Recent research on the effects of wild pigs in California showed that they can disturb up to 35–65% of the ground annually where they occur in high densities, and that they significantly reduce acorn survival (Sweitzer and Van Vuren 2002). In addition to feral pigs, a high density of invasive weeds and nonnative plants in the understory affect oak regeneration. Some studies have found browsing by deer or livestock to be an important factor negatively impacting recruitment (Bartolome et al. 2002), while others have found that grazing by small mammals (Tyler et al. 2002) or large mammals (Borchert et al. 1989) is very detrimental. Recruitment in many tree species, particularly oaks, can be highly cyclical and dependent on long-term rainfall patterns.

A more recent influence on oak woodlands is sudden oak death. The disease, first identified in 1995, has since spread to 12 counties and killed tens of thousands of oaks. Research indicates that coast live oaks and black oaks appear to be the most susceptible to this disease (Rizzo et al. 2002). Sudden oak death, caused by the pathogen *Phytophthora ramorum*, is a serious threat to oak woodlands and mixed evergreen forests in northern California. The pathogen can kill adult oaks and madrone; California bay, buckeye, and maple host the pathogen without being killed by it. Blue oak and valley oak have not shown symptoms of the pathogen. Sudden oak death has been confirmed in Alameda, Contra Costa, and Santa Clara Counties. It is unknown whether climatic or other factors will limit the spread of sudden oak death into the study area.

Intensive, year-round livestock grazing, type conversion from perennial grasses to annual grasses, increased populations of pocket gophers, urban development, and firewood harvesting have had significant impacts on oak forests throughout California.

Due to the rarity and slow regeneration of some species of oak, several oak-dominated land-cover types are considered sensitive communities by CDFG (Table 3-1).

Additionally, when urban land is in close proximity to these land-cover types, there is a considerable reduction in habitat value. Noise, light, irrigation, and frequent disking for fire protection can substantially degrade habitat conditions. Habitat is also threatened by invasion of exotic plant species in the understory.

Riparian Forest and Scrub

Riparian vegetation in the study area was classified into three land-cover types.

- Willow riparian forests, woodlands, and scrub.
- Central California sycamore alluvial woodland.
- Mixed riparian woodland and forest.

CDFG considers central California sycamore alluvial woodland a sensitive biotic community (California Department of Fish and Game 2003).

Because stream systems are so closely tied to riparian forest and scrub land cover, the *riverine* land cover type is also discussed in this section.

Historical Extent and Composition

From the foothills to the valley floor, riparian forest, woodland, and scrub communities surround riverine watercourses, thriving along stream banks and floodplains. While the largest and most diverse riparian forests occurred on mainstem rivers with natural levees, well-developed riparian forest and scrub was found along virtually all watercourses in central California (Katibah 1984). Historically, riparian vegetation was shaped by its proximity to streams and was maintained by seasonal flooding in the winter and spring and by summer drought. Riparian, forests developed on the natural levees of river-deposited silt, lining many of the study area's drainages. Virtually all streams supported dense vegetation from the water's edge to the outer moist-soil zone, whether or not natural levees are present. Precolonial riparian vegetation was characterized by corridors of dense, broadleaf vegetation of varying widths bounding the stream channel with widths determined by local geologic and hydrologic conditions (Katibah 1984).

With the gold rush in 1849, rapid development of some portions of California began. Riparian vegetation removal was one of the first significant losses in the natural environment. Although they are more fragmented today, these land-cover types still support many plant species and a diverse collection of birds, amphibians, and mammals. Significant impacts have also resulted from the expansion of agriculture and livestock grazing, along with water diversion and flood control projects (Katibah 1984).

Under natural conditions, most of Coyote Creek was seasonally dry. Streams draining the Diablo Range traveled overland, down the mountain slopes until reaching the valley floor where water spread out over the loose alluvial soils, percolating into the groundwater basin (Grossinger et al. 2006). Water traveled underground until reaching the main stem of Coyote Creek, where it surfaced and continued to drain through the salt marshes and into the San Francisco Bay. As land was claimed for agriculture, streams leading from the mountains were channelized into ditches to be used for drinking water and irrigation. The modern-day network of constructed drainage ditches and channels took place largely prior to 1900. Today nearly 50% of the valley floor watercourses draining into Coyote Creek are constructed channels (Grossinger et al. 2006).

The two main tributaries to the Guadalupe River, Guadalupe Creek and Los Gatos Creek, were historically connected to the Guadalupe River much as they are today. Much like the small tributaries of Coyote Creek, smaller tributaries of the Guadalupe River, such as Ross Creek, historically percolated into the valley floor but were not connected via surface flow to the Guadalupe River. Today, many of these small tributaries are now connected to the Guadalupe River via man-made channels (Oakland Museum of California n.d.). The Guadalupe River historically flowed into Guadalupe Slough but has since been redirected to Alviso Slough for navigation purposes.

As discussed above, the existing stream network was largely developed through human intervention and has been manipulated by the introduction of canals and ditches to provide additional flexibility in water supply, to increase the amount of developable land around streams, and to reduce flooding in the valley. As such, channels and ditches now cross between previously disparate riverine systems. One example of this is the Coyote-Alamitos Canal that was built to carry water from the Coyote Canal along Coyote Creek to Alamitos Creek and the Guadalupe percolation basin in the Almaden Valley (Horii 2004).

Common Wildlife Associations

Riparian habitats provide food, water, migration and dispersal corridors, and nesting and cover habitat for numerous wildlife species (Grenfell 1988). These habitats have high value due to their limited extent and widespread use by an abundant and diverse assemblage of wildlife species.

Wildlife species that are often associated with this land-cover type include amphibians such as Pacific tree frogs (*Pseudacris regilla*), California newts (*Taricha torosa*), and California slender salamander (*Batrachoseps attenuatus*); reptiles such as western aquatic garter snake (*Thamnophis couchii*) and San Francisco garter snake (*Thamnophis sirtalis tetrataenia*); birds such as Wilson's warbler (*Wilsonia pusilla*), Swainson's thrush (*Catharus ustulatus*), California yellow warbler (*Dendroica petechia brewsteri*), green heron (*Butorides striatus*), wood duck (*Aix sponsa*), spotted towhee, and red-shouldered hawk (*Buteo lineatus*); and mammals such as long-tailed weasel (*Mustela frenata*), San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*), gray fox (*Urocyon cinereoargenteus*), mountain lion (*Puma concolor*), Townsend's big-eared bat (a federal and state species of concern), and California myotis (*Myotis californicus*).

Riverine systems, particularly healthy riverine systems, provide habitat for aquatic macroinvertebrates, which are an important food source for local and downstream populations of fish, birds, and other animals. Some of the streams in the study area are used by anadromous fish species such as south/central California coast steelhead (*Oncorhynchus mykiss*), central California coast steelhead (*Oncorhynchus mykiss*), Central Valley fall-run Chinook salmon (*Onchorhynchus tshawytscha*), and Pacific lamprey, which move upstream to spawn (Santa Clara Basin Watershed Management Initiative 2001). South/central California coast steelhead and central California coast steelhead also use streams with suitable depths, velocities, and temperatures for juvenile rearing and feeding. Juvenile Central Valley fall-run Chinook salmon use the margins of rivers and streams after emerging from gravels to feed. They also use overhanging vegetation and substrate for cover.

~~Riparian forest-associated wildlife species covered under this Plan that are known to occur in the study area include south/central California coast steelhead (*Oncorhynchus mykiss*), central California coast steelhead (*Oncorhynchus mykiss*), Central Valley fall-run Chinook salmon (*Onchorhynchus tshawytscha*),~~ Riparian forest-associated wildlife species covered under this Plan that are known to occur in the study area include California red-legged frog, foothill yellow-legged frog (*Rana boylii*), western pond turtle, Townsend's western big-eared bat, and least Bell's vireo (*Vireo bellii pusillus*).

South/central California coast steelhead and central California coast steelhead use streams with suitable depths, velocities, and temperatures for juvenile rearing and feeding. Juvenile Central Valley fall-run Chinook salmon use the margins of rivers and streams after emerging from gravels to feed. They also use overhanging vegetation and substrate for cover. California red-legged frog uses riparian habitat type for breeding, foraging, and refugia. Foothill yellow-legged frog and western pond turtle utilize aquatic habitat for thermoregulation, foraging, and avoidance of predators. The turtle is also known to overwinter in leaf litter or soil at upland sites. Townsend's western big-eared bat uses corridors for travel between roost sites and foraging sites. Least Bell's vireo has been found foraging in riparian areas in the southern portion of the county and may be nesting, especially when a dense shrub layer exists, although no confirmed nests have been found.

No covered plants are associated with riparian forest and scrub land-cover types.

Riparian Forest and Scrub Land-Cover Types

Within the Plan study area, Riparian Forest and Scrub land-cover types were identified primarily by their landscape position along creeks and around open water bodies. Several common riparian trees species – willows, cottonwood, and sycamore – appeared to hold their leaves after they turn color in fall, and early winter imagery clearly showed these distinctive yellow crowns, either in pure stands or mixed with the dark green canopies of coast live oak and bay in more mixed riparian woodland.

The plant assemblage and width of riparian corridors found along the banks and floodplains of rivers and streams, vary. Dominant influencing factors include the steepness of the channel, the frequency of disturbance, and the hydrologic regime present.

The *riparian forest and scrub* land-cover type is dominated by phreatophytic woody vegetation associated with permanent water sources. Riparian woodland is dominated by trees and contains an understory of shrubs and forbs. Riparian scrub is dominated by young willow trees and shrubs, typically representing an early successional stage of riparian woodland.

At the state level, riparian plant communities are considered sensitive because of habitat loss and their value to a diverse community of plant and wildlife species. Additionally, CDFG has identified them as habitat of special concern (Wetlands Resource Policy, California Department of Fish and Game Commission 1987).

Willow Riparian Forests, Woodlands, and Scrub

Willow riparian forests, woodlands, and scrub land-cover types occur in and along the margins of active channels on intermittent and perennial streams.

Black willow (*Salix gooddingii*), red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*), and narrowleaf willow (*Salix exigua*) are the dominant canopy species in this habitat. In addition, Fremont cottonwood, white alder (*Alnus rhombifolia*), bigleaf maple, California sycamore (*Platanus racemosa*), and coast live oak are often found in these communities.

A range of conditions exists among the willow riparian forest, woodland, and scrub communities. Forests are typically composed of dense, mature willows integrating with central coast live oak riparian forest and white alder riparian forest on well-established stream terraces, often with scattered California sycamore trees. Woodland communities contain dense willow riparian scrub, dominated by young trees and shrubs, on young and dynamic alluvial deposits. Scrub communities typically consist of scattered willows and mulefat (*Baccharis salicifolia*) occurring in and along the margins of open sandy washes. Understory development in willow forest or scrub land-cover types is controlled by canopy density.

Willow riparian forests, woodlands, and scrub occupy approximately 2,707 acres, which is about 0.5% of the total study area. This land-cover type is associated with streams throughout the study area. Particularly large stands of this land-cover types are found along the major creek and streams including Guadalupe River, Coyote Creek, Uvas Creek, Llagas Creek, Pacheco Creek, and the Pajaro River along the county line.

Willow riparian forests, woodland, and scrub provide important habitat for many covered wildlife species (Table 3-5). For example, this land-cover type provides the primary habitat for least Bell's vireo in the study area. California red-legged frog and western pond turtle will also utilize this land-cover type within the aquatic systems. Species that move through or forage in this land-cover type include California tiger salamander, bank swallow, purple martin, saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*), and Townsend's big-eared bat. Steelhead trout, Chinook salmon, Pacific lamprey (*Lampetra tridentata*), and Monterey roach (*Lavinia symmetricus subditus*) may move through or spawn within this land-cover type during in suitable streams.

Central California Sycamore Alluvial Woodland

Central California sycamore alluvial woodland was readily identified by the large well-spaced sycamore crowns. In early winter aerial imagery the large pale branches and halo of fallen golden-yellow leaves were visible. The landscape position, on broad alluvial valley floors, was also indicative of this land cover type.

The *central California sycamore alluvial woodland* open land-cover type is generally present on broad floodplains and terraces along low gradient streams with deep alluvium. Areas mapped as sycamore alluvial woodland are generally open canopy woodlands dominated by California sycamore (*Platanus racemosa*), often with white alder and willows (*Salix* spp.). Other associated species include bigleaf maple, valley oak, coast live oak, and California bay.

The understory is disturbed by winter flows, and herbaceous vegetation is typically sparse or patchy. Typically, plants such as willows, coyote brush, mulefat, California buckeye, blackberry, Italian thistle (*Carduus pycnocephalus*), ~~poison oak~~poison-oak, common chickweed (*Stellaria media*) and bedstraw (*Galium aparine*) populate the stream banks.

Central California sycamore alluvial woodland occupies only 274 acres, which is about 0.1% of the total study area. ~~Major~~ All stands of this land-cover type are found along Coyote Creek ~~in the Santa Clara Valley~~or Pacheco Creek. ~~, which have been identified as having statewide importance (Keeler-Wolf et al. 1996).~~ Air photos and field mapping conducted by CDFG of this land-cover type in 1992 identified only 17 major stands statewide occurring on 2,032 acres (Keeler-Wolf et al. 1997). Among the stands mapped by this project were three sites in the study area on Coyote Creek (40.1 acres between Ogier Ponds and Anderson Dam), Upper Coyote Creek (49.2 acres above Coyote Reservoir), and on Pacheco Creek along Highway 152 (135.4 acres). At that time, the study area supported 11% of this land-cover type in the state. All stands were also quantitatively sampled by CDFG, providing a basis for a detailed description of this land-cover type in California. Results from the CDFG study are similar to the mapping conducted for the HCP/NCCP (225 acres vs. 274 acres[15]).

California red-legged frog and western pond turtle may be found in this land-cover type year-round, while California tiger salamander and foothill yellow-legged frog may move through this land-cover type (Table 3-5). Covered species that may forage in this land-cover type include Townsend's big-eared bat, bank swallow, purple martin, and possibly least Bell's vireo. Steelhead trout, Pacific lamprey, and Monterey roach may move through this land-cover type during high flow events in streams.

Mixed Riparian Woodland and Forest

Mixed riparian woodland and forest land-cover types are similar to willow riparian forests and woodlands in species occurrences. They are found in and along the margins of the active channel on intermittent and perennial streams. Generally, no single species dominates the canopy, and composition varies with elevation, aspect, hydrology, and channel type. This land-cover type captures much of the riparian woodland and forest in the study area and includes several associations that could not be distinguished on the aerial photographs. The major canopy species throughout the study area are California sycamore, valley oak, coast live oak, black willow, and California bay. Associated trees and shrubs include California black walnut, other species of willow, California buckeye, Fremont cottonwood, and bigleaf maple. Nonative invasive species that may be present include giant reed (*Arundo donax*) and Himalayan blackberry (*Rubus discolor*).

Mixed riparian woodland and forest occupies approximately 3,165 acres, which is about 0.6% of the total study area. Mixed riparian is found in association with streams throughout the study area.

[15] Differences in results may be due to differences in mapping techniques, differences in air photos used, and changes in environmental conditions over the 13 years between the studies.

Covered species associated with this land-cover type are the same as willow riparian forests, woodlands, and scrub (Table 3-5).

Riverine (Streams)

The *riverine* land-cover type includes perennial, intermittent, and ephemeral watercourses characterized by a defined bed and bank. *Perennial streams* support flowing water year-round in normal rainfall years. These streams are often marked on USGS quadrangle maps with a blue line, known as *blue-line* streams. In the semi-arid Mediterranean climate of the study area with its wet and dry seasons, perennial streams are supported in the dry season either through groundwater aquifer contributions, flows from shallower springs/seeps, or reservoir releases. *Intermittent (seasonal) streams* carry water though ~~all or~~ most of the wet season (November–April) and are dry through most or all of the dry season (May–October) in a normal rainfall year. More specifically, in the wet season, intermittent streamflow occurs when the water table is raised, or rejuvenated, following early season rains that fill shallow subsurface aquifers. Intermittent flows can also be considered as the 'baseflows' between storm events that continue on through much of the winter season. *Ephemeral streams* carry water only during or immediately following a rainfall event. The ~~main~~ principal named waterways in the study area are perennial due to urban runoff and/or high groundwater (Santa Clara Basin Watershed Management Initiative 2001).

The riverine land-cover type is most closely associated with riparian plants (see the *Riparian Forest and Scrub* section above for discussion of riparian land-cover types). The riparian plant composition and width of the riparian corridor vary depending on ~~the steepness of the channel~~channel slope, magnitude and frequency of channel and overbank flows, and the frequency/duration of flooding flows that inundate the broader floodplain. ~~and the hydrologic regime present (e.g., frequency of flooding).~~Some of the riverine areas in the study area, particularly on the valley floor streams include braided stream forms with multiple channel threads and swales, intermediary channel bars, raised side channel benches (that are still actively flooded), and higher terrace sequences that may no longer be actively flooded. In ~~some areas~~such systems where there is frequent flooding, gravel bars with mulefat scrub occur as an early seral community (Santa Clara Basin Watershed Management Initiative 2001). Willows may become established in-channel in areas of sediment deposition. Woody debris, such as fallen trees that are submerged in streams, provides good habitat and shelter for fish and aquatic invertebrates.

Several invasive, nonnative plant species are found in riverine land covers within the study area. One of the most prevalent is giant reed, which is often found in large pure stands. Other invasive, nonnative plants potentially found in the study area include blue gum eucalyptus, acacia, fennel (*Foeniculum vulgare*), periwinkle, English ivy, French broom, black locust, Algerian ivy (*Hedera canariensis*), Cape ivy, Himalayan blackberry, weeds, curly dock (*Rumex cripus*), thistle, blackwood acacia (*Acacia melanoxylon*), tree-of-heaven (*Ailanthus altissima*), glossy privet (*Ligustrum lucidum*), fig, poison hemlock, black mustard, black walnut, and almond (Santa Clara Basin Watershed Management Initiative 2001).

Major streams in the study area include Coyote Creek, Guadalupe River, Uvas Creek, Llagas Creek, Pajaro Creek, and their various tributaries (Figure 3-6). Riverine habitats were not mapped as polygons but are derived from USGS and SCVWD stream data. Based on this information there are an estimated XX miles of riverine habitat in the study area.

The major species covered by this Plan that use riverine land-cover include Pacific lamprey, south/central California coast steelhead, central California coast steelhead, Central Valley fall-run Chinook salmon, and Monterey roach. Other species that may be found living in or nearby this land-cover type include California red-legged frog, foothill yellow-legged frog, western pond turtle, least Bell's vireo, tricolored blackbird, bank swallow, and saltmarsh common yellowthroat.

Physical Conditions that Affect Covered Fish Species

The following section discusses general physical characteristics of riverine systems that support covered fish species. Salmonids, including steelhead trout and chinook salmon, have narrow habitat requirements. Thus, much of the discussion on important physical features will focus on these species.

Flow

No factor is as fundamental to the health of a stream system as flow. Flow not only ensures maintenance of aquatic conditions, it also serves to connect habitat types, allowing organisms to track resources between habitats. Without sufficient flows, juvenile steelhead and other coldwater species may experience low growth, weight loss, or mortality. Reduced flows or dry reaches may also impede migration, increase predation and competition for increasingly scarce food and habitat, result in increased water temperatures, or affect territorial behavior and aggression among members of the same species.

As a result of the Mediterranean climate, numerous streams in the Central California region, including streams within the HCP/NCCP study area, typically become discontinuously wetted or completely dry during the summer or fall. The wet-winter/dry-summer seasonal pattern results in summer conditions that are warmer and characterized by lower summer flows than "classic" steelhead streams to the north. To some degree, steelhead using the waters of the study area watersheds would be expected to be adapted to these natural summer conditions of low flow and warm water.

Given the natural flow conditions, streams in this region are vulnerable to adverse effects from even small flow alterations during late spring, summer, and fall low-flow periods. Groundwater pumping, small dams and flow diversions all may reduce baseflow. Large dams may increase or reduce baseflow depending on how flows are managed. Channel incision may draw the water table down and agricultural drains can reduce recharge to the groundwater system, while summer irrigation (when using imported water from distant sources) may increase summer baseflow. Increased summer baseflows in urban areas may occur due to watering of gardens and lawns.

Inadequate flows can also present a barrier to fish migration and movement. While upstream spawning migration by adult salmonids typically occurs during the wet season when flows are generally sufficient (unless the onset of rains is late), inadequate flows in the spring, as the result of agricultural and residential drains, can pose a potentially significant barrier to fish movement within the basin and to smolts migrating out of the system. Dry reaches can also impact juvenile steelhead at other times of the year by eliminating or restricting access to habitat during the rearing period.

The Santa Clara Valley Water District has assessed flow in the Guadalupe River, Coyote Creek, and major tributaries of both systems (SCVWD 2000). Extensive flow data exists for both pre-dam and current flow regimes. As is common in watersheds that have dams, winter storm peak type flows are reduced in comparison to the natural condition and spring, fall, and especially summer baseflow type flows are enhanced both in terms of magnitude and duration. Additionally, in the Coyote and Guadalupe watersheds, intra-basin transfers with flows transferred from the Sacramento-San Joaquin Delta have added additional output to the system and also added salmonid attractants to the system that are drawing in central valley chinook populations which would have not historically used south bay streams.

A single USGS gauge exists in Llagas Creek that was installed in November 2002. SCVWD maintains flow records for outflow from both the Uvas and Chesbro Reservoirs. Fisheries studies completed throughout both watersheds, completed in 1972-1974 (Smith 1982) also provide detailed flow observations and correlations with fisheries presence. As with the Coyote and Guadalupe watersheds, dams on both Uvas and Llagas Creek result in winter storm flows that are reduced in comparison to the natural condition and spring, fall, and especially summer flows that are enhanced.

Access and Passage Impediments

Barriers to fish movement can cause significant adverse impacts on fish populations within a basin by restricting the ability of anadromous fish to leave and return to the system and the ability of rearing juveniles and resident adults to track resources within the system. The impact of barriers on salmonids should ultimately be assessed with respect to the quantity and quality of upstream habitat that is being permanently blocked to spawning anadromous fish and any partial or temporary barriers to fish movement during the freshwater phase of the life cycle. By disrupting habitat connectivity, even a small number of barriers can have a disproportionately large impact on a population if the barriers obstruct access to large amounts of habitat.

In addition to dams, in-channel structures (such as flow diversions, culverts, and road crossings) may create steep drops in the channel that cannot be jumped by fish or may concentrate flows to such a degree that fish cannot overcome the current to move upstream. Even barriers that fish are able to pass after some effort may be significant if the level of effort required exhausts fish and reduces their reproductive fitness or longevity. Although most attention is typically focused on barriers to upstream passage, many structures, including those passable to adults, may also impair downstream movement of juvenile salmonids or outmigrating smolts.

Within the Guadalupe watershed, Vasona, Almaden, Calero, and Guadalupe Dams present complete barriers to anadromous fish movement and disconnect upper watershed streams from steelhead production. In the Coyote watershed, Anderson Dam disconnects a large portion of the upper watershed from production.

Below these structures, the Santa Clara Valley Water District catalogued all potential fish passage impediments in the Guadalupe River, Coyote Creek, and major tributaries of both systems (SCVWD 2000). All barriers were assessed for passage of adults and juveniles and the completeness of the barrier. Modifications to barriers have also been catalogued. At the time of the FAHCE evaluation (1997-1998), 46 passage barriers or impediments were identified in the Guadalupe watershed, with 34 barriers or impediments identified in the Coyote watershed. A third of all identified barriers or impediments identified in these watersheds are under the ownership of SCVWD.

[***Note to Reader:*** *Jones & Stokes is developing a figure of these passage barriers based on data forthcoming from SCVWD. In the meantime, the key barriers can be viewed on-line at http://www.valleywater.org/water/Watersheds_-_streams_and_floods/Taking_care_of_streams/FAHCE/index.shtm*]

In the Uvas watershed, Uvas Dam disconnects the upper portion of the watershed from steelhead use. In the Llagas watershed, Chesbro Dam disconnects the upper portion of the watershed from steelhead use. No other data on impediments in the watershed currently exists.

Temperature

Changes in water temperatures have profound direct and indirect impacts on fish and other cold-blooded aquatic organisms because they are unable to internally regulate their body temperature. The direct impacts of high water temperatures may include both acute and chronic effects. Acute effects tend to involve decreased or disrupted enzyme function, which may compromise a wide range of physiological functions and result in total incapacitation and death of the organism. Chronic effects tend to involve changes that slowly degrade the condition of the organism, such as increased metabolic rate (which reduces growth efficiency), reduced immune system function (which increases susceptibility to disease), or an increased tendency to become exhausted (which reduces foraging efficiency).

Steelhead may experience several summer seasons while rearing, during which they may be subject to warm water temperatures and the resulting thermal stresses. In addition, water temperatures during the rest of the year determine, in part, whether juvenile steelhead and chinook can remain mobile enough to feed and grow beyond the summer. Growth during the fall or spring, for example, may be of particular importance to steelhead populations in the southern portion of each species range, which includes Santa Clara County watersheds.

Changes in water temperature may also have substantial indirect effects on fish by altering the physical properties of the water on which the fish depend. For coldwater fish such as steelhead and Chinook salmon, reduced dissolved oxygen associated with high water temperatures is frequently an important problem (the dissolved oxygen capacity of water is inversely related to temperature). Other indirect temperature-related issues include temperature-dependent changes in the biological activity of a pollutant, and changes in behavior or physiology that affect the competitive balance among species and hence may result in a shift in fish species composition or relative abundance.

In addition, because steelhead and Chinook salmon are sensitive to increases in temperature, any additional factors that might increase physiological stress, such as disease, food limitations, elevated turbidity, or increased competition between species, have the potential to worsen the impact of elevated temperatures.

The FAHCE Technical Advisory Committee assessed temperature in the Guadalupe River, Coyote Creek, and major tributaries of both systems using hourly temperature recordings for 1998 and 1999 (SCVWD 2000). Additionally, the Guadalupe River, Los Gatos Creek, and Guadalupe Creek have been assessed as part of the SCVWD and U.S. Army Corps of Engineers Adaptive Management Team (AMT) program, which has monitored salmonid habitat suitability in the context of temperature modeling from assessments of riparian cover and streamflow.

Ultimately, both the FAHCE and AMT programs are the result of concerns over increased summer water temperatures in both the Guadalupe and Coyote watersheds. Urbanization of both watersheds has resulted, to varying degrees, in loss of riparian cover, which has increased temperature loading throughout both watersheds. Additionally, flow management has led to localized periods of low velocities that increase the potential for temperature loading in streams.

No recent data is available on temperature in relation to salmonid habitat in the Uvas and Llagas watersheds[16]. As with the Coyote and Guadalupe watersheds, urbanization of lower Uvas and Llagas Creek has resulted to varying degrees in loss of riparian cover, which has increased water temperatures throughout both watersheds (although is not nearly as great in extent as in the Guadalupe and Coyote watersheds). The upper areas of both catchments are only sparsely developed. Additionally, flow management has led to localized periods of low velocities that increase the potential for temperature loading in streams.

Rearing Habitat

Rearing habitat consists of two distinct functional habitats – winter rearing and summer rearing. Each seasonal rearing habitat provides unique functions necessary for juvenile salmonids.

During summer, when flows are typically lowest and water temperatures highest, pools, substrate interstices, and other complex habitats provide rearing steelhead

[16] Smith (1982) examined stream temperature and riparian cover during the fisheries assessment conducted in 1972-1974, but this data set is now more than 30 years old.

with important refugia from high temperatures and predation. A lack of summer rearing habitat can reduce the growth and fitness of juvenile steelhead, increasing competition for food and space, and increasing the risk of predation. Displacement or mortality caused by high winter flows frequently limits production of juvenile steelhead that do not have access to refuge habitat associated with large woody debris, large substrates such as boulders, interstitial spaces, off-channel habitat, or other features that provide velocity refuges. Certain habitat elements, such as substrate interstices, may also increase winter survival by providing resting or hiding sites for fish when water temperatures are coldest.

The FAHCE Technical Advisory Committee assessed rearing habitat quantity and quality in the Guadalupe River, Coyote Creek, and major tributaries of both systems (SCVWD 2000). Specific results from the assessment are not currently available, but the general conclusion was that habitat conditions for juvenile salmonids are poor in these systems.

There are no data on juvenile rearing habitat quality and quantity in the Uvas and Llagas watersheds.

Ecosystem Functions

Function and Integrity

While riparian land-cover types occupy a very small percentage of the total land cover in the study area, they are particularly important because they are among the most structurally complex and richly diverse habitat types in terms of plant and animal associations.

Riparian communities support both terrestrial and aquatic species by providing movement corridors across the landscape and both nesting and foraging habitat. They also support high levels of invertebrate production; provide moist, cool refugia during the hot, dry summer; have moderate stream temperatures; help armor stream banks; and support the aquatic food chain by means of input of vegetative and other detritus.

Dense canopies reduce direct solar radiation to streams and creeks, thereby lowering water temperatures and increasing habitat value for aquatic wildlife. Differences in vegetative structure between riparian communities lead to varying effectiveness in providing these ecosystem functions. For example, riparian scrub, with its lower vegetation structure, is often less effective in reducing stream temperatures than riparian woodland. On the other hand, riparian scrub may provide better nesting and foraging habitat for migratory passerine birds that prefer the dense thicket habitat provided by scrub. Living and dead woody debris that enter the stream channel from the riparian forest provide valuable habitat benefits for fish (Opperman DATE).

Physically, ~~open water~~ riverine systems, most notably natural streams, ~~(particularly naturally occurring streams) plays a central~~provide the essential conduits to convey flows, sediments, and nutrients across the watershed. ~~role in~~

~~the sediment cycle. As mountains and hills erode,~~ Sstreams ~~carry~~ transport weathered minerals and eroded sediments from upper watershed source areas through intermediate watershed positions ultimately to lower watershed depositional areas or discharges beyond the watershed. While the general, and classical, characterization of watersheds into 'upper erosional', 'middle transitional', and 'lower depositional' areas may often hold true; in greater detail, all areas of the watershed can witness erosion, transport, or storage functions. ~~sediment out of the hills and into the valleys. Through sediment transport, rocks are broken down into fine soil.~~ Nutrients from exposed soil and decomposed organic matter are also carried downstream with the sediment, across the valley floor and finally into the estuary. Alluvial soils, high in organic content and nutrients, are excellent for agriculture. Sediment influx to estuaries helps maintain a marshland buffer along the shoreline that supports a myriad of wildlife.

Built to provide a reliable water supply and provide flood control, reservoirs present a challenge in properly maintaining intact and healthy stream system. One of the biggest issues surrounding dams is that they deter, or block entirely, access by migratory fish, such as steelhead and lamprey, to prime upper watershed spawning areas. All of the reservoirs in the study area represent complete migration barriers for fish. Reduced access to these tributaries is one of the main factors in the decline of steelhead in Coyote Creek and Guadalupe River (Santa Clara Basin Watershed Management Initiative 2001).

Streams provide ecosystem functions and values much greater than the proportion of the landscape they occupy. Streams provide habitat for a wide array of aquatic insects that, in turn, function as food for amphibians, birds, and other insectivorous species. Perennial streams function as permanent water sources in an otherwise dry landscape. Streams also provide movement corridors between different terrestrial communities. In this way, networks of ephemeral, seasonal, and perennial streams link chaparral/scrub, oak woodland, oak savanna, riparian woodland, and grassland habitats. These links are not only important for the movement of wildlife, but also represent the fastest means of transporting energy and nutrients through a watershed. Thus, it is through stream networks that organic matter and minerals are transported from the highlands and deposited in the lowlands.

Disturbance

Riparian communities are shaped by their proximity to water and by periodic flooding that maintains the structure and composition of this land-cover type. Wet-season flooding replenishes alluvial soils that are deficient in minerals and organic matter. Flooding also subjects riparian forest to frequent disturbance that benefits regeneration of certain species, including California sycamore, white alder, and black willow. Regeneration from seed appears to occur in pulses correlated with large flood events (Shanfield 1984). Additionally, trees that are damaged by flooding can resprout from the roots and trunk (Shanfield 1984).

Threats

In the greater Bay Area, flood control activities, cultivated agriculture, aggregate mining, and urban development have significantly reduced the distribution of this land-cover type. Riparian forest can also be severely impacted by improper grazing management. Therefore it is possible that this cover type was much more abundant prior to the onset of intensive livestock grazing. Finally, seedling establishment and growth is heavily dependent on access to surface water or shallow groundwater during the majority of the year (Sacchi and Price 1992). As such, water operations and land alterations that result in reduced stream baseflows and/or increased depth to the water table will have a significant negative effect on this land-cover type. Sycamores in the study area, including those that dominate Sycamore alluvial woodland, are frequently infected by Sycamore anthracnose (*Apiognomonia veneta*), a fungal disease that affects trees throughout the state (Keeler-Wolf et al. 1997). Livestock grazing can substantially degrade riparian woodland and scrub communities when cattle and other livestock have unrestricted access to stream systems and stocking rates are high.

All riverine systems within the study area have been altered significantly by human impacts including water diversions, channelization, flood control projects, loss of riparian vegetation, and increased rates of sedimentation. These impacts reduce habitat complexity and habitat quality, affecting such things as pool/riffle relationships, level of dissolved oxygen, and substrate composition. Loss of riparian vegetation results in decreased shading, increased water temperatures, reduced cover, and decreased input of nutrients (Santa Clara Basin Watershed Management Initiative 2001). Trash and other pollutants that are washed into streams may degrade water quality to the point the aquatic life cannot persist. Aquatic invertebrates, often sensitive to water quality, may die off, thus disrupting the food chain.

Conifer Woodland

In addition to hardwood-dominated upland land-cover types, conifer dominated land-cover types also occur in the study area. The three conifer-dominated communities listed below occur in the study area.

- Redwood forest.
- Ponderosa pine woodland ~~and forest~~.
- Knobcone pine woodland.

Historical Extent and Composition

Prior to European settlement, the Santa Clara Valley supported a mosaic of plant and wildlife communities. Upland regions were heavily forested with redwoods that flanked creeks and rivers as they traversed the landscape to lower elevations. Under mesic habitat conditions, pine and oak forests dotted the land (Bolton 1927, 1930). The foothill forests and woodlands were heavily thinned in the mid- to late-1800s to house and support the growing population in the region (Santa Clara County 1973). With habitat alterations came the replacement of