3.0 CURRENT STATUS OF LOWER AMERICAN RIVER ECOSYSTEM

The *Baseline Report*, described in Chapter 2, provided a foundation upon which to build the FISH Plan. This chapter summarizes and presents the key information presented in the *Baseline Report* regarding the existing condition of the aquatic resources and associated habitats of the lower American River. This information informed development of the conceptual models for how the lower American River ecosystem and related restoration processes function; these processes are described in Chapters 4 and 5. It also informed development of the recommended restoration and management actions found in Chapter 6.

At this time, a number of supplementary analyses are still being conducted which may subsequently be included in the *Baseline Report*. This additional work includes several evaluations to better ascertain the relationships between physical habitat parameters and biological indices related to lifestage history and in-river production of fall-run chinook salmon and steelhead in the lower American River. Results of these analyses will be reflected in revisions in a subsequent draft of the report and, as appropriate, may be used to update this chapter.

1.1. WATERSHED DEVELOPMENT AND MIGRATION BARRIERS

Historically, anadromous salmonids had access to over 125 miles of habitat in the upper reaches of the American River. However, since the early 1900s, access has been impeded by dams constructed for mining debris containment, flood control, and water supply diversions. Many of these dams had inadequate or no fish ladders. In 1950, Old Folsom Dam’s fish ladder was destroyed by floods, blocking fish passage upstream of River Mile (RM) 25. Construction of Folsom and Nimbus dams in 1955 permanently blocked upstream passage past RM 23, and reportedly blocked approximately 70 percent of the spawning habitat historically used by chinook salmon, and all of the historic steelhead spawning habitat. Anadromous salmonids are now restricted to the lower 23 miles of the American River extending from Nimbus Dam to the Sacramento River.

1.2. HYDROLOGY

Changes in American River hydrology have dramatically altered the ecology of the lower American River, relative to unimpaired conditions. Flows in the lower American River are now more evenly distributed throughout the year.

Annual peak flows historically occurred in the spring, but now occur in early winter. Historically, summer and early fall months were characterized by very low flows and high water temperatures. Summer flows are higher and water temperatures are presently lower than they were historically. This overall dampening of extremes results from the ability to store runoff and regulate flows, and make selective water temperature withdrawals from the penstock inlet ports at Folsom Dam. Under current hydrologic conditions the lower American River, which historically was not extensively used by anadromous salmonids for spawning, can support naturally spawning fish populations including fall-run chinook salmon and steelhead.

1.3. GEOMORPHOLOGY

The current geomorphic character of the lower American River has been contoured by its hydrologic history. Gold mining from 1855 to 1884 inundated the river's spawning grounds with an estimated 257 million cubic yards of gravel, sand, silt and debris deposited in the river. Five to 30 feet of gravel, sand, and silt were deposited on the bed of the lower American River, from the present location of Nimbus Dam to the mouth, as a result of hydraulic mining and dredging. The riverbed at the mouth of the river underwent extreme change, as 15 square miles were covered with debris. Since 1955, the lower American River has generally incised down to its previous bed elevation.

While dams block further influx of sediment from upstream areas, banks, points, and bars still serve as sources of stored sediment in the lower American River. Generally, the riverbed is mobilized at flows of about 50,000 cubic feet per second (cfs), although parts of the riverbed remain immobile. Between 1968 and 1986, the lower American River exhibited between 1.1 and 13.9 feet of erosive lateral migration per year. Under the river's current sediment transport and erosive mechanisms, there is no indication that the lower American River will be starved of suitable spawning gravels in key reaches within the near future.

1.4. AQUATIC HABITAT

Geomorphic and hydrologic changes also have impacted the in-stream and riparian habitat of the lower American River. There has been an overall decrease in shaded riverine aquatic (SRA) habitat, a decrease in habitat complexity and diversity, a reduction in woody debris, and an increase in invasive exotic vegetation. The artificial levee system has caused localized bank erosion, incision, and general channelization of the river corridor. Modification of the spring and summer hydrograph from flow regulation has likely affected the potential for cottonwood regeneration. Reduction in the abundance of near-channel cottonwoods has reduced shaded channel surface. Large woody debris is noticeably deficient in many stretches of the lower American River, particularly in upstream areas. Generally, shoreline habitat has undergone a trend toward simplification.

1.5. FISH

Although development in the watershed has drastically and permanently transformed the lower American River ecosystem, the river still supports a very diverse and relatively prolific array of fish species. The lower American River supports approximately 43 species of native and nonnative fish, including several anadromous species. Two species of anadromous salmonids inhabit the lower American River: fall-run chinook salmon and steelhead.

3.1.1. CHINOOK SALMON

With over 125 miles of accessible riverine habitat, the lower American River historically supported spring- and fall-run chinook salmon. Spring-run chinook salmon typically entered the American River from May through July, and fall-run entered the river from September through December. By 1955, it is believed that spring-run chinook salmon had been extirpated from the American River.

It has been estimated that the American River historically may have supported runs exceeding 100,000 chinook salmon annually. Population numbers fell during the 1944-1955 period primarily due to migration barriers and habitat blockage, increasing agricultural diversions, acid drainage from hard rock mining, and over-fishing. Since 1955, chinook salmon populations have been augmented by hatchery operations.

Fall-run chinook salmon, a candidate species under the federal Endangered Species Act, has been the dominant run of chinook salmon in the lower American River since the 1940s. One goal of the 1992 Central Valley Project Improvement Act is to double (from the 1967-1991 baseline period) the natural production of anadromous salmonids in the Central Valley, including the lower American River. The doubling goal takes into account numerous factors including commercial and sport harvest. Nonetheless, for comparative purposes, from 1967 through 1991estimated annual in-river adult chinook salmon escapement averaged 32,307 fish, whereas estimated annual escapement has averaged 41,933 fish from 1992 through 1999. Remarkably, the preliminary estimate for this year's (fall 2000) spawning escapement exceeds 100,000 fish.

Since construction and operation of the Nimbus Hatchery began in 1955, lower American River chinook salmon runs have generally increased. Hatchery practices implemented to increase survival have contributed to this increase. A majority of the total annual spawning run was estimated to be comprised of hatchery-reared fish, based on coded-wire tagging studies conducted from 1978 to 1984. However, since the hatchery tagging experiments conducted from 1978 to 1984, no constant marking programs have been implemented in Central Valley hatcheries. The result is a lack of sufficient data to directly determine the current contribution of hatchery-reared fish to the total lower American River spawning population.

Water temperature affects fish behavior. Adult chinook salmon migrate up the Sacramento-San Joaquin Delta and into the lower American River generally from July to January. Spawning extends from as early as the beginning of October to January, and peak spawning typically occurs from mid to late-November. The timing of fall-run chinook salmon spawning is responsive to temperature changes in the lower American River, which are affected by changes in Folsom Dam shutter configuration and cold water pool management. Initiation of spawning can vary by one month or more (early October to mid-November), depending on the prevailing water temperature regime. Relatively high water temperatures at the beginning of the fall-run chinook salmon spawning season can delay the onset of spawning in many years. Spawning typically does not occur until mean daily water temperatures decrease to about 60°F. Also, Nimbus Hatchery data suggest that percent egg fertilization rapidly increases when daily median temperatures decline below 60°F. In the last ten years, mean daily water temperatures at or below 60°F in the upper reaches of the lower American River have typically not occurred until the end of the first week of November.

Spawning distribution (timing and location) also is influenced by flow conditions. Habitat availability and utilization are inversely related to, and directly affected by, flow conditions. Also, low flows are associated with an increase in redd superimposition.

Most (about 95 percent) of the spawning occurs in the upper eight miles of the lower American River (Ancil Hoffman Park area to the base of Nimbus Dam). The lowermost nine river miles downstream of Watt Avenue supports relatively little spawning. For successful salmonid incubation, spawning gravels must be sufficiently free of fines, and have sufficient intra-gravel flow to maintain adequate dissolved oxygen levels. Fall-run chinook salmon have a high selectivity for bar-complex run and flat-water glide habitats for spawning, depending on the flow conditions. Intragravel permeability appears to strongly influence spawning site selection.

Several environmental conditions influence the in-stream production of fall-run chinook salmon in the lower American River. Flow, water temperature, substrate, and cover are believed to be the most important of those factors. Flow and water temperature have been identified as particularly critical factors.

Juvenile fall-run chinook salmon require varying habitats at different developmental stages and time periods during their in-river residence period. Juvenile chinook salmon tend to aggregate in areas of moderate current and some cover in the form of large substrate or surface turbulence. Apparent trends in habitat use suggest that backwaters, runs, and glides contain the majority of juvenile fall-run chinook salmon early, when the fish are small. Riffles typically contain the smallest number of individuals, but the largest average size of juvenile fall-run chinook salmon.

Results of the last nine years (1992 through 2000) of seining and emigration surveys on the lower American River indicate that juvenile survival to emigration may be inversely related to January flow conditions. Also, fluctuating flow causes stranding in certain areas, but the magnitude of the impact on the population is still under investigation. Peak emigration was not found to be associated with peak flows.

Water temperature may directly contribute to the triggering of seaward migration. Water temperature moderates emigration timing by controlling the rate of growth and physiologic development of juvenile salmonids. However, most fall-run chinook salmon emigrate from the lower American River as post-emergent fry and, therefore, require additional growth and development after leaving the lower American River before entering the ocean if they are to attain a size conducive to survival to adulthood. Emigration timing varies from year to year but primarily occurs between late December and April. The timing of juvenile chinook salmon emigration in recent years is comparable to that observed during 1988 and 1989, but is much earlier than that observed during 1945 through 1947 period. The relatively early emergence and emigration currently observed in the lower American River is likely a result of the temperature-moderating effect of Folsom and Natoma lakes, or resulting from the different runs of chinook salmon that historically spawned upstream in the American River Basin.

As with other populations of fall-run chinook salmon in the Central Valley, fall-run chinook salmon of the lower American River have been subjected to increasing ocean harvest rates over the years. However, the ocean harvest index has dropped from more than 70% from 1985 through 1995, to near 50% in the past few years. This trend, if it continues, may contribute to increases in the number of chinook salmon returning to Central Valley streams, including the American River.

3.1.2. STEELHEAD

The lower American River originally supported summer-, fall-, and winter-run steelhead. Summer-run steelhead typically entered the river between May and July, fall-run between September and November, and winter-run between December and April. All steelhead spawning occurred upstream of what is now the Nimbus Dam site. By 1955, it is believed that summer-run steelhead had been extirpated from the American River and only remnant populations of the fall- and winter-run steelhead remained.

Central Valley steelhead are listed as threatened under the federal Endangered Species Act, and their Evolutionarily Significant Unit (ESU) encompasses the lower American River. From 1956 through the late 1980s, the Nimbus Hatchery has propagated eggs of steelhead strains from other locations in California and Washington, planting the fry into the lower American River. Phenotypic expression of steelhead in the lower American River most closely resembles that of the historic winter-run strain of American River steelhead, as well as the Eel River strain of winter-run steelhead.

Natural production of steelhead in the American River will continue to be limited due to inaccessibility of the headwaters. The proportion of hatchery origin fish spawning in the river remains uncertain. It is known, however, that the vast majority of the steelhead returning to the hatchery is of hatchery origin.

Adult steelhead spawn primarily in the upper portion of the lower American River above RM 16. Steelhead use the upper portion of the river for spawning to a similar extent as fall-run chinook salmon. However, some steelhead spawning has been observed below Paradise Beach (RM 5), which is not observed for fall-run chinook salmon. Adult steelhead appear to prefer flat-water glide habitat for spawning.

Flow and temperature conditions affect the lifestage periodicity of lower American River steelhead. Cooler water temperatures upstream during the spring may be responsible for later steelhead emergence in upstream locations relative to downstream locations. Also, smaller average fish size in the uppermost reaches of the lower American River after March may indicate later spawning, slower developmental rates, and later and protracted emergence due to longitudinal temperature differences.

Young-of-the-year steelhead (YOY) begin appearing in rotary screw traps at the earliest in mid-January (1997) but more typically in mid-March. Steelhead YOY begin appearing in seining surveys, however, typically before mid-March. The earlier appearance of YOY in seining surveys suggests that emergence and emigration are not necessarily coincident. Despite rotary screw trap catches of YOY, it appears that few steelhead, if any, actively emigrate as YOY.

Yearling steelhead typically appear in the rotary screw traps during the winter prior to March, somewhat earlier than YOY. The presence of apparent in-river produced yearling fish in February and March strongly suggest some over-summer survival, but the origin of these fish is uncertain. Furthermore, the presence of YOY steelhead in October indicates over-summer survival. Yearling fish catches in the fall and winter may indicate, however, that YOY steelhead spend summers outside of the lower American River and return during late fall and winter.

Summer water temperature appears to be the most important stressor affecting steelhead, because steelhead rear throughout the year in the lower American River. Summer water temperatures frequently exceed those reported as suitable for juvenile steelhead rearing.

Early YOY rearing occurs primarily in upstream areas of the lower American River, proximate to spawning areas. By late summer, young-of-the-year steelhead are distributed throughout the lower American River and exhibit site fidelity. Limited mark and recapture evaluations of juvenile steelhead collected by seining in the lower American River since 1996 indicate that juveniles tend to occupy specific habitats throughout the summer. Yearling steelhead are found in bar complex and side channel areas characterized by habitat complexity in the form of velocity shelters, hydraulic roughness elements, and other forms of cover. Larger fish typically inhabit fast-water areas such as riffles.

1.6. WATER QUALITY

Current water quality does not appear to be a major stressor affecting fish populations in the lower American River. In general, ambient water quality characteristics meet applicable regulatory standards. Occasional exceedances for toxicity, selected heavy metals, coliform, chlorpyrifos, and diazinon exist, however. Generally, concentrations of contaminants increase downstream from Nimbus Dam to Discovery Park.

Groundwater contamination exists below the lower American River. The highest concentrations and widest distribution of chemicals are found within the middle of the three aquifers lying below the lower American River. Concentrations of TCE (trichloroethylene) also are found in the upper aquifer bordering the lower American River. However, Aerojet groundwater contamination, at present, does not appear to pose a water quality threat to fish resources in the lower American River.

1.7. CONCLUSIONS

The *Baseline Report* provided the basis for prioritizing opportunities for restoration in the lower American River. The *Baseline Report* established that flow and temperature improvements have the greatest potential for restoration with respect to the fish of primary management concern. As a result, the most immediate opportunities that exist for fish habitat improvement involve hydrologic systems operations and management actions. Manipulating the timing, temperature, and rate of flow released from Folsom and Nimbus dams is likely to produce the most immediate and effective results for fish restoration. Within the hydrologic and regulatory constraints inherent in attempting to manage the American River Basin water supply, opportunities for physical fish restoration actions also exist. The FISH Plan is the mechanism for investigating and pursuing these opportunities, using the *Baseline Report* as an information baseline.