Critical Habitat Comments
Stanislaus River

by Steve Cramer

STANISLAUS BASIN HABITAT FOR RAINBOW TROUT

The Stanislaus River is dammed at several locations for the purpose of flood control, power generation, and water supply. The largest of these dams, New Melones Dam at RM 68, is a U.S. Bureau of Reclamation project, holds a capacity of 2.4 million acre-ft of water, and has no fish passage facilities. This storage capacity is roughly double the mean annual runoff of the river, so flow released from the dam is regulated throughout most years. Water uses include irrigation and municipal needs, as well as recreational activities and water quality control. Because there are no perennial tributaries that enter the Stanislaus River below New Melones Dam, its operation is the second most important factor, after total runoff, controlling flows in the lower Stanislaus River.

Goodwin Dam, at river mile (RM) 58 of the Stanislaus River, blocks the upstream migration of anadromous fish. No spawning of rainbow/steelhead has been observed in the river below Goodwin Dam. Fall chinook spawn from Goodwin Dam down to the town of Riverbank (RM 34), but not below that point. Resident rainbow trout are abundant from Goodwin Dam down to Knights Ferry, a distance of 4 miles, and the popular sport fishery for these trout extends through the first 10 miles downstream from Goodwin Dam. In 1993, snorkel surveyors counted 35 age 1+ or older rainbow in a 300 ft stretch of river near RM 57 and 15 age 1+ or older rainbow in a 3,600 ft stretch of river near RM 54 (Cramer and Demko 1993). Age 0+ rainbow were observed in about equal numbers to those that were age 1+ or older in each area. Several rainbow over 15 inches were observed. There are anecdotal reports of occasional adult steelhead being observed above RM 40, but there are no reports of multiple steelhead being observed in the river together.

The rarity with which large migratory rainbow are observed, despite the abundance of resident rainbow for several miles below Goodwin Dam, suggests there is not a self-sustaining population of steelhead in the river. California Department of Fish and Game (CDFG) records prior to the 1990's indicate there was no indigenous population of steelhead present in the San Joaquin Basin. CDFG biologists Robert Reavis (1991) reported, "*There are no records of steelhead in the San Joaquin River system. If steelhead were present in this system, they may have been extirpated before the turn of the century due to gold mining activities.*" Cramer et al (1995) worked with a large team of consultants to assemble the available information on California steelhead, and found no information to contradict the report by Reavis (1991). Cramer et al. (1995) concluded, "Apparently, conditions for growth and migration of rainbow trout in the San Joaquin basin are such that the resident life history has a selective advantage over anadromy." CALFED's (1997) Ecosystem Restoration Program Plan (ERPP) acknowledges, "The presence of a distinct anadromous run of steelhead in the basin has not been confirmed" (Volume II, p. 346). EA Engineering (1991) reviewed all CDFG and U.S. Fish and Wildlife Service (USFWS) data from 10 years of fyke net sampling and seining during 1973-1986 in the Tuolumne River, and found no record of steelhead smolts being captured.

Anadromous fish are now constrained to the lowermost portion of the Stanislaus River that they once occupied, and the stream geomorphology limits the availability suitable habitat for rainbow/steelhead or chinook spawning and rearing. The elevation at the base of Goodwin Dam is only 300 ft, and half of this is lost in the first 4.5 miles of stream (Figure 1), through the reach known as Goodwin Canyon. The stream gradient remains at about 0.07% from RM 53 to the city of Riverbank (RM 34) and then is only 0.04% from Riverbank to the mouth (Figure 1). Thus, the lower 34 miles of the river is a meandering valley-bottom stream composed mostly of long glides. There are few riffles or distinct pools below RM 34. Stream gradient is too low for formation of even chinook spawning riffles below about RM 34, so spawning occurs above that point. Preferred habitat for juvenile salmonids is pools, riffles and the interfaces between the two, so most rearing habitat for rainbow/steelhead and chinook is above RM 40. Juvenile rainbow/steelhead also prefer pools and riffles, but with a strong preference for increasing water velocity as fish size increases (Chapman and Bjornn 1969; Everest and Chapman 1972). Because rainbow trout remain in the river throughout their life and grow to 15 to 20 inches long, their preferred stream velocities are in the higher stream gradients found above Knights Ferry (RM 54) (Figure 1).

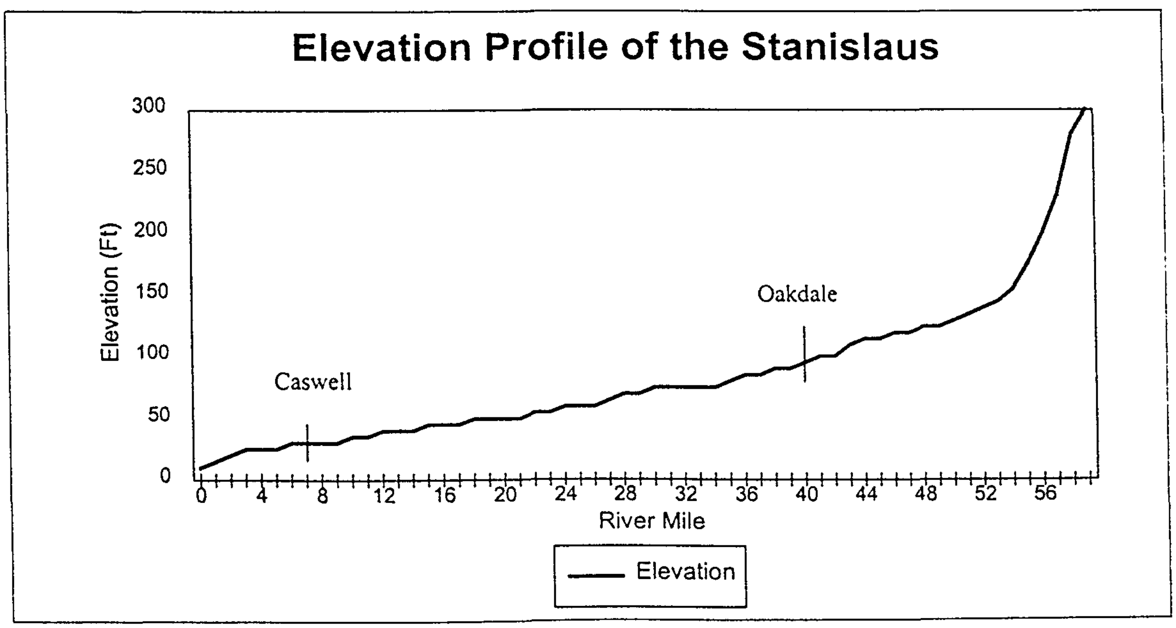

Figure 1. Stream elevation profile of the lower Stanislaus River .

As a result of the decreasing gradient of the river downstream of RM 54, the lowermost riffle with gradient sufficient to produce even small waves on the water is just below Orange Blossom Bridge near RM 48. The lack of gradient substantially influences the potential for rearing steelhead not only because it limits the formation of riffles and pools, but also because it limits the availability of velocities that juvenile steelhead strongly prefer for rearing. Carefully designed studies of habitat preferences for juvenile steelhead have established that parr chose habitat based on preferences for depth first, velocity second, and cover third. Yearling steelhead show a strong preference for velocities of 0.7 to 1.7 feet/second (Beecher et al. 1993). Water velocity is even more important to steelhead than these preferences indicate, because studies by Don Chapman Consultants (1989) in the Wenatchee River, Washington, showed that steelhead parr generally selected stations where adjacent velocities were 6-8 times faster than their nose velocity. Further, Don Chapman Consultants (1989) found that steelhead concentrated in high gradient reaches (>5%), and usually stationed individually behind boulders where surface turbulence provided cover. Dambacher (1991) found that electivity of age >1 steelhead increased for increasing slope of habitat types in large channels (steelhead parr preferred cascades). Bisson et al. (1988) surveyed third and fourth order streams in western Washington and found that age 1+ steelhead occurred most in riffles and preferred lateral scour and plunge pools, which are pool types that have moderate velocities within them. Anderson (1986) reported steelhead densities at age 1 for different micro-habitat types in 365 habitat units on streams of the central Oregon Coast. In that study, Anderson (1986) found that age 1 steelhead showed highest densities in rapids (0.139/m^2), followed by plunge and lateral scour pools (0.075 -0.057/m^2), and riffles with boulders or cobbles (0.06 - 0.045/m^2). These types of high velocity habitats are rare to absent in most of the Stanislaus River below RM 40 during August and September under natural (pre-development) flow conditions (50-300 cfs).

Not only does the low gradient of the river below about RM 34 prevent the formation of distinct pools and riffles, it also allows for rapid heating of the river, regardless of stream flow. Findings from the temperature model for the Stanislaus River recently completed by the USBR indicate that river temperatures at Riverbank and downstream will rise to 65EF and higher by mid to late May under most flow conditions (Rowell 1993). Another way of expressing this same finding is that only very large differences in flow affect water temperature below Riverbank , and air temperature becomes the dominant factor causing variation in stream temperature below this point. This characteristic of stream temperature is related to the morphology of the river, because stream gradient approaches zero below Riverbank, and water moves slowly through the 35 miles of meandering channel before it reaches the San Joaquin River. A clear example of the dominant influence of air temperature occurred in 1989 when water temperatures at Ripon climbed to 23°C for four consecutive days from May 3-7, at the same time that flows climbed to about 1,300 cfs, their highest during that spring (Figure 6). In contrast, flows were only 950 cfs during the first week of May in 1988, and river temperature at Ripon remained near 14°C.

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The low-gradient river below RM 35 is generally used by chinook salmon (the only anadromous salmonid present) only as a migration corridor. Juvenile chinook generally do not pause to rear for extended periods between the migrant traps at RM 40 and RM 6 in the Stanislaus River (Demko and Cramer 1995, 1997), even though stream temperatures throughout the river are satisfactory for rearing of juvenile chinook during February thorugh mid May when juveniles are present. The lack of rearing below RM 40 was indicated by the similarity in mean lengths between fish captured at Oakdale (RM 40) and Caswell (RM 6), and by the short travel time (2-6 days) between those locations for marked fish (Demko and Cramer 1995, 1997). If the low gradient habitat was not used for rearing by chinook, it certainly would not be appropriate for rearing of steelhead, which almost always rear upstream of, and in higher gradients than juvenile fall chinook.

Some or all of the reports of occasional adult steelhead being caught in the Stanislaus River are likely to result from adult steelhead that stray from the Mokelumne Hatchery. Straying of hatchery steelhead is well documented. The Working Paper on Restoration Needs for the Central Valley (Volume 2, p. VIII-21) states, *"Since the target number of adult spawners do not currently reach the hatchery* (Mokelumne), *eggs are supplied primarily from surplus Feather River Hatchery and Nimbus Fish Hatchery eggs (Reynolds et al. 1993). Plants of steelhead raised at the Mokelumne River Fish Hatchery typically return as adults to the American River (Reynolds et al. 1990).*" Thus, straying of steelhead from Mokelumne Hatchery is common. Staley (1976) found that many Coleman Hatchery steelhead were being caught by anglers in the American River, and that most of these fish had been released in the vicinity of Sacramento. In Oregon, special mark-recapture studies were conducted in recent years to determine the extent of straying by hatchery fish. It was determined from those studies, that stray hatchery fish composed about 10% of the steelhead spawning in unstocked coastal streams (Lindsay et al. 1993). Lindsay et al. (1993) found that hatchery steelhead had a higher tendency to stray to areas near to the area in which they were reared. Thus, we should expect some straying of steelhead from the Mokelumne River Hatchery into streams of the San Joaquin Basin.

The number of these stray steelhead from Mokelumne River Hatchery would have increased substantially in recent years, because the number of steelhead smolts released was quadrupled, starting with the 1988 brood, from about 50,000 to about 200,000. Further, juvenile steelhead were released off station into the Mokelumne River during the 1980's in order to provide catchable trout rather than adult steelhead. This practice has recently been changed, and hatchery fish are now released at a time and place designed to produce anadromous returns.

An indication of whether a naturally reproducing population of steelhead exists in the Stanislaus River can be taken from data on sampling of juvenile salmonids. We sampled with rotary screw traps near Oakdale in 1993 and 1995, 1996, and 1998 during April-June. We captured some rainbow trout in each year, but the number that had smolting characteristics ranged from 0 in 1993 to a high of only 18 in 1995. During the same sampling, we captured thousands of juvenile chinook, even though spawning escapements were extremely low. The small number of apparent steelhead smolts we have captured indicates that natural production of steelhead is near zero, and that the few smolts observed could easily have been produced by spawning of stray hatchery fish that must certainly be present.

The rainbow migrants could also have been produced by a very small portion of the resident population expressing anadromy or potamadromy. For example, Hallock et al. (1961) found a "sizeable" population of resident trout between 14 and 20 inches in upper Sacramento River, and Scott Hammelberg, USFWS at Red Bluff, confirms that large resident rainbow continue to return to Coleman National Fish Hatchery (CNFH) each year. These fish are not rearing in Battle Creek, so their life history must include migration within freshwater. Fisher (1961) studied the outmigration of catchable rainbow stocked in Big Sur River during 1958. Although only 3.4% to 32% of the stocked trout in that study moved downstream before capture, they composed the majority of outmigrants, because the numbers stocked were so much greater than the numbers of naturally produced fish. Furthermore, stocked fish captured in the downstream trap were marked and taken back upstream for release. For the three test periods in which this was done, the proportion returning back downstream to the trap before being caught by anglers ranged from 8% to 50%. This is noteworthy, since catch rate was estimated to be near 100%. Since catchable trout have steelhead ancestry, many may be migrating to sea and returning as adult steelhead. Such behavior would easily account for the occasional sightings of steelhead in many southern California streams that are stocked with catchable trout (as is the case in San Joaquin basin reservoirs).

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