APPENDIX B

Native Habitat Assessment

Survey for Native Fish habitat in Streams of the City of Calabasas with Special Reference to Restoration for Native Fishes

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CHAPTER 1.0
INTRODUCTION

The southern California creeks draining the City of Calabasas historically had the potential to hold seven species of freshwater fishes. A few additional fish species that enter freshwater in estuaries near the coast in southern California would not have been expected this far inland. The streams in Calabasas are low gradient, mostly less than 2% slope or gradient. These streams historically could have supported most if not all of the inland freshwater species under pre-settlement, natural conditions. The distribution, biology, and current status of these species have been reviewed by Swift et al. (1993), Swift and Seigel (1993), Stephenson and Calcarone (1999), and Moyle (2002) and personal observations on these local fishes have been added as well.

The fishes possible in these streams can be divided into two groups (Table 1). One group is found in the Malibu Creek drainage that includes Las Virgenes Creek. Only three native species of freshwater fishes are historically known to have occurred in this creek: Pacific lamprey (*Lampetra tridentata*), rainbow trout or steelhead (*Oncorhynchus mykiss*), and arroyo chub (*Gila orcutti*). The second group may be found in the McCoy and Dry Canyon Creek drainages, which drain northwest into the Los Angeles River drainage that originally had the previous three species as well as four additional ones, Pacific brook lamprey (*Lampetra pacifica* spp.), Santa Ana speckled dace (*Rhinichthys osculus* ssp.), Santa Ana sucker (*Catostomus santaanae*), and unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*). The steelhead and Pacific lamprey are anadromous, meaning they reproduce in freshwater, go to sea as juveniles to mature, and return to freshwater streams to spawn. This behavior is similar to the close relatives of steelhead, the Pacific salmons found farther north. Unlike salmon, steelhead do not necessarily die after spawning and may go back to the ocean and return on one or more successive years to spawn again. All the other previously mentioned freshwater fish species are restricted to inland waters and would not have gone to sea. All but one of these species have been locally extirpated in Calabasas and only arroyo chubs still occur in Las Virgenes Creek. However, all the other fish were known historically from farther down in their respective drainages and it has been 50 or more years since some have been taken in the Los Angeles area (Swift and Seigel 1993). The purpose of this study was to survey the streams in Calabasas for these species and their habitat and offer recommendations for restoration towards bringing some or all of the native fishes back to the area.

Table 1
Potential Fish Species Historically Found in the Calabasas Area

Creek	Species of Fish
Las Virgenes Creek	Arroyo chub – *Gila orcutti* Pacific lamprey – *Lampetra tridentata* Steelhead trout – *Oncorhynchus mykiss*
Dry Canyon Creek* McCoy Creek*	Arroyo chub – *Gila orcutti* Pacific brook lamprey – *Lampetra pacifica* spp. Pacific lamprey – *Lampetra tridentate* Santa Ana speckled dace – *Rhinicthys osculus* spp. Santa Ana sucker – *Catostomus santaanae* Steelhead trout – *Oncorhynchus mykiss* Unarmored threespine stickleback – *Gasterosteus aculeatus williamsoni*

* known from the Los Angeles River

CHAPTER 2.0
METHODS

All the creek segments were walked and habitat features were noted with reference to freshwater fishes. The six main creek habitat types noted were bedrock, riffle, run, pool, artificial bottom, and barrier. Artificial habitats included culverts, concrete bottoms under bridges or other channels, and riprap and concrete walls constraining the lateral sides of the floodplain. Riffles are places where shallow, rapidly moving water causes some turbulence in passing, usually over shallow rocks, gravel, or boulders. Some riffles in the local streams are over clay with dense roots that create similar turbulence as found in other riffles. Runs are stretches with similar width and depth such that the water runs through relatively undisturbed; runs usually flow slower than riffles. Runs can have almost any substrate from mud to bedrock. Pools are areas that are particularly deep with shallower entrances and exits. Pools usually form below falls or near resistant features like tree stumps or large boulders where the water flow meets resistance causing it to scour the softer adjacent substrate away.

Substrates or bottom materials in the stream are usually classified by the size of the particles involved. Silt/clay has particles less than 0.05 inches in diameter, sand 0.05 to 0.08 inches in diameter, gravel 0.08 to 2.5 inches, cobble, 2.5 to 5 inches, rock 5.0 to 10 inches, and boulders more than 10 inches. Bedrock is solid immovable rock.

Cover or shelter is rated by the amount of protection or hiding space existing for fish in the water and can consist of aquatic vegetation, logs, brush, boulders, undercut banks, rock ledges, root masses, "bubble curtain" (the dense foam formed by falls), and rapid riffles. Just depth alone provides protection from predators that cannot see into deep pools or are unable to pursue fish in deeper water. To provide cover in the absence of any other places to hide, the depth has to be over about 45 centimeters (cm) (about 18 inches) for average-sized fishes 5 to 10 cm long (2 to 4 inches). Shallower water can suffice for smaller young and juveniles, and deeper water is needed for larger fishes. Turbidity also provides cover when present by blocking the fish from view.

Canopy is the amount of overhead protection from the sun or open sky that is present over the wetted portion of the stream channel. Canopy is usually provided by overhanging trees, streamside herbaceous vegetation, sedges, tules, cattails, or rock ledges. Occasionally bridges, pipeline crossings, and other artificial structures can provide beneficial canopy. While high canopy values can be beneficial by shading and cooling streams, excessive canopy can block all sunlight and reduce plant growth and productivity of the stream. Deciduous trees like willows can be more desirable since they allow sunlight in winter and block the sun less in summer than darker evergreen species like oak, which strongly block the light all year.

During the survey, temperature was measured and clarity of water was observed, and the conditions of adjacent shores and floodplain were assessed. Flow was estimated in cubic feet per second (cfs).

Observations were made of fishes present and representatives were preserved to verify identification and document existence at the time of the observations. All collections were made under the auspices of a California Department of Fish and Game Scientific Collecting Permit # 801137-03 (expires November 2, 2003). When referring to fishes, YOY means young-of-the-year, fish born in the year of the observations; juveniles refer to immature fish in at least their second season of life; and adult refers to sexually mature individuals. Fish lengths given here are in total length from the anteriormost point, usually the snout, but occasionally the protruding lower jaw, to the tip of the tail. Often fish length in scientific papers is given as standard length, from the tip of the snout to the base of the tail (caudal fin) and is 10% or so less than total length.

The following creeks were examined in the spring of 2003:

- Las Virgenes Creek above the 101 Freeway on 13 February from 09:30 to 10:00 and from Mulholland Drive upstream to the 101 Freeway on 12 March from 06:50 to 15:04 (Figure 1.1);
- upper Dry Canyon Creek and tributaries near junction of Old Topanga and Mulholland down to culvert at the north segment of Old Topanga; 12 March from 16:40 to 17:10, and Dry Canyon Creek from its exit from the culvert opposite the junction of Wrencrest Street and Old Topanga downstream to the cement-lined channel just above the 101 Freeway on 19 April from 12:40 to 14:35 (Figure 1.2); and
- McCoy Creek from about 300 meters above Calabasas Golf Course (100 meters above end of Ariella Drive on Parkway Calabasas) downstream through the golf course and downstream to entrance of Ed Edelman Tennis and Swim Center and crossing of Park Sorrento on 19 April from 08:10 to 12:10 (Figure 1.3).

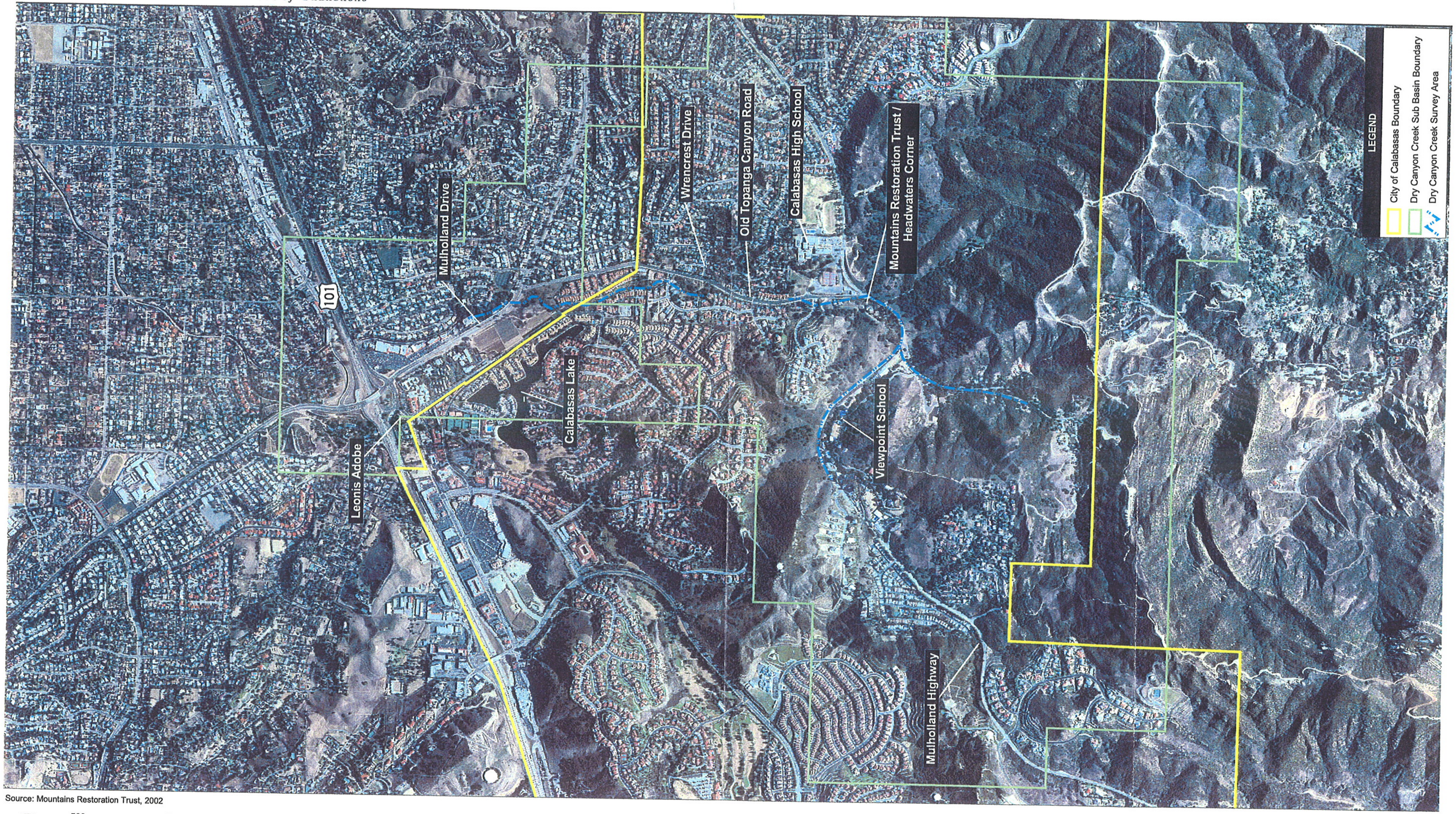
Virtually all the stream reaches in these sections were walked and examined. Flowing water was present in all streams examined. The length of each creek segment for a particular habitat type was estimated and the summary totals by reach are presented in Table 2. These figures are to be treated as estimates and may vary somewhat from actual measured lengths. However, the relative proportion or percent of each habitat type is close to the estimated values.

Source: Mountains Restoration Trust, 2002

500 0 500 1000 Feet

Scale: 1 : 6,000; 1 inch = 500 feet

Figure 1.1
Fish Survey Area
Las Virgenes Creek



Source: Mountains Restoration Trust, 2002

500 0 500 1000 Feet

Scale: 1 : 6,000; 1 inch = 500 feet

Figure 1.2
Fish Survey Area
Dry Canyon Creek

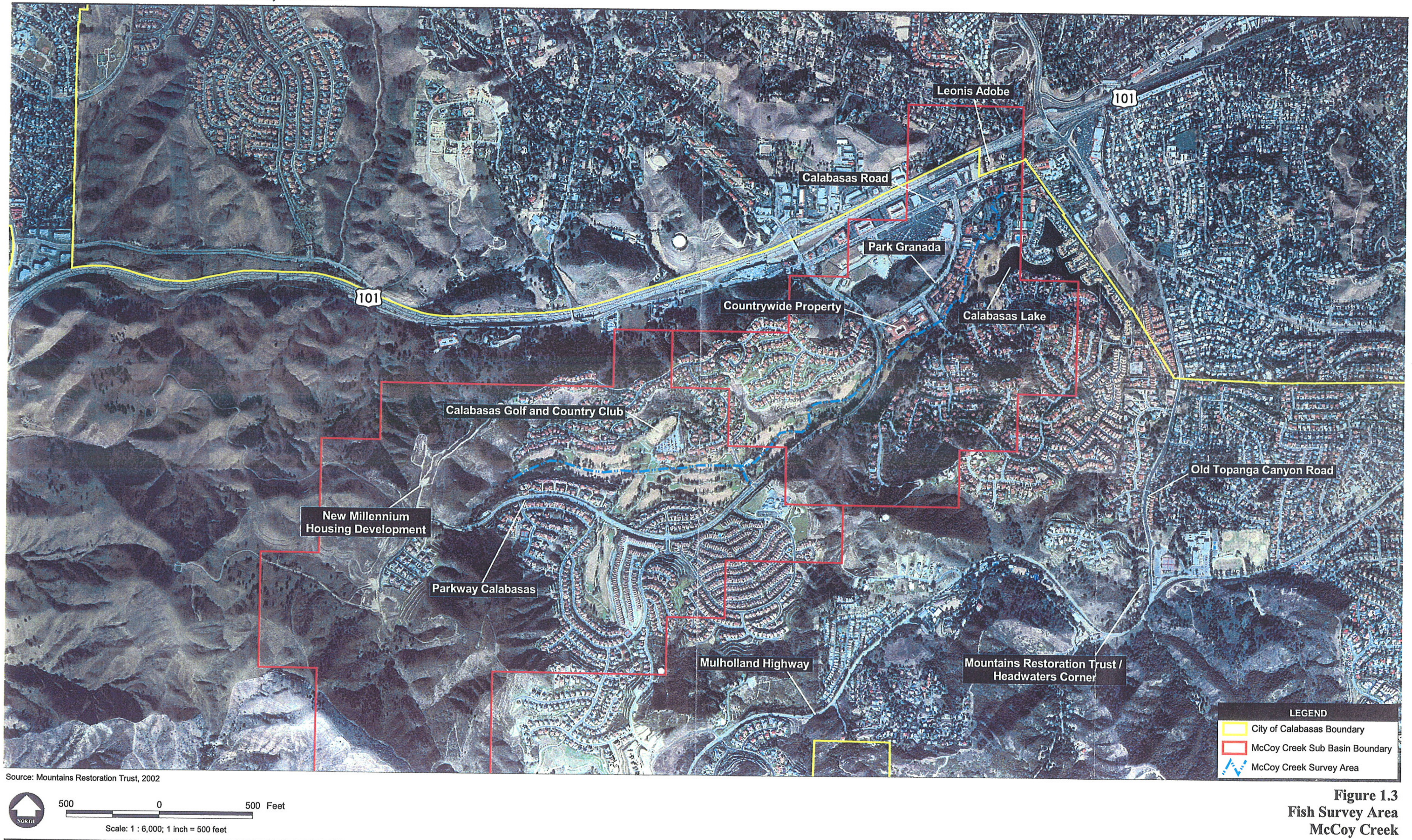


Figure 1.3
Fish Survey Area
McCoy Creek

Table 2
Summary of Habitat Types in Las Virgenes, McCoy, and Dry Canyon Creek Drainages in Calabasas, California, Spring 2003

Creek	Artificial Bottom, meters	Bedrock, meters	Runs, meters	Riffles, meters	Pools, meters	Barrier, meters	TOTAL, meters
Las Virgenes Creek	211 (4.3%)	0	1,221 (25.1%)	1,394.5 (28.7%)	2,009 (41.3%)	27.5 (0.6%)	4,863
Dry Canyon Creek	163 (14.2%)	0	270 (23.5%)	166 (14.3%)	550 (48.0%)	0	1,149
McCoy Creek, downstream	109 (8.3%)	15 (1.1%)	386 (29.2%)	414 (31.4%)	396 (30%)	0	1,320
McCoy Creek, Golf Course	905 (55.2%)	50 (3.0%)	270 (16.5%)	251 (15.3%)	164 (10.0%)	0	1,640
TOTALS	1,388 (15%)	65 (0.7%)	2,147 (24%)	2,225.5 (25%)	3,119 (35%)	27.5 (0.3%)	8,972

Note: Totals do not include small portions of Las Virgenes Creek above the 101 Freeway, or Dry Canyon Creek drainage above Wrencrest Drive and Old Topanga Canyon Road as summarized in the text.

CHAPTER 3.0
RESULTS

Approximately 8,972 meters (8.9 kilometers) of creek were examined for this study. This included about 4,863 meters of Las Virgenes Creek (plus about an estimated 1,200 meters above the 101 Freeway), 1,149 meters in Dry Canyon Creek, and about 2,960 meters in McCoy Creek (1,640 meters in and above Parkway Calabasas and 1,320 meters downstream of the downstream of Parkway Calabasas). The field survey excluded the shorter sections of Las Virgenes Creek and its tributary immediately above the 101 Freeway. Short segments of upper Dry Canyon Creek were spot-checked in the headwaters area. Flows were present in all the creeks surveyed: approximately 5 to 8 cfs in Las Virgenes Creek, 1 cfs or less in upper Dry Canyon Creek, 2 to 3 cfs in lower Dry Canyon Creek, and 2 to 3 cfs in McCoy Creek.

Las Virgenes Creek

Las Virgenes Creek was the largest continuous stream segment present and was an estimated 4,863 meters. Only 4.3% was artificial, mostly in the upper quarter of the stream segment; 25% was runs, 28.7% was riffles, 41.3% was pools, and 0.6% was barriers of some sort. At least four barriers to fish movement were present. One was a 1-meter-high falls over an eroded clay bank and another was a concrete water diversion structure also 1 meter high. Both of these barriers are between Mulholland Highway and Lost Hills Road bridges. Both had pools below them more than 1.5 meters deep and could be jumped by large steelhead, but not by other smaller fishes. The clay falls had been observed prior to this study on 10 April 2001 and, at that time, the water was only a few cm deep at the base of the falls, making it impassable to all fishes. Apparently high flows have since scoured out a very deep, brushy pool below these clay falls. About 200 meters above Lost Hills Road, a gunnited section of stream ends in a falls again about 1 meter high. Finally a 50 to 60 cm falls exists just downstream of Agoura Hills Road. In addition, very shallow gunnited areas exist under the Lost Hills Road, Meadow Creek Lane, and Agoura Road bridges. These areas are all very shallow and sloped and are probably barriers to fish movement up- and downstream. The canopy was mostly 70% or more except in the gunnite sections above and below the road bridges. Many pools were more than 1 meter deep and cover was good to excellent in many stretches.

Las Virgenes Creek and tributaries above the 101 Freeway occupied about another 500 to 600 meters from its crossing under the 101 Freeway upstream to the crossing of Las Virgenes Canyon Road. This stretch was relatively natural and had lots of gravel, cobble, and sand.

Several pools were deep and fast and a large volume of water was present during the visit. Above Las Virgenes Road, the main creek enters a completely concrete channel, only emerging from a concrete bottom much farther upstream on the Ahmanson Ranch Property at or near the Ventura County line. A tributary from the east lied along the north edge of the 101 Freeway for about another 500 meters and was about 80% natural sand and gravel bottom but included three segments with a concrete slope for substrate. These stretches upstream of the 101 Freeway were not entirely examined and are not included in the totals in Table 2.

Fishes were noted only in Las Virgenes Creek and only arroyo chub were seen. The arroyo chub were first encountered about 800 meters below Lost Hills Road, with crayfish also present, and became more common upstream to Agoura Hills Road. Just below Agoura Hills Road, 10 to 15 YOY chubs were observed indicating reproduction within the previous 2 to 4 weeks. Overall, a few hundred chubs were observed and three or four were preserved for verification. There were no steelhead, or Pacific lamprey, identified during the field visit

The crayfish seen in the vicinity of the arroyo chub in upper Las Virgenes Creek were the nonnative or exotic red swamp crayfish (*Procambarus clarki*) long known to inhabit the Malibu Creek watershed. The crayfish is known to adversely affect native fish and amphibian species elsewhere in the Santa Monica Mountains.

Dry Canyon Creek

The farthest upstream segments of Dry Canyon Creek examined were above the junction of Old Topanga Canyon Road and Mulholland Highway. These segments are fairly steep and had very little water flowing, less than 0.5 cfs. The tributary upstream along Old Topanga Canyon Road was a series of step pools in bedrock and seemed too small to support fish. The main reach was constrained between Mulholland Highway and development in the canyon. The Mulholland reach was rocky and gravelly and had two pools deeper than 30 cm in a length of about 150 meters of creek examined. Farther downstream at the crossing of Old Topanga Canyon Road, before it goes underground in a concrete culvert, the pools were much larger and deeper, up to 1.2 meters deep. Rock and bedrock predominated in the 200-meter section along the Mountains Restoration Trust's Headwater Corners section. The gradient appeared to be 2% or more in these upstream areas; the substrate was almost completely gravel, cobble, rock, or bedrock; and the canopy was extensive, 80% or more.

The lower section of Dry Canyon Creek from Wrencrest Drive to the 101 Freeway was lower in gradient, estimated at mostly 0.5 to 1.5%. Of this stretch 14% of the creek length was artificial, 23.5% was runs, 14.3% was riffles, and 48% was pools. Many of the pools were deeper than 1 meter and often had boulders, brush, and logs for cover. Good portions of gravel, rock, and sand were present and only small areas of muddy substrate were observed. The canopy was generally 70% or more with both oaks and willows forming the canopy in different sections. The areas with less canopy were from about 100 meters above and below the Park Ora bridge. The floodplain was wide except above the Park Ora bridge for about 200 meters where it is constrained between vertical concrete brick walls about 10 to 15 meters wide. The only barrier to fish movement was a falls about 1 meter high at the downstream end of the Mulholland Drive bridge and falls of gunnite just downstream of the culvert opening at Wrencrest Drive at the upper end of the segment.

The only aquatic vertebrates encountered were small frog larvae (tadpoles) and a turtle in the lower portion of the creek. The tadpoles were hylid frog tadpoles, with possibly some western toad tadpoles, and a few individuals were vouchered in the Hertetology Collection of the Natural History Museum of Los Angeles County. The turtle was not seen well enough to positively identify the species. It was about 10 cm in carapace length and was seen in the large, deep pool just below the creek's emergence from the culvert at the end of Wrencrest Drive. Another disturbance in a pool about 150 meters downstream of Park Ora was almost certainly a turtle or large frog but the animal was not actually seen.

McCoy Creek

The section of McCoy Creek in the Calabasas Golf and Country Club (Golf Course) and above is highly artificial for a little more than half of its length, due to concrete lining or underground culverts (55.2%). The gradient above the Golf Course is about 2% or more. Only the lower portions of the creek are in fairly natural condition: runs 16.5%, riffles 15.3%, and pools 10%. Bedrock makes up the remaining 3%. Several barriers clearly impassable to fishes consist of the following: one pair of falls just above Park Entrada; one barrier 2 meters high just below Parkway Calabasas; and four low barriers, 50 to 80 cm high and lying about 30 meters from each other just upstream of the Golf Course where the stream turns natural again. These barriers look like old water works or debris dams; one barrier is broken down such that it probably does not affect fish movement. The other three barriers are vertical falls 40 to 60 cm high and are impassable to small fish. These falls create deep pools below, which is relatively good habitat for native fish. Only larger fish like steelhead or rainbow trout could jump over these falls. In addition, the road bridges at Parkway Calabasas, Park Capri, and Park Sorrento are floored with concrete and the flow is only a few centimeters deep and not passable by most fishes. The bridge at Park Entrada has a natural soft bottom, which allows for normal channel development in the creek.

Downstream from the Golf Course the fish habitat is much better. Only 8.3% of the creek length in this reach is artificial, consisting of either culverts or cement lining, and 1.1% is bedrock. Riffles make up 31.4%, runs 29.2%, and pools 30% of this stretch. Many of the pools are more than 1 meter deep and often have boulders and logs providing much cover. Almost all of this area has 70% to 100% canopy, which keeps the stream well shaded. The gradient was estimated to be 1% to 1.5% in this section.

The only aquatic vertebrates encountered were small frog larvae (tadpoles). The tadpoles were hylid frog tadpoles, with possibly some western toad tadpoles, and a few individuals were vouchered in the Hertetology Collection of the Natural History Museum of Los Angeles County.

CHAPTER 4.0
SYNOPSIS OF BIOLOGY OF NATIVE SPECIES

The seven native species of freshwater fishes have a variety of habitat requirements and some of these needs are incompletely understood. Steelhead and lamprey require the coolest waters and largest streams since they attain the largest sizes among the locally known species. Santa Ana sucker also requires cooler water, but less consistently cold than steelhead and lampreys. The Santa Ana speckled dace and stickleback are intermediate in temperature requirements between the steelhead and sucker and the arroyo chub, which tolerates the warmest conditions. All of the local native fishes are the southern populations of mostly more northern cool and cold-water species and thus are adapted to the cooler range of aquatic conditions.

Steelhead Trout

Steelhead trout spend most of their juvenile and adult life in the ocean growing and they mature for 1 year or more. They return to local creeks during mid-winter high flows, usually from about 15 December to 15 April at temperatures of 8 to 12 degrees C. (46 to 54 degrees F.) to spawn in tributary streams. Adults can jump barriers up to 2 or more meters high but must have an unobstructed pool directly below the barrier at least one and a half times deeper than the height of the barrier. Of course, larger fish can jump higher barriers. Larger fish can also swim faster and overcome faster water while moving upstream. Usually fish move after peak flows, while water is still high but slower than at the peak. The females excavate a depression in large gravel in the shallow lower ends or tails of larger pools. One or more male steelhead fertilize the eggs as they are laid amongst the gravel and the female covers the eggs with more gravel. Thus a few inches of gravel free of finer sediment like sand or mud with water 50 to 80 cm (4 to 7 inches) deep is required. The water has to stay between about 9 to 12 degrees C. (48 to 54 degrees F.) for a total of 5 to 6 weeks for the young to emerge from the gravel and become free-living young steelhead trout. These juveniles only need shallow water, up to 10 cm (4 inches) deep at first but require deeper water with age. At first in quiet shallow marginal waters, intermediate-sized fishes, up to 10 cm (4 inches) long, tend to be found in riffles, fish 10 to 20 cm (4 to 8 inches) tend to be in runs, and larger fishes prefer deeper pools. Ideal temperatures appear to be about 15 to 18 degrees C. (60 to 66 degrees F.) and temperatures above 20 degrees C. (68 degrees F.) can be stressful or even lethal. Steelhead in freshwater feed largely on invertebrates, mostly insects, that are from the water or carried in from terrestrial sources. Insects are most abundant and numerous in riffles where production is highest for these invertebrates compared to runs and pools. Thus riffles are desirable for high-quality trout habitat as well as for the other native species. The juvenile and adult steelhead can also reside in ponded water like coastal lagoons.

Lamprey

Adult lamprey spend their life in the ocean and, like steelhead, return to the freshwater streams to spawn in the coolest winter and early spring periods. Their spawning habits also require gravelly substrate and cold temperatures in the same range as for steelhead. The young lamprey in freshwater are called ammocoetes or ammocoetes larvae. They are elongate, worm-like, and almost eyeless and live in sandy and muddy substrate in well-oxygenated streams. They are usually buried in the bottom materials with their mouth at the surface feeding on detritus (decaying plant material). They spend a year or so growing to about 10 to 15 cm (4 to 6 inches) long and when the winter rains come they transform into the adult form with the development of large eyes and strong rasping teeth in their conical, jawless mouth. They migrate to the ocean for an adult life of parasitizing other fishes.

Santa Ana Speckled Dace and Arroyo Chub

Dace are often found in riffle and pool environments with lots of rock and cobble and faster flows. Dace reach only about 7.5 cm (3 inches) in length and mostly live only 1 year with some large individuals living for a second year. They spawn in the early spring (late March to early June) and their spawning habits involve crowding into rocky and gravelly riffles and laying eggs among the rocks and gravel. They hatch out in a week or so and the larvae also inhabit the shallowest margins of the stream near faster water. After a week or two the juveniles take up a benthic existence in moving water. Generally dace do not tolerate ponded, standing water but they will live in pools of streams where the flow is fairly slow. Dace, as well as arroyo chub, feed largely on aquatic invertebrates.

Arroyo chub are also stream fish but will inhabit ponds and lakes. They formerly were considered pests in some lakes and reservoirs when they multiplied profusely after being introduced. Chubs grow to about 15 cm (6 inches) in length and can live for 3 to 4 years. Like the steelhead, dace, and Santa Ana sucker, the female chubs average larger in size than the males. Male chub reach between 10 to 12.5 cm (4 to 5 inches) in total length. Chub are known to live for 2 to 4 years. They live in streams but will invade pools and slow-moving water more than dace and Santa Ana suckers. Arroyo chub will spawn in water from approximately 15 to 25 degrees C. (60 to 78 degrees F.) and appear to require flowing water to spawn. The females release the eggs against brush or vegetation trailing in slowly flowing water and the eggs adhere to the vegetation. They take about 5 to 8 days to hatch at a size of 4 to 6 millimeters long (about one-quarter inch). These minute larvae are almost invisible along the shallowest quiet water near the edge of streams. Very small arroyo chub can be found during all of the 9 to 10 warmer months so spawning can take place for much of the year. As they grow they inhabit increasingly deeper water and resemble trout in living and feeding in the water column between the bottom and the surface. The largest individuals are usually hiding under rocks, logs, or other cover and often are not seen without snorkeling or netting. A study in the West Fork of the San Gabriel River found that large chub eat many of the same invertebrates (mostly insects) as the trout in the same stream.

Santa Ana Sucker

Santa Ana sucker attain larger sizes than chub and dace, up to 20 cm (8 inches) in length. Sucker live mostly on the bottom and have strong cartilaginous ridges on their jaws to scrape algae and invertebrates from rocks, logs, and other hard substrate. Sucker live virtually exclusively in flowing water and do not utilize ponds, lakes, and other standing water. They do live in pools in streams. Like the other native species, the size of the fish determines the depth of water inhabited; the smallest fish live in shallow margins and as they grow they inhabit deeper, faster water. Spawning takes place in slow flowing stream water in gravel and sand substrate. The suckers spawn in small groups depositing the adhesive eggs in the gravel. The eggs hatch out in 5 to 10 days and the larvae hatch out at 8 to 10 millimeters (about one-quarter to one-half inch), about twice the size of chub larvae. The larvae and early juveniles, up to about 20 millimeters (three-quarters of an inch) live at the surface and mid-water. Larger fish have the typical turned-down mouth of a sucker and become much more benthic, similar to the adults. Sucker start to spawn earlier than chubs and dace, at 12 to 20 degrees C. (54 to 68 degrees F.) and later than trout, which spawn at cooler temperatures.

Unarmored Threespine Stickleback

Threespine stickleback are small sized, the maximum at about 7.5 cm (3 inches), and mostly live for only 1 year. They are named for the three sharp spines on the back that are elevated to deter predators. The males become brightly colored in the breeding season with red on the sides and undersides of the head and anterior body. The rest of the body is bright green or bluish. The male builds a small mound-like nest of plant debris and excavates a tunnel through it. The female is attracted to the male's display and swims through the tunnel to lay her eggs. The male fertilizes them and guards the nest and eggs until they hatch in a few days. He protects the young for a few more days after which they become independent at about 7 to 10 millimeters (one-quarter to three-eighths inch) in length. The stickleback spawn during most of the warm months, like arroyo chubs. When winters are light and streams are not disrupted, spawning may occur almost year-round. Possibly they cease spawning during the warmest months and resume in the late summer and/or early fall when the water cools. Stickleback have very small mouths and eat very small animal matter, smaller than the other native fishes. Stickleback prefer the slowest of flowing waters near the edges of slow moving portions of streams, often with abundant aquatic vegetation like water cress, veronicas, or cattails and sedges. Thus they are often also in relatively shallow water, less than 30 cm (12 inches) deep, although they may inhabit deeper water if larger predators are absent.

All of these native species prefer cool to cold water and do not do well in waters that are warm all the time, namely over the mid-20 degrees C. or low 80 degrees F. Trout are stressed in water over 70 degrees F. but most of the other species, except perhaps the cold water lampreys, can tolerate water temperatures into the low 80s. Water temperatures in the high 80s or more can be stressful to all the native species. Most of the creeks in Calabasas appear to have good canopy that shades the streams and may keep the water in the streams from warming up too much.

Part of the reason high temperatures are stressful is the lack of dissolved oxygen in the water. The warmer the water is the lower the capacity it has for holding oxygen. So warm water without riffles, falls, or other disturbances to mix in oxygen from the air will be too low in oxygen to support fishes. Oxygen is also produced by plants in the water during photosynthesis in the day time but ceases during the night and oxygen can drop to low levels. Organic and other materials in the water can also oxidize and use up oxygen in the water. Fish kills can occur in streams in the morning if oxygen has been used up over night by pollutants oxidizing the oxygen in the absence of photosynthesis.

Reproduction is restricted from a few weeks to 2 months in the late winter and spring for the steelhead, lamprey, sucker, and dace. The arroyo chub and stickleback can breed over a longer period during the warmer months of the year. In other areas of the southwestern United States, dace have been observed to spawn during high water events several times a year, but this does not occur in southern California. The stickleback is the only native fish in southern California with parental care.

Because of the seasonal and year-to-year variation in water flow, local populations of native fishes can fluctuate widely over the year and between years. Winter storm and flood flows often reduce populations to low numbers. Later in the spring, summer, and fall, numbers will increase greatly. These numbers are greatest during wet years and lowest during dry years when the amount of aquatic habitat to support fishes shrinks. Because of southern California's Mediterranean climate, these fluctuations occur on an annual basis as well as on multi-year cycles of wet years and drought years.

Natural waters in coastal southern California are usually clear or nearly so, becoming turbid only during high winter flows or with local disturbance introducing sediments into the water. Arroyo chub, stickleback, and trout are mostly visual feeders and need clear water to thrive. The suckers, dace, and lamprey are less dependent on clear water but are still found most abundantly in clear streams.

Arroyo chubs, speckled dace, and stickleback are small in size and can tolerate the smallest streams. Trout and suckers attain larger sizes and tend to be restricted to larger streams. Lamprey are specialized for soft substrates where good flow also exists. Dace, trout, and lamprey invade the farthest upstream in local tributaries, into gradients of more than 3%; whereas, sucker do not go as far, remaining in gradients of about 2% or less. Stickleback and chub also remain mostly in lower-gradient streams, usually less than 2%, and these two species inhabit the slower parts of the streams.

The populations of native fishes also provide prey items for several other native species that historically, and perhaps presently, occur in the area. Garter snakes prey on fishes like stickleback, chub, and trout, as well as on tadpoles of tree and redlegged frogs. Some tree frog tadpoles were taken in Dry Canyon and McCoy creeks during the present study. Garter snakes and redlegged frogs certainly occurred historically in the area and might be considered for reintroduction as part of the recovery of these species.

CHAPTER 5.0
DISCUSSION

The physical habitat of the streams appeared good to excellent in most stretches examined. Based on observed conditions, the amount of flow, kinds of substrate, depth of water, and presence of a variety of habitats are reasonable for the native fishes that occur there now (only arroyo chub in Las Virgenes Creek) or that might be restored to the area (steelhead and lamprey in Las Virgenes Creek and these and all the other species in Dry Canyon and McCoy creeks). However, this conclusion is based on a one-time survey in the spring when flows were relatively good and temperatures were still cool. The lack of any fish in Dry Canyon and McCoy creeks may indicate that the water does not flow year-round, and during the warm summer months water temperatures may increase to unacceptable levels for the fish to survive. It is also possible that the lack of fish in the creeks results from the creeks completely drying out during the summer months. The lack of exotic fishes is also encouraging since they often adversely impact the native species.

The abundance of sand, gravel, and rocks and a good proportion of riffles, runs, and pools with pool depth often 1 meter or more indicate all the habitat requirements of all the fish species discussed here. Good to excellent ratings for cover with rocks, boulders, logs, or brush in many pools and runs indicate adequate protection and hiding places for the native fish species. The canopy is extensive in almost all areas except near bridges and in the Golf Course where much of the stream is artificial. While helping to keep the streams cool, the heavy stands of oak canopy in some areas may be reducing productivity (photosynthesis) of the streams.

Two other observed features (barriers in the study area and those outside of Calabasas) and one unknown feature (water quality) are or may be detrimental to native fish populations. Several barriers to fish movement were noted in the surveys and are described in Section 3.0 of this report. These divide fish populations into smaller segments since interchange of individuals is rendered impossible or only possible in a downstream direction. Thus fish can go over the falls to the area downstream but downstream fish are unable to return. The steelhead and lamprey are migratory and thus would be denied entrance to the areas above barriers. In all the other species the young tend to drift or be washed downstream a few meters to a kilometer or two and as they grow they reinvade upstream areas. With barriers, the fish are unable to return. Even resident fish are divided into smaller reproductive populations that may be more vulnerable to extirpation. The known barriers in the area were enumerated in Section 3.0 and other barriers are probably present downstream of Calabasas. At least two barriers are known downstream on Las Virgenes Creek. A third barrier on Malibu Creek, Rindge Dam, has prevented steelhead from entering the area since the late 1920s. There are some conservation efforts underway to possibly remove Rindge Dam, including a feasibility study conducted by the US Army Corp of Engineers and California State Parks. If Rindge Dam is removed, Las Virgenes Creek could become accessible to steelhead if the other barriers noted here are also removed or ameliorated. Downstream of Dry Canyon and McCoy creeks, Sepulveda Dam and the vast expanses of concrete-lined channels are barriers to movement of native fishes into and out of the Calabasas area. Even if the habitat is suitable in Calabasas, there is no way for native fish to naturally recolonize the area given the existing conditions downstream. The documented barriers in Dry Canyon and McCoy creeks would make it hard for the fish to survive without being able to exchange individuals. It is desirable to maintain the longest continuous segments of stream possible in order to maintain fish populations.

Water quality and quantity are currently unknown for these three creeks. Data were not available regarding the amount of water present year-round. Even with much lower flows in summer and fall, native fishes have the potential to survive in the many deep pools observed that should hold some water in the dry season. This presumes that excess nutrients, pollutants, or other factors of water quality are not making the water unsuitable for the native fishes. Most of these native fishes are known to live with some degradation of water quality in the Santa Clara and Santa Ana rivers, including tertiary treated wastewater treatment effluent. Thus some altered water quality is not necessarily detrimental and in many cases is providing the necessary water to support populations of native fishes elsewhere. The steelhead, lampreys, and stickleback were the first fish to disappear from the Los Angeles River watershed in the 1940s and 1950s. These species apparently were more sensitive to water quality issues than the dace, chub, and sucker, which lasted longer and still occur in a few places in the Los Angeles River watershed. This indicates that the chubs, sucker, and dace would be the easiest to reestablish in the Calabasas streams; the others would require more restoration, or at least work to identify the factors that have to be corrected. The Riverside-Corona Resource Conservation District has had success in maintaining self-reproducing populations of chub and dace in an outdoor artificial stream and were able to hold suckers in the same stream for most of a year. This means it is possible to bring populations of these fish back to areas where they have been extirpated.

CHAPTER 6.0
RESTORATION NEEDS AND RECOMMENDATIONS

Based on the previous chapters, the five main needs for restoration of native fishes in these streams in Calabasas can be divided into five categories: (1) habitat improvement, (2) barrier removal, (3) reintroduction of native fish species, (4) elimination and management of exotic species, and (5) improved access to the area from downstream sources of native fishes. Water quality and seasonal quantity should also be studied to determine if the quality and amount of water are appropriate for native fishes. Barriers should be removed and more natural substrate used to make these areas passable to native fishes. These barriers are formed by clay banks eroded headward, concrete vertical drops, and/or cement-lined channel bottoms that render them impassable to fishes. Thus, the solutions are different for each type of barrier.

The restoration of the physical conditions of the McCoy Creek is needed in the Golf Course area where the creek is mostly obliterated underground in culverts. The creek in the Golf Course, the main canyon, and the side canyon coming in from the southwest should be returned to surface flow and designed with no obstacles to upstream movement of fishes. A combination of riffles, pools, and runs could be established to provide habitat for native freshwater fishes. This higher-gradient, upper portion of the upper creek would normally have more riffles and pools than runs. Usually runs develop more in lower-gradient areas downstream that meander more. An upstream riffle and pool stretch with relatively high gradient in the Golf Course would be more amenable to the trout, sucker, and dace; whereas, the stickleback and chub would be more prevalent downstream of the Golf Course where gradients are lower and more quiet water runs and pools would be present. However, young of sucker and dace would drift downstream into the lower-gradient area in the spring and after growing bigger would tend to move back upstream into the higher-gradient areas.

The higher-gradient creek section in the Golf Course should be mostly rocks, gravel, and boulders stepped such that fish could freely move up- and downstream. In addition, riparian vegetation should be included to provide shade and keep the stream cool and better oxygenated. The design should prevent nutrients and pollutants from entering the stream and possible groundwater sources should be used to maintain high water quality and to keep water temperatures low. The large pond in the Golf Course should be kept free of exotic aquatic organisms that could adversely affect the native species. Arroyo chub and stickleback could thrive in a pond habitat if the water was appropriate for them. As observed during the survey, the water in this section was very greenish, as if plankton blooms were taking a lot of the fishes. A simultaneous educational effort should accompany any restoration effort. This can reduce inadvertent introductions of aquatic organisms and build local support for native species restoration.

The crayfish were identified in Las Virgenes Creek above Lost Hills Road. These invertebrates are known to impact native fish in various stream segments of the Malibu Creek watershed. Before efforts are made at native fish reintroduction these exotic invertebrates should be controlled or eliminated. The combination of exotic removal with habitat improvements will greatly improve the native fish reintroduction efforts.

One of the basic tenets of the Endangered Species Act is habitat restoration. Therefore, improving these streams should be looked upon favorably by the agencies that administer this Act. Of the fish species included here, steelhead and unarmored threespine stickleback are federally endangered, the sucker is federally threatened, and the dace and chub are California Species of Special Concern. The freshwater species of lamprey has been extirpated in southern California. The migratory lamprey is now being reviewed for possible consideration for the endangered species list. Thus, considerable coordination with the National Marine Fisheries Service (steelhead), the U.S. Fish and Wildlife Service (stickleback and sucker), and the California Department of Fish and Game (chub, dace, lamprey) will be required. They will most likely require detailed plans for bringing native species back to these stream, including monitoring of fish populations before, during, and after all projects to ensure that the results are assessed scientifically.

CHAPTER 7.0
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