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EXECUTIVE SUMMARY

The goals of this project were to survey and map both native and non-native amphibians, their habitats, and associated benthic macroinvertebrate communities to help identify restoration and monitoring priorities along the Santa Clara River. A total of eleven (11) survey areas were selected from within the study area (Santa Clara Watershed). Specifically, seven (7) study areas were located within the mainstem Santa Clara River and four (4) were located in major tributaries including Aliso, Escondido, lower Sespe, and Santa Paula Creeks (Survey Period Mar 2005 – Aug 2006).

Three (3) of six (6) target native amphibian species were detected within the eleven (11) study areas including the Pacific chorus frog, California chorus frog and California toad. Western spadefoot are known to be present within the study area but were not documented during the survey efforts. Two (2) introduced predatory amphibian species including the African clawed frog and bullfrog were also documented throughout the majority of the study areas. The benthic macroinvertebrate assessments conducted at each of the study areas resulted in the identification of thirty (30) genera, thirty (30) families of insects, and four (4) non-insect taxa.

In general, the abundance and diversity of amphibians and benthic macroinvertebrates is higher in the tributaries of the Santa Clara River than in the mainstem. With the exception of Escondido Creek, which was similar in macroinvertebrate taxonomic composition to the Santa Clara River mainstem, there is a trend toward a diminishing number of aquatic insect families and genera proceeding from the tributaries, Aliso, Sespe, and Santa Paula (mean=17.75 families) to the mainstem of the Santa Clara River (mean=10.43 families). Also, several of the major tributaries, some of which were not surveyed as part of the project remain occupied by federally listed species including the arroyo toad (Castaic, Middle/Upper Piru, Upper Sespe Creeks) and California red-legged frog (San Francisquito Canyon). These species were historically (arroyo toad as recent as 2005) documented within the mainstem of the Santa Clara River.

Significant stressors that continue to directly and/or indirectly impact native benthic macroinvertebrates and native amphibian species (several of which likely contributed to the extirpation of the arroyo toad and California red-legged frog from the Santa Clara River floodprone area) include, point source discharge effects to water quality, loss of upland amphibian habitat (urbanization and agricultural uses), unnatural releases from reservoirs which alter geomorphology, reservoir impacts on population fragmentation (arroyo toads in upper Castaic, middle and upper Piru Creeks), invasive plant species, mining, and groundwater extraction (can result in reducing duration of pooling needed for the completion of amphibian metamorphosis).

Based on the results of the study, recommendations include implementing a program for population control of African clawed frogs and bullfrog, continuation of programs for controlling introduced plants (*Arundo donax* and *Tamarisk* species), encouraging riparian vegetation restoration in all drainages and upland vegetation within 1 km (0.6 mi) of streams and rivers, restoration of the natural historic flow regime or creation of a regime that provides maximum benefit for native biodiversity, development of a management and monitoring program based on Total Maximum Daily Load standards, and the minimization of development impacts on aquatic habitats primarily focusing on the use of riparian buffer zones.

Monitoring efforts should include developing a long-term water quality/target species monitoring program, groundwater level monitoring program throughout the watershed to determine to what

extent extraction is having on the successful recruitment (successful breeding) of amphibians throughout the floodprone area, initiation of focused surveys for the western spadefoot, arroyo toad and California red-legged frog to determine presence/absence at select sites, and implementation of a public environmental education program. Continued support for existing programs that promote water conservation, recycling, water quality protection, and respect for our natural resources (while protecting the publics passive use of open space areas) will represent one of the most important approaches to assuring that native benthic macroinvertebrates and amphibians persist in the Santa Clara Watershed.

1.0 OVERVIEW & GOALS OF THE PROJECT

Worldwide declines in amphibian populations are at the forefront of the global biodiversity crisis and southern California is a hotspot of amphibian declines (Jennings 1988, Fellers and Drost 1993, Jennings and Hayes 1994, Drost and Fellers 1996, Fisher and Shaffer 1996, Davidson et al. 2002). The primary factors contributing to amphibian population declines are habitat loss and degradation (Alford and Richards 1999, Blaustein and Kiesecker 2002). It has been estimated that as much as 90% of the historic riparian habitat in southern California has been eliminated at the hand of anthropocentric-induced impacts and pressures. Coastal watersheds, such as the Santa Clara River Watershed, have suffered due to dams, diversions, channelization, urban and agricultural development, livestock grazing, and other disturbances (Dennis et al. 1984, Bell 1997). In Los Angeles County alone, over 97% of the wetlands once present are now gone, and the wetland and riparian communities remaining are intensely threatened. This significant loss of habitat has been accompanied by a decline in wildlife populations that depend wholly or in part on riparian systems.

The ninth annual report of the U.S. Council on Environmental Quality (1978) states “no ecosystem is more essential than the riparian system to the survival of the nation’s fish and wildlife” (Faber et al. 1989). Krueper (1992) estimates that wetland and riparian habitat occupies less than 1% of the total land area in the western U.S., yet is critical for up to 80% of terrestrial vertebrate species. Many aquatic vertebrate species that depend on low-elevation (<3,000') riparian habitats are now Federally- and/or State-listed as endangered, threatened, or sensitive (*Table 1*; USDA 2000). Riparian habitats are truly among the rarest and most sensitive ecosystem types in the western United States.

Table 1
Southern California Threatened, Endangered, or Sensitive Species of Aquatic Ecosystems

Species	<3,000 ft
California red-legged frog	Yes
Foothill yellow-legged frog	Yes
Mountain yellow-legged frog	No
Coast Range newt	Yes
Arroyo toad	Yes
Santa Ana sucker	Yes
Santa Ana speckled dace	Yes
Arroyo chub	Yes
Southern steelhead	Yes
Shay Creek stickleback	No
Unarmored threespine stickleback	Yes
California red-sided garter snake	Yes
Southwestern pond turtle	Yes

Development and alteration of stream and river channels, associated terraces, and upland habitats are major factors contributing to the loss of aquatic and semi-aquatic amphibians and reptiles. Rapid growth in agriculture, industry, and urban development has resulted in dramatic direct and indirect impacts to the Santa Clara River and its tributaries. Degradation from the cumulative impacts of polluted runoff, concrete channelization, mining, water treatment plants, grading and infill, and other contributors such as the ARCO pipeline oil spill threatens the inhabitants of this wild river system. For instance, excessive concentrations of suspended sediment can outright kill aquatic organisms and impair the productivity of the River (Trombulak and Frissell 2000). The Santa Clara River Watershed is under intense development pressure, putting native amphibians at risk of extinction.

Exotic plant and wildlife species in both aquatic and terrestrial habitats have substantially degraded and disrupted the natural communities that native amphibians depend upon for survival. Numerous introduced species are now abundant in the riparian communities of southern California; some were intentionally introduced for erosion control, recreation for anglers, or mosquito abatement, while others, such as ornamentals, have escaped cultivation due to their adaptive physiology. Introduced species have disrupted the ecological integrity of entire watersheds which has had profound effects on species that are adapted to and dependent upon these natural communities. As these communities become invaded and dominated by non-native species they become less able to support native species. Dudley and Collins (1995) conducted a statewide analysis of non-indigenous species, and concluded that the South Coast Bioregion has more non-native species than any other ecoregion in California.

The invasion of alien species to riparian systems is detrimental to amphibians (Kiesecker 2003, Kats and Ferrer 2003). Non-native species can harm amphibians through competition (Kiesecker 2003), disease transmission (Kiesecker et al. 2001, Blaustein and Kiesecker 2002), and predatory interactions (Kats and Ferrer 2003). Introduced fish are evidently the most widespread predators on amphibians (Stebbins and Cohen 1995). Most non-native fish have been introduced to lakes and ponds to provide game for sport fishermen (Cory 1963, Knapp 1996, Stein et al. 2000, Kats and Ferrer 2003), though they can spread easily to stream and river systems during major flood events (Bradford 1989). Even hatchery-reared salmonid fishes may eat native amphibians (Bradford 1989) or infect them with pathogens (Blaustein et al. 1994, Kiesecker et al. 2001). Mosquitofish (*Gambusia*) have been introduced into many systems because of their effectiveness at controlling mosquito populations (Miura et al. 1979, Bence 1988) but their diet also includes amphibian larvae (Webb and Joss 1997, Goodsell and Kats 1999, Kats and Ferrer 2003). Crayfish (*Procambarus clarkia*) are also effective predators of amphibians (Gamradt and Kats 1996), as are bullfrogs (*Rana catesbeiana*) (Zweifel 1955, Beringer and Johnson 1995, Kiesecker and Blaustein 1997, Kats and Ferrer 2003). These non-native predators can drive local amphibian populations to extinction (Bradford 1991, Bradford et al. 1994, Gamradt and Kats 1996, Matthews et al. 2001).

Arundo, or giant reed *(Arundo donax*) is an introduced plant species that has become established in many parts of the Santa Clara River Watershed. This exotic plant is particularly invasive, eliminating native plants and significantly changing the character of the habitat for wildlife (Faber et al. 1989). *Arundo donax* is now widely distributed in moist places in California, and has displaced extensive amounts of native vegetation along streams and watercourses, particularly at elevations below 1,000 feet (Faber et al. 1989). It is extremely invasive, competitive, and difficult to control in riparian communities, and provides neither food nor nesting habitat for native animals (Bell 1997). This exotic plant compromises the ability of riparian communities to support native species because it doesn't provide the physical, structural, or chemical characteristics necessary for proper ecosystem function. Exotic plant invasion significantly diminishes habitat quality and quantity (Faber et al. 1989).

Several contaminants may also adversely affect amphibian populations, such as pesticides, herbicides, fungicides, fertilizers, and numerous pollutants (Sparling et al. 2000, Blaustein and Kiesecker 2002). These contaminants can cause direct mortality, have an effect on behavior, reduce growth rates, act as endocrine disrupters or induce immunosuppression (Alford and Richards 1999). Agriculture is a major land use, particularly in the lower watershed. In 1998 alone, California farmers used over 90 million kg of pesticide-active ingredients (Department of Pesticide Regulation 1998). Researchers have documented the transport and deposition of pesticides from the agriculturally intensive Central Valley to the adjacent Sierra Nevada Mountains (Cory et al. 1970, Datta et al. 1998). Even low levels of pesticides can cause fatalities in amphibians (Taylor et al. 1999, Davidson et al. 2002).

Ground water pumping has also drastically altered the hydrology of the Santa Clara River and its tributaries and has likely triggered a substantial reduction in riparian vegetation. There are a number of wells that extract groundwater from the aquifers at rates greater than 100 gallons per minute and several small volume private wells scattered throughout the watershed. Concerns over groundwater supplies arose as early as the 1920s (Schwartzberg and Moore 1995). Groundwater levels have been declining ever since due to an increase in industrial, commercial and residential uses in conjunction with prolonged drought (AMEC 2004). Groundwater supplies are now at record lows, with several wells in the upper watershed at catastrophically low levels.

Water quality on the main stem and several tributaries has also been degraded are listed as impaired under Section 303(d) of the Clean Water Act due to excessive total dissolved solids, sulfate and chloride in 2006 (RWQCB). Total dissolved solids are measured as the amount of material that is dissolved in water and can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions. These listings make these riparian stretches eligible for the development of intensive management plans called Total Maximum Daily Load (TMDL) plans. TMDLs are implemented by the Regional Water Quality Control Board, which evaluates the cause of water quality deterioration and then enacts an implementation plan to return water quality to targeted values. Other water quality efforts either completed or in progress include development of a chloride TMDL (Total Maximum Daily Load) for the upper reach of the River, a nutrient TMDL, and on-going NPDES permit related monitoring (AMEC 2004).

Amphibians are considered ecological barometers of ecosystem and watershed health because they experience both aquatic and terrestrial stressors (Blaustein and Wake 1995, Blaustein and Kiesecker 2002). Amphibians, such as the arroyo toad (*Bufo californicus*), are ideal aquatic habitat quality indicators because of their dependence on riparian and adjacent upland habitat, high water quality, and native ants. The arroyo toad is known to utilize upland habitats up to 1.2 km beyond the riparian zone (Holland and Sisk 2001a). Similarly, Western spadefoot toad (*Spea hammondii*) requires seasonal pools for breeding but may travel hundreds of meters outside the breeding area to forage and reach underground refugia**.** While semi-aquatic reptiles, such as pond turtle (*Actinemys marmorata pallida*) and two-striped garter snake (*Thamnophis hammondii*) require nearby uplands for nesting and over wintering movement requirements (Rathburn et al. 1992, Rathburn et al.1993). This seasonal migration between wetland and upland habitats makes these species vulnerable to roadkill (Rosenberg et al. 1997). The remaining riparian communities in the watershed are crucial to the survival of native amphibian populations.

Ecologically, aquatic macroinvertebrates (mainly consisting of insects, mites, mollusks, crustaceans, and annelids) act as prey, predators, pollinators, water purifiers, grazers, soil reducers, mosquito control agents, and more. As a source of food they are extremely important, serving as a link between their food sources (detritus, algae, vascular plants, microorganisms, fungi, and other invertebrates) and all classes of vertebrates including fish, amphibians, reptiles, birds and mammals. For example, in late spring and summer, emerging aquatic insects provide food for breeding migratory birds and for residential species that use this supplemental food source to raise their young (Faber et al. 1989).

The distribution of aquatic macroinvertebrate populations is determined by the physiochemical tolerances of individuals in a population to a suite of environmental factors. Thermal tolerances are often the primary determinate of a species range of occurrence, both within and between different habitats (Ward 1994). Within their range of occurrence, the abundance of aquatic invertebrates is regulated by the availability of food resources and suitability of the habitat. Riparian vegetation serves as both a source of organic energy to shredding invertebrates and as a regulator of thermal conditions in the river. Shade created by riparian vegetation prevents summer stream temperatures from becoming too extreme, which can be lethal to invertebrates, amphibians and fish. When stream-side vegetation is reduced, the number of niches for insects is likewise reduced, resulting in fewer numbers of species and populations (Ohmart 1994).

The abundance and species richness of macroinvertebrates are often monitored because they serve as indicators of water quality and can provide a spatially and temporally integrated measure of stream health. Rosenberg and Resh (1993) concluded that macroinvertebrates are frequently used as a biomonitoring tool because: 1) they are ubiquitous and consequently affected by perturbations in many different aquatic habitats; 2) the large number of species exhibit a range of responses to environmental stress; 3) their sedentary lifestyles permits determination of the extent of spatial perturbations; and 4) their long life cycles allow the examination of temporal changes in abundance and age structure. In addition, they can be used to evaluate the effects of anthropogenic stressors at all levels of biological organization, ranging from the molecular to the ecosystem. At present 49 of 50 states in the United States use macroinvertebrates in water quality monitoring programs and the 50th state is currently developing a program (USEPA 2002). An understanding of anthropogenic as well as natural stressors on the distribution and abundance of aquatic macroinvertebrates in the Santa Clara River is critical for comprehensive impact assessment and for the development of protection and restoration programs that are vital to maintain and improve the ecological health of the Santa Clara River and the tributaries that sustain it.

In years with average annual precipitation, systems such as the Santa Clara may undergo partial summer drying, with little or no surface flow along large sections of the river; at this time, aquatic organisms may become dormant or retreat to more permanent water sources. In winter and spring, heavy rainfall over the watershed may send churning floodwaters down-channel, removing accumulated sediments (and dormant arthropods), overturning heavy substrate materials, and clearing-away aquatic vegetation. Even moderate amounts of storm runoff may create high levels of turbidity and remove fine sediments. Precipitation patterns during this study were particularly unusual. The first year saw the heaviest rainfall on record, and the second year experienced early rainfall events with little subsequent rainfall. Global climate change such as wide variations in precipitation and temperature can affect the breeding phenology of some amphibians (Blaustein et al. 2001), with most responding by breeding earlier.

To maximize the efficacy of future restoration activities, it is important to gather baseline data to document the distribution of listed and sensitive species and non-native invasive species. The presence of native amphibians and associated benthic macroinvertebrate communities are critical to riparian restoration efforts and overall watershed protection. Since many historical records have not been verified recently, and recent changes have occurred from urban, industrial, and agricultural development within the watershed, there is substantial need to measure the change in the presence and distribution of aquatic species. This project surveyed and mapped native and non-native amphibians, their habitat, and associated benthic macroinvertebrate communities to provide a baseline for future riparian habitat restoration opportunities in the watershed.

The project goals were to survey and map non-native species and native amphibians, their habitats, and associated benthic macroinvertebrate communities to help identify restoration priorities along the Santa Clara River. This effort fulfills Santa Clara River Enhancement and Management Plan objectives, supplements the Ventura County Planning Division inventories or locally rare species and environmentally sensitive habitat overlay, and contributes research to the Hendrick Ranch Enhancement Plan. While surveys were focused on amphibians and benthic macroinvertebrates, all observations of fishes, reptiles, birds, and mammals were documented. The project focused on the following objectives:

- Develop habitat suitability maps for target amphibian species
- Locate and map native aquatic and semi-aquatic amphibian species, and exotic aquatic predators to establish baseline conditions. Compare existing conditions with historical occurrence data.
- Map amphibian populations, highlighting threatened and endangered species and invasive species.
- Conduct benthic macroinvertebrate assessments to determine general health of the river and correlate to amphibian populations.
- Create summary analysis and report of findings and restoration recommendations.

2.0 PROJECT BACKGROUND INFORMATION

2.1 INTRODUCTION OF STUDY AREA/SURVEY AREAS

As discussed below in detail, the study area and specific survey areas are located completely within the Santa Clara watershed as shown in Figure 1, *Regional Location Map*. A total of eleven (11) survey areas were selected from within the study area as shown in Figure 2, *Vicinity/Survey Site Location Map,* and outlined in Table 2, *Survey Areas*.

Table 2
Survey Areas

Number	Survey Area
(1)	Santa Clara River Main Stem #1
(2)	Santa Clara River Main Stem #2
(3)	Santa Clara River Main Stem #3
(4)	Santa Clara River Main Stem #4
(5)	Santa Clara River Main Stem #5
(6)	Santa Clara River Main Stem #6
(7)	Santa Clara River Main Stem #7
(8)	Aliso Creek
(9)	Escondido Creek
(10)	Lower Sespe Creek
(11)	Santa Paula Creek

2.2 STUDY AREA WATERSHED DESCRIPTION

The study area is located within the Santa Clara watershed (Los Angeles and Ventura Counties) and drains a total area of approximately 1,600 square miles. The Santa Clara River is the largest drainage located within the watershed and represents the largest free-flowing drainage in southern California where it extends for approximately 100 miles through northern Los Angeles and southern Ventura Counties from Pacifico Mountain to the Pacific Ocean (Court et al. 2000). Elevations within the watershed range from 8,800 feet high from within the Los Padres National Forest to low-lying floodprone areas extending to the Pacific Ocean near the City of Ventura. Nearly 70% of the upper watershed is located within the Los Padres and Angeles National Forests.

As stated by Court:

> "*The riparian zone along the Santa Clara River can be divided into several distinct habitat types based on the dominant species within each habitat. These plant community names follow those proposed by Holland (1986). Mule fat scrub, southern willow scrub, southern willow riparian woodland, southern cottonwood/willow forest, arrow weed scrub, alluvial scrub, and big sagebrush scrub are the dominant riparian communities located on the upper and lower terraces of the active channel. Areas that are saturated for prolonged periods of time support valley freshwater marshes and ponds. Non riparian communities adjacent to the Santa Clara River include coastal sage scrub, chamise chaparral, and coast live oak woodland*." (Court et al. 2000)

The entire reach of the Santa Clara River located within Los Angeles County has been designated a Significant Ecological Area (SEA).

2.3 STUDY AREA CONNECTIVITY DESCRIPTION

The Santa Clara River represents the most significant regional wildlife movement corridor within the watershed. Several large tributaries drain into the Santa Clara River including Santa Paula Creek, Sespe Creek, Hopper Creek, and Piru Creek in Ventura County, and Castaic Creek, Bouquet Canyon Creek, San Francisquito Creek, Aliso Creek in Los Angeles County. These drainages and adjacent open space habitats are connected via the Santa Clara River floodplain.

With the exception of reservoirs located upstream within Piru, Castaic and Bouquet canyons, no insurmountable barriers exist which would prevent movement between the Santa Clara River basin and the headwaters of these systems. In some cases, larger mammals and reptiles are expected to utilize existing road networks and open space habitats located adjacent to the reservoirs to circumvent the barrier. However, reservoirs generally represent insurmountable barriers for fish (event when ladders are present) and amphibian species. The Van Freeman diversion facility located approximately 10 miles upstream of the Pacific Ocean in the Santa Clara River basin consists of a concrete dam, denil fishway (fish ladder), screened fish bay, downstream migrant trap, various canals and spreading grounds (UWCD 2007). Although the concrete dam represents a barrier to fish, the ladder allows for the movement of fish through the facility. The facility is expected to represent a barrier to movements of native amphibians and aquatic reptiles.

2.4 EXISTING/PROPOSED ENVIRONMENTAL IMPACTS

The primary change in the environmental condition of the Santa Clara River between 1927 and present is the general absence of riparian thickets on the floodplain. (Court et al. 2000) The decline of this habitat types within the floodprone area (dominated by mule fat and willow), has likely contributed to the extirpation of target sensitive species throughout the drainage. Approximately seventeen (17) species listed by the state and/or federal government as threatened or endangered can be found primarily in the upper Santa Clara River watershed (The Nature Conservancy 2006).

Water quality remains a primary environmental concern as development expands throughout the Santa Clara watershed, primarily within or adjacent to floodprone regions. Specifically, five (5) municipal wastewater reclamation and/or treatment plants discharge effluent into the Santa Clara River (The Nature Conservancy 2006). Also, reservoirs which drain into the Santa Clara represent a potential environmental impact resulting from modifications to the geomorphology (preventing natural scouring), reduced sediment load (important for maintaining bench habitats utilized for foraging and aestivation by select amphibian species), representing and creating downstream refugia for exotic fish and frogs, and unregulated flows which could dislodge/smother amphibian egg masses during the breeding season. Unregulated flows may also reduce the local abundance of macroinvertebrates by increasing physical abrasion and dislodgement. Unpredictable and non-seasonal flows may also alter the physical cues necessary to promote lifecycle changes in many species of macroinvertebrates, further reducing their local abundance and consequently the energy available for higher trophic levels, including amphibians.

Environmental impacts resulting from the distribution of invasive plants include a decrease in quality and quantity of native habitat, decrease water quantity and quality, alter fire regimes and alter geomorphology (The Nature Conservancy 2006).

Introduced predators of native amphibians continue to represent an environmental stressor. Specifically, the bullfrog (*Rana catesbeiana*) and African clawed frog (*Xenopus laevis*) represent aggressive predators of all life stages of amphibians know to occur within the Study Area.

Additional significant environmental impacts to the Santa Clara River and tributaries include unnatural reservoir releases, recreational activities within riverbed, industrial development (sand & gravel mining), illegal dumping, agricultural, and distribution of exotic floral and faunal species.

2.5 TARGET SPECIES NATURAL HISTORY

The study includes the documentation of native aquatic and semi-aquatic amphibian species, and exotic aquatic predators for the purpose of establishing baseline conditions, Table 3, *Target Species Natural History & Background Summary*. Although the foothill yellow-legged frog (*Rana boylii*) was historically documented within the Study Area (Piru Creek), the species has been extirpated and is not included as a target species. The foothill yellow-legged frog was last documented near Frenchman's Flat/Piru Creek in 1977 with species collected in 1970 (Jennings and Hayes 1994).

Table 3
Target Species Natural History & Background Summary

Species	Habitat Requirements	Historical Distribution within Study Area	Current Distribution within Study Area	Threats within Study Area
Pacific Chorus Frog (*Pseudacris regilla*)	grasslands, chaparral, woodland, desert oases, agricultural regions, and residential areas. breeds in marshes, ponds, lakes, ditches, and slow-moving streams.	throughout study area within and adjacent to the Santa Clara River floodprone area, including but not limited to major tributaries.	throughout study area within and adjacent to the Santa Clara River floodprone area, including but not limited to major tributaries.	declining water quality, non-native aquatic predators. habitat loss/fragmentation.
California Chorus Frog (*Pseudacris cadaverina*)	found near canyon streams and washes where there are rocks, quiet pools, and shade.	upper reaches of Santa Clara River and within most intermittent major tributaries including but not limited to (Santa Paula, Sespe, Piru, Castaic, San Franciscquito, Bouquet, and Aliso Creeks).	isolated reaches of upper Santa Clara River, including but not limited to Santa Paula, Sespe, middle/upper Piru and upper Castaic Creeks.	declining water quality, augments to hydrogeomorphology caused by development, reservoirs and regional water use. exotic predatory species. habitat loss/fragmentation.

Species	Habitat Requirements	Historical Distribution within Study Area	Current Distribution within Study Area	Threats within Study Area
California red-legged frog (*Rana aurora draytonii*) - FT. CSC	most often located in or adjacent to pools, ponds, or perennial streams with emergent wetland/riparian vegetation.	throughout study area including Santa Clara River and major tributaries. 6 miles SE Acton where stream crosses Aliso Canyon Road [Los Angeles County Natural History Museum record, date not cited]".	San Francisquito (tributary to Santa Clara) River, Agua Blanco Canyon (tributary to middle Piru Creek). Sespe Creek.	loss of habitat, declining water quality, augments to hydrogeomorphology caused by development, reservoirs and regional water use. exotic predatory species. habitat loss/fragmentation.
Western Spadefoot (*Spea hammondii*) - CSC	lowland grassland, sparsely vegetated upland habitats adjacent to seasonal pools.	throughout terrace habitats located adjacent to upper Santa Clara River and major tributaries.	scattered localities within undeveloped regions of Santa Clara River basin and terrace habitats, including but not limited to Castaic and San Francisquito Canyons.	loss of breeding/aestivation habitat, non-native aquatic predators. habitat loss/fragmentation.
Arroyo Toad (*Bufo californicus*) - FE, CSC	medium to-large-sized streams in coastal/desert drainages and adjacent riparian/scrub terrace habitats.	upper/lower Santa Clara River Basins and major tributaries. confluence of Santa Paula Creek and the Santa Clara River (Camp 1932).	confluence of Santa Clara River /San Francisquito Canyon (Ramirez 2003). Upper Santa Clara (Sandburg, Havore, USFWS 2005) Upper Castaic, Middle/Upper Piru, Upper Sespe Creeks.	declining water quality, augments to hydrogeomorpholgy caused by development, reservoirs and regional water use. exotic predatory species. habitat loss/fragmentation.

Species	Habitat Requirements	Historical Distribution within Study Area	Current Distribution within Study Area	Threats within Study Area
California (western) Toad (*Bufo boreas halophilus*)	inhabits a variety of habitats - marshes, springs, creeks, small lakes, meadows, woodlands, forests, desert riparian areas.	throughout study area within and adjacent to the Santa Clara River floodprone area, including but not limited to major tributaries.	throughout study area within and adjacent to the Santa Clara River floodprone area, including but not limited to major tributaries.	declining water quality, non-native aquatic predators. habitat loss/fragmentation.
INTRODUCED				
African clawed frog (*Xenopus laevis*)	inhabits warm stagnant ponds, streams and reservoirs. almost completely aquatic, leaving water for migration only.	not endemic, introduced species.	throughout the Santa Clara and south fork Santa Clara Rivers.	represents a predator and threat to native aquatic species.
Bullfrog (*Rana catesbeiana*)	generally located within or adjacent to aquatic resources including, ponds, rivers, lakes, etc.	not endemic, introduced species.	lower reaches of Santa Clara River including but mot limited to Santa Paula Sespe and middle Piru Creeks.	represents a predator and threat to native aquatic and terrestrial species.

FT-Federally Listed Threatened, FE-Federally Listed Endangered, CSC-State Species of Special Concern

2.5.1 Pacific Chorus Frog

The Pacific chorus frog is California's most common amphibian, as it is absent only from the dry desert regions. This small frog measures 1.9 - 5 cm and exhibits a black or dark brown eyestripe, as shown in Figure 3, *Target Species Photographs*. Coloration is highly variable on the dorsum, ranging from green, tan, reddish, gray, brown to black, with cream on the ventral side and yellowish hindquarters.

This species can be found in a variety of upland habitats, including grassland, chaparral, woodland forest, desert oasis, and even some agricultural areas. However, breeding is primarily restricted to slow moving streams, marshes, lakes, ponds, and reservoirs (Stebbins 1985).

2.5.2 California Chorus Frog

California chorus frogs (*Pseudacris cadaverina*) are patchily distributed from central San Luis Obispo County south to the Mexican border (Morey 1988) and can occur at elevations up to 1690 m (5500 ft)(Stebbins 1985) (Figure 3, *Target Species Photographs*).

Adults occur in deeply cut canyons with stream boulders and large, slow pools (CDFG 1988). They summer under rocks, or in rock cracks at the water's edge, and spend late fall and winter inactive in deep moist crevices (CDFG 1988). They breed in quiet waters of rivers and creeks, and tadpoles require standing water up to 2.5 months (Stebbins 1985).

Frogs in Los Angeles County living along an ephemeral stream made daily movements up to 200 m, although 83% of all movements measured were less than 25 m (CDFG 1988). Home ranges of individuals overlap.

Long-distance movements are restricted to streamside areas and vary between 34 and 506 m (CDFG 1988). Two of nine frogs displaced 300 m from the point of capture were recaptured (CDFG 1988). Frogs rarely move from the streamside, spending summer under rocks, or in rock cracks at the water's edge, and the fall and winter inactive in crevices up to 12 m (39 ft) from streams (CDFG 1988).

2.5.3 California Red-legged Frog

The California red-legged frog (*Rana aurora draytonii*) is the largest native frog in the western United States, and is one of two subspecies of the red-legged frog (*Rana aurora*) (Figure 4, *Target Species Photographs*). It may have red on its' lower abdomen and underside of the hind legs, though this is highly variable. The dorsal surface may be brown, gray, olive, or reddish and is often covered with small black flecks and larger, irregular dark spots. Males are substantially smaller than females and possess more webbing between their toes (USFWS 2000).

The historic range of the California red-legged frog extended from the vicinity of Redding in Shasta County west to the coast and southward to northwestern Baja California, Mexico (Jennings and Hayes 1994). Historically, the California red-legged frog occupied 46 counties; it's now present in 31 counties, having been eliminated from 70 percent of its former range (USFWS 2000). Currently, the California red-legged frog is locally abundant in a few localities in the San Francisco Bay area and along the central coast; it also occurs in one isolated locality in the Sierra Nevada, with a small number of localities along the northern Coast, and in the northern Transverse Ranges. In southern California, it has been extirpated from nearly every historic locality (USFWS 2000). At present, the known populations south of the Santa Clara River include Cole Creek (Riverside County) (approximately 2 male frogs), east fork Las Virgenes Creek (Los Angeles County) (approximately 25 adult frogs) and San Francisquito Creek (Los Angeles County) (estimated 10-12 adult frogs). Extensive surveys elsewhere in southern California and the Sierra Nevada have failed to detect any additional populations (Dan Holland, pers. comm.).

The species is threatened within its remaining range by a wide variety of human induced impacts including agriculture, urbanization, mining, overgrazing, recreation, timber harvesting, water impoundments and diversions, degraded water quality, invasion of non-native plants and introduced predators, such as bullfrogs, African clawed frogs, mosquitofish (*Gambusia affinis*), bass (*Micropterus salmoides*) carp (*Carassius auratus*), and green sunfish (*Lepomis cyanellus*), red swamp crayfish (*Procambarus clarkii*) and other exotic species (USFWS 2000). In 1996, the U.S. Fish and Wildlife Service listed the California red-legged frog as a Federally Threatened species. The species is also identified as a California Species of Special Concern and a fully Protected Species by the California Department of Fish and Game.

California red-legged frogs utilize several types of aquatic, riparian and upland habitats including ephemeral ponds, riparian corridors, intermittent streams, seasonal wetlands, springs, seeps, permanent ponds, lake margins, perennial creeks, dune ponds, marshes, lagoons, blackberry (*Rubus* sp.) thickets, non-native annual grasslands, oak savannas and some man-made aquatic features. The species favors slow-moving streams, pools, and ponds greater than 2.3 feet deep, surrounded by dense herbaceous or shrubby riparian vegetation that provides stream shading, an important habitat component (USFWS 2000; Hayes and Jennings 1986). The species diet is highly variable and includes aquatic and terrestrial insects, crustaceans, worms, fish, tadpoles, smaller frogs and mammals such as deer mice (*Peromyscus maniculatus*) (CDFG 1988). Larvae foraging ecology is not well known but it is assumed that they are algal grazers (USFWS 2000). Larvae typically metamorphose in May-August, and very rarely may overwinter and transform in their second year (Dan Holland, pers. comm.).

Adults are recognized for making substantial shifts within their local aquatic habitats (Jennings and Hayes 1994). However, during wet periods, some individuals may disperse and/or move through upland habitats (USFWS 2000). The species has been recorded within streams at distances more than 2 miles from the breeding site, and have been observed up to 100 feet from water in adjacent dense riparian vegetation, for up to 77 days (USFWS 2000). Other evidence indicates that in some areas the species may move extensive distances (well over 1 mile) overland between water sources.

The breeding season for California red-legged frogs is between late November and April (USFWS 2000). The location where eggs are deposited in winter and early spring is often different from the feeding habitat occupied during spring and summer. Juveniles commonly utilize shallow water with dense submergent or emergent vegetation in the vicinity of breeding pools (California Department of Fish and Game 1988). Juvenile frogs are active diurnally and nocturnally, whereas the adult frogs are often but not invariably nocturnal (USFWS 2000).

2.5.4 Western Spadefoot

The range of the western spadefoot stretches throughout the central valley and the Coast Ranges from Point Conception south to the Mexican border. Primarily found in lowlands, river floodplains, alluvial fans, and grassland habitats, it can sometimes also occur in valley-foothill hardwood woodlands. As its name suggests, a wedge-shaped, black spade is present on each of the hind feet. It is dusky green or gray dorsally with light colored stripes, whitish ventrally, and the eye is usually pale gold (Stebbins, 1985), as shown in Figure 4, *Target Species Photographs.*

2.5.5 Arroyo Toad

The arroyo toad (*Bufo californicus*) is a small species (50-74 mm snout-urostyle length). The species is cryptically colored and may be a light gray-green, buff, brown, or salmon (Camp 1915 in CDFG 1994) (Figure 5, *Target Species Photographs*). Small dark-colored markings are present on the dorsum (back). Ground color can change somewhat with temperature and emotional state. Incomplete and faint stripes on the back are rarely present; then usually only on the posterior one-third of the dorsum. The belly is unmarked. There is usually a light-colored stripe along the raised cranial boss. Pupils appear horizontal when viewed in profile (Dan Holland, pers. comm.).

The arroyo toad is a southern California regional endemic. The species is discontinuously distributed from the Salinas River system south through the Los Angeles Basin and the coastal drainages of Orange and Riverside counties to the San Diego River system (Myers 1930; CDFG 1994); desert populations have also been recorded from the Mojave River, Little Rock Creek, Whitewater River, San Felipe Creek, Vallecito Creek, and Pinto Canyon (CDFG 1994); although, the last three records are not considered valid (E. Ervin unpubl. data.). Populations also exist in drainages in Baja California Norte south to the Rio Santo Domingo (Sweet 1991). This species has disappeared from approximately 76% of its historic range in the United States. Populations have been eliminated or severely reduced throughout the range of the species (California Department of Fish and Game 1988).

Development and alteration of the stream channel, associated terraces, and upland habitat are the major factors contributing to the decline of this species. Arroyo toads are known to utilize upland habitats up to 1.2 km beyond the edge of the upland-riparian ecotone (Holland and Sisk 2001a). Other major factors include excessive human use of campgrounds near streams, manipulation of hydrologic regime (dams and water diversions, changes in the timing and extent of water flow), urban development, mining, off-road vehicle use, introduction of non-native predators, cattle grazing, and wildfire (Jennings and Hayes 1994). The arroyo toad was federally listed as an Endangered species on January 17th, 1995; it is also a California State Species of Special Concern (CDFG 2001). The United States Fish and Wildlife Service (USFWS 2005) proposed 478,400 acres of critical habitat on June 8, 2000, in Monterey, San Luis Obispo, Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, Orange, and San Diego counties, much of which lies within NFS boundaries (USFWS 2000a); however, this hardly encompasses the true extent of habitat utilized by the species (Dan Holland, pers. comm.).

The arroyo toad has perhaps the most specialized habitat requirements of any amphibian occurring in California (Jennings and Hayes 1994). It prefers washes, streams, rivers, and arroyos in the semiarid parts of the southwest. Breeding adults require overflow pools adjacent to the inflow channel of 1st order or greater streams; the species strongly favors exposed shallow pools with a sand or gravel base, a low velocity, and a minimum of marginal woody vegetation (CDFG 1994; Sweet 1991, 1993; Dan Holland, pers. Comm.). Shoreline or central terraces with some emergent vegetation seem to be preferred, particularly those with a moderately well-developed but scattered shrub and tree canopy of mule fat, California sycamore, Fremont's cottonwood, or coast live oak (Myers 1930; Cunningham 1962; CDFG 1994).

The arroyo toad feeds at night, primarily on ants (Sweet, 1991); beetles, snails, Jerusalem crickets, caterpillars, and moths are also occasionally consumed. Arroyo toad larvae are highly specialized feeders, gleaning the substrate for organic matter and interstitial algae, and fungi, bacteria, and protozoans (Jennings and Hayes 1994), while young toads feed almost exclusively on ants.

Adults are primarily nocturnal, but are occasionally diurnally active, with peak activity occurring between the first substantial rains (January to February) and mid-summer (early August). Males arrive at the breeding pools before females and begin calling at night from March to June; breeding occurs anytime between January-February (in San Diego County) and July. Approximately 2,000 to 10,000 eggs are laid on mud, sand or gravel in calm areas of clear streams (CDFG 1988). Larvae are unable to swim for the first few days after hatching. It takes about 65-85 days for metamorphosis to occur; metamorphic toads often remain on sand or gravel bar for approximately 8 to 9 weeks, but even recent metamorphs may burrow into sand (Jennings and Hayes 1994; Holland and Sisk 2001a). Juveniles remain in the vicinity of their natal pool until they reach 20-25 mm, when they begin to move away from the pool and become nocturnal (Holland and Sisk 2001a). At 30 millimeters in size, they may disperse into surrounding riparian vegetation around breeding pools and burrow into sandy pockets (Jennings and Hayes 1994; Holland and Sisk 2001a, 2000b). This species is an obligate riparian breeder, but requires upland habitats for foraging, movement and overwintering sites (Holland and Sisk 2000a, 2000b).

2.5.6 California (Western) Toad

The California (western) toad (*Bufo boreas halophilus*) ranges from western British Columbia and southern Alaska south through Washington, Oregon, and Idaho to northern Baja California, and east to Montana, western and central Wyoming, Nevada, high elevation areas in Utah, and western Colorado (Stebbins 1985). The California toad is not considered a special status species (Figure 5, *Target Species Photographs*).

In California, western toads occur up to 10,000 ft elevation in most habitats except deserts (Morey 1988, Sullivan 1994). Upland habitats in the planning area include grasslands, coastal scrub, chaparral, and oak and riparian woodlands. Aquatic habitats include lakes, ponds, vernal pools, roadside ditches, irrigation canals, permanent and intermittent streams, and rivers (Morey 1988). Eggs are laid in water 6 to 12 inches (30 cm) in depth (Olson 1992, Stebbins 1954).

While there is substantial variation in home range, individuals living in low elevation areas are occasionally encountered up to 1000 m from potential breeding sites, and some have been tracked through a wide range of habitats up to 5 km from their breeding areas (Morey 1988, Corn et al. 2001).

Dispersal distances among breeding sites have not been measured. After breeding, adult toads move up to 1 km to 5 km through wide range of potentially inhospitable habitats (Morey 1988, Corn et al. 2001). Tadpole dispersal is probably not significant: breeding adults in a population tend to lay their eggs at the same location (Sullivan 1994) and their tadpoles clump in large masses until they metamorphose (Nussbaum et al. 1983).

2.5.7 African Clawed Frog (*introduced*)

As stated by Stillwater Sciences:

> "*The Santa Clara River is home to a number of amphibians, including the non-native African clawed frog, known scientifically as Xenopus laevis, a native of the cooler regions of sub-Saharan Africa. African clawed frogs are part of the family*

Pipidae, which includes the Surinam Toad (Pipa pipa) and several other species in which the young develop in capped pits in the dorsal skin on the female's back before emerging as tiny froglets (Stebbins 2003). However, African clawed frogs breed through pelvic amplexus and scatter their eggs, similar to bullfrogs and native California red-legged frogs. African clawed frogs have flattened, smooth skin, and are usually almost completely aquatic and tongueless (Stebbins 2003). Pipidae species have no teeth and generally lack eyelids (Stebbins 2003, Beck 1994). The term "Xenopus" is Latin for "peculiar foot," describing the enormous, webbed, five-toed, three-clawed rear feet. African clawed frogs have smooth slippery skin ("laevis" means "smooth") which can be multicolored with blotches of olive, gray, brown, or gray, and the underside of the frog is usually creamy white with a yellow tinge (Kaplan 1995, Chang 1998, Stebbins 2003). African clawed frogs are almost completely aquatic, only leaving water to migrate (Nieuwkoop and Faber 1994, Beck 1994, Kaplan 1995). They breathe through highly developed lungs, instead of through their skin, as with most native California frogs (Kaplan 1995, Simmonds 1985). This is a useful adaptation in areas where ponds dry up, particularly in dry years, forcing frogs to burrow into the mud (leaving a tunnel for air) and remain dormant for up to a year (Simmonds 1985). African clawed frogs cannot hop; they can only crawl, but are excellent swimmers. They live in warm, stagnant grassland ponds as well as in streams in arid and semi-arid regions, tolerating a wide variety of aquatic conditions, including extreme levels of acidity, low oxygen levels, and high water temperatures. African clawed frogs are long-lived; some individuals have been recorded to survive for 15 years (Simmonds 1985)." (Stillwater Sciences 2007).

"*As a "sit and wait" predator, adult African clawed frogs feed on essentially whatever prey/food items they encounter (similar to the non-native bullfrog). In the Santa Clara River system, this may include a wide range of native aquatic invertebrates and vertebrates, including tadpoles and juvenile amphibians, young arroyo chub (Gila orcutti), the federally endangered unarmored threespine stickleback (Gasterosteus aculeatus), and the (also federally endangered) tidewater goby (Eucyclogobius newberryi) (Chamberlain 1997, Stebbins 2003, Lafferty and Page 1997). Predators do not appear to find African clawed frogs distasteful, and in South Africa they are eaten by large fish, turtles, frogs, snakes, aquatic insects, and birds (Chamberlain 1997). Potential predators of African clawed frogs in California may include two-striped garter snakes (Thamnophis couchi hammondi), bullfrogs (Rana catesbeiana), and a number of amphibian eating bird species (Chamberlain 1997, Stebbins 2003).*" (Stillwater 2007)

African clawed frogs are considered impossible to get rid of without implementing extreme measures. Eradication would likely require a complete poisoning and drainage of occupied pools including the removal of vegetation and top layers of mud to eradicate this species completely (Figure 6, *Target Species Photographs*). These extreme measures would also significantly impact native aquatic and semic-aquatic species by reducing, although temporarily, potential breeding, foraging, and refugia habitat.

2.5.8 Bullfrog *(introduced)*

As stated by Bruening:

> *North American bullfrogs (Rana catesbeiana) are only native to the Nearctic region. They are found from Nova Scotia to central Florida, from the East coast to Wisconsin, and across the Great Plains to the Rockies. The natural western limits of this species are now confused due to their introduction into places as far west as California and Mexico. It is known that bullfrogs were introduced to areas of California and Colorado in the early 1900's. The species has also been introduced (accidentally or on purpose) into southern Europe, South America, and Asia.* (Figure 6, Target Species Photographs)
>
> *North American bullfrogs must live in water and are therefore usually found near some source of water, such as a lake, pond, river, or bog. Warm, still, shallow waters are preferred. Bullfrogs are becoming increasingly common in areas that have been modified by humans. Increased water temperatures and increased aquatic vegetation, which are common factors of lakes polluted by humans, favor bullfrogs by providing suitable habitats for growth, reproduction, and escape from predators. North American bullfrogs prefer warm weather and will hibernate during cold weather. A bullfrog may bury itself in mud and construct a small cave-like structure for the winter. Their hunting style is 'sit and wait.' Bullfrogs can wait for a long time for some type of prey to come by, then, with a flash of the tongue, they grab it and bring it back into their mouths. Bullfrogs are active both during the day and at night; they are most active when the weather is moist and warm.*
>
> *North American bullfrogs are the largest true frog found in North America, weighing up to 0.5 kg and 203 mm in length. Typical length ranges from 90 to 152 mm. Color varies from brownish to shades of green, often with spots or blotches of a darker color about the back. The hind feet are fully webbed. The sex of an adult bullfrog can be easily determined by examining the size of the tympanum (the external ear of the frog) relative to that of the eye. The tympanum is a round circle located on the side of the head near the eye, and in males it is much larger than the eye. In females the tympanum is as large or smaller than the eye. Also, during the breeding season the throat of the male bullfrog is yellow, whereas the female's is white.*
>
> *Breeding takes place in May to July in the north, and from February to October in the south. Fertilization is external, with the females depositing as many as 20,000 eggs in a foamy film in quiet, protected waters. Tadpoles emerge about four days after fertilization. These tadpoles may remain in the tadpole stage for almost 3 years before transforming into frogs. Adults reach sexual maturity after 3 to 5 years. The average bullfrog lives seven to nine years in the wild.* (Bruening 2002)

As with the African clawed frogs, bullfrogs are also considered a difficult species to eradicate in large aquatic resources without implementing extreme measures. The eradication of these species from the Study Area is not likely and implementing control measures represents the most reasonable approach to limiting population densities and distribution. Specific recommendations are presented in Section 6.0, Recommendations.

2.5.9 Macroinvertebrates

The study includes the documentation of aquatic macroinvertebrates in the Santa Clara River and its tributaries, for the purpose of establishing baseline conditions. Macoinvertebrates are an ecologically diverse group of organisms found in rivers and streams around the world. The term Macroinvertebrate refers to invertebrate fauna that are retained by a 500 μm mesh net or sieve, whereas fauna passing through a 500 μm mesh, but retained by a 40 μm mesh net or sieve, are considered meiofauna. The macroinvertebrate fauna of healthy lotic systems can consist of several hundred species comprising numerous phyla, (Hose et al. 2004). These phyla include arthropods (insects, mites, scuds, and crustaceans), mollusks (snails, limpets, mussels, and clams), annelids (segmented worms and leeches), nematodes (roundworms), and turbellarians (flatworms). Because of their importance as a fundamental link between organic matter resources (detritus, algae, leaf litter) and higher trophic levels (amphibians and fish) they continue to be a focus of river ecology and a useful tool in the assessment of stream health.

Most stream macroinvertebrates species are benthic and are associated with surfaces of the channel bottom (bedrock, cobble, finer sediments), or other stable organic substrates (trees, roots, aquatic vegetation or leaf packs). Many macroinvertebrates, however, are free-swimming insects found in slower moving stream pools or associated with the surface film or water-land interface of the flowing river. In addition, interstitial spaces between gravel layers in the hyporheic zone often serve as habitat for small instars of larger macroinvertebrate species.

Stream macroinvertebrates include groups that are either terrestrially derived (insects) or marine in origin (mollusks and crustaceans). Insects are often the numerically dominant organisms in running waters and 13 orders of aquatic insects occur in North America (Merritt and Cummins 1996). There are five strictly aquatic orders (at least one life-history stage that is obligatorily aquatic), including the dragonflies and damselflies (Odonata), the stoneflies (Plecoptera), the mayflies (Ephemeroptera), the caddisflies (Trichoptera), and the hellgrammites (Megaloptera). The remaining eight orders are comprised of primarily terrestrial inhabitants but have aquatic members that often exhibit high species richness. These orders include the beetles (Coleoptera), true flies (Diptera), moths (Lepidoptera), springtails (Collembola), grasshoppers and allies (Orthroptera), true bugs (Hemiptera), spongillaflies (Neuroptera), and wasps (Hymenoptera).

Lotic macroinvertebrates display a wide variety of adaptations to solve the functional problems presented by running water habitats. In particular, solutions for obtaining oxygen, remaining in a fixed position in flowing currents, gathering and processing food, and for reproduction have resulted in a diverse set of morphological, physiological and behavioral adaptations. Macroinvertebrates use respiratory tubes, temporary storage of air bubbles, respiratory pigments, and tracheal gills (Erickson et al. 1996) to obtain oxygen from the atmosphere or water. To maintain position in a turbulent environment macroinvertebrates utilize suckers, modified gills, legs, and anal hooks to attach to smooth surfaces. In addition, may species use sclerotized projections to form hydrofoils to streamline body shape and reduce inertial drag. Many taxa including the Trichoptera, Lepidoptera, and Diptera also utilize silk for attachment, food collection and shelter. Behavioral drift and subsequent downstream transport is an effective mechanism for colonization, searching for food, and the avoidance of predators. The resulting downstream losses due to drift are compensated for by upstream migration of winged adults to breed and lay eggs.

The survival and reproduction of lotic macroinvertebrates is also dependent on specific adaptations to the dynamic hydrologic regime of rivers and the spatial heterogeneity in thermal conditions. A variety of ephemeral and perennial streams drain the mountains and plains of coastal California. Many of these rivers, including the Santa Clara experience large seasonal changes in discharge. These rivers typically flood after intense rainstorms in the wet season (November to March) but during the summer and fall dry season, sections dry at the surface or consist of isolated pools connected by subsurface flow. Many macroinvertebrates have responded to this seasonal drying with a variety of life history adaptations including dormant egg stages (Williams 1987), seasonal timing of larval diapause (Gray and Fisher 1984), and temporal separation of growth and adult emergence (Butler 1984). Stochasticity in thermal regime and resource availability results in considerable variation in the length of macroinvertebrate life cycles. Some species complete several life cycles per year (multivoltine), others complete two life cycles per year (bivoltine), one life cycle per year (univoltine), or may require multiple years to complete their lifecycles (semivoltine). Life cycle duration may also vary with geographic location. For example in Coastal California many macroinvertebrates display univoltine or bivoltine lifecycles whereas in colder climes the same species may display semivoltine lifecycles.

Physical conditions, organic energy inputs and the resulting biota of rivers change in a predictable manner along the longitudinal profile of a stream ecosystem (Vannote et al. 1981). The headwaters, midwaters and tailwaters will be inhabited by different assemblages of macroinvertebrates based on differences in the stream environment. Headwaters are generally heavily shaded by riparian vegetation and receive significant allochthonous input from stream-side trees. Leaf fall is colonized by bacteria and fungi, and this conditioned vegetation is utilized by a variety of shredding insects including caddisflies, tipulids and stoneflies. Hard substrates in riffles are often dominated by filter-feeding insects including hydropsychid caddisflies and blackflies (*Simulium*). Midwaters are wider, more open and often receive direct solar insolation. These well-lit sections support the growth of benthic algae and macrophytes, which in turn support grazing invertebrates such as baetid maylfies, caddisflies, and those organisms which use these organic materials as a substrate (hydroptilids and chironomids). The tailwaters are larger and more open, but often the flowing water is turbid due to upstream transport of sediments. Amphipods, snails, corixids, damselflys, and a variety of dytiscid and hydrophilid beetles often occupy this particular habitat. A variety of mayflies and stoneflies that collect and ingest fine detritus in the water column and on the bottom substrate are also present. Predators (odonates, megalopterans, hemipterans, and coleopterans) are also well represented in most stream sections.

The faunas of most undisturbed streams in southern California are similar but there are differences in specific taxonomic composition among streams. The Santa Clara River drainage is home to a diverse and complex assemblage of macroinvertebrates, which occupy a variety of habitats including turbulent high velocity riffles, moderately flowing long runs and slow moving pools. Invertebrates are found occupying large tracts of fine sandy sediments, gravel/cobble substrates, and organic substrates such as leaf packs and algal mats. Urbanization, agriculture, dam construction, stream channelization, and discharge of sewage effluent affect the biota of the Santa Clara River mainstem. Human activities have dramatically altered flow regimes and channel morphologies and sedimentation rates, decreased riparian cover and degraded water quality. Invertebrates in affected downstream sections are often reduced in abundance or diversity compared to upstream, undisturbed sections of the mainstem or its tributaries. Invertebrates able to tolerate these disturbed conditions are baetid mayfly nymphs, snails (*Physella*), hydropsychids, the damselflies *Argia* and *Archilestes*, the dragonflies *Libellula* and

Anax, blackflies (*Simulium*), Assorted Dipterans, a variety of Dytiscid and Hydrophilid beetles, leeches (Hirudinea), and hempiterans (*Gerris*, *Abedus* and *Notonecta*).

3.0 MATERIALS & METHODS

3.1 LITERATURE REVIEW

Existing biological resource conditions within and adjacent to the study area was initially investigated through review of pertinent scientific literature. Federal register listings, protocols, and species data provided by the USFWS were reviewed in conjunction with anticipated federally listed species potentially occurring within the Study Area. The Natural Diversity Database (CNDDB), a California Department of Fish and Game (CDFG) Natural Heritage Division species account database, was also reviewed for all pertinent information regarding the locations of known occurrences of sensitive species in the vicinity of the survey areas. In addition, numerous regional floral and faunal field guides were utilized in the identification of species and suitable habitats. These and other references are listed in the References section of the document. Combined, the sources reviewed provided an excellent baseline from which to inventory the biological resources potentially occurring in the Study Area. Other sources of information included consultations with, and identification by, qualified experts in relevant fields, examination of herbarium specimens, and unpublished biological resource letter reports, assessments and Environmental Impact Reports.

3.2 SURVEY AREA SELECTION

Survey areas were selected based on accessibility, safety, CNDDB review, Baskin and Hagland studies, unpublished reports of general and focused surveys conducted on the River/tributaries including all of the released documents for Newhall Ranch projects (Valencia Annex 1 & 2, East Creek, River Park, etc.), Frank Hovore and Associates records and reach surveys of the Santa Clara River that include riparian and aquatic invertebrates. Historical records from Los Angeles County Museum of Natural History collection for amphibians and reptiles were also reviewed.

3.3 BENTHIC MACROINVERTEBRATE SURVEYS

Sampling protocols were designed to permit comparison of sample sets from each stream system, regardless of substrate type, water depth, or rate of flow. A rectangular net was stationed within the flow, and a linear meter transect of substrate, approximately 1/3 meter wide, was disturbed such that the flow carried the invertebrates into the net. This procedure was repeated in three comparable linear transects within a sample reach to approximate a square meter of substrate sampled. Net samples were then examined macroscopically and taxa recorded to family or genus level, with some specimens taken and returned to the Frank Hovore and Associates laboratory for a more detailed taxonomic determination. Estimates of abundance were taken from direct counts or approximations of the number of specimens within each of the three linear samples. If flows were insufficient to employ standard sampling techniques, pools were sampled subjectively by dip-net collection, sand washing, and observation.

Specifically, field protocols were developed for sampling benthic macroinvertebrate faunas, based upon methodologies detailed in the Environmental Protection Agency (EPA) Rapid Bioassessment Protocols for Use in Streams and Rivers (RBP) (1989). The EPA RBP protocols were established for use in aquatic systems with more stable, non-seasonal or episodic flows (in the eastern and northwestern U.S.), as opposed to the highly seasonal and episodic flows that occur within the study portion of the Santa Clara River. Southern California stream channels periodically undergo scouring which cut banks and carry flows rapidly out into floodplains, as opposed to RBP area flood patterns, which generally raise water levels and back streams up into their tributary channels.

The following outline summarized some of the more important comparative differences between stable system RBP watersheds and more-dynamic southern California drainages.

Typical RBP System		**Typical Southern California System**
Many connected drainages, often in close proximity, with similar resource values		Systems generally larger, often widely-separated, exhibiting different habitat values
Local endemism uncommon, high biotic congruence, sensitive species rarely present		Endemism common, low biotic congruence, often with sensitive species present
Perennial flows common		Intermittent flows common
Scouring floods uncommon		Regular scouring floods
Extended droughts rare		Periodic drought cycles
Channel sides sloped, bottoms rocky, often composed of shale or larger boulders		Sides steeply undercut, or open and broadly level, bottom substrate usually sand or gravel
Riparian forest overstory common, providing shading; waters cool		Riparian overstory uncommon, thinner marginal waters warm
Organic debris accumulates, nutrient levels relatively high		Organics lost to annual flooding, nutrient levels relatively low
Fish diversity relatively high, found in most systems		Native fish diversity low, absent from most intermittent systems.

In years with average annual precipitation, systems such as the Santa Clara may undergo summer drying, with little or no surface flow; at this time, aquatic organisms may become dormant or retreat to more permanent water sources. In winter and spring, heavy rainfall over the watershed may send churning floodwaters down-channel, removing accumulated sediments (and dormant arthropods), overturning heavy substrate materials, and clearing-away aquatic vegetation. Even moderate amounts of storm runoff may create high levels of turbidity and transport fine sediments.

Given the special circumstances of southern California aquatic ecosystems, it was hypothesized that differences in specific seasonal hydrologies might in fact create significant biotic differences between sample sites. In order to compensate for these potential differences, a more focused, detailed analysis of benthic macroinvertebrates was undertaken. By modifying standard RBP protocols to provide more of a “fine-grained” assessment of the relationship of the fauna to water quality and quantity, we are better able to asses the differences between sample sites, the direct effects of water received from the Water Quality Control Plant, and seasonal dynamics of the fauna. A one-time baseline sample was obtained on the first sample date (November 1993) from Sespe Creek, a tributary of the Santa Clara River but without effluent contributions.

The following protocols were established to provide qualitatively and quantitatively comparable samples of macroinvertebrates from freshwater stream channels in southern California. These streams are characteristically scoured by flooding during winter rainfall, dropping to low flows in spring, becoming intermittent, warm and algae-choked by summer, and may be fragmented or entirely dry from June/July until about November. Field sampling methods utilized are modified from the EPA Rapid Bioassessment Protocol, Level II benthic macroinverterates, and enable samplers to make replicate collections in similar systems throughout the area.

The objectives included the uniform macroinvertebrate sampling from 1m/sq. of benthic substrate from streams during low to moderate high flows as outlined below.

- Establish meter plot sites within mid-range flow areas; sites will be chosen in the Santa Clara River to correspond with areas of hydrologic testing. Meter areas are defined by in-flow collection unit, oriented to capture direct flow, channeling water through the unit into dragnets on the outflow end. Net bases are set firmly into cobble or gravel below substrate surface level. Samplers stand below or at sides of unit, never stepping into the upstream flow zone.

- Algal bloom, if present, is assessed quantitatively for percent cover within meter area, and then carefully removed from surface. Sampling is for invertebrates within the stream bottom, and test samples have shown that while only a small percentage more material is obtained from algal mats, this may skew data somewhat; careful removal will not disturb the underlying substrate. Algae was preserved in samples where appropriate.

- Large rocks are lifted, turned and scrubbed clean within the flow, then discarded to the side. Remaining cobble, gravel, and sand is turned rapidly and thoroughly to a depth of 10 cm, using three-prong rakes; 20 rake line passes are made with the flow and 20 across the flow, forming a grid which overturns all of the substrate equally. Water must be flowing through the system as raking passes are completed.

- Lift Nets are lifted into flow and upward to level, clear water is poured through samples to filter fine sediments and cleanse mesh. Net bags are inverted into clean water in plastic basin; nets are thoroughly cleared of all material, leaves and other non-living debris are then picked out (taking care to not remove clinging organisms). The sample is first poured into a fine mesh transfer net and then the entire sample is poured into alcohol for storage. Vials are labeled to indicate place and date of sample.

- Preserved samples are sorted, identified and quantified in the laboratory subsequent to collection. Assessment of significance of samples shall approximate RBP guidelines.

3.4 AMPHIBIAN SURVEYS

Stream channels were surveyed by visual inspection of pools and banks in appropriate amphibian habitat from March 2005 – August 2006. A complete list of survey dates, survey areas and surveyors is provided in Table 4, *Survey Area Sample Dates*. If amphibians were not readily observed, active searching was employed by turning rocks, logs, and dried algal mats. If amphibians appeared to be absent from the site, surveys were repeated at night. Specifically, survey routes were largely based on habitat suitability and accessibility.

3.5 GENERAL VEGETATION/WIDLIFE SURVEYS

Transect zones were established within the bed and bank of stream channels, centered on invertebrate sampling sites. Transects were approximately 100 yards long, and width varied according to the width of the channel. Transect width was sufficient to include the riparian zone within the channel, and adjacent upland areas. Vegetation was assessed qualitatively within the transect zone. All plants within the transect zone were identified to species when possible. Separate plant lists for riparian and upland zones were recorded.

During the course of conducting amphibian, benthic macroinvertebrate, and vegetation surveys, observations were made of resident wildlife. Although no formal surveys were done, all species encountered were identified and recorded.

3.6 TARGET SPECIES HABITAT SUITABILITY ANALYSIS

Habitat suitability for target species was determined at each of the eleven (11) Study Areas. The analysis included a literature search for the historic distribution of target species in the vicinity of respective Study Areas and a detailed characterization of suitable breeding, foraging, and aestivation habitat. Stressors documented at each of the Study Areas was also noted and presented in the Section 4.2, Survey Area Baseline Conditions.

4.0 RESULTS

4.1 HISTORICAL OBSERVATIONS OF SPECIES WITHIN STUDY AREA

The following section describes the historical distribution of the target species known from within or adjacent to the Santa Clara watershed Study Area as shown in Figure 7, *Historical Occurrences of Target Species Within Study Area*. The following referenced distributions should be interpreted as the minimal extent of historic occupancy. Limited historical distribution data for target species throughout the watershed warrant that other factors to be considered including variation in habitat and hydrological characteristics of the Study Area prior to the development of reservoirs and urbanization of this region.

4.1.1 Pacific Chorus Frog

The Pacific chorus frog represents the most common amphibian species documented within the Study Area. The Pacific chorus frogs is expected to have been historically distributed throughout the Study Area including all reaches of the Santa Clara River including but not limited to major tributaries (Santa Paula Creek, Sespe Creek, Piru Creek, Castaic Creek, Escondido, and Aliso Creek). Although this species is expected to have a slightly more restricted current distribution through the Study Area, individuals were documented at all eleven (11) of the Study Areas ranging from common to abundant. Stressors expected to reduce the distribution and/or abundance of this species include restricted water flows below reservoirs, depleted water tables that reduce the duration of surface pooling, and reduced water quality at or immediately downstream of urban point source discharges.

4.1.2 California Chorus Frog

The California chorus frog is expected to have been historically distributed throughout the upper reaches of Santa Clara River including but not limited to major tributaries (Santa Paula Creek, Sespe Creek, Piru Creek, Castaic Creek, Aliso Creek). This species was documented at five

(5) of the eleven (11) Study Areas. Stressors expected to reduce the distribution and/or abundance of this species include introduced predators, restricted water flows below reservoirs, depleted water tables that reduce the duration of surface pooling, unnatural releases from reservoirs during the breeding season, and reduced water quality at or immediately downstream of urban point source discharges.

4.1.3 California Red-legged Frog

The California red-legged frog is expected to have been historically distributed throughout the Santa Clara River Study Area extending upstream of the estuary to at least Aliso Creek. Historical records of this species are also noted from Sespe Creek, Piru Creek, San Francisquito, Placerita Canyon, Mint Canyon (CNDDB 2008, USFS 2002). California red-legged frogs were not detected at any of the eleven (11) Study Areas during the focused survey efforts. Current populations persist in San Francisquito Canyon and Aqua Blanco Canyon (a tributary to middle Piru Creek). Stressors expected to reduce the distribution and/or abundance of this species include introduced predators, unnatural reservoir releases which alter geomorphology, depleted water tables that reduce the duration of surface pooling, unnatural releases from reservoirs during the breeding season, and reduced water quality.

4.1.4 Western Spadefoot

The western spadefoot is expected to have been historically distributed throughout the Santa Clara River floodprone area and adjacent upland habitats throughout the Study Area (excluding the estuary), including the lower elevation floodprone areas and terrace habitats of major tributaries. Western spadefoot were not detected at any of the eleven (11) Study Areas during the focused survey efforts. Current populations have been documented within the undeveloped regions of the Santa Clara River basin and terraces including but not limited to Castaic and San Francisquito Canyons. Stressors expected to reduce the distribution and/or abundance of this species include loss of breeding and aestivation habitat, introduced predators, and depleted water tables that reduce the duration of surface pooling.

4.1.5 Arroyo Toad

As stated by Stillwater:

> "*The arroyo toad was historically found in the upper and lower Santa Clara River watershed. The Santa Clara River basin crosses Ventura and Los Angeles counties, with Los Angeles County encompassing most of the upper watershed and Ventura County containing most of the lower. Many historical records of arroyo toad populations in the watershed are outdated or no loner exist, but it is almost certain that toads occupied much of the main stem Santa Clara from the Los Angeles County line to a few miles from the ocean, as they do in drainages on MCB (Marine Corps Base) Camp Pendleton today (S. Sweet, UC Santa Barbara, pers. comm., 28 March 2006;Lannoo 2005). A large flood in 1928 and extensive agricultural modification of the lower floodplain beginning as early as 1880 likely extirpated a significant amount of the arroyo toad habitat (S. Sweet, pers comm..,, 28 March 2006). For example, arroyo toads were found in the Santa Clara River basin on May 22, 1912, at Santa Paula, Ventura County (USFWS 1999). This site (now located along Highway 150) apparently was part of a formally extensive oak (Quercus spp.) woodland on the floodplain near*

Santa Paula Creek (USFWS 1999). The current creek floodplain (75 to 120 m [250 to 400 ft] in elevation) has been urbanized extensively for approximately for 4.8 kilometers (3 miles) along the river, and arroyo toads have been extirpated from the area (USFWS 1999).

Arroyo toads currently persist in large numbers along Sespe Creek in the Los Padres National Forest, Ventura County, from about Hot Springs Canyon upstream to the mouth of Tule Creek (Sweet 1992, USFWS 1999). The maximum elevation is approximately 1,040 m (3,400 ft) and there are 24 km (15 mi) of suitable arroyo toad stream habitat in Sespe Creek (USFWS 1999). The upper half of the portion of Sespe Creek inhabited by arroyo toads has generally contained large areas of excellent habitat and numerous high quality breeding pools, while the lower portion supports few stream terraces with suitable substrates, and fewer pools appropriate for use as arroyo toad breeding sites (Sweet 1992). Sweet (1992, 1993) found through repeated surveys of Sespe Creek during the 1980's and 1990's that the arroyo toad population fluctuated between approximately 130 and 250 adults. The Lions Creek fire in 1991 reduced vegetative cover and led to severe erosion in approximately half of the upland habitat in the upper half of the creek basin, reducing the extent and quality of the upland and breeding habitat (USFWS 1999).

Arroyo toads have been historically found along Piru Creek (Ventura and Los Angeles counties) between the confluence of the Santa Clara River (elevation 205 m [660 ft]) and Bear Gulch (elevation 945 m [3,100 ft]) (USFWS 1999). With the construction of Lake Piru in the 1950s and Pyramid Lake in the 1970s, arroyo toads were eliminated form much of their historic range in the drainage and now are restricted to short segments above each of the two reservoirs (Sweet 1992 as cited in USFWS 1999). Upper Piru Creek supports small populations of arroyo toads distributed in a range of good to marginal habitats, while lower Piru Creek generally has larger numbers of arroyo toads distributed over areas of good to excellent habitat that generally are undisturbed by human activities (Sweet 1992, USFWS 1999). The lower segment is from Blue Point Campground upstream to lower Piru Gorge (elevation 340 to 410 m [1,100 to 1,350 ft]), a distance of 5.6 km (3.5 mi), and the upper segment is from the headwaters of Pyramid Lake upstream to Bear Gulch (elevation 760 to 945 m [2,500 to 3,100 feet]), a distance of 7.2 km (4.5 mi) (USFWS 1999).

Potential habitat for the arroyo toads probably exists in the upper Santa Clara River basin, Los Angeles County, and in some of the other canyons that drain from the north (USFWS 1999). Drainages that are potential candidates for arroyo toad habitat include parts of the San Francisquito Canyon drainages and Bouquet Canyon drainages (S. Sweet, pers. comm., 1997 as cited in USFWS 1999). Additionally, along Castaic Creek , Los Angeles County, on California Department of Water Resources land and the Angeles National Forest, arroyo toads were recently found below the dam at Castaic lake, throughout a 3.2 kilometer (2-mile) segment of the creek, as sell as above the reservoir in the dredge spoils (Campbell et al. 1996, F. Hover, Planning Consultants Research, pers. comm., 1997 both cited in USFWS 1999). Arroyo Toads were likely more widespread in the Castaic Creek drainage before the reservoir was constructed in the 1970s (USFWS 1999)." (Stillwater Sciences 2007).

Arroyo Toads were not detected at any of the eleven (11) Study Areas during the focused survey efforts. Stressors expected to reduce the distribution and/or abundance of this species include loss of upland aestivation habitat, loss of breeding habitat, introduced predators, unnatural reservoir releases which alter geomorphology, depleted water tables that reduce the duration of surface pooling, unnatural releases from reservoirs during the breeding season, and reduced water quality.

4.1.6 California (Western) Toad

The California toad represents the second most prevalent amphibian documented within the Study Areas. Historically this species is expected to have occurred throughout the Study Area with abundant populations in the vicinity of annual breeding sites located within the floodprone areas and adjacent terrace habitats of the Santa Clara River and major tributaries. California toads were documented at ten (10) of the eleven (11) Study Areas ranging from uncommon to abundant. The notes of uncommon occurrences suggest that populations may be in decline in regions of the Study Area where direct and/or indirect impacts are reducing recruitment. Stressors expected to reduce the distribution and/or abundance of this species include introduced predators, unnatural reservoir releases which alter geomorphology, depleted water tables that reduce the duration of surface pooling, unnatural releases from reservoirs during the breeding season, and reduced water quality.

4.1.7 Macroinvertebrates

Thirty identified genera and 30 families of insects, and 4 non-insect taxa were collected from the Santa Clara mainstem and its major tributaries (Table 6). In general, the majority of aquatic insects collected from sample sites were environmentally tolerant aquatic beetles (Coleoptera), flies/midges (Diptera), dragonflies and damselflies (Odonata), water striders and toe-biters (Hemiptera), and snails (Gastropoda), whereas few environmentally sensitive taxa such as mayflies (Ephemeroptera) or stoneflies (Plecoptera) were collected. Taxa primarily consisted of generalized collectors (collector–gatherers and collecter-filterers) and predators. Non-insects comprised only a very small portion of the invertebrate assemblage, with only snails (Gastropoda) being widely distributed and abundant.

With the exception of a few individual taxa, with specialized habitat and water quality requirements (*Cordulegaster dorsalis* and *Ryacophila*), the assemblage of macroinvertebrates collected from sample sites in the Santa Clara mainstem and its tributaries are moderately to highly tolerant of poor environmental conditions, and are both feeding and habitat generalists. Based on these characteristics, the macroinvertebrate assemblages collected from sample sites are expected to have been historically distributed throughout the Santa Clara River drainage basin (excluding the estuary). Sampling results, however, indicate that the abundance and diversity of insects is higher in the tributaries of the Santa Clara River than in the mainstem. There is a trend toward a diminishing number of aquatic insect families and genera proceeding from the tributaries, Aliso, Sespe, and Santa Paula, to the mainstem of the Santa Clara River. On average, the number of families in the mainstem of the Santa Clara River represents only 59% of the families found in the tributaries, Aliso Creek, Sespe Creek and Santa Paula Creek. In general, the insect families and genera found in Aliso Creek, Sespe Creek and Santa Paula Creek are also found in the Santa Clara mainstem, so the Santa Clara insect fauna represents a subset of the taxa found in its tributaries (a depauperate fauna).

Urbanization, agriculture, dam construction, stream channelization, point source discharge of sewage effluent, and ground water extraction are likely to negatively affect the biota of the

Santa Clara River by reducing the distribution and abundance of many species. These human impacts have dramatically altered flow regimes, channel morphologies and sedimentation rates, decreased riparian cover and degraded water quality. Invertebrates in affected downstream river sections are often reduced in abundance or diversity compared to upstream, undisturbed sections. In general, tributaries of the Santa Clara River were less disturbed by human activities, had more intact riparian zones, were fed by natural ground water sources rather than sewage effluent, were located in areas with untapped water tables, and had greater heterogeneity of substrate types and larger particle size (cobbles/boulders vs. sand/silt) than did the mainstem of the Santa Clara River.

4.2 SURVEY AREA BASELINE CONDITIONS

The results of the habitat assessments and focused survey efforts conducted at eleven (11) Study Areas for target amphibian species and benthic/littoral macroinvertebrates are presented in the following subsections. The studies included a site description, vegetation characterization including dominant plant list, survey results for target species, habitat assessment results, and a list of incidental wildlife species documented within and/or adjacent to each respective survey area. A complete list of survey dates and surveyors is provided in Table 4, *Survey Area Sample Dates*.

Table 4
Survey Area Sample Dates

Survey Area	Survey Dates	Surveyors
Santa Clara River Main Stem #1	Sept 1 2005, June 12 2006, July 17 2006	F. Hovore, D. Wing, T. Savaikie, K.Penrod
Santa Clara River Main Stem #2	June 2005, Sept 1 2005, June 12 2006, July 17 2006	F. Hovore, D. Wing, T. Savaikie, K.Penrod
Santa Clara River Main Stem #3	City Property - March, April, May, June, Sept 1 2005, May 15 2006, June 12 2006, July 17 2006 Capra Property - March, April, May, June 2005, May 15 2006, July 17 2006, Aug 12 2006	F. Hovore, D. Wing, T. Savaikie, K.Penrod
Santa Clara River Main Stem #4	May 17 2006, Aug 23 2005, Sept 1 2005, June 11 2006, July 17 2006	F. Hovore, D. Wing, T. Savaikie, K.Penrod
Santa Clara River Main Stem #5	May 15 2006, July 31 2006	F. Hovore, D. Wing
Santa Clara River Main Stem #6	March 17 2005, June 29 2005, Sept 06 2005, July 31 2006	F. Hovore, N. Sandburg D. Wing, T. Savaikie, K.Penrod

Survey Area	Survey Dates	Surveyors
Santa Clara River Main Stem #7	March 17 2005, June 29 2005, Sept 6 2005, July 31 2006	F. Hovore, N. Sandburg D. Wing, T. Savaikie, K.Penrod
Aliso Creek	March, May, June 2005, Sept 1 2005, June 12 2006, July 17 2006	F. Hovore, D. Wing, T. Savaikie, K.Penrod
Escondido Creek	July 17 2006	F. Hovore, D. Wing
Lower Sespe Creek	March 17 2005, Sept 1 2005, July 31 2006	F. Hovore, D. Wing, T. Savaikie
Santa Paula Creek	March 17 2005, June 29 2005, Sept 8 2005, Jul 31 2006	F. Hovore, N. Sandburg D. Wing, T. Savaikie

4.2.1 (1) Santa Clara River Main Stem #1

Survey Area Location

The #1 Santa Clara River Main Stem survey area is located at 34°26.23’N, 118° 13.18’W within the United States Geological Survey (USGS) Acton Quadrangle near the Maryhill road crossing as shown in Figure 2, *Vicinity/Survey Site Location Map*.

Survey Zone

The survey area included the creek channel, bed and bank, +/- 100 yds up and downstream of the site location noted above (road crossing). Representative photographs of the survey area are presented in Figure 8, *(1) Santa Clara River Main Stem #1 Photographs*.

Site Description

The Maryhill Road site lies along the reach of the Santa Clara River immediately west of the point of entry for Arrastre Canyon tributary, just west of the deep alluvial plains of the southwestern corner of the Acton Basin. The Acton basin is very broad and deep, and surface flows are absorbed into the alluvial aquifer for several miles. Historic areas of surface flow within Kentucky Springs, Arrastre and Kashmere canyons no longer persist beyond the cessation of heavy precipitation. The type locality for the unarmored three-spine stickleback (*Gasterosteus aculeatus williamsoni*) now no longer carries surface flows, and the first place that persistent surface water typically occurs on the main stem of the Santa Clara River is at “Thousand Trails” RV Park, below the confluence with Arrastre Creek. This facility features lawn areas and a number of recreational pools and ponds, and the consistent presence of surface flows from the park may in part be augmented by runoff or discharge. The Maryhill Road crossing parallels Bootlegger Road crossing, situated about 0.1 mile west, and is bridged with a low, pipe-culvert overpass and low-water crossing for heavy vehicles. During the heavy rainfall of winter 2004/2005, this site was buried in alluvial sediments, diverting the creek to the sides of the channel and rending the road crossings impassable; grading to restore the road also straightened and deepened the channel from the park boundary to well-below Bootlegger Road crossing. The Maryhill site was selected because of the two crossings, it had the least-severe in-channel grading impacts, and the natural restoration of streamflow and emergent riparian growth was more rapid.

The survey area was situated in the channel immediately downstream of the road crossing, with some supplemental samples taken around the margins of the pond that formed behind the culvert constriction. At this point the channel of the creek is relatively flat, lightly braided, with flows shallow (2 – 10” in depth; 3 – 8 feet in width), with a rapidly diversifying and maturing growth of streamside plant species. Because of the complete removal and alteration of all previous riparian features and channel topography in spring, 2005, this site offers an excellent opportunity to investigate habitat value recovery rates and diversity.

River channel morphology around the creek flow zone consists of a wide, open bottom, approximately 300 feet wide at survey zone, rising gradually to the surrounding slopes of the Mt. Gleason to the south, and the Sierra Pelona ridge to the north. The very heavy flows of 2004/2005 raised the channel bed about 3 feet over its former elevation. The deep deposit of silt, sand, cobble, rocks and small boulders was distributed across the entire width of channel, but grading cut a relatively narrow, straight flow alignment, with a 3 foot berm along each side some of which has already been eroded away by moderate flows during the past winter. The southern margin of the channel has a more-stable terrace deposit, and this was eroded only by light surface channeling. The terrace community structure is predominantly willow – cottonwood woodland, consisting of mature Fremont cottonwood (*Populus fremontii*), arroyo willow (*Salix lasiolepis*), and mule fat (*Baccharis salicifolia*), with a largely ruderal understory.

Channel surface flows during invertebrate surveys ranged from 2 – 6” depth at 4 – 8 foot widths, numerous deeper, slow-flow pools below larger rocks. Bottom substrate is light cobble in hard-flow areas, medium-coarse to fine sand on slow-flow beds, with gelatinous algal bloom extensive in summer months.

<u>Vegetation</u>

Vegetation was assessed qualitatively within a transect zone extending approximately 100 yards within the bed and bank of the restoring channel, carried out to the still-unvegetated channel basin margin, about 30 feet from the flow, and into the terrace woodland, about 50 feet beyond the flowing creek.

The emergent riparian vegetation community is comprised most-densely by water cress (*Rorippa nasturtium-aquaticum*), water speedwell (*Veronica anagallis-aquatica*), and knotweed, with seedlings only of future overstory species, including western sycamore (*Platanus racemosa*), Fremont cottonwood, and arroyo willow.

The surrounding upland vegetation community is distant from the flow zone of the channel, and has been heavily disturbed by human activity on the south bank. The present formation consists largely of disturbed California buckwheat (*Eriogonum fasciculatum*), chamise (*Adenostoma fasciculatum*), scrub oak (*Quercus berberidifolia*), foothill yucca (*Yucca whipplei*) and deerweed (*Lotus scoparius*), surrounded by an extensive and dense ruderal and non-native grassland formation.

Riparian Species (*identified within transect zone*)

arroyo willow, *Salix lasiolepis*
black mustard, *Brassica nigra*
Fremont cottonwood, *Populus fremontii*
jimson weed, *Datura wrightii*
knotweed, *Polygonum* sp.
lamb's ears, *Stachys albens*
mugwort, *Artemisia douglasiana*
mule fat, *Baccharis salicifolia*
small monkeyflower, *Mimulus brevipes*
southern cattail, *Typha domingensis*
spiny ragweed, *Ambrosia artemisiifolia*
stinging nettle, *Urtica dioica*
tarragon, *Artemisia dracunculus*
tumbleweed, *Amaranthus albus*
water cress, *Rorippa nasturtium-aquaticum*
water speedwell, *Veronica anagallis-aquatica*
western sycamore, *Platanus racemosa*
white nightshade, *Solanum douglasii*
white sweet-clover, *Melilotus alba*
willow herb, *Epilobium ciliatum*

Survey Results

Benthic and Littoral Macroinvertebrates

Sample dates: 01 Sept 2005; 12 June 2006; 17 July 2006. Abundance values: abundant = more than 10 specimens per net sample taken; common = present in each net sample, numbers variable but not exceeding 10 per sample; uncommon = fewer than three individuals per net sample, and not present in all samples; rare = one to a few individuals seen within entire survey sample.

Benthic Species

- olive snail, *Physella virgata*, rare;
- Hemiptera: Gerridae, water strider, *Gerris remigis*, adults and nymphs common; Notonectidae, water boatman, *Notonecta* sp.; toe-biter, *Abedus indentatus*, common;
- Ephemeroptera: clear-water mayflies, prob. *Ephemerella* sp., uncommon;
- Coleoptera: Dytiscidae, black dytiscid beetle, *Agabus tristis*, larvae common, adults rare; dytiscid beetle, genus indet., larvae common, no adults; Hydrophilidae, water scavenger beetles, at least 2 spp. indet, larvae only common;
- Diptera: misc. undeterminable Dipteran larvae;
- Odonata: Libellulidae, big red skimmer, *Libellula saturata*, common; Lestidae, California archilestes, *Archilestes californica*, rare; Coenagrionidae, violet dancer, *Argia vivida*, common.

Littoral/Interstitial Zone Species

- Coleoptera: Carabidae, bombardier beetle, *Brachinus* sp., rare.

Comments

This portion of the reach was completely buried in sediment following the heavy rainfall of 2004/2005, and the survey zone itself lies within a re-graded channel alignment. Therefore, all flora and fauna within the survey zone has re-established by seedbank persistence, seed drift, float-in, fly-in or terrace refugia. The relatively lower diversity, then, actually may be regarded as representing a remarkable recovery from barren silt and sand, and heavy mechanical scarification. The creek (= river) channel emergent vegetation is thick, and the densely vegetated stems capture airborne dust, falling leaves, and other organic debris, and as more ephemeral plants die, they decay *in-situ*, contributing to the surface accumulation of nutrient-laden organic material. The new growth also attracts insects, some of which may assist in the recycling of organic debris, others of which contribute to it as they reproduce and die. Insects in turn provide food resources for adult amphibians and songbirds, accelerating the recovery of secondary ecosystem levels. Unless this area is hit with high-energy flows in the next few winters, it should fully recover normal floral and faunal assemblage diversity within 5 years, and riparian scrub – woodland structural stature within a decade.

Fishes (incidental observations)

Fish Species

- unarmored three-spine stickleback (*Gasterosteus aculeatus williamsonii*) common
- arroyo chub (*Gila orcuttii*) common
- Santa Ana sucker (Catostomus santaanae) not seen but known from this area

Amphibians

Amphibian Species

- Pacific chorus frog (*Pseudacris regilla)* uncommon

Comments

The presence of better-protected refugial areas for native fish, probably upstream of the site within the 1000 Trails facility, permitted unarmored three-spine stickleback and arroyo chub to immediately respond to slowing flows and creation of riffle zones, and they bred within the pond on the upper side of the road crossing, fry of both being abundant within the creek below the road. Amphibians, particularly California toads, have been slower to recolonize the creek, no doubt reflective of the fact that all in-channel refugia were obliterated by the silt deposition and subsequent bulldozing of the sediments. Adult amphibians observed (all *P. regilla*) probably entered the relaxed flows from refugia on the adjacent alluvial terrace. Why California toad was not found in the survey zone may be an artifact of sampling timing or the specific area selected for the sample, as it likely has recolonized areas further up and downstream of the site. Channel configuration and exposure are not of the sort generally tolerated by California chorus frog (*Pseudacris cadaverina*), and it would not be expected to occur in this portion of the reach. The area does appear at least marginally suitable for arroyo toad (*Bufo californicus*), although this species has not been recorded from this portion of the river, the nearest known metapopulational units being on upper Littlerock Creek, and Monte Cristo Campground on upper Big Tujunga Creek, on the southern slope of the San Gabriel crest. No evidence of this species was detected during surveys, and it is not expected to occur within the vicinity of the survey zone.

Incidental Wildlife Observations

Reptile species observed within the survey zone included California side-blotched lizard (*Uta stansburiana elegans*), Great Basin fence lizard (*Sceloporus occidentalis longipes*), Great Basin whiptail (*Cnemidophorus tigris tigris*), and San Diego gopher snake (*Pituophis catenifer annectens*).

A comprehensive list of incidental bird species documented during the survey efforts is included in APPENDIX –Survey Area Bird Species Compendium

4.2.2 (2) Santa Clara River Main Stem #2

Survey Area Location

The #2 Santa Clara River Main Stem survey area is located at 34°25.45'N, 118° 18.49'W within the Agua Dulce USGS Quadrangle near the old Soledad Campground.

Survey Zone

The survey area included the creek channel, bed and bank, +/- 100 yds up and downstream of the site location noted above (entry trail of campground). A representative photograph of the survey area is presented in Figure 9, *(2) Santa Clara River Main Stem #2 Photograph*.

Site Description

Soledad Campground once was an active camping area, but in recent years has been maintained as a day use site, with a riparian / stickleback interpretive display set along the top of the riverbank. The canyon at this point rises steeply on the southern side of Soledad Canyon Road, and is largely raw, exposed granitics and mixed metamorphic parent material, with a thin soil layer supporting moderately sparse chaparral growth. Coast live oak (*Quercus agrifolia*) woodland dominates the upland terrace and slough areas, but understory values have been severely altered by vehicle and foot traffic, clearing for fire prevention, and introduction of non-native ornamental shrubs and trees. The south-facing slopes of the canyon support xeric burned-over chamise chaparral and buckwheat scrub.

The survey portion of the creek lies within a mature willow – cottonwood riparian community, situated in a broad area of the river's floodplain, with a deep alluvial base and open banks. Dominant cover species are willows (*Salix* spp., mostly *lasiolepis*) and Fremont cottonwood. The understory includes dense mule fat thickets, but because of the dynamic nature of the channel at this locality, flows often re-align and re-braid, leaving open sand as the predominant substrate.

The survey area encompasses about 100 feet of the flowing channel nearest the south bank below the interpretive site, but away from the area of observed frequent human use. At this point the channel of the creek is shallow, and set within the deep, broad alluvial plain, but the underlying hydrology supports a maturing layered tall tree woodland overstory. Most of the annual herbaceous regrowth is confined to narrow zones along the creek channel margins, but channel re-alignment has precluded more than one or two years of maturation.

Channel morphology is very broad, braided, open bottom, alluvial plain, approximately 0.1 mile wide at survey zone, with almost not exposed coarse cobble, the slowing flows having covered the heavier materials with sand – silt terraces. The Fremont cottonwood and arroyo willow overstory are maturing, with some trees in excess of 50 feet tall, but the central portion of the channel, where flooding and disturbance are most frequent, exhibits a mixed riparian scrub – willow woodland formation.

Channel flows during invertebrate surveys ranged from 1 – 10" depth at 2 - 10 foot widths, with a few areas of deeper, slower flows where the channel has cut around the bases of willows. Bottom substrate is mixed light cobble and fine sand throughout, with only very sparse filamentous algal bloom. Flow margins annually fill with water cress and speedwell, creating habitat for benthic macroinvertebrates, and unarmored three-spine stickleback.

Vegetation

Vegetation was assessed qualitatively within a transect zone extending approximately 100 feet along the creek channel within the riparian woodland, and laterally about 100 feet on the north side of the channel, and 50 feet on the south side (at which point the upland vegetation was reached).

The riparian woodland community is dominated by willows (*Salix lasiolepis* overstory, *S. exigua* on the terraces) and a relatively sparse herbaceous and woody shrub understory component. Fremont cottonwood is distributed throughout the terrace areas and into the adjacent upland slough deposit areas, below the roadway.

The coast live oak woodland along the southern rim of the channel, mostly below Soledad Canyon Road, is a remnant of formerly more-extensive oak formations along the margins of the canyon, much of which were removed by road construction and subsequent erosion below the road alignment. The upland formations on the rocky, thin-soils of the steep north-facing slopes are a mixture of chamise chaparral and black sage (*Salvia mellifera*) scrub with mountain mahogany (*Cercocarpus betuloides*), toyon (*Heteromeles arbutifolia*), scrub oak, and other pioneering species attaining dominance by slope angle and orientation. The south-facing margin of the drainage has much less severe relief, and rises gradually toward the low hills separating the Soledad drainage from Escondido Canyon.

Riparian Species (*identified within transect zone*)

arroyo willow, *Salix lasiolepis*
cardinal monkeyflower, *Mimulus cardinalis*
cocklebur, *Xanthium strumarium*
evening primrose, *Oenothera elata* ssp. *hookeri*
Fremont cottonwood, *Populus fremontii*
knotweed, *Polygonum* sp.
mugwort, *Artemisia douglasiana*
mule fat, *Baccharis salicifolia*
rabbitsfoot grass, *Polypogon monspeliensis*
narrow-leaf willow, *Salix exigua*
sow thistle, *Sonchus oleraceus*
spiny ragweed, *Ambrosia artemisiifolia*.
wand buckwheat, *Eriogonum* sp., prob. *elongatum*
water cress, *Rorippa nasturtium-aquaticum*
water speedwell, *Veronica anagallis-aquatica*
white sweet clover, *Melilotus alba*
willow herb, *Epilobium ciliatum*
wire lettuce, *Lactuca* sp.

Upland Species (*identified from the canyon above the river*)

black sage, *Salvia mellifera*
California blackberry, *Rubus ursinus*
California buckwheat, *Eriogonum fasciculatum*
chamise, *Adenostoma fasciculatum*
coast live oak, *Quercus agrifolia*
deerweed, *Lotus scoparius*
dove weed, *Eremocarpus setigerus*
foothill yucca, *Yucca whipplei*
mountain mahogany, *Cercocarpus betuloides*
scrub oak, *Quercus berberidifolia*
tree of heaven, *Ailanthus altissima*
virgin's bower, *Clematis ligusticifolia*
yerba santa, *Eriodictyon crassifolium*

Survey Results

Benthic and Littoral Macroinvertebrates

Sample dates: 01 Sept 2005; 12 June 2006; 17 July 2006. Abundance values: abundant = more than 10 specimens per net sample taken; common = present in each net sample, numbers variable but not exceeding 10 per sample; uncommon = fewer than three individuals per net sample, and not present in all samples; rare = one to a few individuals seen within entire survey sample.

Benthic Species

- olive snail, *Physella virgata*, abundant;
- Hemiptera: Gerridae, water strider, *Gerris remigis*, adults and nymphs rare; Notonectidae, water boatman, *Notonecta* sp., rare; toe-biter, *Abedus indentatus*, rare;
- Coleoptera: Dytiscidae, black dytiscid beetle, *Agabus tristis*, rare; Hydrophilidae, water scavenger beetles, genera *Berosus,* spp. indet, uncommon;
- Diptera: Chironomidae, Tipulidae, spp. indet; misc. undeterminable Dipteran larvae;
- Odonata: Aeshnidae, multicolored darner, *Aeshna multicolor,* rare; Lestidae, California archilestes, *Archilestes californica*, uncommon; Coenagrionidae, violet dancer, *Argia vivida*, common.

Littoral/Interstitial Zone Species

- Coleoptera: Carabidae, Oregon tiger beetle, *Cicindela oregona*, uncommon; bombardier beetle, *Brachinus* sp., rare;
- Homoptera: Cicadellidae, leafhoppers, abundant on willow stems and foliage, many of them falling onto the surface of the water in the channel.

Comments

Channel flows at this point in the river remain relatively high-energy through spring and into summer, relaxing by July, but still without much algal growth or marginal vegetation. Taxonomic diversity and abundance values were the lowest encountered within the upper reach of the River despite good water quality and constant flows. In part this may be due to the constant meandering and braiding of the surface flows over relatively deep alluvial deposits, with relatively little deposition of sediment and organic matter on the bottom substrates. Also, there is little in the way of boulders, logs, or marginal growth away from the flow, so sheltering sites are lacking and herbaceous host material is sparse.

Fishes (incidental observations)

Fish Species

- unarmored three-spine stickleback (*Gasterosteus aculeatus williamsoni*) common
- arroyo chub (*Gila orcuttii*) common
- Santa Ana sucker (Catostomus santaanae) not seen but known from this area

Amphibians

Amphibian Species

- California toad (*Bufo boreas halophilus*) uncommon

- Pacific chorus frog (*Pseudacris regilla*) uncommon

Comments

No amphibians were encountered within the flowing channel or within the marginal vegetation until the last of the survey dates, and then only one *P. regilla* was seen, near the water, with the few California toads having been up in the parking area near the restrooms. To some extent this might be explained by the strong, narrow channel flows through 2005 and into spring / summer 2006, not being suitable for reproduction within the survey zone, or this particular segment of the reach. Because of the high flows during the survey period, most amphibian reproduction may have been confined more to pools and other out-of-flow subsites, and where damming or constricting the flow. Certainly these two species reproduce here, and nocturnal surveys conducted at several points between the Agua Dulce Canyon Road bridge crossing and the campground entrance in March, April and May 2005 and 2006, noted *P. regilla* vocalizing in abundance (listening points: Agua Dulce Canyon Road bridge; 0.1 mi E; 0.3 mi E).

Habitat values within this portion of the reach are marginally suitable for arroyo toad, but the species has not been recorded east of the Agua Dulce Canyon Road crossing on the river. No evidence of this species was found during the surveys, nor were any heard during the aforementioned nocturnal "calling" surveys. Amphibian surveys conducted by Frank Hovore & Associates at Soledad Campground in 1987 (with C.S.U. Northridge graduate student C.R. Carter) found numerous adult clawed frogs in the creek channel, and the species is well-established within the lower portion of the reach, in some of the impoundments along the river, and on the Agua Dulce Creek tributary. Despite its presence for several decades, it has not become super-abundant outside of the deeper ponds and pools, and despite predation by these frogs, arroyo chub and unarmored three-spine stickleback continue to reproduce successfully within this segment of the reach. Both fish species were common within the survey zone, with adults and fry observed during July 2006. Rainbow trout fingerlings (*Onchorynchus mykiss*), no doubt escapees from local fishing ponds, also were found during the 1987 surveys in the channel below the campground.

Incidental Wildlife Observations

Reptile species observed within the immediate vicinity of the channel survey zone included California side-blotched lizard, Great Basin fence lizard, San Diego alligator lizard (*Elgaria multicarinata webbii*), western whiptail (*Cnemidophorus tigris* ssp. *indet.*), coast horned lizard (*Phrynosoma coronatum*) (roadkill); southern Pacific rattlesnake (*Crotalus oreganus helleri*) (roadkill). Red coachwhip (*Masticophis flagellum piceus*), chaparral whipsnake (*M. lateralis*), San Diego gopher snake and western skink (*Eumeces s. skiltonianus*) all were observed along the road or within the river channel, or identified from roadkill within one road mile of the site during the overall survey timing. Gopher snakes seen in this area exhibit coloration of both the San Diego and desert subspecies (*deserticola*), and for many reptile species, Agua Dulce - Escondido Canyon appears to within a zone of subspecies intermediacy.

Several other species were found within one mile of the site during other Frank Hovore & Associates survey work in this portion of the canyon (1994 – present), including: coastal patch-nosed snake (*Salvadora hexalepis virgultea*), night snake (*Hypsiglena torquata*), California kingsnake (*Lampropeltis getulus californiae*), glossy snake (*Arizona elegans* ssp. indet.), two-striped garter snake (*Thamnophis hammondi*), and night lizard (*Xantusia v. vigilis*).

Two other Frank Hovore & Associates file historic observations from within the vicinity of the site are of biogeographical interest for the reptile species involved: a submature desert horned lizard (*Phrynosoma platyrhinos*) was found in the parking area of the Robin's Nest recreation park in 1994 (this may be the westernmost record for the species), and a western racer (*Coluber constrictor mormon*) was found at the Soledad Campground in the early 1960s (recorded in Schoenherr, 1976, *The Herpetofauna of the San Gabriel Mountains*, only as "Soledad Canyon.".

A comprehensive list of incidental bird species documented during the survey efforts is included in APPENDIX –Survey Area Bird Species Compendium

4.2.3 (3) Santa Clara River Main Stem #3

Survey Area Location

The #3 Santa Clara River Main Stem survey areas are located at 34°25.96'N, 118° 20.77'W (City - CEMEX) and 34°25.78'N, 118° 21.32'W (Capra) within the Acton USGS Quadrangle.

Survey Zone

The survey area includes the City CEMEX property: creek channel, bed and bank, ±100 yds down-stream of location data presented above (known arroyo toad breeding pool); and Capra property: ±100 yd reach within narrows and out onto open alluvium. Representative photographs of the survey area are presented in Figure 10, *(3) Santa Clara River Main Stem #3 Photographs*.

Site Description

City (CEMEX) Property

The survey area is within the portion of the reach passing through a historic aggregate mining area, a portion of which currently is under surface mineral rights lease from the Bureau of Land Management. Mining activities are on-going in upland areas adjacent to the site, and water uses associated with proposed expansion of the mining may directly affect surface hydrology within the reach. The river channel through this site was relocated from its' historic configuration to accommodate placement of an elevated railroad track alignment through the canyon. The creek now lies south of the railway berm, in part separated from the alignment by vertical concrete walls. The southern margin of the channel rises steeply up a silt pile, deposited during prior mining operations, and now revegetated with native scrub species.

The channel of the river is deeply cut and has artificially elevated side margins, but still is broad enough to support open channel riparian vegetation, typically with a layered tall tree overstory, woody thicket and scrub understory, and annual herbaceous growth along creek channel margins. Where the flows pass over blasted-through bedrock, small waterfalls and plunge pools form in higher rainfall years, below which the channel opens for about 0.1 mile, then closes again as the railroad alignment impinges along the northern bank of the river.

Channel morphology is open bottom, between 20 and 45 feet wide through the survey zone; heavy flows have deposited medium – coarse cobble, rocks and small boulders within the channel, in places forming sand – silt terraces in the middle of the flow, and some fine silt terraces along the margins where protected by intruding rocks. A small fire in summer, 2003 burned through the entire riparian area, killing crowns and trunks of most trees and initiating vigorous regrowth of herbaceous and woody riparian taxa, and also of giant reed (*Arundo donax*). Pre-fire community structure was a southern willow scrub with a few tall Fremont cottonwood and arroyo willow forming a loose overstory.

Channel surface flows during invertebrate surveys ranged from 5 - 12" depth at 5 – 9 foot widths, and with a few deeper, slow-flow pools below larger rocks. Bottom substrate is medium-grain sand in stronger flow areas, finer on slow-flow beds. The margins of the flow were heavily overgrown with herbaceous species from mid-spring through summer, when the high temperatures caused much of the growth to wilt; filamentous algal bloom was extensive in more open portions of the flows during summer months.

Capra Road

The Capra Road site was selected for comparative purposes only, after surveys on the City - CEMEX site proved difficult to interpret. Frank Hovore & Associates had survey information from prior years for this site, and because it is easily accessed at any time, it was checked as part of the surveys on the City property. It is a heavily-impacted recreational use area (most of the impacts are from illegal off-road vehicle use in the channel), but lies only about 0.5 mile downstream of the City property, at a similar elevation and orientation, but with somewhat less-stable supporting hydrology. Bear Canyon tributary, a steep, narrow, rocky channel with a limited watershed, enters from the south about 0.2 mile east. Amphibian surveys only were conducted at this site, as surface flows in 2005 were very high-energy, and compromised by extensive Off Road Vehicle driving within the channel through all of summer; and in 2006 the flows diminished below the level which would have permitted comparable invertebrate sampling, the channel being almost entirely dry by mid-July. Because the site is always accessible by vehicle, both daytime and nocturnal (calling) surveys were performed.

The survey area lies within a portion of the reach which was blasted through the foot of a ridgeline to relocate the channel and permit construction of the elevated railway alignment through the canyon. The creek now lies south of the railway berm, the sides of which are vertical concrete walls flowing over exposed bedrock and a shallow layer of silt, dropping through several rock passages before reaching the level of the original alluvial bed at the end of Capra Road. The rocky "narrows" protects this portion of the reach from vehicle intrusion, but also limits the persistence of surface flows, as there is no underlying subsurface water. It also experiences scouring flows with in moderately high rainfall years, but it has regrown with early stage mule fat – willow scrub since the cessation of high water flows in spring, 2005 (see image, below).

Channel morphology is entirely exposed bedrock (created by blasting through the adjacent ridges) with accumulated alluvium of varying depths, between 15 and 25 feet wide through the survey zone. Surface flows are extremely flashy within this sub-reach, with high-energy flows tending to press along the base of the concrete embankment, spreading into level alluvial areas and then narrowing and cutting through the exposed rocks. The lack of underlying sediments results in briefer flows, drying quickly over the thin alluvial areas, but with a few plunge pools persisting below larger rocks. The step-down effect of the blasted bedrock has resulted in an annual phenomenon fish and amphibian mortality in the pools, caused by the rapid drying of flows on the alluvial bed at the foot of Capra Road, during which time mobile organisms retreat up the flow to the pools, where they then are trapped against the rock uplift. As the pools dry, chorus frog and toad tadpoles, hundreds to thousands of unarmored three-spine stickleback and arroyo chub fry and adults, and often dozens of adult suckers crowd the shallow water, where the combination of water temperature, lack of oxygen, and predators (especially raccoon, *Procyon lotor*) quickly reduce them to decaying muck in the bottom of the depression, which eventually is harvested by ants (*Pogonomyrmex* sp.; *Linepithema humile*) and yellowjacket wasps (*Vespula pensylvanica*). This is not a natural feature of the Santa Clara River, which otherwise has no natural waterfalls, step-down passages, or other physical barriers in its main stem alignment. Since the railroad alignment was created many decades ago, these un-natural rocky drop-passages in the profile of bedrock have been directly responsible for the non-selective mortality of unknown thousands of individuals of the unarmored three-spine stickleback, a California fully-protected and Federal Endangered species.

Vegetation

City (CEMEX) Property

Vegetation was assessed qualitatively within a transect zone extending approximately 100 yards along the bed and bank of the channel, encompassing the invertebrate sample zone. A visual transect was extended up the steep, confining slope of the silt pile embankment and cut slope, and within the upland portion of the channel, permitting identification of the dominant species of the surrounding uplands.

The riparian vegetation community is dominated by a vigorous post-fire regrowth of narrow-leaf (sandbar) willow, arroyo willow, Fremont cottonwood, mule fat, and a diverse herbaceous component. Portions of the reach with rocky margins are sparsely vegetated, but areas with deeper alluvial sediments have grown-over with water speedwell, water cress, and other species to such an extent as to completely close-over the flow.

Regrown upland vegetation on the silt pile consists of pioneering sage scrub – chaparral species-- it has been about 18 years since the pile was created-- predominantly yerba santa (*Eriodictyon crassifolium*), Great Basin sagebrush (*Artemisia tridentata*), butterweed (*Senecio flaccidus*), California buckwheat, and rubber rabbitbrush (*Chrysothamnus* sp.). The original arroyo, above where the silt pile is located, contains mature, xeric chaparral, dominated by chamise, mountain mahogany, scrub oak, hoary-leaf ceanothus (*Ceanothus crassifolius*), holly-leaved redberry (*Rhamnus ilicifolia*), and an intermixture of other typical chaparral species.

Capra Road

Vegetation was assessed qualitatively within a transect zone extending approximately 75 yards along the bed and bank of the channel, encompassing the vegetated portion of the overall amphibian survey zone. A visual assessment was taken on the steep, cut slope above the channel, permitting identification of dominant species thereon.

Riparian regrowth in the passage is dominated by narrow-leaf (sandbar) willow, arroyo willow, Fremont cottonwood, mule fat, white sweet clover, water cress and a few other herbaceous taxa. The dominant component of the steep, rocky slope above is mountain mahogany, with California buckwheat, chamise, hoary-leaf ceanothus, and other typical chaparral species intermixed. Nevin brickellbush (*Brickellia nevinii*), once considered rather rare (but actually common locally on steep rocky cuts) also is present on the slope.

Riparian Species – City (CEMEX) Property
(*identified within transect zone*)

arroyo willow, *Salix lasiolepis*
big sagebrush, *Artemisia tridentata* ssp. *parishii*
broad-leaved cattail, *Typha latifolia*
California sagebrush, *Artemisia californica*
cardinal monkeyflower, *Mimulus cardinalis*
cocklebur, *Xanthium strumarium*
deergrass, *Muhlenbergia* sp.
deerweed, *Lotus scoparius*
evening primrose, *Oenothera elata* ssp. *hookeri*
everlasting, *Gnaphalium luteo-album*
fennel, *Foeniculum vulgare*
Fremont cottonwood, *Populus fremontii*
giant reed, *Arundo donax*
gray mustard, *Hirschfeldia incana*
horsetail, *Equisetum* sp.
horseweed, *Conyza canadensis*
jimson weed, *Datura wrightii*
lamb’s ears, *Stachys albens*
mugwort, *Artemisia douglasiana*
mule fat, *Baccharis salicifolia*
narrow-leaf willow, *Salix exigua*
pampas grass, *Cortaderia jubata*
rabbitsfoot grass, *Polypogon monspeliensis*
Rosaceae, prob. *Fragaria* sp.
rush, *Cyperus* sp.
sow thistle, *Sonchus oleraceus*
spotted monkeyflower, *Mimulus guttatus*
stinging nettle, *Urtica dioica*
tarragon, *Artemisia dracunculus*
telegraph plant, *Heterotheca* sp.
thistle, *Cirsium* sp.
thistle, *Cirsium* sp.
tree tobacco, *Nicotiana glauca*
tumbleweed, *Amaranthus albus*
verbena, *Verbena lasiostachys*
water cress, *Rorippa nasturtium-aquaticum*
water speedwell, *Veronica anagallis-aquatica*
white alder, *Alnus rhombifolia*
white nightshade, *Solanum douglasii*
white sweet-clover, *Melilotus alba*
willow herb, *Epilobium ciliatum*
wire lettuce, *Lactuca* sp.
wiregrass, *Juncus* sp.
wooly mullein, *Verbascum thapsus*
yerba santa, *Eriodictyon crassifolium*

Upland Species – City (CEMEX) Property
(*identified from the silt pile and slope*)

bedstraw, *Galium angustifolium*
black sage, *Salvia apiana*
California buckwheat, *Eriogonum fasciculatum*
Canterbury bells, *Phacelia campanularia*
chamise, *Adenostoma fasciculatum*
deerweed, *Lotus scoparius*
dove weed, *Eremocarpus setigerus*
foothill yucca, *Yucca whipplei*
hoary-leaf ceanothus, *Ceanothus crassifolius*
holly-leaved redberry, *Rhamnus ilicifolia*
mountain mahogany, *Cercocarpus betuloides*
purple sage, *Salvia leucophylla*
scrub oak, *Quercus berberidifolia*
wire lettuce, *Stephanomeria* sp.
yerba santa, *Eriodictyon crassifolium*

Riparian Species – Capra Road
(*identified within the passage area of the channel*)

arroyo willow, *Salix lasiolepis*
cardinal monkeyflower, *Mimulus cardinalis*
cocklebur, *Xanthium strumarium*
Fremont cottonwood, *Populus fremontii*
giant reed, *Arundo donax*
gray mustard, *Hirschfeldia incana*
lamb's ears, *Stachys albens*
mugwort, *Artemisia douglasiana*
mule fat, *Baccharis salicifolia*
narrow-leaved cattail, *Typha angustifolia*
rabbit's foot grass, *Polypogo*n *monspeliensis*
sandbar willow, *Salix exigua*
sow thistle, *Sonchus oleraceus*
spotted monkeyflower, *Mimulus guttatus*
tamarisk, *Tamarix ramosissima*
tarragon, *Artemisia dracunculus*
tree tobacco, *Nicotiana glauca*
water cress, *Rorippa nasturtium-aquaticum*
water speedwell, *Veronica anagallis-aquatica*
white sweet-clover, *Melilotus alba*
willow herb, *Epilobium ciliatum*
wire lettuce, *Lactuca* sp.

Upland Species – Capra Road
(*identified from the slope above the passage*)

bedstraw, *Galium angustifolium*
black sage, *Salvia apiana*
California buckwheat, *Eriogonum fasciculatum*
chamise, *Adenostoma fasciculatum*
deerweed, *Lotus scoparius*
hoary-leaf ceanothus, *Ceanothus crassifolius*
mountain mahogany, *Cercocarpus betuloides*
Nevin's brickellbush, *Brickellia nevinii*

Survey Results

Benthic and Littoral Macroinvertebrates – City (CEMEX) Property

Sample dates: 01 Sept 2005; 12 June 2006; 17 July 2006. Abundance values: abundant = more than 10 specimens per net sample taken; common = present in each net sample, numbers variable but not exceeding 10 per sample; uncommon = fewer than three individuals per net sample, and not present in all samples; rare = one to a few individuals seen within entire survey sample.

Benthic Species

- olive snail, *Physella virgata*, abundant;
- stone leech, Hirundinida, common;
- Hemiptera: Gerridae, water strider, *Gerris remigis*, adults and nymphs common; Notonectidae, water boatman, *Notonecta* sp. uncommon; toe-biter, *Abedus indentatus*, common; Gelastocoridae, toad bug, *Gelastocorus oculatus*, common.
- Plecoptera: stoneflies, prob. *Ryacophila* sp., rare;
- Coleoptera: Dytiscidae, black dytiscid beetle, *Agabus tristis*, common; dytiscid beetle, genus indet., prob*. Deronectes* sp., common; Hydrophilidae, water scavenger beetles, *Berosus, Enochrus,* spp. indet, uncommon; Dryopidae, long-toed beetle, *Pelonomus* sp., adults uncommon, larvae common;
- Diptera: Ceratopogonidae, Chironomidae, Simuliidae, Tipulidae, spp. indet; misc. undeterminable Dipteran larvae, common;
- Odonata: Libellulidae, big red skimmer, *Libellula saturata*, common; red-tinged skimmer, *Sympetrum illotum*, uncommon; Aeshnidae, common green darner, *Anax junius*, uncommon; Calopterigidae, ruby-spot, *Hetaerina americana*, rare; Lestidae, California archilestes, *Archilestes californica*, abundant; Coenagrionidae, violet dancer, *Argia vivida*, abundant.

Littoral/Interstitial Zone Species

- Coleoptera: Carabidae, Oregon tiger beetle, *Cicindela oregona*, rare; brown ground beetle, *Agonum brunneomarginatum*, common; bombardier beetle, *Brachinus* sp., uncommon; false bombardier beetle, *Chlaenius* sp., uncommon; Omophronidae, hemispherical tiger beetle, *Omophron* sp., common.
- Diptera: Dolichopodidae, long-legged flies, prob. *Tachytrechus* sp. common;
- Orthoptera, Acrydiidae, pygmy mole cricket, *Tridactylus minutus*, common.

Comments

Invertebrate diversity and abundance values within this portion of the river channel were the highest encountered on the main stem of the Santa Clara, exceeded only by those of Aliso Creek in taxonomic diversity. In part this may be attributable to the fact that this segment of the reach lies within a corner in the boundary of the Angeles National Forest, so that it is essentially surrounded by the forest on the west, south and east sides, and by completely undeveloped (except for historic mining) land on the north side. There is little direct runoff from areas of human activity except from mining roads, and the distance to the nearest upstream recreational site on the reach is about three miles, so effluent contributions from that sort of facility would be greatly diluted and filtered by the time they reach the sample zone. The recent fire which burned through the exact area of the known arroyo toad habitat no doubt temporarily reduced evapotranspiration rates within the riparian formation, but recovery to dense willow scrub has been very rapid, and giant reed also is spreading on the banks of the channel, so vegetation effect upon surface flow probably is not significantly different than prior to the fire.

Flows persisted at high volume and velocities throughout summer and fall, 2005, forming a few long off-channel pools, but never dropping to the point where bottom sediment transport ceased. During summer, 2006, however, flows gradually subsided and pools formed within the channel and in small ox-bows apart from the area of continuous flow. As of July 2006, there was relatively high surface flow through the entire reach.

Fishes (incidental observations)

Fish Species

- arroyo chub (*Gila orcutti*) abundant
- Santa Ana sucker (*Catostomus santaanae*) common
- unarmored three-spine stickleback (*Gasterosteus aculeatus williamsonii*) abundant

Comment

Unarmored three-spine stickleback were very common throughout the reach in riffle flows and open channel flows with marginal growth of water cress and speedwell. This species breeds within the reach passing through the CEMEX site, and water measurements taken in 2002 (1030 hours on the 29 April, San Marino Environmental, FH&A file data) measured parameters at 17.5°C, salinity 0.02, pH 8.28, conductivity 0.573, and DO 11.1 (all within the norms for unarmored three-spine stickleback breeding sites).

Amphibians

Amphibian Species – City Property

- California toad (*Bufo boreas halophilus*) abundant/rare
- California chorus frog (*Pseudacris cadaverina*) uncommon/rare
- Pacific chorus frog (*Pseudacris regilla*) abundant/rare

Comments

Winter 2004/2005 runoff and accreted flows within this reach of the river were very heavy, scouring the channel to bedrock in many areas, widening the bed on the alluvial portions, and clearing out most of the first year of post-fire regenerated herbaceous growth. At no time did the flows through the CEMEX site relax to levels which would have permitted breeding by arroyo toad, but the other two amphibian species present bred profusely within a few small off-flow pools. The more-moderate rainfall of 2005/2006 reconstructed some of the scoured areas, filling them with fine sand and silt, and allowed for more pool and low-flow channel areas. The entire survey zone was still flowing hard into spring, again with only limited out-of-flow ponding, but by mid-July the main flow areas also appeared suitable for arroyo toad and other amphibian breeding use. California toad and Pacific chorus frog over-populated the few pools which were available for breeding in spring, 2006, and the sudden shift from cool-to-hot weather seemed to accelerate their reproduction efforts.

However, the annotation of abundance for all species changed from their initial reproductive effort through their subsequent transformation period. By September, 2005 and July, 2006, it was very difficult to find any metamorphs or juveniles of even the common species. No tadpoles, metamorphs or adults of arroyo toad were found during any of the surveys despite the fact that the breeding pools from their original discovery were similar in characteristics to their configuration and flow when the toads were found. In September, 2005, the entire area was trampled, with shoe and boot prints thick on the shoreline of the flowing channel, and much of the algal mat cover pulled to the side and flipped over onto the sand. It appeared as if someone had purposefully removed the algae from the flow, and perhaps also removed the amphibians. Two trained biologists found only one California toad and two Pacific chorus frogs in two and one half hours of searching, under ideal conditions and at the appropriate time of day. Although no evidence of extensive human activity was noted in July 2006, there nevertheless were almost no metamorphs of any of the species of amphibians noted breeding in abundance in spring, even though the protected pools still held abundant larvae.

The near-complete absence of amphibians from the site in September 2005 is difficult to interpret, given the robust breeding activity within the small pools in the off-channel areas. Considerable trampling of the shoreline and algal removal were observed during the late part of the breeding season within the exact area wherein larval and metamorph arroyo toads had been found in other years. The source and purpose of the disturbances cannot be determined *a priori*, but such activities could have had a direct, adverse effect upon whatever tadpoles and juvenile amphibians were present within the area of trampling and in-channel habitat destruction.

Channel characteristics and flows were ideal for arroyo toad in mid-summer 2006, but no evidence of breeding was detected within the areas where they formerly occurred. As in September, 2005, finding amphibians (other than tadpoles) was very difficult within the portion of the reach surveyed, but no trampling or algal removal was noted. The atypical winter – summer transition, which was late and abrupt, with no "Spring" conditions in between, may have had an adverse effect upon amphibian reproductive success. Flows stayed heavy through the normal beginning of the breeding season (March – April), but relaxed to suitable conditions by late June – early July, and tadpoles of chorus frog and California toad were abundant within pools and slow-flow side channels in June. A series of very hot days ensued, concluding with record highs through the later part of July, and channel flows dried very rapidly during this time. It is possible that the extreme temperatures induced high mortality within late-transforming tadpoles and metamorphs, or within amphibians in general, or they may have driven them into refugia. The latter possibility was explored by turning rocks, logs, dried algal mats, etc., and checking some activity areas at night (not the CEMEX site, though). Numbers were slightly higher at night, but there remained an unexplained significant decrease in individuals compared to the numbers seen in other years.

An active, breeding population of arroyo toads was found in the same area as the surveys in 2001 and 2002, but has not been documented from the reach since that year. Drought and heavy rainfall in the intervening years may have resulted in low or no recruitment since 2002, but it must be assumed that the species is extant, and will breed when channel conditions permit.

California red-legged frog may once have occurred within or near the survey site; Schoenherr (1976, *The herpetofauna of the San Gabriel Mountains*, Spec. Publ. SW Herp. Soc., 95 pp.) records the species from "Soledad Canyon ± 15.0 miles NNE or NE San Fernando [Museum for Vertebrate Zoology record, date not cited]", and from nearby Placerita Canyon (Slevin, 1928, without further annotation). Surveys by M. Jennings and M. Hayes (M. Jennings, pers. comm. to F.T. Hovore; and 1994, *Amphibian and reptile species of special concern in California*, CDFG contract #8023, 255 pp.) specifically included all of the known *Rana aurora* sites in their field surveys, and failed to record this species from its few historic localities on the Santa Clara River. No evidence of this species was seen during the focused surveys for this report, but subjectively suitable ponds often form during low-flow years, and may persist for decades between heavy rainfall events, providing potential red-legged frog habitat. One such pond was found in June, 2001 (F. Hovore, N. Sandburg, FH&A file record), immediately down-channel of the silt pile road crossing, but was washed out in 2005.

Incidental Wildlife Observations – City (CEMEX) Property

Reptile species observed within the survey zone included California side-blotched lizard, Great Basin fence lizard, coastal western whiptail (*Cnemidophorus tigris stejnegeri*), western skink, coast horned lizard, San Diego alligator lizard, red coachwhip, San Diego gopher snake, two-striped garter snake, southern Pacific rattlesnake.

Ringtail (*Bassariscus astutus*), a mammal of special interest was seen within the survey zone during work conducted by Frank Hovore & Associates and San Marino Environmental in 2002. It was seen by both survey teams during night-time surveys for arroyo toad.

Amphibian Species – Capra Road

- California toad (*Bufo boreas halophilus*) abundant/rare

- Pacific chorus frog (*Pseudacris regilla*) abundant/rare

Comments

Nocturnal "listening" surveys for calling adult amphibians were conducted as time and opportunity permitted through the spring months of 2005 – 2006. The listening stations were selected during the day, and included a sequence of sites along the margin of Soledad Canyon Road, each providing a good vantage point from which to clearly hear amphibians calling from the river channel. Timing of acoustic surveys was opportunistic, with start times varying from one-half hour past sundown to 10 p.m. Each station was attended for 20 minutes on each session, working stations 1 – 4 or 4 – 1 on alternating sequence of nights. A total of 11 nights were surveyed in 2005; 7 nights in 2006. Night-time temperatures varied greatly over the survey timing, from a low of about 50°F in March to highs slightly above 70°F in May or June; these were not the lows for the night, but rather the spot temperature at the time of the survey, and through the spring months, air temperature dropped about 2 – 5 degrees per hour after sunset, sometimes even more dramatically, in some instances with daytime highs in the 90s and early morning lows in the high 30s. Traffic along Soledad echoes through the canyon, and is heavy until after 10 p.m., but it made hearing amphibians difficult, not impossible.

Station point distances were taken from the intersection of Soledad Canyon Road and Agua Dulce Canyon Road [ADCR], and were as follows:

1. 0.7 mi W: this site overlooks the entire mining operation, and is acoustically excellent for hearing the creek within the arroyo toad activity zone;
2. 0.4 mi W: just east of the mining site entry drive, overlooks canyon, with creek channel about 150 yards distant, somewhat obscured by railway berm, but nevertheless a good spot for hearing calling amphibians;
3. 0.2 mi W: about 100 yards from creek, lower than other sites, area of calling is within cottonwood – willow woodland, burned about 3 years ago;
4. 0.4 mi E of river crossing, 0.5 mi E of ADCR: large turnout on S side of road, listening spot from margin of road immediately above channel; alluvial plain is about 100 yards wide at this spot, with dense willow – cottonwood riparian woodland formation. Small private residences on either side of site.
5. Capra road, half-way down the grade, where the road curve overlooks the big bend in the river, and at the terminus of the pavement, from the railway margin.

Pacific chorus frog was consistently heard at each of the sites when nighttime temperatures were above 50°F, and were abundant at stations 2 and 4, and at both Capra listening points. California chorus frog was heard at stations 3 and 4, and at the lower Capra listening point, never more than one or two calling at any given time. California toad tadpoles were found throughout the reach during diurnal observations, and adults were seen on the roadway at night between stations 1 and 3, and at Capra Road.

Incidental Wildlife Observations – Capra Road

Reptile species observed within the survey zone included California side-blotched lizard, Great Basin fence lizard, coastal western whiptail, San Diego alligator lizard, yucca night lizard, banded gecko (*Coleonyx variegatus*, probably subspecies *abbotti*), red coachwhip, coast patchnose snake, San Diego gopher snake, California kingsnake, San Bernardino ring-neck snake (*Diadophis punctatus modestus*), southern Pacific rattlesnake. Some of these were roadkills on Soledad Canyon Road within one mile of the survey reach.

Channel morphology is a broad, open bottom, varying in width through the survey zone, from about 0.2 mile wide below the Grand Avenue access, narrowing to about 150 feet wide at the road crossing, the banks steeply cut and 10 – 20 feet high, then rising at a moderate slope toward the ridges which define the canyon. Heavy winter flows have deposited huge boulders and numerous moderate to large rocks in the channel, with the central channel flowing over medium – coarse cobble. The width of the flow was between 15 and 40 feet in summer, 2006. There are no silt or light sand terraces, except thin deposits along the base of the channel banks, no doubt a reflection of the combination of steep confining channel banks and relatively high frequency of powerful, scouring storm flows. Vegetation within the channel is thin and emergent, mostly typical riparian scrub species, although smaller side channels support stands of willow (*Salix* sp.) and western sycamore.

Surface flows during invertebrate surveys ranged from 12 - 24” depth along the shoreline, with a few slow-flow pools behind larger rocks and other obstructions. Bottom substrate is moderate cobble with coarse sand in slow-flow sub-sites, and with abundant growth of filamentous algae along the shoreline in summer months.

Once the channel reaches the terminus of Grand, it appears to have been excavated and straightened to confine the flows and divert them past the city below. The channel area surveyed lies above the level of most of the commercial wells in the City of Fillmore orchard and agriculture areas, and likely is unaffected by well draw down, but a resident (Van Tries) offered the notion [unverified] that the city returns treated effluent to the upper portion of the channel. Direct runoff was observed from several orchards which were irrigating at the time of the surveys, and at least one orchard operation had a sump-pump in the creek and was pumping water from the channel to the orchard above.

Vegetation

Lower Sespe Creek

Vegetation was assessed qualitatively within the general in-channel zone extending approximately 0.3 mile above the entry point off Goodenough Road. Because of the channel bank configuration and the presence of roads and agriculture on the margins above the channel, the vegetation survey was confined to the channel. The invertebrate sampling sites were along the west bank below the terminus of Grand, and along the east shoreline about 0.1-mile below the Van Tries road-crossing.

Riparian vegetation in the channel is in a repeating cycle of recovery from flooding effects, and the emerging seedlings and saplings are dominated by arroyo and narrow leaf willow, mule fat, western sycamore, mugwort, willow-weed (*Polygonum lapathifolium*), white sweet-clover and tamarisk.

Upland vegetation on the Van Tries Ranch portion of the survey area is dense, rank, senescent-appearing coast live oak forest with an understory of shade-tolerant chaparral shrubs, including toyon and blue elderberry, overgrown with poison oak. Access problems prevented more than a cursory inventory of the channel uplands.

Riparian Species - Lower Sespe Creek (*identified within channel bed*)

arroyo willow, *Salix lasiolepis*
brickellbush, *Brickellia californica*
California everlasting, *Gnaphalium californicum*
cardinal monkeyflower, *Mimulus cardinalis*
cocklebur, *Xanthium strumarium*
deerweed, *Lotus scoparius*
downy monkeyflower, *Mimulus pilosus*
durango root, *Datisca glomerata*
everlasting, *Gnaphalium luteo-album*
gray mustard, *Hirschfeldia incana*
mugwort, *Artemisia douglasiana*
mule fat, *Baccharis salicifolia*
narrow-leaf willow, *Salix exigua*
Oregon ash, *Fraxinus latifolia*
groundsel, *Senecio vulgaris*
rabbitsfoot grass, *Polypogon monspeliensis*
smilograss, *Piptatherum miliaceum*
southern cattail, *Typha domingensis*
sow thistle, *Sonchus oleraceus*
tamarisk, *Tamarix ramosissima*
thistle, *Cirsium* sp.
tree tobacco, *Nicotiana glauca*
water speedwell, *Veronica anagallis-aquatica*
western sycamore, *Platanus racemosa*
white hedge nettle, *Stachys albens*
white sweet-clover, *Melilotus alba*
willow-herb, *Epilobium ciliatum*
willow weed, *Polygonum lapathifolium*

Riparian Species – Little Sespe Creek (*identified within channel bed*)

arroyo willow, *Salix lasiolepis*
black cottonwood, *Populus balsamifera trichocarpa*
brickellbush, *Brickellia californica*
California black walnut, *Juglans californica*
California chicory, *Rafinesquia californica*
deerweed, *Lotus scoparius*
durango root, *Datisca glomerata*
everlasting, *Gnaphalium luteo-album*
giant rye, *Leymus condensatus*
mule fat, *Baccharis salicifolia*
snapdragon, *Antirrhinum coulterianum*
sow thistle, *Sonchus oleraceus*
spotted monkey flower, *Mimulus guttatus*
tamarisk, *Tamarix ramosissima*
western sycamore, *Platanus racemosa*
wire lettuce, *Stephanomeria virgata*.

<u>Survey Results</u>

Benthic and Littoral Macroinvertebrates - *Lower Sespe Creek*

Sample dates: 01 Sept 2005; 31 July 2006. Abundance values: abundant = more than 10 specimens per net sample taken; common = present in each net sample, numbers variable but not exceeding 10 per sample; uncommon = fewer than three individuals per net sample, and not present in all samples; rare = one to a few individuals seen within entire survey sample.

Benthic Species

- olive snail, *Physella virgata*, common;
- stone leech, Hirundinida, uncommon;
- Hemiptera: Gerridae, water strider, *Gerris remigis*, adults and nymphs common; minute riffle bug, *Microvelia* sp. common; Notonectidae, water boatman, *Notonecta* sp. rare; toe-biter, *Abedus indentatus*, common; Naucoridae, creeping water bug, *Ambrysus* sp.;
- Ephemeroptera: clear-water mayflies, prob. *Ephemerella* sp., common;
- Trichoptera: Hydropsychidae, caddisfly, gen. indet., small, tubular cases on undersides of rocks in strong flow, common;
- Plecoptera: stoneflies, prob. *Ryacophila* sp., common;
- Coleoptera: Dytiscidae, black dytiscid beetle, *Agabus tristis*, common; dytiscid beetle, prob. *Deronectes* sp., common; Psephenidae, water penny, *Psephenus* sp., larvae common on

undersides of rocks in moderate flow; Hydrophilidae, water scavenger beetles, *Enochrus* sp. indet, common; Dryopidae, long-toed beetle, *Pelonomus* sp., adults uncommon, larvae abundant;
- Diptera: Ceratopogonidae, Psychodidae, Tipulidae, spp. indet; misc. undeterminable Dipteran larvae;
- Odonata: Libellulidae, big red skimmer, *Libellula saturata*, common; widow, *Libellula luctuosa*, rare; Aeshnidae, green darner, *Anax junius*, common; multicolored darner, *Aeshna multicolor*, common; yellow-backed biddie, *Cordulegaster dorsalis*, uncommon; Lestidae, California archilestes, *Archilestes californica*, common; Coenagrionidae, violet dancer, *Argia vivida*, common.

Littoral/Interstitial Zone Species

- Coleoptera: Carabidae, Oregon tiger beetle, *Cicindela oregona*, uncommon; false bombardier beetle, *Chlaenius* sp., common;
- Orthoptera, Acrydiidae, pygmy mole cricket, *Tridactylus minutus*, uncommon.

Comments

Aquatic invertebrate diversity and abundance values within Sespe Creek were considerably higher in summer than in spring, but this was directly attributable to the high flows that persisted throughout the early sample period. Sespe Creek carries heavier flows than any of the other systems sampled, and in 2005 flows never really relaxed to a level that permitted slow-water invertebrate community formation. Diversity encountered in 2006 was relatively high, and included several taxa not found on other tributary creeks or in the main stem of the Santa Clara River. Within the reach, diversity and abundance values were much higher in the portion of the sample zone accessed from Goodenough Road than from within the shoreline below the terminus of Grand Avenue.

Fishes - Lower Sespe Creek (incidental observations)

Fish Species

- partially armored threespine stickleback (*Gasterosteus aculeatus* microcephalus) uncommon
- arroyo chub (*Gila orcutti*) common
- undetermined fingerlings (*Oncorhynchus mykiss*?) common
- Santa Ana sucker (Catostomus santaanae) not seen but known from this area

Amphibians - Lower Sespe Creek

Amphibian Species

- bullfrog (*Rana catesbiana*) common
- California toad (*Bufo boreas halophilus*) abundant/rare
- Pacific chorus frog (*Pseudacris regilla*) abundant/rare
- California chorus frog (*Pseudacris cadaverina*) common/rare

Comments

The deeper, broader channel flows in Sespe Creek permit anadromous fishes to enter the reach, and once supported a major steelhead run, plus many other species historically found in healthy, mid-elevation channels (pond turtle, red-legged frog, foothill yellow-legged frog).

Steelhead still occur in the reach, and southwestern pond turtle persists populationally above the areas of intense human activity, three specimens having been seen during the 2006 surveys, basking on rocks in the reach below the orchards off Goodenough Road. The native ranid frogs, however, no longer appear to occur within the lower extension of the overall drainage, below the Van Tries Ranch property.

Observations in spring, 2005 found Pacific chorus frogs common along the western shoreline, with adults and juveniles this species also very common in fall of that year, along with lesser numbers of California toad, and fewer still of California chorus frog. Breeding was confined primarily to slow-flow pools around boulders at the edge of the channel, but this produced modest numbers of juveniles. Summer surveys in 2006, however, failed to detect specimens of any of these species except two adult *P. cadaverina* along the eastern shoreline near the Van Tries property. Tadpoles of California toad were rare, but occasional, along the shoreline in sheltered mini-coves behind rocks, and tadpoles of both chorus frogs and bullfrog also were seen in moderate numbers where algal blooms and slower shoreline flows formed habitat. Dozens of dead tadpoles of all species were found in the algae, along with similar numbers of dead, decomposing fish (mostly stickleback and arroyo chub). A few specimens of a slightly larger fish (± 5 – 8" long, species undetermined, possibly a sucker) were observed lying dead on the bottom of deeper pools, and a few live individuals were seen which had blotches of raw tissue on the dorsum, and behaved very sluggishly, as if injured or diseased. The cause of the die-off was not immediately evident, but some of the mortality may have been attributable to predatory birds (herons, night herons, egrets). The extreme summer temperatures of late July undoubtedly affected amphibians throughout the lower drainages, where drying effects and heating of the water reached unusual limits, but Sespe Creek is a very large system, comparatively, and the deeper reaches of the channel should have served to balance against rapid changes in water quality, quantity or temperature.

Incidental Wildlife Observations

Lower Sespe Creek

Reptile species observed within the survey zone included southwestern pond turtle, California side-blotched lizard, Great Basin fence lizard, and San Diego gopher snake, the latter a roadkill on Grand Avenue. There is so little natural habitat along the channel banks at and below the access points that only smaller vertebrates can maintain viable populations in the areas of highest human use disturbance.

A comprehensive list of incidental bird species documented during the survey efforts is included in APPENDIX –Survey Area Bird Species Compendium

Little Sespe Creek

The site was chosen as a comparison creek, being the most accessible tributary drainage to the main survey portion of Sespe Creek, but without any evident potential for anthropogenic water quality issues. The segment surveyed lies about 500 feet higher elevation than the Van Tries Ranch crossing, in a narrow, closed canyon with no oil wells or roads within the drainage above or below (the nearest well lies about 0.4 miles distant in a separate drainage). The habitat values were in an early stage of post-flooding recovery, which no doubt reduced the potential diversity of the aquatic species, but the intent was to determine whether or not the near-complete disappearance of amphibians in the Sespe waters was related to issues of water quality.

The small pool adjacent to the road crossing held several *P. regilla* tadpoles, and one or two other tadpoles were found in slow-flow pools above and below the road crossing, but no adult chorus frogs or toads were found. A recently-born (13") two-striped garter snake was found in one of the pools, probably hunting for tadpoles. The only other reptiles seen were western fence lizards. Benthic invertebrates were practically absent, although water striders (*Gerris remigis*) were present on the larger pools and in pooled water on the roadside. No littoral zone insects were found. It may be expected that this steep channel will require several years without scouring flooding to recover a normal small vertebrate and invertebrate fauna.

The number of tadpoles found, and the homogeneity of their size suggested that the cohort represented only one egg set of Pacific chorus frog in this site. The fact that once again tadpoles were found, but no adults mirrors the findings from Sespe Creek, but differences in channel conditions may explain the apparent similarities. The level of flood-induced in-channel substrate disturbance to Little Sespe Creek was nearly complete, and the entire creek ecosystem is in an early recovery stage. Flood events of such magnitude flush most of the refugial areas and clear much of the fauna from the system, so that natural restoration is slow and incremental. If only one or a few adult frogs had been present in spring, then not finding them in summer may be indicative of nothing so much as scarcity, without any underlying mortality.

The presence of dead fishes and tadpoles in Sespe Creek is evidence that something is depressing aquatic vertebrate activity and inducing direct mortality, but no obvious causal agent could be found. The lack of adult or metamorph amphibians could be as a result of die-off, but also could reflect a pattern of deep sheltering to avoid heat, retreat from the open creek channel, or a complete shift to nocturnal activity.

4.2.10 (11) Santa Paula Creek

Survey Area Location

The Santa Paula Creek survey area is located at 34°24.74'N, 119°4.92'W within the Santa Paula USGS Quadrangle.

Survey Zone

The survey area included the creek channel, bed and bank, +/- 100 yds up and downstream of the Steckel Park access drive bridge crossing. A representative photograph of the survey area is presented in Figure 18, *(11) Santa Paula Creek #11 Photographs*.

Site Description

Santa Paula Creek is a wide but steeply confined channel, originating below Topa Mountain and draining a basin that collects from numerous tributaries behind Santa Paula Ridge and Sulphur Mountain. The low hills surrounding the upper end of the main channel are dotted with oil wells and tanks, and there are sulphur and petroleum seeps in the drainage. The creek channel is flecked with small globs of floating oil, and the rocks in the channel are coated with layers of oil residue.

The survey area is within the steep-sided channel below Steckel Park, where public access to the creek is available from the margin of the park road, which crosses the creek on an older bridge. The park sits in an open terrace, and has been highly altered by human uses and landscaping, but once was a western sycamore / coast live oak woodland. Parking lots, roadways and lawn areas have largely converted the understory to non-native ruderal elements and open ground, but specimen shrubs of laurel sumac (*Malosma laurina*), toyon, blue elderberry and poison oak provide some scattered cover.

Channel morphology in the sub-reach is broad, with an open bottom, varying in width from about 100 to 200 feet wide, with large to moderate cobble forming most of the substrate, but some medium-sized to very large boulders are present, mostly along the sides of the overall channel basin. The bottom substrate was graded up and down the channel to form linear lines of flow as it approaches the bridge, probably during or after the 2004/2005 winter flooding, but has since received sufficient flow to obscure most of the grading effects. The width of the flow was between 20 and 30 feet during most of the surveys. There are no silt or light sand terraces, except where finer materials accumulate along the channel banks and around larger boulders, and human use of the west bank has compacted the soils and exposed roots from the trees on the terrace above. Vegetation along the margins of the channel is mostly emergent riparian - willow (*Salix* sp.) scrub, and likely is maintained in an early successional stage by frequent flooding.

Surface flows during invertebrate surveys ranged from 6 - 18” depth along the shoreline, with a few deeper pools behind large rocks and other obstructions. Bottom substrate is moderate – coarse cobble with very little open sand, and with thin but extensive growth of filamentous algae in the shallow flow areas during the summer survey dates. Water play and other day uses from the adjacent park have resulted in numerous small dams and diversions, and a considerable amount of trash along the margins of the channel.

Vegetation

Vegetation was assessed qualitatively within bank and bed of the channel to the extent of the survey zone. The park alterations, roads and oil extraction activity outside the channel have severely compromised the upland habitats, and out-of-channel areas are characterized briefly.

As noted earlier, the emergent riparian scrub in the channel is maintained in a repeating early successional cycle of post-flooding recovery. Most of the marginal fringe of regrowth consists of seedlings and saplings of willows (*Salix lasiolepis, S. exigua*), black cottonwood (*Populus balsamifera trichocarpa*), mule fat, western sycamore, mugwort, white alder, willow-herb, white sweet-clover and narrow-leaved cattail (*Typha angustifolia*).

Upland vegetation on the overhanging bank and inner slopes included coast live oak, sycamore, arroyo willow and black cottonwood with an understory of shade-tolerant chaparral shrubs, including laurel sumac, toyon, elderberry, poison oak, coyote brush (*Baccharis pilularis*) and virgin’s bower (*Clematis ligusticifolia*). Tramping and other human activities has promoted the growth of smilo grass (*Piptatherum miliaceum*) and other ruderals (not inventoried) along the access trails and around parking areas.

Riparian Species (*identified within channel bed*)

arroyo willow, *Salix lasiolepis*
black cottonwood, *Populus balsamifera trichocarpa*
black mustard, *Brassica nigra*
California everlasting, *Gnaphalium californicum*
cardinal monkeyflower, *Mimulus cardinalis*
coast live oak, *Quercus agrifolia*
cocklebur, *Xanthium strumarium*
crabgrass, *Cynodon dactylon*
deerweed, *Lotus scoparius*
English plantain, *Plantago lanceolata*
everlasting, *Gnaphalium luteo-album*
mugwort, *Artemisia douglasiana*
mule fat, *Baccharis salicifolia*
narrow-leaf willow, *Salix exigua*
narrow-leaved cattail, *Typha angustifolia*
pigweed, *Chenopodium album*
poison oak, *Toxicodendron diversilobum*
rabbitsfoot grass, *Polypogon monspeliensis*
sow thistle, *Sonchus oleraceus*
stinging nettle, *Urtica dioica*
tumbleweed, *Amaranthus albus*
verbena, Verbena lasiostachys
virgin's bower, *Clematis ligusticifolia*
western sycamore, *Platanus racemosa*
white alder, *Alnus rhombifolia*
white hedge nettle, *Stachys albens*
white sweet-clover, *Melilotus alba*
willow-herb, *Epilobium ciliatum*

Upland Species (*dominants only*)

arroyo willow, *Salix lasiolepis*
black cottonwood, *Populus balsamifera trichocarpa*
coast live oak, *Quercus agrifolia*
coyote brush, *Baccharis pilularis*
elderberry, *Sambucus mexicana*
laurel sumac, *Malosma laurina*
smilograss, *Piptatherum miliaceum*
toyon, *Heteromeles arbutifolia*
western sycamore, *Platanus racemosa*

Survey Results

Benthic and Littoral Macroinvertebrates

Sample dates: March 17, 2005, 08 Sept 2005; 31 July 2006. Abundance values: abundant = more than 10 specimens per net sample taken; common = present in each net sample, numbers variable but not exceeding 10 per sample; uncommon = fewer than three individuals per net sample, and not present in all samples; rare = one to a few individuals seen within entire survey sample.

Benthic Species

- olive snail, *Physella virgata*, abundant;
- Hemiptera: Gerridae, water strider, *Gerris remigis*, adults and nymphs common; minute riffle bug, *Microvelia* sp. common; Notonectidae, water boatman, *Notonecta* sp. rare; toe-biter, *Abedus indentatus*, common;
- Ephemeroptera: Baetidae, mayflies, abundant; clear-water mayflies, prob. *Ephemerella* sp., uncommon;
- Trichoptera: Hydropsychidae, caddisfly, gen. indet., small, tubular cases on undersides of rocks in strong flow, common;
- Plecoptera: stoneflies, prob. *Ryacophila* sp., common;
- Coleoptera: Dytiscidae, black dytiscid beetle, *Agabus tristis*, common; dytiscid beetles, *Acilius semisulcatus*, uncommon; sp. indet., prob*. Deronectes* sp., uncommon; Psephenidae, water penny, *Psephenus* sp., larvae uncommon on undersides of rocks; Hydrophilidae, water

scavenger beetle, *Tropisternus ellipticus*, rare; Dryopidae, long-toed beetle, *Pelonomus* sp., adults uncommon, larvae abundant;
- Diptera: Tipulidae, spp. indet; misc. undeterminable Dipteran larvae;
- Odonata: Libellulidae, big red skimmer, *Libellula saturata*, common; Aeshnidae, green darner, *Anax junius*, rare; multicolored darner, *Aeshna multicolor*, uncommon; Lestidae, California archilestes

Littoral/Interstitial Zone Species

- Crustacea, pillbug, *Armadillidium vulgare*, common;
- Coleoptera: Carabidae, false bombardier beetle, *Chlaenius* sp., abundant;
- Orthoptera, Acrydiidae, pygmy mole cricket, *Tridactylus minutus*, uncommon.

Comments

Invertebrate sampling sites were within the median flow areas of the channel, above and below the bridge. Taxonomic diversity and abundance values were higher in late summer 2006 than in spring, 2005, no doubt a reflection of the heavier-than-normal flows of the latter year. The species composition was a mixture of species generally tolerant of disturbance and poor water quality (olive snails, the tubular caddisflies and tipulid larvae) and species typically associated with clear-water flows (water pennies, the mayflies). The affect of the oil in the water on the fauna was difficult to assess, but certainly the rocks which are coated in oil globs are not suitable substrates for any of the benthic species, and the oil itself likely is toxic to some species.

Fish

Fish Species

- arroyo chub (*Gila orcutti*) — uncommon
- partially armored threespine stickleback (*Gasterosteus aculeatus* microcephalus) — not seen but known from this area
- Santa Ana sucker (Catostomus santaanae) — not seen but known from this area

Amphibians

Amphibian Species

- bullfrog (*Rana catesbiana*) — uncommon
- California toad (*Bufo boreas halophilus*) — common
- Pacific chorus frog (*Pseudacris regilla*) — abundant
- California chorus frog (*Pseudacris cadaverina*) — rare

Comments

Observations during the spring of 2005 found Pacific chorus frogs abundant along the western shoreline, and tadpoles were present early in side-of-channel pools. Also present, but much less common, were California toad, although tadpoles were common and bullfrog tadpoles. No bullfrog adults were seen or heard. As was the case elsewhere, the mid-summer surveys in 2006 detected only a few adult specimens of any of these species (several *P. regilla* only), but a few tadpoles of *P. cadaverina* and *P. regilla and* were present along the creek above the bridge. Like Sespe Creek, the Santa Paula Creek through the survey zone is relatively deep and comparatively less-vulnerable to rapid drying or heating effects, but amphibian activity was a very low, despite high levels of breeding activity in spring. Although no California red-legged frogs were detected in the survey area, suitable habitat is present.

A historic record of the arroyo toad was documented near the confluence of Santa Paula Creek and the Santa Clara River (Camp 1932).

Incidental Wildlife Observations

Reptile species observed within the survey area included California side-blotched lizard, Great Basin fence lizard and San Diego alligator lizard (*Elgaria multicarinata webbii*).

A comprehensive list of incidental bird species documented during the survey efforts is included in APPENDIX –Survey Area Bird Species Compendium

4.3 TARGET SPECIES HABITAT SUITABILITY ANALYSIS

The results of the focused target species and habitat assessment surveys is presented in Table 5, *Target Amphibian Species Occurrences/Habitat Suitability at Survey Areas, and* discussed in the following section.

4.3.1 Pacific Chorus Frog

The Pacific chorus frog and associated suitable habitat was documented at all eleven (11) survey areas, Figure 2, *Vicinity/Survey Site Location Map*. In addition to the species being documented at all of the survey areas, Pacific chorus frogs are expected to be distributed throughout the study area including the entire reach of the Santa Clara River downstream of the Aliso Creek confluence to the estuary as well as all major tributaries.

4.3.2 California Chorus Frog

The California chorus frog and/or associated suitable habitat were documented at six (6) survey areas, Figure 2, *Vicinity/Survey Site Location Map*. Suitable habitat for this species was documented in the upper reaches of the Santa Clara River (upstream of the confluence of Castaic Creek) as well as most of the major tributaries including but not limited to Santa Paula, Sespe, Piru, Castaic, San Francisquito, Bouquet, Escondido and Aliso Creeks.

4.3.3 California Red-legged Frog

Although the California red-legged frog was not documented at any of the eleven (11) survey areas, known occurrences and/or suitable habitat was documented in San Francisquito Canyon extending upstream from the confluence of Santa Clara River, Aliso Creek, lower Santa Paula, lower Sespe Creek, and Piru Creek (CNDDB 2008, USFS 2002). Historical records of this species extend throughout the Santa Clara River from Santa Paula to Soledad Canyon, Figure 7, *Historical Occurrences of Target Species Within Study Area* (USFS 2002).

4.3.4 Western Spadefoot

Although the western spadefoot were not documented during the surveys, suitable habitat was documented within and or adjacent to the upper reaches of the Santa Clara River floodprone area and major tributaries upstream of the Castaic Creek confluence. The western spadefoot has also been documented in scattered locations within suitable upland habitats located outside of floodprone areas, Figure 7, *Historical Occurrences of Target Species Within Study Area* (CNDDB 2008).

4.3.5 Arroyo Toad

Although no arroyo toads were documented at any of the survey areas, suitable habitat is located throughout the majority of the Santa Clara River floodprone area extending from Aliso Canyon downstream to the estuary. Suitable habitat and/or recent observations of the species have also been documented in but not limited to Santa Paula, Sespe, Piru, Castaic, and Aliso Creeks. Resent observation of the arroyo toad in the Santa Clara River have not been reconfirmed since 2005 following several survey efforts (2003 – confluence of San Francisquito, 2005 – Soledad Canyon).

4.3.6 California Toad

The California toad was documented at ten (10) of the eleven (11) survey areas, Figure 2, *Vicinity/Survey Site Location Map*. Suitable habitat and historic records of this species were documented through study area, Figure 7, *Historical Occurrences of Target Species Within Study Area* (USFS 2002). This species is expected to occur throughout the Santa Clara River floodprone area as well as all major tributaries.

Table 5
Target Amphibian Species Occurrences/Habitat Suitability at Survey Areas

Survey Area	Pacific chorus frog	CA chorus frog	CA red-legged frog	western spade-foot	arroyo toad	CA toad	<u>non-native</u> African clawed-frog	<u>non-native</u> bullfrog
Santa Clara River Main Stem #1	**X-U**			**SH**	**SH**	**SH**	**SH**	
Santa Clara River Main Stem #2	**X-U**			**SH**	**SH**	**X-U**	**X1987**	
Santa Clara River Main Stem #3	**X-AR**	**X-AR**		**SH**	**SH**	**X-AR**	**SH**	
Santa Clara River Main Stem #4	**X-AR**	**X-AR**	**X1976**	**SH**	**X2001** **X2002** **X2003**	**X-AR**	**SH**	
Santa Clara River Main Stem #5	**X-AR**				**SH**	**X-AR**	**SH**	

Survey Area	Pacific chorus frog	CA chorus frog	CA red-legged frog	western spade-foot	arroyo toad	CA toad	non-native African clawed-frog	non-native bullfrog
Santa Clara River Main Stem #6	X-AR				SH	X-AR	X-A	X-C
Santa Clara River Main Stem #7	X-AR				SH	X-CR	X-A	SH
Aliso Creek	X-A	X-C	X1996	SH	SH	X-A	SH	SH
Escondido Creek	X-C	SH		SH		X-AC	SH	SH
Lower Sespe Creek	X-AR	X-CR	SH			X-AR	X-A	X-C
Santa Paula Creek	X-A	X-R	SH		X1932	X-C		X-C

X-A =abundant, X-C=common, X-AC=abundant/common, X-AR=abundant/rare, X-U=uncommon, X-UR=uncommon/rare, X-CR=common/rare, X (year) = historic observation, SH = suitable habitat

4.3.7 Macroinvertebrates

The results of the focused target species and habitat assessment surveys is presented in Table 6, *Macroinvertebrate Taxa Occurrences and Functional Group Designations at Survey Areas,* and discussed in the following section.

Thirty identified genera and 30 families of insects, and 4 non-insect taxa were collected from the Santa Clara River mainstem and its major tributaries (Table 6). In general, the abundance and diversity of insects is higher in the tributaries of the Santa Clara River than in the mainstem. With the exception of Escondido Creek, which was similar in taxonomic composition to the Santa Clara River mainstem, there is a trend toward a diminishing number of aquatic insect families and genera proceeding from the tributaries, Aliso, Sespe, and Santa Paula (mean=17.75 families) to the mainstem of the Santa Clara River (mean=10.43 families). On average, the number of families in the mainstem of the Santa Clara River represents 59% of the families found in the tributaries, Aliso Creek, Sespe Creek and Santa Paula Creek. In general, the insect families and genera found in Aliso Creek, Sespe Creek and Santa Paula Creek are also found in the Santa Clara River mainstem, so the Santa Clara River mainstem insect fauna represents a subset of the taxa found in its tributaries (a depauperate fauna). Exceptions to this pattern were as follows:

Collected only in Aliso Creek: *Limnogonus* (Hemiptera, Gerrridae), *Pelodytes* (Coeloptera, Haliplidae) *Copius notatus* (Coeloptera, Noteridae), Amphipoda (Ph. Arthropoda), *Caloparyphus* and *Euparyphus* (Diptera, Stratiomyidae).

Collected only in Sespe Creek: *Cordulegaster dorsalis* (Odonata, Cordulegastridae), *Libellula luctuosa* (Odonata, Libellulidae), *Ambrysus* (Hemiptera, Naucoridae).

Collected only in Sespe Creek and Santa Paula Creek: *Psephenus* (Coeloptera, Psephenidae)

Collected only in Aliso Creek, Sespe Creek, and Santa Paula Creek and not the Santa Clara mainstem: *Hydropsyche* (Trichoptera, Hydropsychidae).

Collected only in Aliso Creek, Santa Paula Creek, and Escondido Creek and not the Santa Clara mainstem: *Tropisternus ellipticus* (Coeloptera, Hydrophilidae), Ceratopogonidae (Diptera).

Collected only in Santa Clara River mainstem: *Sympetrum illotum* (Odonate, Libellulidae), *Gordius* (Ph. Nematomorpha), *Procambrus clarkii* (Ph. Arthropoda, Decapoda).

In general, the majority of aquatic insects collected from the Santa Clara River and its major tributaries were aquatic beetles (Coleoptera), flies/midges (Diptera), dragonflies and damselflies (Odonata), water striders and toe biters (Hemiptera), and snails (Gastropoda), whereas few mayflies (Ephemeroptera) and no stoneflies (Plecoptera) were collected. Regarding functional feeding group representation, 19% of the invertebrates collected form individual streams were generalized collectors (collector–gatherers and collecter-filterers), whereas 66% were predators. Non-insects comprised only a very small percentage of the invertebrate assemblage, with only snails (Gastropoda) found in all sites. Environmentally sensitive taxa, i.e., those with CAMLnet tolerance scores ≤ 2 were rare in both the Santa Clara River mainstem and its tributaries (7% of invertebrates collected). In contrast, the relative abundance of environmentally tolerant taxa, i.e., those with CAMLnet tolerance scores ≥ 8 were common in both the Santa Clara mainstem and its tributaries (33% of invertebrates collected).

The macroinvertebrate fauna of the Santa Clara River mainstem and its tributaries, Aliso Creek, Sespe Creek, Santa Paula Creek and Escondido Creek, are similar but there are differences in specific taxonomic composition among streams. Urbanization, agriculture, dam construction, stream channelization, point source discharge of sewage effluent, and ground water extraction, negatively affect the biota of the Santa Clara River by reducing the distribution and abundance of many species. These human impacts have dramatically altered flow regimes, channel morphologies and sedimentation rates, decreased riparian cover and degraded water quality. Invertebrates in affected downstream sections are often reduced in abundance or diversity compared to upstream, undisturbed sections of the mainstem or its tributaries. In general, tributaries were less disturbed by human activities, had more intact riparian zones, were fed by natural ground water sources rather than sewage effluent, were located in areas with untapped water tables, and had greater heterogeneity of substrate types and larger particle size (cobbles/boulders vs sand/silt) than did the mainstem of the Santa Clara River. Subsequently, these environmental differences between the Santa Clara River mainstem and its tributaries produced an increase in water quality, habitat heterogeneity and stability, enhanced allocthonous energy supplies, provided consistent annual surface flow and thermal buffering from an intact riparian corridor within Aliso Creek, Sespe Creek, and Santa Paula Creek. Favorable conditions in these sites produce a corresponding increase in macroinvertebrate diversity and abundance. Exceptions to this general trend include the ephemeral tributary Escondido Creek and Santa Clara River Site #3 (CEMEX). Escondido Creek has a limited drainage area and insufficient flow to maintain surface water over most of its course during the dry season. The lack of available surface flow results in a significant reduction in the diversity and abundance of invertebrate taxa within this particular tributary site. In contrast, invertebrate diversity and abundance values within the Santa Clara River Site #3 (CEMEX) were the highest encountered on the main stem of the Santa Clara River, similar to those of Aliso Creek, Sespe Creek and Santa Paula Creek in taxonomic diversity. In part, this pattern may be attributable to the fact that this segment of the river is surrounded by the Angeles National Forest on the west, south and east sides, and by undeveloped (except for historic mining) land on the north side. There is little direct runoff from areas of human activity except from mining roads, and the distance to the nearest upstream recreational site on the reach is approximately three miles, so effluent contributions would be greatly diluted and filtered by the time they reach the sample zone. Surface water was also persistent and produced continuous flow throughout the entire reach the duration of monitoring (2005-2006).

Table 6
Macroinvertebrate Taxa Occurrences and Functional Group Designations at Survey Areas

	FG[1]			Sample Sites[2]								
Taxa		1	2	3	4	5	6	7	8	9	10	11
Ephemeroptera												
Baetidae												
Baetis	cg							A				A
Ephemerellidae												
Ephemerella	cg	UC			R	R			UC		C	UC
Odonata												
(Anisoptera)												
Cordulegastridae												
Cordulegaster dorsalis	p										UC	
Aeshnidae												
Aeshna multicolor	p		R				C	UC	•		C	UC
Anax junius	p			UC			C				C	R
Libellulidae												
Libellula saturata	p	C		C	R	UC	R		C		C	C
Libellula luctuosa	p										R	
Sympetrum illotum	p			UC								
Calopterigidae												
Hetaerina americana				R					R			
(Zygoptera)												
Lestidae												
Archilestes californica	p	R	UC	A					C		C	C
Coenagrionidae												
Argia vivada	p	C	C	A	UC	UC	UC	C	C	A	C	C
Hemiptera												
Veliidae												
Microvelia	p							C			C	C
Gerridae												
Gerris remigis	p	C	R	C	UC	R		UC	C	C	C	C
Limnogonus									R			

	FG[1]	Sample Sites[2]										
Taxa		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Belostomatidae												
Abedus indentatus	p	C	R	C	R			R	C	C	C	C
Corixidae								C				
Naucoridae												
Ambrysus	p										•	
Notonectidae												
Notonecta	p	•	R	UC				R	•		R	R
Gelastocoridae												
Gelastocorus oculatus				C	R	UC		C	C			
Trichoptera												
Hydropsychidae												
Hydropsyche	cf								UC		C	C
Rhyacophilidae												
Rhyacophila	p			R					UC		C	C
Coleoptera												
Haliplidae												
Peltodytes	mh								UC			
Dytiscidae												
Agabus tristis	p	C	R	C					C	C	C	C
Acilius semisulcatus	p											UC
Deronectes	p			C					R	UC	C	UC
Indeterminate					R	R	R	R				
Hydrophilidae												
Berosus	p		UC	UC					C			
Enochrus	cg			UC					C		C	
Tropisternus ellipticus	p								C	UC		R
Indeterminate		C										
Psephenidae												
Psephenus	sc										C	UC
Dryopidae												
Pelonomus				C					A		UC	A
Noteridae												
Colpius notatus									UC			
Diptera												
Tipulidae			•	•		R		UC	•		•	•
Culicidae						UC	C	A		•		
Psychodidae				•					•		•	
Ceratopogonidae	p								•	•	•	
Simulidae				•					•	•		
Chironomidae			•	•	C	UC	UC	A	•	•		
Stratiomyidae												
Caloparyphus	cg								•			
Euparyphus	cg								•			
Indeterminate		•	•	C					R		•	•

Taxa	FG[1]	Sample Sites[2]										
		1	2	3	4	5	6	7	8	9	10	11
Non-insect taxa:												
Ph. Nematomorpha												
Gordius								R				
Ph. Mollusca												
Cl. Gastropoda, *Physella virgata*	sc	R	A	A	UC	UC	UC	C	A	UC	C	A
Ph. Annelida												
Cl. Hirudinea	p			C	C			A	UC		UC	
Ph. Arthropoda												
Sub Ph. Crustacea												
Cl. Malacostraca,												
Super-Order Peracarida, O. Amphipoda	cg								R			
Super-O. Eucarida, O. Decapoda, *Procamburus clarkii*	om					R						
Number of Insect Families		9	11	17	8	9	6	13	23	9	21	18
Number of Insect Genera		8	8	17	8	5	5	8	22	7	20	19
Number of Non-Insect Taxa		1	1	2	2	2	1	3	3	1	2	1

[1]Functional feeding groups: p = predator, cg = collector-gatherer, cf = collector filterer, mh = macrophyte herbivore, ph = piercer herbivore, sc = scraper, sh = shredder, om = omnivore.

[2] Code for sites on the Santa Clara River Mainstem and major tributaries: Site #1 (SCR), Site #2 (SCR), Site #3 (SCR), Site #4 (SCR), Site #5 (SCR), Site #7 (SCR), Site #8 (SCR), Site #8 (Aliso Creek), Site #9 (Escondido Creek), Site #10 (Lower Sespe Creek), Site #11 (Santa Paula Creek),

Codes for abundance values: (A) abundant = more than 10 specimens per net sample taken; (C) common = present in each net sample, numbers variable but not exceeding 10 per sample; (UC) uncommon = fewer than three individuals per net sample, and not present in all samples; (R) rare = one to a few individuals seen within entire survey sample; (•) Dots represent the presence of specimens in samples.

5.0 SUMMARY ANALYSIS

The following section summarized the results of the focused surveys and habitat assessment studies including direct and/or indirect impacts noted at each of the eleven (11) Study Areas within the Santa Clara Watershed.

5.1 BASELINE CONDITIONS

With the exception of isolated populations in major tributaries, two (2) federally listed species historically known to occur within the Santa Clara River appear to have been extirpated from the drainage. Recent observations of the federally endangered arroyo toad near the confluence of San Francisquito Canyon and in Soledad Canyon have not been reconfirmed since 2005. Although suitable habitat is located throughout the majority of the drainage for this species, subsequent surveys are only expected to result in limited observations. Isolated populations persist in upper Castaic, Middle/Upper Piru and Upper Sespe Creeks.

Although historical observations of the California red-legged frog have been documented throughout the Santa Clara River, the only known remnant populations of this species are known from upper San Francisquito Canyon and Agua Blanca Canyon (a tributary to middle Piru Creek).

Several native amphibian species persist in the study area including the Pacific chorus frog, California chorus frog, California toad, and western spadefoot. However introduced predatory amphibian species including the African clawed frog and bullfrog continue to represent a significant stressor to native amphibians during all life stages.

Other significant stressors that are impacting native amphibian species and which likely collectively contributed to the extirpation of the arroyo toad and California red-legged frog from the Santa Clara River floodprone area include, point source discharge effects to water quality, loss of upland habitat, unnatural releases from reservoirs, invasive plants species, mining, and groundwater extraction (can result in reducing duration of pooling needed for the completion of amphibian metamorphosis).

With the exception of Santa Clara River Site #3 (CEMEX), the Santa Clara River mainstem has less taxonomic richness than it major tributaries, Aliso Creek, Sespe Creek, and Santa Paula Creek. The remaining sampled tributary, Escondido Creek, has a relatively depauparate taxa and is similar in taxonomic composition to the Santa Clara River mainstem. In general, the majority of aquatic insects collected from the Santa Clara River and its major tributaries were highly dispersive, tolerant of poor environmental conditions, and consisted of resource and habitat generalists. The taxa are dominated by aquatic beetles (Coleoptera), flies/midges (Diptera), dragonflies and damselflies (Odonata), water striders and true bugs (Hemiptera), and snails (Gastropoda), whereas few mayflies (Ephemeroptera) and no stoneflies (Plecoptera) were collected.

Taxa tolerant to poor environmental conditions are common in both the Santa Clara River mainstem and its tributaries. Thirteen taxa [*Limnogonus* (Hemiptera, Gerrridae), *Pelodytes* (Coeloptera, Haliplidae) *Copius notatus* (Coeloptera, Noteridae), Amphipoda (Ph. Arthropoda), *Caloparyphus* and *Euparyphus* (Diptera, Stratiomyidae), *Cordulegaster dorsalis* (Odonata, Cordulegastridae), *Libellula luctuosa* (Odonata, Libellulidae), *Ambrysus* (Hemiptera, Naucoridae), *Psephenus* (Coeloptera, Psephenidae), *Hydropsyche* (Trichoptera, Hydropsychidae), *Tropisternus ellipticus* (Coeloptera, Hydrophilidae), and Ceratopogonidae (Diptera)] are found in tributaries (Aliso Creek, Escondido Creek, Sespe Creek, and Santa Paula Creek) that are not found in the Santa Clara River mainstem, whereas only 3 taxa [*Sympetrum illotum* (Odonate, Libellulidae), *Gordius* (Ph. Nematomorpha), and *Procambrus clarkii* (Ph. Arthropoda, Decapoda)] are found only in the Santa Clara River mainstem. The majority of tributary taxa not found in the Santa Clara River mainstem are moderately tolerant to environmental perturbation. The absence of these particular taxa and the lower number of insect families found in the Santa Clara River mainstem is likely due to the affects of urbanization, agriculture, dam construction, point source discharge of sewage effluent, ground water extraction, and stream channelization. These stressors have dramatically altered flow regimes, channel morphologies and sedimentation rates, decreased riparian cover and degraded water quality to a point that the environmental conditions are likely to limit the distribution and abundance of moderately tolerant and sensitive macroinvertebrate biota.

5.2 DATA LIMITATIONS

Based on the limited number of sample sites, duration, and time of surveys, some native amphibians are expected to have been underrepresented. However, historical data and the results of the extensive number of focused amphibian surveys conducted in this region as part of environmental compliance for various types of projects, complimented the dataset collected during this study.

Aquatic macroinvertebrate species composition shows a distinct seasonal succession with typical winter and summer invertebrate fauna. Based on the limited number of sample sites and the varied dates of sampling surveys, some macroinvertebrates are expected to have been underrepresented in benthic samples. The semi-quantitative nature of the invertebrate sampling protocol allows a course analysis of general patterns of invertebrate distribution and abundance but precludes the use of more fine-grained analytical tools to characterize biotic condition and to establish thresholds of ecological impairment.

5.3 DIRECT IMPACTS

Direct impacts to native amphibian species within the Study Area include loss of upland habitat to development, road kills, predation by native and introduced predators, collection, and off highway vehicle traffic within the floodprone area.

As stated by Sweetwater:

> *"Arroyo Toads require habitat near water, and due to construction and development activities (such as flood control structures, dams, roads, agriculture, urbanization, and recreational facilities), many arroyo toad populations have been reduced in size or extirpated due to extensive habitat loss from 1920 to 1980 (USFS 1999). Habitat loss coupled with habitat alteration due to the manipulation of water levels in may central and southern California stream and rivers, as well as predation from introduced aquatic species such as the bullfrog, have extirpated arroyo toads from about 75 percent of the previously occupied habitat in California (Jennings and Hayes 1994). The arroyo toad was listed as an endangered species because of these threats and due to the current limited natural occurrences of arroyo toads. The remaining populations are small and highly susceptible to extinction from naturally occurring events (such as extended droughts or fires) (USFWS 1999)."* (Stillwater 2007)

As stated by Stephenson:

> "*Bullfrogs are strongly implicated in the decline of many native amphibians and aquatic reptiles (Schwalbe and Rosen 1988; Jennings and Hayes 1994). First introduced into California in 1896 (Jennings and Hayes 1985), the have progressively spread over much of the state and today occur in most suitable streams and water bodies west of the Sierra Nevada Mountains and southern deserts (Stebbins 1972).*" (Stephenson & Calcarone 1999)

> "*African clawed frogs are currently not as widespread as bullfrogs, but they area a potent predator of native fish and amphibians. Concerns about their consumption of the endangered unarmored threespine stickleback fish have led to eradication efforts on the Santa Clara River in Soledad Canyon (Dick 1988).*

Although trappable, African clawed frogs are difficult to eradicate because they are highly aquatic and resistant to chemical toxins such as rotenone (Dick 1988)" (Stephenson & Calcarone 1999)

5.4 INDIRECT IMPACTS

Indirect impacts to native amphibian species within the Study Area include reduced water quality, unnatural releases from reservoirs/point source discharges and excessive groundwater extraction. These impacts can significantly impact the natural fluvial conditions of the drainage and change the geomorphology to conditions not suitable for breeding by some target amphibian species.

Effluent discharge impacts to water quality and geomorphology are considered one of the most significant indirect impacts to the viability of native amphibian and macroinvertebrate populations. As stated by the California Regional Water Quality Control Board:

"*It is clear that the mainstem of the Santa Clara River has lower quality water than most of its tributaries. For many constituents, concentrations increase from the top to the bottom of the mainstem." …almost all of the Surface Water Ambient Monitoring Program (SWAMP) bioassessment sites in the mainstem exhibited pool quality benthic invertebrate communities (low Index of Biological Integrity (IBI) scores) while tributary sites were generally marginal or good with a few exceptions. However, some of the SWAMP sampling took place after a major storm event and the benthic invertebrate communities may not have had a chance to recover, particularly in the mainstem which carries very large flows during storms*." (RWQCB 2006).

"*The SWAMP sampling found water column toxicity at sites in the mainstem of the river, the northern portion of Piru Creek subwatershed, Bouquet Canyon, and in the estuary. Toxicity identification evaluations found that diazinon was the probable cause of toxicity in Bouquet Canyon while toxicity in the estuary may have been caused by DDT, PCB's, chlorpyrifos, or arsenic. DDT and PCBs would have been used historically in the watershed but they are very persistent chemicals and the estuary will be a site of some deposition after storms so their presence at that site would not be considered unusual. Diazinon and chlorpyrifos are both water-soluble pesticides used for ant/termite control around residential agricultural areas. Both aluminum and arsenic may have anthropogenic sources but they are also natural in origin and are found in the soil*" (RWQCB 2006).

"*Although somewhat variable throughout the watershed, pH levels do not appear to be a problem. Supersaturation of oxygen may be occurring at some locations which may cause respiratory problems in aquatic organisms. Dissolved oxygen results are highly dependent on the time of day sampling occurs so results may be quite variable due to the sampling approach. On the other hand, it is clear that nitrate concentrations in the mainstem (which compared against a USEPA guideline for unimpacted streams of 1.0 mg/l are a problem*" (RWQCB 2006).

5.5 CUMMULATIVE IMPACTS

Historically runoff from the San Gabriel and Castaic Ranges supported riparian and aquatic habitat along the river and its tributaries. The presence of broad sandy washes suggests that flows may have been seasonal along some stretches but close enough to the surface to sustain riparian vegetation. The continuous stands of sycamore and cottonwood riparian forest, willow woodland and riparian scrub provided avenues for riparian and aquatic species to move between the river and its tributaries. Winter rains likely facilitated dispersal of aquatic organisms and allowed species such as arroyo chub, Santa Ana sucker, and Unarmored three-spine stickleback to move among tributaries and the main stem of the river. Historical records indicate an intermittent flow regime in the mainstem of the river, with seasonal surface flows in years of high precipitation, and infrequent but torrential floods (Schwartzberg and Moore 1995, AMEC 2004).

Ground water pumping has drastically altered the hydrology of the Santa Clara River and its tributaries and has likely triggered a substantial reduction in riparian vegetation. There are a number of wells that extract groundwater from the aquifers at rates greater than 100 gallons per minute and several small volume private wells scattered throughout the planning area. The major water purveyors are Los Angeles County Water Works District, Acton Camp, a trailer park, and a few large private wells installed in the southern part of the Acton Valley Groundwater Basin, with 21 private wells in the Soledad Canyon Alluvial Channel (AMEC 2004). Concerns over groundwater supplies arose as early as the 1920s (Schwartzberg and Moore 1995). Groundwater levels have been declining ever since due to an increase in industrial, commercial and residential uses in conjunction with prolonged drought (AMEC 2004). Groundwater supplies are now at record lows, with several wells in the upper watershed at catastrophically low levels.

Water quality on the main stem and several tributaries has been impaired. Mint Canyon and several reaches of the Santa Clara River were listed as impaired under Section 303(d) of the Clean Water Act due to excessive total dissolved solids, sulfate and chloride in 2006 (RWQCB). Total dissolved solids are measured as the amount of material that is dissolved in water and can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions.

6.0 RECOMMENDATIONS

Based on the results of the study and a review of previous inventory/baseline surveys conducted within the Santa Clara River Watershed, the following section summarizes the restoration opportunities and monitoring efforts as shown in Table 6, *Survey Area Restoration Opportunities/Priorities*. The goals of the restoration efforts are to protect and expand existing populations of target species documented in the study area, provide for the survivorship and expansion of amphibians with limited distribution (i.e. arroyo toad, California red-legged frog), to assist in documenting trends of target species and possibly determine a correlation with a chance in water quality, hydrogeomorphology, ground water depletion, etc.

6.1 RESTORATION OPPORTUNITIES/PRIORITIES & BENEFITS

A program for controlling introduced predatory species should be developed and represent a high priority effort. The population control of African clawed frogs and bullfrog would significantly increase the survivorship and recruitment of all target species. Although, the complete eradication of these predatory species from the study area is unlikely, the plan should focus on developing measures that reduce numbers of all life stages and restrict the potential dispersal of these species into currently unoccupied regions. Although this report focuses on a select list of target species, general native wildlife species known from within the survey area would also benefit from a predatory species control program.

A program for controlling introduced plants (*Arundo donax* and *Tamarisk* species) is currently being implemented by the Upper Santa Clara Arundo/Tamarisk Removal Plan (SCARP). The SCARP and Environmental Impact Report (EIR) was prepared for the Ventura County Resource Conservation District. The eradication and control of these invasive plant species would benefit the target species by increasing available surface water, restoring natural fluvial conditions to the extent possible, restoring upland movement routes, and creating potential aestivation/foraging habitat.

As stated by the Santa Margarita/San Luis Rey Watershed Weed Management Area:

> "*Although it has often been stated that Arundo provides no benefit for native wildlife, Arundo has in fact been found to be used by some wildlife. However, Arundo still provides little value for native wildlife in comparison to native vegetation, especially when it forms large, monotypic stands. Wildlife such as woodrats and coyotes, and many bird species have been found using Arundo for cover and nesting (Greaves). Two endangered bird species, Least Bell's vireo and the southwestern willow flycatcher, have been found to use Arundo as a nest host. Least Bell's vireos have been found nesting on Arundo along the Santa Clara River and the San Luis Rey River. On the Santa Clara River from 1994 to 1999 approximately 5% of the vireo nests were recorded on Arundo (Greaves, pers. comm.), and on the San Luis Rey River from 1988 to 2000 there were approximately 0.5% on Arundo (5 out of a total of 906 nests) (Kus, pers. comm.). Although Arundo may provide a nest site or nest concealment, the entire territory of these birds encompasses areas with native vegetation. More data is needed to fully understand the use of Arundo by native wildlife in comparison to the native habitat, and the degree of Arundo usage in proportion to its abundance. Data is also needed on the use of Arundo by arthropods, the main food source for many bird species.*
>
> *While Arundo cannot simply be dismissed as having no use for native wildlife, it clearly does not provide the complexity and diversity of native habitat. Furthermore, it is important not to lose site of the larger picture – the functioning of the entire riparian system. A riparian system that is dominated by Arundo is simply not going to function in the same manner as a native system, either ecologically or hydrologically. Arundo alters large-scale processes such as erosion, sedimentation, flooding, and fire which affect the entire 'life cycle' of the riparian system and all the creatures within it (whether they be plants, birds, fish, mammals, or insects). The natural flood regime and riparian succession after these events is altered by the presence of Arundo. The use of Arundo by some native wildlife indicates that Arundo control efforts should consider both present and future ecological impacts. Such considerations may include carrying out control work when native wildlife are not breeding or are not present. Replanting after Arundo removal may be needed in areas that are not expected to re-establish on their own within a reasonable period of time (such as areas that have a compromised/altered hydrological regime). This may be particularly important in drier riparian areas, 'marginal' riparian habitat, or 'man-made' riparian areas (e.g. irrigation ditches, berms) that may be outside of the zone of*

flooding and probably would not re-establish native vegetation without intervention. While these areas may be considered 'degraded' riparian habitat, they may still be very important to native wildlife and provide an important connection between the main riparian areas and upland habitat.

If we do not proceed with Arundo control then our valuable riparian systems will continue to be degraded by the ever expanding Arundo. These control efforts are very important to the long-term viability of all the species in the riparian systems, but should be carried out in a manner that does not unnecessarily impact the native wildlife, especially endangered species." (Santa Margarita/San Luis Rey Watershed Weed Management Area 2008)

Encourage riparian vegetation restoration in all drainages and upland vegetation within 1 km (0.6 mi) of streams and rivers. These areas may restrict plant or animal movements and compromise water quality by increasing erosion and non-point sources of pollution. If restored, these areas would support aquatic and semi-aquatic species and enhance movement through both aquatic and riparian habitats. Discourage the construction of concrete-banked streams and other channelization projects.

Wherever possible restore the natural historic flow regime or create a regime that provides maximum benefit for native biodiversity. Work with National Marine Fisheries Service, California Department of Fish and Game, Los Angeles County Department of Public Works, Los Angeles County Regional Planning Water Districts, Ventura County Public Works Agency, Ventura County Watershed Protection District, U.S. Army Corps of Engineers, watershed groups and others to investigate the historic flow regimes and develop a surface and groundwater management program to restore and recover properly functioning aquatic/riparian conditions based on parameters developed by NFMS (1996).

Stream reaches listed as impaired under the Clean Water Act make these riparian stretches eligible for the development of intensive management plans called Total Maximum Daily Load (TMDL) plans. TMDLs are implemented by the Regional Water Quality Control Board, which evaluates the cause of water quality deterioration and then enacts an implementation plan to return water quality to targeted values. Other water quality efforts either completed or in progress include development of a chloride TMDL (Total Maximum Daily Load) for the upper reach of the River, a nutrient TMDL, and on-going NPDES permit related monitoring (AMEC 2004).

Conservation measures to minimize the impacts of development on aquatic habitats primarily focus on the use of riparian buffer zones. Regulations exist to limit development along or near streams and rivers (Barton et al. 1985, Allan 1995, Wilson and Dorcas 2003). However, although these buffers are intended to prevent erosion and filter runoff of contaminants (U.S. Environmental Protection Agency), research suggests that current regulations are inadequate to protect populations of semiaquatic reptiles and amphibians. A functional buffer must encompass a sufficient amount of upland habitat to maintain water-quality and habitat characteristics essential to the survival of many aquatic and semiaquatic organisms (Brosofske et al.1997, Wilson and Dorcas 2003). However, maintaining riparian buffers will not suffice for some species, for instance, to preserve salamander populations in headwater streams, land use must be considered at the watershed level (Wilson and Dorcas 2003).

Mitigate the effects of road crossings in riparian zones. Coordinate with the California Department of Transportation, National Marine Fisheries Service, California Department of Fish and Game, Los Angeles County Planning Department, Los Angeles County Department of Public Works, Ventura County Planning Division, and Ventura County Public Works Agency to evaluate existing stream crossings and upgrade culverts, stream crossings, bridges, and roads that impede movement (USFWS 1998).

6.2 MONITORING EFFORTS

Developing a long-term water quality/target species monitoring program throughout the Santa Clara River which focuses sampling points at random survey sites in addition to the confluences of major tributaries, and significant point source discharge locations is critical in detecting potential correlations between water quality and population fitness trends. A recent volunteer citizen monitoring water quality program (Santa Clara River Monitoring Program) was conducted from 2004-2007 by Friends of the Santa Clara River. This recent water quality study represents an ideal opportunity to develop a collaborative monitoring effort which should incorporate amphibian metrics data collection at sample sites. Because amphibians can be directly and indirectly impacted by even slight variations in aquatic and terrestrial habitat conditions, they represent ideal barometers for monitoring indices of biological integrity.

As stated by Bottorff and Burres:

> "*The program consisted of monthly monitoring of the river's mainstem at six sites distributed from Soledad Canyon to just above the Victoria Avenue bridge near the City of Oxnard. Monitoring took place during 22 consecutive months with a completeness rate of over 95% for all parameters measured except for stream discharge (77%) due to high flows or extensive aquatic plant growth blanketing the stream channel. The following parameters were measured in the field: flow, temperature, dissolved oxygen, pH, conductivity, total dissolved solids, and turbidity. Grab samples were taken for dissolved inorganic nutrients that were analyzed by the Schimel Laboratory at the University of California at Santa Barbara. Nutrient analytes included ammonia-nitrogen, nitrate-nitrogen, total dissolved nitrogen, ortho-phosphate, and total dissolved phosphorus*." (Bottorff and Burnes 2007)
>
> "*In general, measurements fell within expected levels with no particular outliers. Highest stream temperatures were recorded at SC02 which is below the Freeman Diversion where flows can be low due to diversions and subsequent solar heating can be high. Dissolved oxygen (DO) had relatively high standard deviation due to the diel fluctuation of that parameter. Most minimum DO values were above 6 mg/L except at the Victoria Avenue Bridge site during very low flow periods when water temperatures were sometimes high. pH varied from 7.8 to 8.9 except for one isolated value; standard deviation values were less than or equal to 0.4. As expected, turbidity varied with storm water runoff. Nutrient concentrations were relatively low, particularly at the upper most site (Soledad Canyon), with the higher values associated with the more urbanized and agricultural areas*." (Bottorff and Burnes 2007)

An additional study conducted by AMEC focused on developing a comprehensive water quality monitoring plan for the Santa Clara River Watershed. However as previously stated, any future long-term water quality monitoring programs should incorporate target amphibian species as a metric in conducting bioassessments within the watershed.

As stated by AMEC, the focused of their study was to:

> "*compile and review existing water quality data, determine data gaps, and develop a Comprehensive Monitoring Plan (CMP) for the Santa Clara River. The goals of this plan are to: 1) develop baseline conditions for the watershed; 2) have a mechanism to measure improvements or degradations in the water quality; and 3) provide sufficient information to assist the PSC in making important management decisions regarding the watershed. To develop the CMP, AMEC gathered existing monitoring data for the Santa Clara River, assembled a comprehensive water quality and flow database, identified data gaps, evaluated the constituents monitored and made recommendations regarding modifications to existing monitoring protocol and procedures necessary to ensure development of a comprehensive water quality monitoring program*." (AMEC 2006)

Due to the use of various drinking water disinfectants, both chlorine and chloramines (chlorides) levels should be monitored as part of any future water quality sampling. The effect chloramines may have on aquatic systems is unknown and only a long term monitoring effort will detect potential correlations with the increase or decrease in native target aquatic species richness.

Additional variables that should be sampled during the water quality monitoring efforts include chlorpyrifos, coliform bacteria, diazinon and general toxicity.

Groundwater levels should also be monitored throughout the watershed to determine to what extent extraction is impacting successful recruitment (successful breeding) of amphibians throughout the floodprone area.

Based on the results of the target species habitat assessments conducted at each of the survey areas, focused surveys for the arroyo toad and California red-legged frog should be conducted to determine presence/absence at select sites, Table 6, *Survey Area Restoration Opportunities/Priorities*. Although the likelihood of detecting these species is low, both are know from the region based on the review of historical data, suitable habitat is present, and prior to conducting focused surveys, absence should not be assumed. Small remnant populations can be difficult to detect during general assessments and all focused survey efforts should be conducted when activity periods for these species is high. Focused surveys for the western spadefoot should also be conducted where suitable upland and/or breeding pools are located.

Public environmental education remains a vital part of protecting our natural resources. Continued support for existing programs that promote water conservation, recycling, water quality protection, and respect for our natural resources (while protecting the publics passive use of open space areas) will represent one of the most important approaches to assuring that native amphibians persist in the Santa Clara Watershed.

Table 7
Survey Area Restoration Opportunities/Priorities

Survey Area	Impacts	Restoration Potential	Priorities	Recommendations
Santa Clara River Main Stem #1	exotic predators urban runoff	African clawed frog, bullfrog control program	exotic species eradication program	develop/implement exotic species control program monitor water quality conduct focused surveys for western spadefoot and arroyo toad
Santa Clara River Main Stem #2	exotic predators recreation uses	African clawed frog, bullfrog control program.	exotic species eradication program	develop/implement exotic species control program monitor water quality Inform public of conservation measures, seasonal closures conduct focused surveys for western spadefoot and arroyo toad
Santa Clara River Main Stem #3	exotic predators, plants recreation uses mining operation	African clawed frog, bullfrog, exotic plant control program	exotic species eradication program	develop/implement exotic species control program monitor water quality Inform public of conservation measures, seasonal closures assess direct/indirect impacts of mining operations – propose operational chances if warranted. conduct focused surveys for western spadefoot and arroyo toad.

Survey Area	Impacts	Restoration Potential	Priorities	Recommendations
Santa Clara River Main Stem #4	exotic predators, plants urban runoff water quality	African clawed frog, bullfrog, exotic plant control program	exotic species eradication program	develop/implement exotic species control program monitor water quality conduct focused surveys for arroyo toad conduct focused surveys for western spadefoot and California red-legged frog
Santa Clara River Main Stem #5	exotic predators, plants residential development	African clawed frog, bullfrog, exotic plant control program	exotic species eradication program	develop/implement exotic species control program monitor water quality
Santa Clara River Main Stem #6	exotic predators	African clawed frog, bullfrog control program	exotic species eradication program	develop/implement exotic species control program monitor water quality
Santa Clara River Main Stem #7	exotic predators, plants residential development	African clawed frog, bullfrog, exotic plant control program	exotic species eradication program	develop/implement exotic species control program monitor water quality
Aliso Creek	exotic predators ground water pumping/Acton Basin	African clawed frog, bullfrog control program	exotic species eradication program	develop/implement exotic species control program monitor water quality monitor groundwater levels and determine impacts to amphibian recruitment - propose operational chances if warranted. conduct focused surveys for western spadefoot and arroyo toad conduct focused surveys for California red-legged frog.

Survey Area	Impacts	Restoration Potential	Priorities	Recommendations
Escondido Creek	exotic predators	African clawed frog, bullfrog control program	exotic species eradication program	develop/implement exotic species control program monitor water quality conduct focused surveys for western spadefoot
Lower Sespe Creek	exotic predators oil extraction water extraction mineral concentrations	African clawed frog, bullfrog control program	exotic species eradication program	develop/implement exotic species control program monitor water quality monitor groundwater levels/water quality and determine impacts to amphibian recruitment - propose operational changes if warranted.
Santa Paula Creek	exotic predators recreation uses	African clawed frog, bullfrog control program	exotic species eradication program	develop/implement exotic species control program monitor water quality Inform public of conservation measures, seasonal closures conduct focused surveys for arroyo toad conduct focused surveys for California red-legged frog

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