Leidy 2000). Freshwater juveniles or smolts range between 13-25 centimeters in length (Moyle 2002) and are similar in color to adults except that they have 8-13 parr marks centered on the lateral line, 5-10 dark marks on the back between the head and dorsal fin, white to orange tips on the dorsal and anal fins, and few or no black spots on the tail (McPhail and Lindsey 1970). Steelhead at hatching are 14-15.5 millimeters total length, with alevins ranging between 23-26 millimeters in total length (Wang 1986). Juveniles that remain in the freshwater as "smolts" are 13-25 centimeters in total length (Moyle 2002). Eggs are spherical to slightly irregular in shape, non-adhesive, demersal, and are 3-6 millimeters in length (Wang 1986).

Range, Populations and Activity. The range of the Central California Coast ESU includes coastal river basins from the Russian River south to Soquel and Aptos Creek, California (inclusive), and the drainages of San Francisco and San Pablo Bays, including the Napa River. Also included are adjacent riparian zones, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay from San Pablo Bay to the Golden Gate Bridge. Major river basins containing habitat comprise approximately 6,516 square miles. These basins are located within Alameda, Contra Costa, Marin, Mendocino, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma counties (NOAA and NMFS 2002). Historically, most streams with suitable habitat within the San Francisco Bay Estuary supported steelhead populations (Leidy 2000). However, currently only small runs, estimated to be less than 10,000 fish, exist in the San Francisco Bay tributaries (Leidy 2000).

Historically, the Central Valley ESU steelhead were well-distributed throughout the Sacramento and San Joaquin river systems: from the upper Sacramento/Pit river systems south to the Kings and possibly Kern river systems in wet years (Yoshiyama *et al*. 1996). Presently, the Central Valley contains only winter steelhead, but fish counts made prior to the era of large dam construction indicate that summer steelhead also occurred in the Sacramento River system (Needham *et al*. 1941, USFWS and CDFG 1953). Because adults need to over-summer in deep pools in mid to high elevation tributaries, summer steelhead were probably eliminated with the construction of large-scale dams during the 1940s, 1950s, and 1960s (IEPSP 1998). Yoshiyama *et al*. (1996) estimated that more than 82% of steelhead spawning and rearing habitat in the Central Valley had been lost. In the late 1950s, the California Department of Fish and Game (CDFG 1965) estimated an annual run size of approximately 30,000 steelhead for the Sacramento River above the mouth of the Feather River and 40,000 steelhead for the remainder of the Central Valley, including tributaries to San Francisco Bay. Also in the 1950s, Hallock *et al*. (1961) estimated the average annual steelhead run size was 20,540 adults in the Sacramento River system above the mouth of the Feather River.

Currently, the Central Valley steelhead ESU includes steelhead in all river reaches accessible to the Sacramento and San Joaquin Rivers and their tributaries in California (Federal Register 2000a). Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the San Joaquin River upstream of the Merced River confluence and areas above specific dams identified or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) (Federal Register 2000a). Based on Red Bluff Diversion Dam counts, hatchery counts, and prior natural spawning escapement estimates from the early 1990s, McEwan and Jackson (1996) roughly estimated the total annual run size (hatchery and wild) for the entire system at no greater than 10,000 adult fish.

Steelhead in both ESUs are classified as "ocean-maturing" and enter freshwater ready to spawn. Most steelhead in the County are likely "winter" run that migrate to freshwater in the fall and winter, where they spawn within a few weeks or months (McEwan and Jackson 1996). Steelhead will migrate upstream after 1-4 growing seasons at sea (Burgner *et al*. 1992). Most of these steelhead have well-developed gonads and often spawn shortly after entering a freshwater river or stream (Leidy 2000). In addition to adults, a few immature steelhead also migrate upstream from the ocean (Leidy 2000). Ocean-maturing steelhead typically spawn between December and April, with the peak between January and March, but migrating steelhead may be seen in the San Francisco Bay and Suisun Marsh and Bay as early as August (Leidy 2000). After spawning, steelhead may return to the ocean and spawn the following year (Leidy 2000).

Steelhead spawn in redds constructed by the female over a gravel and cobble substrate (Leidy 2000). Eggs are layed by the females in these redds where they are then fertilized by the males. Depending on their size, female steelhead produce between 200 and 12,000 eggs each (Scott and Crossman 1973, Moyle 1976). The incubation period for the eggs is related to the water temperature in the redd. Wales (1941) observed incubation lasting for 19 days with an average water temperature of 15.5 degrees Celsius, while Shapovalov and Taft (1954) estimated the incubation period at 25-35 days with emergence beginning 2-3 weeks following hatching. Alevins emerge from the redd following yolk sac absorption and are ready to feed as fry or juveniles (Leidy 2000). Within 1-4 years (usually two years), steelhead migrate downstream as "smolts" (juvenile fish which can survive the transition from fresh water to salt water). Juveniles may be able to reach smolt size at an earlier age when they inhabit warmer and more productive streams (Moyle *et al*. 1995). Steelhead may spend up to four years in the ocean, but most only survive to age two (Leidy 2000).

Steelhead are primarily drift feeders and may forage in open water of estuarine subtidal and riverine tidal wetland habitats (Leidy 2000). The diet of juvenile steelhead include emergent aquatic insects, aquatic insect larvae, snails, amphipods, opossum shrimp, and small fish (Moyle 1976). Adults may also feed on newly emergent fry (Leidy 2000). Steelhead usually do not eat when migrating upstream and often lose body weight (Pauley and Bortz 1986).

Habitat Use. Steelhead inhabit riparian, emergent, palustrine habitat (Leidy 2000). Spawning and rearing habitat is usually characterized by perennial streams with clear, cool to cold, fast flowing water with a high dissolved oxygen content and abundant gravels and riffles. Preferred water depth for spawning is 6-24 inches, for fry is 2-14 inches, and for parr is 10-20 inches (Bovee 1978). The preferred water velocity for spawning is approximately 2 feet per second (range of 1-3.6 feet per second), although the optimal velocity depends in part on the size of the steelhead (i.e., larger steelhead will spawn in water with higher velocities) (Barnhart 1986). Steelhead use various mixtures of sand-gravel and gravel-cobble substrate for spawning, but the optimal substrate ranges from 0.2-4.0 inches in diameter (Bovee 1978, Reiser and Bjornn 1979). Optimal water temperatures for steelhead are 46-52 degrees Fahrenheit for adult migration, 39-52 degrees Fahrenheit for spawning, 48-52 degrees Fahrenheit for incubation and emergence, 45-60 degrees Fahrenheit for fry and juvenile rearing, and below 57 degrees Fahrenheit for smoltification (Bovee 1978, Reiser and Bjornn 1979, Bell 1986). Although eggs can die at 56 degrees Fahrenheit and fish can experience difficulty in extracting oxygen from the water when temperatures exceed 70 degrees Fahrenheit (Hooper 1973), steelhead are adapted to survive conditions where preferred temperatures are exceeded for long periods of time (McEwan and Jackson 1996). Steelhead also prefer habitat with relatively good water quality that has low suspended sediment and contamination loads, and minimal pollution levels (Leidy 2000). Steelhead also require sufficient flows and habitat characteristics for spawning, rearing, and migration, such as shallow riffles for spawning and deep pools with well-developed cover for rearing (Leidy 2000).

Population Levels and Occurrence in Plan Area. Steelhead are mainly associated with the open water portions of the Freshwater Marsh and Streams/Sloughs within the Plan Area Riparian, Streams, and Freshwater Marsh Natural Community. The species can also be found in open water areas of within the Coastal Marsh Natural Community. Little historical information is available on steelhead distribution in Solano County (JRP Historical Consulting Services 2001). Numerous documents contain references to steelhead or other salmonids, but few detailed surveys have been conducted. Currently, Green Valley Creek and Suisun Creek are known to have or are suspected to occasionally support small steelhead runs (Leidy 2000). Steelhead have also been recently reported within American Canyon Creek. Sampling surveys conducted by the Solano County Water Agency have also identified rainbow trout in several locations in Green Valley Creek and Suisun Valley Creek during the summer; however, it is unknown if these fish are the resident trout or the anadromous steelhead (TRPA 2001). Steelhead can also be expected to occur at least periodically in any of the perennial streams in Solano County such as Ulatis, Alamo, Jameson Canyon, and Ledgewood creeks and their tributaries.

For most streams in Solano County and Plan Area, the lower stream reaches with the major agricultural and urban areas would be used primarily as passage habitat. Summer stream temperatures are typically too warm for steelhead. The upper reaches of the streams in the western portion of the County, however, may provide suitable conditions.

Dispersal. Steelhead migrate to freshwater habitat in the fall and winter, where they spawn within a few weeks or months (McEwan and Jackson 1996). Steelhead will migrate upstream after 1-4 growing seasons at sea (Burgner *et al*. 1992) and spawn between December and April (Leidy 2000). After spawning, steelhead may return to the ocean and spawn the following year (Leidy 2000). Within 1-4 years (usually 2 years), steelhead migrate downstream as "smolts."

Threats to the Species. The number of steelhead in California has declined by one half in the last 30 years from an estimated 500,000 to only 250,000 adults (McEwan and Jackson 1996). Steelhead runs in San Francisco Bay tributaries are estimated to be below 10,000 fish (Leidy 2000). Factors contributing to this population decline include barriers to passage during migration, water diversions, flow fluctuations, sub-optimal water temperatures for incubation and juvenile rearing, sedimentation of spawning habitat, and low summer flows for emigration (Leidy 2000). Migrating steelhead populations within the Suisun Bay/Marsh are threatened by altered flows, entrainment, and mortality associated with trapping, loading, and trucking fish at state and federal pumping facilities (Leidy 2000). Dredging and disposal of dredging material may also adversely affect steelhead habitat and interfere with migration, foraging, and food availability (LTMS 1996).

Critical Habitat. Critical habitat for both the Central California Coast and Central Valley steelhead ESUs was originally designated on February 16, 2000. For the Central California Coast, designated critical habitat includes all river reaches and estuarine areas accessible to listed steelhead in coastal river basins from the Russian River to Aptos Creek, California (inclusive), and the drainages of San Francisco and San Pablo Bays (Federal Register 2000). Also included are adjacent riparian zones, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay from San Pablo Bay to the Golden Gate Bridge. The Sacramento-San Joaquin River Basin of the California Central Valley, tribal lands, and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) are excluded from the ESU. Major river basins containing habitat for this ESU comprise approximately 6,516 square miles in California. The counties that lie partially or wholly within these basins (or contain migration habitat for the species) include: Alameda, Contra Costa, Marin, Mendocino, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma (NOAA and NMFS 2002).

For the Central Valley ESU, designated critical habitat includes all river reaches accessible to listed steelhead in the Sacramento and San Joaquin Rivers and their tributaries in California (Federal Register 2000a). Also included are adjacent riparian zones, river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the San Joaquin River upstream of the Merced River confluence, tribal lands, and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for the Central Valley steelhead ESU comprise approximately 13,096 square miles in California. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Glenn, Marin, Merced, Nevada, Placer, Sacramento, San Francisco, San Joaquin, Shasta, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, and Yuba.

The critical habitat definition included all accessible streams and adjacent riparian zones within the historic range of the species that can still be occupied by any life stage of steelhead. This can include streams where steelhead are not currently present, but which contain habitats which could support or be reasonably restored for steelhead in the future (i.e., potential habitat). Critical habitat information (i.e., specific watersheds, migration barriers, habitat features, and special management considerations) for each ESU is identified in the February 16, 2000 Federal Register notice (Federal Register 2000).

Steelhead critical habitat for both ESUs was vacated pursuant to an April 30, 2002, court order. The court order remanded the critical habitat designations for 19 steelhead and salmon ESUs to NMFS for new rulemaking to redesignate critical habitat because of inadequate economic analysis. This assessment was completed and critical habitat for steelhead was redesignated by NOAA NMFS on August 12, 2005. No streams within Solano County were designated as critical habitat.

Conservation. On July 10, 2000, NMFS published a final rule that identifies several exceptions to the Endangered Species Act's Section 9 take prohibitions. Commercial salmon trollers are not allowed to possess steelhead (McEwan and Jackson 1996).

Conservation Issues. Water quality – urban runoff effects on stream morphology and contaminants, protection and restoration of riparian habitats and stream temperatures particularly in upper reaches of the streams which may provide suitable breeding/juvenile habitat, and adult passage in lower reaches – not to create barriers or eliminating barriers

The primary considerations with respect to covered activities under the Solano Project HCP/NCCP are 1) the direct loss or modification of aquatic and riparian habitats, 2) changes in water quality and quantity related to discharge of surface water from impervious surfaces and landscaped areas into streams, 3) minimizing disturbance and habitat modifications during critical periods, and 4) providing adequate passage by eliminating existing barriers and not creating new barriers to upstream of downstream movement.

Streams or segments of the streams and their associated riparian corridors within much of the County have been modified to increase conveyance for flood control, minimize bank erosion, and increase areas available for development and agricultural uses. These activities typically result in a change in the natural channel geometry (i.e., loss of complexity, reduction of meanders), riparian vegetation is removed, large woody debris is lacking, and water temperatures increase. These activities eliminate or reduce the ability of the habitat to support steelhead. Large woody debris (tree trunks, large limbs) is considered important for steelhead and other anadromous fish because it provides overhead cover, creates calm or lower velocity waters for resting, and creates greater habitat complexity. Large woody debris is typically removed from streams because it creates flooding hazards, blocks flow through culverts or damages culverts and bridges, and increases bank erosion. While some sections of the streams retain narrow, but continuous riparian corridors and some channel complexity, the characters of other stream segments, particularly in the eastern portion of the County, have been channelized.

The effects of changes in water quality and quantity are often not as visually apparent as direct habitat modification. Urbanization alters the natural infiltration capability of the land and generates a host of pollutants that are associated with the activities of dense populations, thus causing an increase in storm water runoff volumes and pollutant loadings in storm water discharged to receiving water bodies. Urban development increases the amount of impervious surface in a watershed as farmland, forests, and meadowlands are converted into buildings, driveways, sidewalks, roads, and parking lots with virtually no ability to absorb stormwater. Stormwater runoff accumulates pollutants from parking lots and roads (oil, grease, heavy metals) and from residential areas (household and garden pesticides). The resulting storm water flows are higher in volume, higher in pollutants, and higher in temperature than the flows from less impervious areas (U.S. EPA 2000). Peak runoff is lower and pollutants are filtered from runoff that originates from areas covered by natural vegetation and soil as compared to impervious surfaces and ornamental landscaping. This can affect steelhead and other aquatic species within streams, rivers, and in downstream estuaries far removed from urban areas.

Natural and man-made barriers in streams can prevent adult steelhead from reaching suitable spawning habitats causing the fish to breed in sub-optimal habitats where survival of the young is unlikely or creating traps where predators have easier assess to concentrations of fish. Barriers can be caused by drop structures in streams or flood control channels, under–sized or poorly designed culverts and bridges, and under-grounding of streams.

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