STEELHEAD AND OTHER FISH RESOURCES OF WESTERN MT. HAMILTON STREAMS

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INTRODUCTION

Steelhead (*Oncorhynchus mykiss*) probably originally made extensive use of both perennial lowland and upstream portions of the streams of the Mt. Hamilton portion of the Diablo Range, but water diversions and barriers to migration apparently sharply reduced these populations by the 1950's. No quantitative data exist for either historical or recent populations. Coho (*O. kisutch*) and chinook salmon (*O. tshawytscha*) were not reported by Snyder (1905) for streams of San Francisco Bay, but there is anecdotal information for occasional fish, especially coho, into the 1950's. Chinook salmon have been reported in some San Francisco Bay streams in recent years, coinciding with central valley hatchery production and efforts to transport juvenile fish around diversion-affected portions of the delta. Most downstream habitats have been extensively modified, affecting not only steelhead, but native warm-water fishes as well. However, many upstream habitats are relatively unmodified and contain healthy populations of resident rainbow trout (*O. mykiss*) and other native fishes.

Steelhead generally require coolwater habitat, but can utilize warmer habitats if food availability is good, such in fastwater riffles, where the fish can feed on drifting insects (Smith and Li 1983). This results in central coast steelhead (and resident rainbow trout) now being found in summer in two different types of habitats. Primarily they are in the shaded pools of small, cool, lowflow upstream habitats typical of the original steelhead habitat in the region. However, they can also occur in the riffles of warmwater habitats below some dams, where summer releases provide high summer flows and fastwater

feeding habitat. These later locations may have originally supported steelhead in shaded, cool, unmodified habitat or may have been occupied by warmwater fishes before the reservoirs provided augmented summer flows.

This report summarizes the general patterns of present fish distribution and status for the Alameda Creek system, the Coyote Creek system, and the eastern portions of the Pajaro River system. It also generally assesses historical impacts to those systems and ongoing and potential restoration actions. Collections by Leidy (1984), historical collections cited by him, and collections by Scoppettone and Smith (1978) and subsequent unpublished collections by Smith provided the basis of the summary. The Pajaro River system is included because portions of the system are adjacent to and east of the target area, because it contains the same fish species and assemblages (Smith 1982), and because it offers important regional opportunities for biodiversity maintenance and restoration.

ALAMEDA CREEK SYSTEM

Past and Present Steelhead

Large reservoirs have been constructed on Calaveras, San Antonio and Arroyo del Valle creeks, three of the major tributaries to Alameda Creek. The reservoir on Calaveras Creek blocks potential steelhead access to Calaveras and Arroyo Hondo creeks, which provided historical perennial steelhead rearing habitat. Water stored in Calaveras Reservoir is pumped outside the basin for domestic use (San Francisco Water Department, SFWD), reducing summer streamflows in Calaveras Creek and in Alameda Creek in the Sunol Regional Park area. In addition, a diversion dam on upper Alameda Creek diverts water to Calaveras Reservoir, further reducing Alameda Creek streamflows, especially in winter and spring. Natural falls downstream of the diversion dam (in the "Little Yosemite" area of Sunol Regional Park) historically blocked steelhead access to most of the upper Alameda Creek watershed. Alameda Creek in Sunol Regional Park has only limited stream shading and relatively warm summer water temperatures. In drier years resident rainbow trout are restricted to, and upstream of, the Little Yosemite area; in cooler,

wetter years trout may extend downstream to the lower park boundary. The stream is normally dry in summer in the vicinity of Highway 680.

San Antonio Reservoir (SFWD) blocks access to most of the San Antonio Creek watershed. No downstream releases are provided from this reservoir. The watershed is relatively small and dry, and the stream may have had only limited perennial habitat and steelhead use even prior to reservoir construction.

Del Valle Reservoir (Alameda County Water Agency, ACWA) blocks access to the upper half of Arroyo del Valle. The reservoir stores water from the watershed and also imported South Bay Aqueduct water. Releases from the reservoir are percolated in the streambed downstream to Livermore. These somewhat erratic releases may have generally increased summer streamflow in the lower portion of Arroyo del Valle, but stream shading is rather limited along much of the channel; summer water temperatures are probably relatively warm. Arroyo Mocho watershed, to the east, is undammed and has perennial flows, even in severe drought years (like 1976-77), because of fault zone seepage. Steelhead access to and from both Arroyo del Valle and Arroyo Mocho is through extensive flat-land channels, portions of which have been modified for flood control. It is likely that early water diversions and groundwater pumping resulted in restricted steelhead migration, especially spring outmigration of smolts, except in the wettest of years. Historical steelhead runs may have varied substantially from year to year with natural spring and winter streamflow conditions.

Alameda Creek from just upstream of Niles Canyon, downstream through Niles Canyon, historically had perennial streamflows and was used by steelhead and even by coho (John Hopkirk, cited in Leidy 1984). Present summer streamflows are substantially augmented by discharges from the South Bay Aqueduct into Arroyo de la Laguna, just upstream of Niles Canyon. Even prior to flow augmentation, the generally well-shaded perennial reach in Niles Canyon would have provided good steelhead rearing habitat. With flow augmentation potential steelhead habitat is good in fast-water habitats, despite somewhat high summer water temperatures (70+ degrees F). Good streamflows can even be present in drought years, although releases are regulated by available stored water and by percolation operations (managed by ACWA), rather than any concerns for aquatic resources; releases may be subject to periodic

shutdowns. Hatchery "catchable" rainbow trout are regularly planted by the California Department of Fish and Game in spring and summer. Two old, unused diversion dams (owned by SFWD) within the reach represent potential barriers to steelhead upstream migration. The lower one is probably passable during regular winter flows, but the upper one, in Sunol, would almost never be passable to upstream migrating steelhead; the dam is nearly 15 feet high.

Downstream of Niles Canyon the natural and augmented flows are percolated in onstream and offchannel percolation ponds (ACWA). The dams for the onchannel ponds are inflatable rubber dams, which are inflated as spring flows subside and deflated prior to winter rains. A concrete grade control structure near the BART tracks is an upstream barrier to migrating steelhead except in extreme floods. However, in most years the regulation of streamflows by dams and percolation operations eliminates streamflows during late spring (April and May) in the lower, channelized portion of Alameda Creek (downstream of the percolation zone). April and May is the normal outmigration period for steelhead smolts, and the regular lack of spring flows would preclude substantial steelhead success, even if upstream access by spawning adults was possible. Summer water temperatures in the onchannel percolation ponds are too warm to allow steelhead rearing.

Presently, "steelhead" in Alameda Creek are occasional rare individuals observed downstream of the grade stabilization structure. No rearing is possible in regularly accessible portions of Alameda Creek, so these fish may be the result of unusual flood-year passage, the result of stocking of hatchery catchables, or may be strays from other south San Francisco Bay streams. "Resident" rainbow trout may produce a small percentage of migratory smolts even after adult access is blocked; this may be occurring in the Guadalupe River watershed, where some smolts are produced in Guadalupe and Alamitos creeks, even though adult access has been blocked for 25 years (Smith, unpublished). However, in the Alameda Creek watershed there are too few resident trout downstream of large reservoirs to serve as a source of a significant number of smolts.

Current and Potential Steelhead Restoration

At the present time the San Francisco Water Department is committed to provide future releases from Calaveras Reservoir and to recapture the water downstream of Sunol Regional Park. These releases, which will average 7 cfs from March 16 through October 31, will provide both improved summer streamflows in about 4 miles of stream and reduced water temperatures for about half of that distance, improving conditions for resident rainbow trout and for other native fishes.

Upstream access for steelhead could be provided in most years by fish laddering the grade control structure at the BART tracks and by modifying or removing the two barriers within and at the head of Niles Canyon. Removal of the upper barrier in Sunol would be difficult, because the dam is filled to the top with sediment.

However, upstream access will provide only limited regular benefit to steelhead unless downstream smolt migration conditions are improved in the lower portion of the Alameda Creek channel. Improving smolt migration conditions would require providing substantial (10+ cfs) streamflows downstream through the channelized lower channel to San Francisco Bay during portions of April and May; this water could probably not be recovered for domestic use. A very modest release of 10 cfs of water during 5 three day periods, spaced 2 weeks apart during April and May, would require 300 acre feet of water ($90,000 per year @ $300 per acre foot). However, larger and/or more frequent releases might be needed to provide smolt passage through the broad, unshaded (and potentially very warm) lower channel of Alameda Creek.

If steelhead access could be restored to Alameda Creek the popular hatchery catchable trout fishery in Niles Canyon would have to be ended to prevent adverse genetic effects on the restored steelhead population; California Department of Fish and Game policy is to avoid hatchery catchable plantings in steelhead streams.

Other Existing and Potential Fish Resources

At the present time healthy populations of resident rainbow trout, California roach (*Lavinia symmetricus*) and Sacramento sucker (*Catostomus occidentalis*) are present in: Alameda Creek in Sunol Regional Park (especially from Little Yosemite Creek, upstream); in Arroyo Hondo Creek and its two tributaries, Smith and Isabel creeks, upstream of Calaveras Reservoir; in Arroyo Mocho upstream of Livermore; and probably in Arroyo del Valle upstream of Del Valle Reservoir (Scoppettone and Smith 1978 and more recent unpublished sampling results and Leidy 1984). Impassable falls are present on upper Arroyo Hondo, but the rainbow trout in Smith and Isabel creeks are assumed to be native, as California roach and Sacramento sucker are also present. Speckled dace (*Rhinichthys osculus*) were collected by Snyder (1905) in Arroyo Hondo and Isabel creeks, but not by Scoppettone and Smith (1978); they are apparently gone from most of their former sites in the central coast. Riffle sculpin (*Cottus gulosus*), a normal associate of the above species in foothill streams, is absent from the Alameda Creek watershed. The only other native fish present at the above locations is prickly sculpin (*C. asper*) in Alameda and Arroyo Hondo creeks above and below Calaveras Reservoir. Green sunfish (*Lepomis cyanellus*) is the only nonnative fish species likely to occur; it has been collected in Alameda Creek and Arroyo Mocho (Scoppettone and Smith 1978).

In Alameda Creek from Sunol Regional Park downstream through Niles Canyon the above species are joined by Sacramento squawfish (*Ptychocheilus grandis*) and occasionally by Pacific lamprey (*Lampetra tridentata*). Predatory squawfish are common and can reach 2 feet in length in the larger pools of Niles Canyon. Pacific lamprey are anadromous, like steelhead, but with their sucking disc mouth they are able to ascend the grade control drop at the BART tracks and spawn upstream. Lamprey larvae (ammocetes), which live in the bottom mud of cool or warm streams, have been captured as far upstream as Sunol Regional Park. Hitch (*Lavinia exilicauda*), an omnivorous native minnow, are common in and downstream of Niles Canyon, where they occasionally hybridize with closely-related California Roach. Sacramento Perch (*Archoplites interruptus*) are present in Calaveras Reservoir, and occasional individuals are caught in Niles Canyon, possibly due to spill from the reservoir. However, the persistent records of a few individuals (Leidy 1984), despite the

difficulty of sampling the deeper habitats in Niles Canyon, may indicate a small, but sustaining population. Although native to California, this rare species is apparently not native to the Alameda Creek system (Aceituno, et al. 1976). Tule perch (*Hysterocarpus traski*) have also occasionally been caught in Niles Canyon (Leidy 1984), where they may sustain themselves in the larger pools.

Sacramento suckers, Sacramento squawfish, hitch, and prickly sculpin are present downstream of Niles Canyon in the onchannel percolation ponds. Native Sacramento blackfish (*Orthodon microlepidotus*) are also present, and tule perch were present through the mid 1970's. Tule perch are apparently still present in several of the offchannel percolation ponds (including Shinn Pond).

COYOTE CREEK SYSTEM

Past and Present Steelhead and Salmon

Anderson and Coyote Reservoirs (operated by the Santa Clara Valley Water District, SCVWD) block access to the upland sections of Coyote Creek. Downstream of Anderson Reservoir the streamflows are heavily regulated except in winters of wet years, when the reservoirs spill.

In summer stored water, and water imported from the San Felipe Pipeline, is released into Coyote Creek downstream of Anderson Reservoir. However, most of the water is subsequently diverted less than one mile downstream into a canal which parallels the natural streambed. This diverted water is then discharged immediately upstream of Metcalf Pond, an onchannel pond created by a flashboard dam about 6 miles downstream of Anderson Reservoir. Therefore, most of the natural channel between Anderson Reservoir and the Metcalf Pond is dry in late summer. All water entering Metcalf Pond is then percolated in the stream bed and in a series of on and offchannel percolation ponds upstream of Hellyer City Park. The streambed immediately downstream of Hellyer Park is dry or intermittent in most summers. Flow resumes further downstream from perched groundwater and is perennial to San Francisco Bay, but summer streamflows are low and water quality is generally poor.

Only in wet years does the lower stream receive scouring flows from the upper watershed in winter. In many years winter and summer flow consists predominantly of runoff from the urbanized portion of the watershed, with its high BOD, silt and toxic (copper, oils) contribution from road runoff.

Upper Silver Creek has low, but perennial, warm summer flows (it flows in the Silver Creek Fault zone); the stream is relatively unshaded but natural in its upper reach, but is diverted into a new channelized channel in its lowest reach. Lower Silver Creek enters Coyote Creek further north and drains the drier Thompson Creek watershed; it has perennial flows in its channelized lower reaches, due to perched groundwater.

Upper Penitencia Creek (a different stream from Lower Penitencia Creek to the north) has relatively cool summer flows within, and immediately downstream of Alum Rock Park. Much of the summer flow is from water stored in Cherry Flat Reservoir (owned by the city of San Jose) in the upstream portion of the city park; this water is bypassed in a pipeline around the upper part of the park and discharges to the natural streambed at the upper picnic area of the park. Arroyo Aguague discharges to Penitencia Creek from the south, but summer inflow is very low; however, the stream flows in the Calaveras Fault zone and does not go completely dry, even in severe droughts. The low summer streamflows from Alum Rock Park percolate rapidly in the recharge zone at the edge of the valley, and the stream is usually dry in summer within 1 mile of the park. The SCVWD operates offchannel percolation ponds adjacent to Penitencia Creek, where it percolates water imported from the South Bay Aqueduct and water diverted from the creek. Water discharged from the percolation ponds is also percolated in Penitencia Creek, usually maintaining a live stream, with relatively warm water temperatures, from the percolation ponds downstream for at least 2 miles. However, these operations are subject to occasional cutoffs, drying the streambed. The SCVWD diversion on the creek is capable of drying portions of the stream in late spring, and blocking steelhead smolt outmigration. Only in wet years is smolt outmigration likely to continue through the normal April and May migration period.

Steelhead are now extremely rare in the Coyote Creek system. Although they probably used much of the watershed for rearing in the past, they now appear to be primarily restricted to Upper

Penitencia Creek, especially within Alum Rock Park. Even then, the SCVWD's diversion is likely to restrict or completely block smolt outmigration in most years. Steelhead can also rear in the portion of the channel used for percolation, downstream of the park, but summer water temperatures are often relatively high and flow cutoffs or reductions can eliminate steelhead.

In Coyote Creek, itself, steelhead rearing is presently very restricted. The lower portion of the stream (from the mouth upstream to Hellyer Park) suffers from low flows and water quality problems, although juvenile steelhead did rear in Standish Lake, behind an onchannel seasonal flashboard dam near the Bay in the mid 1980's. The modified lake is now too warm for steelhead use because of channel widening and riparian vegetation removal for flood control. Further upstream, from the percolation ponds upstream to Anderson Reservoir, much of the steelhead rearing potential is eliminated by bypassing flows in the canal around the natural channel. In addition, the highly regulated percolation operations would restrict or block smolt outmigration downstream of the percolation ponds during April and May of all but the wettest years.

Chinook salmon have spawned in Coyote Creek since at least the mid 1980's. Most of the spawning appears to be in the lowermost reaches, but adult fish have been found almost as far upstream as Metcalf Dam. Some spawning may also occur in lowermost reaches of Upper Penitencia Creek. The areas used for spawning by chinook salmon all appear to have water temperature and water quality problems in summer, but chinook salmon smolts should outmigrate in spring of their first year, before temperature and water quality conditions decline. It is presently not known if spawning/rearing is successful in Coyote Creek; no smolts have been captured there by limited spring trapping by the SCVWD. However, chinook smolts were captured in the adjacent Guadalupe River in spring 1998, so some successful spawning did occur in that system in fall 1997. The 1998 smolts in the Guadalupe River were relatively unexpected, because very heavy winter flooding should have destroyed most chinook redds.

Some coho salmon were apparently present in Coyote Creek as late as the 1950's, at the time Anderson Dam was constructed (L. J. Hendricks, pers. comm.). Because of their 1 year juvenile residence in fresh water and requirement for cool, productive pools and their

requirement for annual access, there is now no possibility of restoring coho to the Coyote Creek system.

Current and Potential Steelhead Restoration

The SCVWD maintains fish ladders at the 3 Ford Road percolation ponds when the dams are left in during drier winters. SCVWD is also planning to install a fish ladder on the Metcalf Dam. This will allow steelhead to spawn between the Metcalf Percolation Pond and Anderson Reservoir. However, most of that newly accessible habitat is allowed to go dry in summer by bypassing the flows around the natural channel in the adjacent canal. In addition, downstream smolt passage in spring would be restricted in many drier years by lack of flows downstream of the percolation ponds.

Coyote Creek, Guadalupe River and Stevens Creek are presently the subject of a lawsuit against the SCVWD to increase reservoir releases under California Fish and Game code 5937. This code requires operators of dams and diversions to maintain downstream fish resources in "good condition." Good condition for steelhead should mean at least maintaining streamflows adequate for steelhead rearing (such as restoring flow to at least a portion the natural channel downstream of Anderson Reservoir). In addition, good condition for *anadromous fish* should also mean providing flows sufficient for migration to and from spawning and rearing areas. In the drier portions of central California these migration flows appear to be the most critical for steelhead.

The best potential for restoration of steelhead populations in the Coyote Creek watershed is by modifying the diversion and percolation operations of the SCVWD. These modifications might include: 1) providing bypass flows at the diversion on Upper Penitencia Creek, to allow for smolt outmigration during April and May; 2) providing supplemental releases from the South Bay Aqueduct/Penitencia percolation ponds or from Cherry Flat Reservoir to provide outmigration flows in drier years; 3) maintaining regular summer releases below the Penitencia percolation ponds in summer and fall, with arranged releases from Cherry Flat Reservoir in case of the need for flow shutoffs; 4) restoring summer flows to the natural channel downstream of Anderson Reservoir, rather than using the bypass canal; and 5) providing sufficient releases in April and May to allow for smolt outmigration downstream of the Coyote Creek

percolation ponds. All of these changes would cost the SCVWD significant amounts of water or otherwise cause some problems with operations. For example, one of the reasons that the bypass canal is used is because of high ground water levels along the natural channel. However, restoring flow to the natural channel, and purchasing streamside land, would allow restoration of extensive riparian forest and wetlands, which could be used as mitigation for flood control and other projects within Santa Clara Valley. The restored riparian habitat could also serve as a corridor for wildlife moving between the hills on the east and west sides of Santa Clara Valley.

At the present time the Coyote Valley along Coyote Creek, from Anderson Dam to Metcalf Percolation Pond, is zoned against residential and industrial development, but there is substantial pressure to open the area to urban development. Much of the high potential for steelhead restoration, if flows are restored to the natural stream bed, would be lost if the area is urbanized. Sedimentation and urban runoff would degrade stream bed and water quality. Urbanization would also substantially degrade the quality of percolated ground water in and downstream of the area.

Other Existing and Potential Fish Resources

Even without steelhead access, Upper Penitencia Creek in Alum Rock Park maintains resident rainbow trout. Other fish species present include California roach, riffle sculpin, and occasionally Sacramento suckers and Pacific lamprey. The offchannel percolation ponds, downstream, are a source of prickly sculpin, as well as introduced fishes, including, green sunfish, largemouth bass (*Micropterus salmoides*) and goldfish (*Carassius auratus*).

The natural portion of Upper Silver Creek contains California roach and threespine stickleback (*Gasterosteus aculeatus*). This small, shallow stream runs in the Silver Creek fault and is perennial, even in severe droughts (1976-77). The presence of these two species in a perennial stream too small to support larger species is unusual in this region.

Between Anderson and Coyote reservoirs and upstream of Coyote Reservoir Sacramento squawfish, California roach, Sacramento

sucker, and occasionally prickly sculpin are present at most of the warmwater sites. Hitch are also present between the two reservoirs. Rainbow trout and riffle sculpin are present at cooler, perennial sites within the uppermost reaches within Henry Coe State Park. Hatchery-origin trout are planted in Coyote Reservoir and can be present up and downstream of the reservoir, although spawning by trout above the reservoir appears to occur at sites too warm for summer survival. The genetic effect of these hatchery fish upon the native rainbow trout population in Henry Coe State Park is not known. San Felipe Creek, a perennial Calaveras Fault line tributary to Anderson Reservoir, contains healthy populations of rainbow trout, California roach, Sacramento sucker and riffle sculpin; fault line seepage maintains the stream, even during severe droughts (1976-77).

From Anderson Reservoir downstream through the percolation ponds, Sacramento sucker, hitch and prickly sculpin are common. Sacramento squawfish, Sacramento blackfish, California roach and threespine stickleback are less common and only occasionally present in most stream sections (Leidy 1984 and Smith unpublished). All of the above, except Sacramento squawfish and California roach, have also been collected in Fisher Creek, a small tributary from the west. Speckled dace were apparently eliminated during flow cutbacks during fall 1977, when only pools below Anderson Resevoir and a portion of the Metcalf percolation pond survived.. Nonnative fish species are often common in the stream and onchannel percolation ponds, primarily as spill from Anderson Reservoir or from the San Felipe Pipeline. These may include sunfishes, bass and catfishes, and also threadfin shad (*Dorosoma pretenense*) and inland silverside (*Menidida beryllina*). Catchable-sized, hatchery-reared rainbow trout are planted by the California Department of Fish and Game immediately downstream of the dam, and some fisherman release trout caught in Parkway Lakes (a pay for fishing percolation pond) into adjacent Metcalf Pond.

Presently, in the reaches of Coyote Creek downstream of Hellyer Park the most abundant native fishes are hitch, California roach (and hitch x roach hybrids), prickly sculpin and Sacramento sucker, but only hitch are common. Because of the poor water quality, tolerant exotic fishes are often the most common species. These include goldfish, red shiner (*Notropis lutrensis*), fathead minnow (*Pimephales promelas*), and mosquitofish (*Gambusia affinis*). During Snyder's (1905) original surveys Sacramento splittail (*Pogonichthys*

macrolepidotus), thicktail chub (*Gila crassicauda*), tule perch and Sacramento perch were present in lower Coyote Creek. None of the first three species have been collected in the stream since the 1920's (Aceituno, et al. 1976; Leidy 1984), but a few Sacramento perch were present in Coyote Creek into at least the late 1950's and in Cottonwood Lake, an artificial pond in Hellyer Park, in the 1960's (L. J. Hendricks, pers. comm.).

EASTERN PAJARO RIVER SYSTEM

Past and Present Steelhead

The Pajaro River empties into Monterey Bay rather than into San Francisco Bay, but its eastern tributaries drain the Diablo Range, including areas adjacent to and east of the Coyote Creek watershed. These tributaries include the Pacheco Creek watershed, the Tequisquita Slough/Arroyo Dos Picachos watershed, and the San Benito River/Tres Pinos Creek watershed. Most of the San Benito River watershed is dry, and its streams are unshaded and warm; it does not now have, and probably never had, significant coolwater habitat for steelhead. However, both Pacheco Creek and Arroyo Dos Picachos have, or recently have had, steelhead runs.

The head of the Pajaro River was originally wetlands associated with San Felipe Lake, a Calaveras Fault zone sag pond located east of Gilroy. When the valley flooded the lake and wetlands drained into the river. To facilitate agricultural development, Miller Canal was constructed from San Felipe Lake directly to a downstream portion of the Pajaro River near its confluence with Llagas Creek, bypassing the flat, meandering wetland channel. The canal allowed for quicker spilling of the lake at a lower elevation, allowing farming around the lake. Miller Canal is flat, narrow and relatively impermeable, and it provides good fish passage when San Felipe Lake spills. Two tributaries empty into San felipe lake from the east: Pacheco Creek, draining from Pacheco Pass, and Tequisquita Slough, draining 3 watersheds northeast of Hollister.

The lower channel of Pacheco Creek, from San Felipe Lake upstream to Highway 156 is normally dry in summer. The broad gravelly channel also tends to dry fairly early in the spring of many years, restricting potential smolt migration downstream to San Felipe Lake

and the Pajaro River. From Highway 156 upstream to North Fork Pacheco Reservoir, just below Pacheco Pass, there is summer flow in most years, but the flows depend upon releases from the reservoir (operated by the locally-controlled Pacheco Water District, PWD). Releases are regulated primarily to accommodate agricultural demands for ground water, and often only limited water is released in late spring, resulting in low streamflows and high water temperatures in May and early June; paradoxically, this is more likely to be true in relatively wet years, when early demands for flows for agricultural use are less. Later in summer the higher releases may provide good potential rearing conditions for the steelhead already eliminated or reduced by the restricted, warm, earlier releases. Stream shading by willows and sycamores is limited in most of the reach and percolation rates are high, so water temperatures increase and streamflows decrease relatively rapidly downstream. Even with good reservoir releases throughout the rearing season, conditions are rarely suitable for steelhead downstream as far as the Casa de Fruta development, but juvenile steelhead can be abundant within the riffles between North Fork Reservoir and the California Division of Forestry fire station.

Two Pacheco Creek tributaries, Cedar Creek and South Fork Pacheco Creek, tend to have mostly intermittent flows in summer, but both were used by steelhead in the early 1970's. The North Fork of Pacheco Creek, upstream of the reservoir, similarly has only intermittent summer flows, although early accounts indicate some steelhead use before the dam was built in the 1920's.

Tequisquita Slough flows through more than 5 miles of valley flat-lands used for agriculture and grazing before emptying into San Felipe Lake. Most of the channel is dry except during winter runoff, and passage in spring for outmigrating steelhead smolts could occur only in very wet years. Two of its tributaries, Santa Ana Creek and Arroyo de las Viboras, drain relatively dry watersheds and have limited perennial flow. The third tributary, Arroyo Dos Picachos has perennial flow, even in severe (1976-77) droughts, along and upstream of Lone Tree Road. Steelhead originally used this spectacular volcanic watershed for spawning and rearing, and may still use it in wet years. Abundant yearling rainbow trout captured in June 1997 above a diversion dam near the Lone Tree Road crossing may have represented steelhead smolts trapped by declining spring flows.

Current and Potential Future Steelhead Restoration

The very difficult smolt passage from Arroyo Dos Picachos through Tequisquita Slough and in lower Pacheco Creek may have been somewhat improved in recent years by percolation of imported water in the Hollister area; it appears that higher groundwater levels somewhat retard the spring drying of these flatland channels. Even so, smolt passage in spring may be the most difficult problem for maintaining, restoring or improving the steelhead runs. In droughts (like in 1976-77 and1987-91) a lack of smolt outmigration can potentially eliminate the runs.

In Pacheco Creek the timing and amount of releases from North Fork Pacheco Reservoir (PWD) controls rearing habitat quality in the stream. With continuous releases from spring through the first rains, rearing can be good. The present spring and fall cutoffs can eliminate most steelhead despite relatively good rearing conditions for much of the summer. However, the very small size (6000 acre feet) of Pacheco Reservoir limits flexibility in providing water for both agricultural and fish habitat needs.

Other Existing and Potential Fish Resources

Arroyo Dos Picachos, and possibly upper Cedar Creek and South Fork Pacheco Creek, contain resident rainbow trout, California roach and Sacramento sucker; the later two streams have not been sampled since the 1970's. As in the Alameda Creek system, riffle sculpin, a frequent associate elsewhere is missing.

The North Fork of Pacheco Creek, upstream of the reservoir, contains only intermittent, warm-water fish habitat. Native California roach, Sacramento sucker and prickly sculpin are joined by introduced green sunfish; the exotics are frequently replenished by spilling from ponds within Henry Coe State Park.

Downstream of Pacheco Reservoir the most common native fish are Sacramento sucker, prickly sculpin and hitch, although threespine stickleback and Sacramento blackfish have occasionally been present. Exotic species, other than green sunfish, are very rare, but brown

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