APPENDIX C

STEELHEAD LIFE HISTORY

1.1 STEELHEAD LIFE HISTORY

Steelhead (*Oncorhynchus mykiss*) in the Ventura River watershed are currently listed as endangered under the Federal Endangered Species Act. Steelhead and rainbow trout were historically present in most coastal California streams, and resident rainbow trout were present in lakes and streams that did not have access to the ocean. In many historical steelhead streams, passage barriers have blocked migration to and from upper stream reaches and resulted in residualization of steelhead populations. On the Ventura River, as in many coastal California streams, there are natural and man-made barriers (e.g. dams and road crossings) to upstream migration that separate populations of steelhead/rainbow trout and resident rainbow trout. Some resident populations may release juveniles to downstream habitats. These fish have the potential to become steelhead and develop a range of migratory behaviors.

A schematic diagram of the lifecycle of steelhead is presented in Figure C-1. Steelhead are anadromous which means that they spend a portion of their lifecycle in rivers and stream and a portion in the ocean. Steelhead usually spend one to two years in the ocean before returning to spawn for the first time (Shapovalov and Taft 1954). Unlike other anadromous Pacific salmonids (i.e. salmon and steelhead), steelhead may survive spawning, return to the ocean and spawn again in a later year (Shapovalov and Taft 1954, Moyle 1976). Steelhead typically migrate upstream when streamflows rise during a storm event (Moyle 1976) and after sandbars, present across the mouth of most Southern California streams, are breached (Shapovalov and Taft 1954). Depending on rainfall, upstream migration and spawning typically occur from January to May, with a peak from February through mid-April, in most Southern California streams (Shapovalov 1944 as cited in ENTRIX 1995, Moyle and Yoshiyama 1992, NMFS 1996, ENTRIX 2002), and can potentially occur through June in the Ventura River (NMFS 1996).

Steelhead usually spawn at the downstream end of pools (where they grade into a faster-moving habitat type) or in riffles with gravel substrate (Moyle 1976). Optimal size of gravel substrate ranges from 0.6 to 10.2 cm or the tail of the pool (Bjornn and Reiser 1991). The female digs a pit in the gravel where she deposits her eggs. Often more than one male will fertilize the eggs before the female covers the eggs with gravel, creating a redd or nest (Moyle 1976). During the egg incubation period, sufficient water must circulate through the redd to supply embryos with oxygen and remove waste products. Abundant fine sediments can interfere with this process and result in embryo mortality (Bjornn and Reiser 1991). Juvenile steelhead emerge from the gravel after approximately five to eight weeks, typically between March and April, depending on water temperature (Shapovalov and Taft 1954, Moyle 1976). In water temperatures around 15.6ºC (60^{o}F), which can be the case in the Ventura River, steelhead can emerge from the gravel in as short as three weeks (Barnhardt 1991).

Young-of-the-year steelhead (e.g. steelhead produced that year) often utilize riffle and run habitat during the growing season (e.g. spring and summer) and move to deeper, slower water habitat during the high-flow months (Baltz and Moyle 1984, Hearn and Kynard 1986). Larger juvenile steelhead, usually yearlings or older, have been observed to use heads of pools for feeding (Cunjak and Green 1983, Baltz and Moyle 1984). The pools provide deeper water with sufficient cover to hide from predators and a food source as water enters the head of the pools carrying invertebrate prey. Coastal lagoons can also provide important rearing habitat for juvenile steelhead, potentially providing the majority of the summer and fall rearing habitat in small coastal streams (Shapovalov and Taft 1954, Smith 1990). The productivity and use of lagoon habitat by steelhead depends on lagoon habitat, water quality and proximity to spawning habitat (J. Smith, pers. comm., 1997).

In California, juveniles generally spend one to three years in freshwater before migrating to the ocean usually between March and June (Shapovalov and Taft 1954). In the mainstem Ventura River, steelhead can have very high growth rates, growing to smolt size during their first year (Moore 1980). Recent studies in the Santa Clara and Santa Ynez rivers indicate that outmigration in Southern California systems can occur between January and June, with a peak from late March through mid-May (ENTRIX 1996, ENTRIX 2002). It also appears the Southern California steelhead may have adapted to the unpredictable climate by being able to remain landlocked for many years or generations before returning to the ocean when flow conditions allow (Titus et al. 1994).

Temperature tolerances and preferences of steelhead vary among seasons, life stages, and stock characteristics. Juvenile steelhead can typically tolerate warmer temperatures than other Pacific salmonids (Moyle 1976). Mortality of eggs begins at 13.3ºC (56ºF) (McEwan and Jackson 1996). At temperatures greater than 21.1ºC (70ºF), steelhead have difficulty obtaining sufficient oxygen from the water (McEwan and Jackson 1996). The preferred temperature range is reportedly 12.8-15.6 ^{o}C (55.0-60.1 ^{o}F) (Rich 1987), although steelhead in the Ventura River have been reported at temperatures as high as 28^{o}C (82.4^{o}F) (Carpanzano 1996). The incipient lethal temperature for steelhead, calculated as the temperature ate which half a group of experimental fish die, is between approximately 25 and 26 ºC (77.0-78.8 ºF) under experimental conditions (Bidgood and Berst 1969, Kaya 1978). Warmer water requires more abundant food resources for fish survival, because of the resultant increase in their metabolic rate (Brett 1971, Fausch 1984). It should be recognized, however, that streams with warmer water would be expected to have more productive insect populations, thus providing the abundant food resources need for fish survival and growth.

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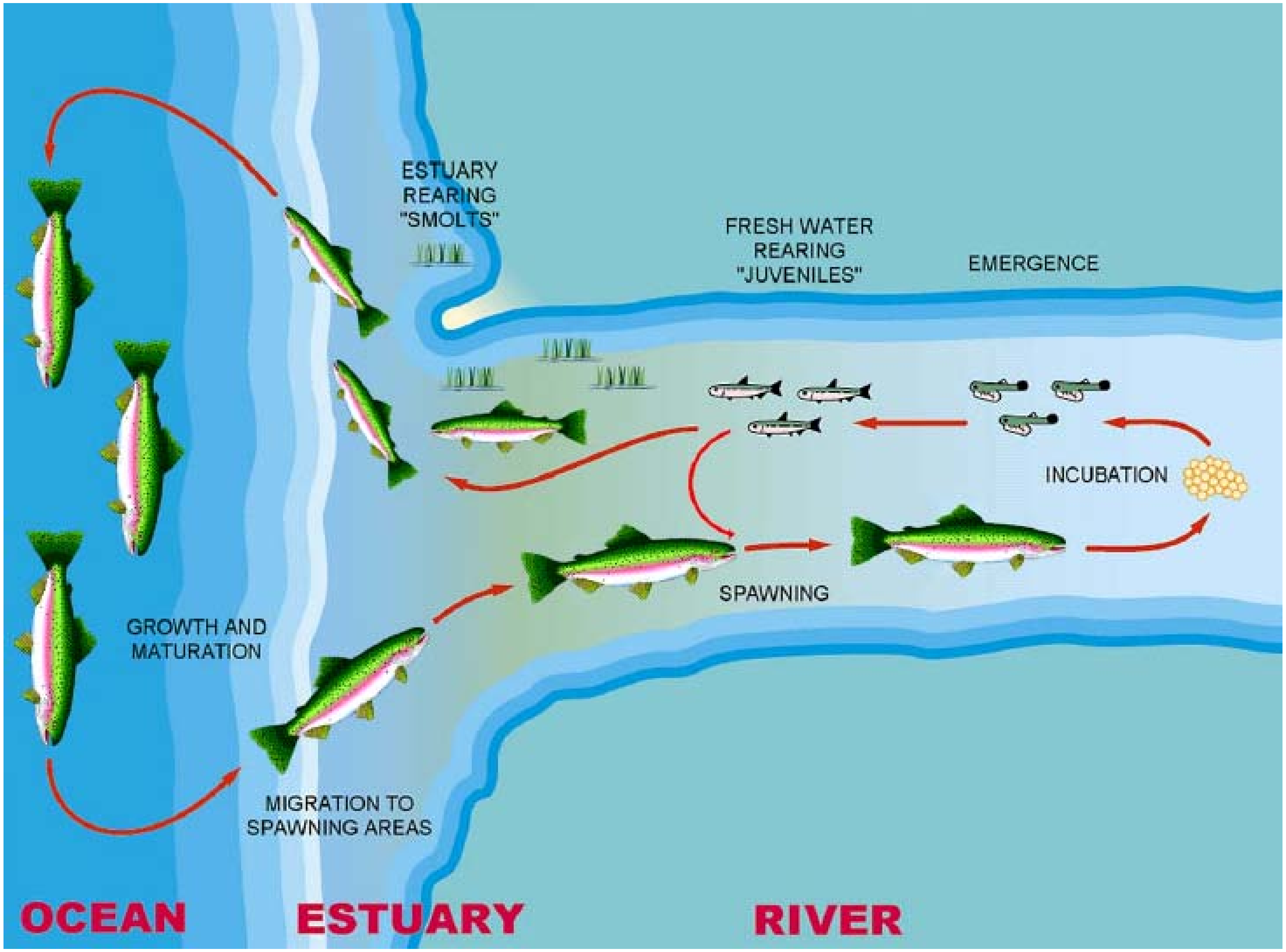

Source: Sonoma County Water Agency

Figure C-1. Steelhead Life History