



Habitat Assessment and Surveys for the Arroyo Toad (*Bufo californicus*) in Cuyamaca Rancho State Park, and Lucky 5 Ranch in Anza-Borrego Desert State Park, 2003



Final Report

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U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

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U.S. GEOLOGICAL SURVEY
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California State Parks

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ABSTRACT

Observations of the federally endangered arroyo toad (*Bufo californicus*) within Cuyamaca Rancho State Park in 1999 created the need for a park-wide study of this endangered amphibian. At that time it was not known what the current distribution of the arroyo toad was or how much suitable habitat for this amphibian occurred on state park properties in this general area. USGS San Diego Field Station was contracted to address both issues. Surveys were conducted in 2002 and 2003 in Cuyamaca Rancho State Park and in 2003 in the adjacent Lucky 5 Ranch properties in Anza-Borrego Desert State Park. Habitat assessment surveys were conducted during daylight hours, and follow-up presence surveys were conducted after dark from June through September to clarify distribution. We used a habitat quality rating system to classify habitats (i.e., drainage reaches) as high, good, marginal, or poor quality for this endangered species. The presence/absence of physical features, known to be highly correlated to the presence of arroyo toad populations were used to score each drainage reach resulting in an overall habitat quality score. Four individual habitat patches were identified as high or good quality within Cuyamaca Rancho State Park; no suitable habitat was located within the Lucky 5 Ranch properties. Because high and/or good quality habitat was found only in Cuyamaca Rancho State Park, focused surveys for arroyo toads were only conducted there. For each arroyo toad observation we report the specific location (latitude / longitude), environmental parameters, age class, and time of observation. Only two observations were made in 2002, while 43 individual observations were made in 2003. The greater number of observations in 2003 than in 2002 was attributed to the greater amount of rainfall and warmer nighttime temperatures in 2003. In addition, we documented breeding (larvae) and recruitment (recent metamorphs) at two of the four high quality habitat patches. It was also noted that this high-elevation arroyo toad population bred later in the season than the coastal and foothill population in the same region. Introduced species including, hatchery-stock rainbow trout (*Oncorhynchus mykiss* var.), threespine stickleback (*Gasterosteus aculeatus microcephalus*), goldfish (*Carassius auratus*), and wild turkey (*Meleagris gallopavo* var.) were all documented within Cuyamaca Rancho State Park and were found to co-occur with the endangered arroyo toads. The potential negative effects each of these introduced species could have on arroyo toad populations are discussed.

INTRODUCTION

In 1994, the U. S. Fish and Wildlife Service (USFWS) (USFWS 1994) listed the arroyo toad (*Bufo californicus*) as endangered. The arroyo toad is considered to have the most specialized habitat requirements of any amphibian found in California (Jennings and Hayes 1994). The arroyo toad is a terrestrial amphibian that occupies habitats with sandy or other friable soil types in relative close proximity to their aquatic breeding sites. Following adequate seasonal rainfall in late winter and/or early spring (March–May) they migrate from upland habitats down to quiet pools that form along low gradient drainages to breed. In 1999 adult arroyo toads were observed foraging along the Sweetwater River at the southwest border of Cuyamaca Rancho State Park (CRSP). At that time, the extent of suitable habitat and the distribution of the arroyo toad within the park were unknown. In 2002 California State Parks contracted with the U.S. Geological Survey - Biological Resource Discipline (USGS), to

determine the potential for additional populations of the arroyo toad within CRSP and conduct surveys to identify occupied habitats (Ervin et al. 2003). In 2003, further studies were continued in CRSP and studies were begun in Anza-Borrego Desert State Park (ABDSP) in the newly acquired Lucky 5 Ranch (L5R) properties.

For this study, our objectives were to: 1) assess drainages that could potentially contain suitable arroyo toad habitat by examining USGS topographic 7.5 minute maps, 2) a. survey (ground truth) the selected drainages, b. identify the areas of suitable arroyo toad habitat, and c., rate them in terms of habitat quality (high, good, marginal, or poor) in regards to the toads life history requirements (see Methods for definitions of habitat rating terms), 3) conduct nocturnal follow up encounter surveys (visual and aural) for arroyo toads only at sites that qualified as either high quality or good quality in search of all life history stage (i.e., calling males, egg strings, and larva as well as searching upland habitats for foraging juveniles and adults), and 4) record all non-native species observed during both daytime habitat assessment and nocturnal encounter surveys.

STUDY AREA

The areas studied are located in the Peninsular Ranges in San Diego County, California and occur within two adjacent California State Parks. CRSP currently consists of 9,988 hectares (24,681 acres) and has an elevation range extending from 1,055 m (3,465 ft.) to 1,985 m (6,512 ft.). The majority of CRSP is drained by the Sweetwater River system, and to a much lesser extent, by Boulder Creek (San Diego River) and its tributaries on the parks northern end. The creeks and rivers within CRSP range from 1st- to 3rd-order drainages with the Sweetwater River being the largest. Collectively the Sweetwater River system forms a dendric drainage pattern. Major plant communities include coniferous forest, chaparral, grassland, oak woodland, and willow riparian.

The L5R, a recent purchase by California State Parks (2001) as an annexation to the neighboring ABDSP, borders CRSP on its eastern boundary. The L5R acquisition serves as a habitat link between CRSP and ABDSP. The L5R consists of two separate properties and for the purposes for this report we refer to them individually as Lucky 5 Ranch–North (L5R–North) and Lucky 5 Ranch–South (L5R–South). Together, the L5R properties consist of 1,083 hectares (2,675 acres) and have an elevation range extending from 1,415 m (4,642 ft.) to 1,735 m (5,696 ft.). Major plant communities include coniferous forest, chaparral, grassland, oak woodland, and willow riparian.

METHODS

To meet our objectives of clarifying the distribution of arroyo toads with California State Park lands we used a three-step process that we recently developed (Ervin et al. 2003) that consisted of: 1) initial site selection, 2) an on-site daytime habitat assessment survey, and 3) follow-up nighttime surveys. In addition, all potentially suitable arroyo toad habitats were

surveyed during their breeding season under favorable environmental conditions. These surveys followed established USFWS protocols defining favorable conditions to maximize our ability to detect arroyo toads. USGS conducted surveys in CRSP in 2002 and 2003 and in L5R in 2003 only.

Initial site selection

The arroyo toad is a habitat specialist known to breed in rivers, creeks and streams (avoiding breeding in reservoirs, lakes, ponds) and requires slow to quiet pools for spawning (Sweet 1992; Jennings and Hayes 1994; Campbell 1996). Water flow is a function of gradient, thus lower stream gradients contain greater amounts of habitat features that are highly correlated with the potential arroyo toad spawning habitat which occurs at sites with low flow. Consequently, 'low channel gradient' (i.e., $\leq 3\%$) is an essential physical component for the formation of suitable arroyo toad breeding habitat (Sweet 1992; Campbell 1996).

With the use of TOPO! California[®] CD-ROM software, we examined the seamless USGS 7.5 minute series topographic maps of the study areas and evaluated all drainage reaches identified as low gradient ($\leq 3\%$) as potentially containing suitable arroyo toad habitat (Table 1).

To determine the estimated gradient of a stream reach we compared contour lines on USGS topographic maps over the distance of a stream. That is, we calculated the difference in elevation from source (top) to mouth (bottom) of stream reach with the use of contour lines. Then we measured the distance of stream reach channel to determine stream reach length. For any given reach gradient (or slope) was then calculated by dividing length, or run, into the difference in elevation, rise, and multiplying the quotient by 100, to express stream gradient as a percentage. For example;

$$\begin{aligned} \text{Rise } (\Delta \text{ in elevation}) / \text{Run (length of stream reach)} = \\ \text{Stream gradient} \times 100 = \% \text{ Gradient} \end{aligned}$$

Daytime habitat assessment surveys

We conducted daytime habitat assessment surveys (ground truthing) along all identified drainages at least once, regardless of stream gradient, so the assumptions of reaches either containing key habitat features conducive to suitable arroyo toad habitat (gradient of $\leq 3\%$), or lacking the habitat features (gradient of $> 3\%$), could be verified.

The daytime habitat assessment surveys consisted of hiking up stream courses and noting the key physical features known to be associated with suitable arroyo toad habitat such as stream gradient, sandy stream substrate, presence of sandy banks and uplands, and braided channels (Sweet 1993, Griffin and Case 2002). In combination, a low gradient reach ($\leq 3\%$) with a sandy depositional substrate often results in conditions conducive to the formation of required seasonal quiet backwater breeding pools (Sweet 1992; Jennings and Hayes 1994; Campbell et al. 1996). Habitat assessments were based on physical features and channel

morphology, and not on the presence of surface water (seasonal breeding pools). Ultimately the classification system used to rate habitat quality is based on the drainage gradient, as the initial qualifier ($\leq 3\%$ or $> 3\%$), as well as the occurrence/absence of the following key physical features shown to be highly correlated with the presence of arroyo toad populations (Sweet 1992; Griffin and Case 2002):

- Channel substrate type being predominately composed of depositional sand and the presence of sandy banks
- Adjacent flat sandy terraces
- Channel braiding

Any given drainage, or portion there of, with a gradient of $> 3\%$ was automatically rated as poor quality using this habitat quality rating process. Conversely, any given drainage, or portion thereof, with a gradient of $\leq 3\%$ was assigned one of four habitat quality types (high, good, marginal, or poor) based on the number of the three key physical features determined to be present within any one reach. The habitat types listed below used to describe the level of habitat quality (i.e., suitability) are based on various combinations of the key stream channel and upland habitat features.

- High: Any given survey reach with a gradient of $\leq 3\%$ and with all three of the key physical features present (i.e., channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding) (Figure 1).
- Good: Any given survey reach with a gradient of $\leq 3\%$ and with only two of the three key physical features present (i.e., channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding).
- Marginal: Any given survey reach with a gradient of $\leq 3\%$ and with one of the three key physical features present (i.e., channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding).
- Poor: Any given survey reach with a gradient of $> 3\%$, or with a gradient of $\leq 3\%$ and none of the three key physical features present (i.e., channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding).

The definitions of the four habitat quality terms for this report have been simplified from the ones used in the 2002 analysis (Ervin et al. 2003) to allow more practical application in the field and to more accurately reflect the physical features that were observed to occur in

combination in nature. Since the other three physical features are in part dependent upon a relatively low gradient of the drainage ($\leq 3\%$), inclusion of slope as a variable in the definitions was determined to be unnecessary. In the first year of the field work (2002) various ranges of gradient (i.e., $\leq 2\%$, 2-3%, or $> 3\%$) were included as part of the definition of each level of quality (high, good, marginal, or poor). However, for this report, drainage gradient is now used as a limit or threshold determining whether a drainage reach would be considered as potential habitat for the toad, hence requiring either an on-site evaluation, or an exclusion from such consideration. And finally, it is especially important to note that *none* of the results (presence/absence of the key physical feature scores or final habitat quality rating) from the first phase of the study (2002) have changed because of the refinement of habitat quality term definitions. For a comparison of the habitat quality rating systems used in 2002 and 2003 see Appendix 1.

In CRSP in 2002, habitat assessment surveys were conducted in six 2nd-order streams and including Stonewall Creek, Harper Creek, Japacha Creek, Juaquapin Creek, Descanso Creek, and Cold Stream (Figure 2; Table 1). The Sweetwater River, a 3rd-order river, was also surveyed; habitat assessment surveys along this river were divided into three segments, including:

- Lower Sweetwater River – Hulburt Grove up river to Green Valley Campground (Figure 2).
- Middle Sweetwater River – from Green Valley Campground up river to State Park Headquarters (Figure 2).
- Upper Sweetwater River – from the State Park Headquarters up to river headwaters (Figure 2).

On the L5R properties habitat assessment surveys were conducted in 2003. Because the L5R properties are located along a high elevation ridge the drainages consist of only 1st- and 2nd-order headwater streams. In addition, because minor streams (1st- and 2nd-order) are often unnamed in this area, we assigned single letters (A – M) to all reaches surveyed within both north and south L5R properties (Figure 3).

Nocturnal presence surveys

Follow-up arroyo toad-specific nocturnal presence surveys were only conducted in habitats that were rated as either good quality or high quality. Nocturnal presence surveys for arroyo toads were not conducted at sites rated as poor quality or marginal quality because they lack the combinations of key physical features that comprise the habitat required by the arroyo toad. Nocturnal presence surveys entailed walking along drainages in search of any of the various behaviors/life history stages (i.e., calling males, egg strings, larvae, metamorphic individuals, and foraging juveniles and adults in upland habitats) of arroyo toads using multiple cues (direct observation and/or aural detection of calling males). Biologists

experienced and familiar with the life history and ecology of the arroyo toad conducted all nocturnal presence surveys. Such experience included the ability to discern between the eggs and the larvae of the western toad (*Bufo boreas*) and the arroyo toad as well as the identification of the male arroyo toad advertisement call. Headlamps with 45,000-candle power were used to provide the required amount of illumination to maximize detection (USFWS 1999b). Age-class and Global Positioning System coordinates were recorded for each arroyo toad observation. Because the arroyo toad is restricted to breeding in lotic habitats, with a range of hydroperiods (i.e., perennial, semi-permanent, seasonal, ephemeral) (Sweet 1992; USFWS 1999a) surveys were conducted irrespective of the presence of surface water.

During 2002 in CRSP follow-up nocturnal presence surveys were only conducted in reaches identified as high quality arroyo toad habitat because no areas qualified as good quality (Figure 4; Table 1). During 2003 in CRSP focused nocturnal presence surveys for arroyo toads were conducted at the sites rated as high quality for a second year. Environmental conditions were more conducive for the detection of arroyo toads during the 2003 survey season.

Surveys on L5R properties were conducted in 2003 only. Because the L5R properties have only recently been acquired by California State Parks little is known about the aquatic and/or aquatic-associated native or non-native species, such as fish, amphibians, and reptiles that potentially occur on these lands. In an effort to collect baseline data on aquatic species, and create a preliminary species list for the L5R properties nocturnal surveys were conducted for multiple taxa along several drainages, even though they were rated as marginal or poor quality habitat.

During years 2002 and 2003 we found it necessary to follow a modified version of the USFWS arroyo toad survey guidelines (USFWS 1999b) because the weather conditions at these high-elevation sites are often outside the recommended guidelines by USFWS (i.e., time of year surveys should be conducted). Below we identify these discrepancies, but with these modifications we feel conditions were sufficient for the detection of toads. Because of the absence of measurable precipitation and warmer nighttime temperatures, nocturnal presence surveys were delayed until April of 2002 and June of 2003. The USFWS arroyo toad survey guidelines recommends commencing nighttime surveys 60 minutes after sunset on nights with an ambient air temperature of 15⁰ C at sundown in the absence of wind, hard rains, and a full moon (USFWS 1999b). Other modifications made to the USFWS guidelines for our nocturnal presence surveys included commencing surveys at approximately 30 minutes after sunset (to take advantage of the darkness but prior to lower air temperatures) and on nights with an ambient air temperature as low as 14⁰ C at sunset, because of the extended unseasonable cold weather trends both years of the study. No nocturnal presence surveys were conducted within four days of a full moon in 2002 or within three days in 2003.

Exotic fish parasite analysis

On 20 August 2003, live fish were collected for parasite/disease assessment in CRSP from the Sweetwater River immediately above and below the State Route 79 bridge. A total of five hatchery-stock rainbow trout, 21 partially armored threespine stickleback, and six goldfish were collected with seine nets. The fish were placed and transported in plastic coolers containing water from capture site and frozen plastic 'ice blocks' to maintain cool water temperatures. To prevent cross contamination species were not mixed. The following morning the fish were packaged and shipped with frozen plastic ice blocks by overnight courier to the USFWS CA/NV Fish Health Center (CNFHC) and received on 22 August to undergo immediate analysis. For examination methodology, refer to CNFHC summary table (Appendix 2).

RESULTS and DISCUSSION

In this section we provide our findings, elaborate on the significance and practical relevance of our findings, and list additional research opportunities. In addition, we provide several management recommendations. In 2002 this study took place in CRSP only. In 2003 the study continued for a second year in CRSP and one year of work was done in ABDSP on the L5R properties. A complete list of species recorded during the 2002 and 2003 surveys in CRSP and the 2003 surveys on the L5R has been provided (Appendix 3). Additional data for each animal record includes date, location (latitude/longitude), age class, quantity, and in most instances, a brief qualitative field note.

Daytime habitat assessment surveys

In CRSP, 2002 habitat assessment surveys were conducted in six 2nd-order streams (Stonewall Creek, Harper Creek, Japacha Creek, Juaquapin Creek, Descanso Creek, and Cold Stream) and a 3rd-order river (Sweetwater River) (Figure 2; Table 2). A total 34.5 km (21 mi.) of riparian habitat was hiked/surveyed and assessed for arroyo toad habitat quality. Only four sites were as high quality arroyo toad habitat with sandy terraces, all along the Sweetwater River. Although the area of each of these sandy patches has not been calculated, the approximate lengths were estimated (Table 1). The remainder of the Sweetwater River qualified as marginal because the gradient was greater than 3% and characterized by narrow bedrock or rocky channels lacking adjacent banks and terraces composed of friable soils. The four high quality sites are located at the Upper Sweetwater River, the South Boundary Fire Road crossing, the Saddleback Trail crossing, and the Park Boundary at Hulburd Grove. To simplify the naming convention for these patches of high quality arroyo toad habitat along the Sweetwater River we assigned site numbers (Sites 1-4) to the descriptive location names:

- Site 1 (Upper Sweetwater River):
 - Located within the Upper Sweetwater River habitat assessment survey reach.
 - Approx. 3.2 km (1.99 mi.) in length.

- Site 2 (South Boundary Fire Road crossing):
 - Located within the Lower Sweetwater River habitat assessment survey reach.
 - Approx. 0.49 km (0.30 mi.) in length.
- Site 3 (Saddleback Trail crossing):
 - Located within the Lower Sweetwater River habitat assessment survey reach.
 - Approx. 0.48 km (0.30 mi.) in length.
- Site 4 (Park Boundary at Hulburt Grove):
 - Located within the Lower Sweetwater River habitat assessment survey reach.
 - Approx. 0.28 km (0.17 mi.) in length.

No areas surveyed within CRSP qualified as good quality habitat. The other six drainages in CRSP (Stonewall Creek, Harper Creek, Japacha Creek, Juaquapin Creek, Descanso Creek, and Cold Stream) were rated as poor quality arroyo toad habitat (Table 1).

During our 2002 assessment surveys in CRSP we found the majority of the drainages were dry by mid-June. Surface water was found, albeit discontinuous, in Harper Creek, Cold Stream, Japacha Creek, Juaquapin Creek, and Descanso Creek and along the Sweetwater River from the park headquarters south to the park boundary at Hulburt Grove. No surface water was observed in Stonewall Creek or along the Sweetwater River upstream of State Park headquarters.

Only two daytime surveys were conducted within CRSP in 2003. One survey at Site 1 for the purpose of searching for surface water upstream from the park headquarters and the second survey at the State Route 79 bridge over the Sweetwater River to collect live fish for parasite and pathogen analysis. Animals observed during these surveys included Pacific treefrog (*Hyla regilla*) larvae and the introduced partially armored threespine stickleback, hatchery-stock rainbow trout, and goldfish (Figures 7 and 8). Historically no native fish would have occurred above Green Valley Falls.

Habitats rated as poor quality lack key arroyo toad habitat features (sandy banks, benches, and terraces; quiet shallow breeding pools) and presumably offer fewer essential resources (food, shelter) and fewer breeding opportunities. The lack of important resources is a possible reason why arroyo toads are seldom found in habitats lacking these key habitat features (Sweet 1992; Campbell et al. 1996; USFWS 1999a). All six of the 2nd-order drainages assessed (Stonewall Creek, Harper Creek, Japacha Creek, Juaquapin Creek, and Descanso Creeks, and Cold Stream) were rated as poor quality habitat because of the combination of slopes greater than 3% and incised channels. As a consequence of the slope and the narrow channel, sand formed by the natural weathering processes of the parent material (granite, schist) in these valleys does not accumulate, but is flushed out during high flow events and deposited on floor of broader valleys below. For example, the scouring of Stonewall Creek, Harper Creek, and Cold Stream has resulted in sand being deposited on the

floor of upper Green Valley. A characteristic of braided channels are the still to slow-moving side-channel pools that are critical for arroyo toad spawning and the subsequent development and growth of larvae (Sweet 1992; USFWS 1999a). Consequently, the portion of the Sweetwater River through upper Green Valley (upstream of the State Route 79 bridge) is composed of a combination of deep sandy alluvium, gravel, cobble, and rock with the highly braided Sweetwater River channel draining it.

Typical of streams in Mediterranean regions, the extent of inundation and amount of flow vary considerably inter- and intra-annually (Gasith and Resh 1999) and the drainages of CRSP and L5R are no exception. Currently, the dynamic nature of the riparian systems upon which the arroyo toad relies for reproduction, development, and survival is still intact within the Sweetwater River in CRSP. Maintaining this dynamic is a critical aspect of maintaining these arroyo toad populations.

Non-sensitive herpetofauna species observed during the habitat assessment surveys included larval phase of the western toad, arroyo toad, Pacific treefrog, California treefrog (*Hyla cadaverina*), one adult southern alligator lizard (*Elgaria multicarinatus*) and one adult western yellow-bellied racer (*Coluber constrictor*). These aquatic-associated species were all observed along reaches where surface water was present. In 2002 two introduced fish species, the partially armored threespine stickleback and hatchery-stock rainbow trout were restricted to the Sweetwater River. The fishes were limited to the discontinuous wetted portions along the Sweetwater River from the confluence of Cold Stream 5.3 km (~3.3 mi.) southwest to the South Boundary Fire Road crossing. In 2003 these fish were also observed as well as goldfish in the pools of the Sweetwater River under the State Route 79 bridge (Figures 7 and 8; Table 4). On the evening of 15 May 2003, Park Ranger Pat Valenta informed us that he had just been notified that a group of people had released a large number of goldfish into the Sweetwater River at the State Route 79 bridge several days prior.

On the L5R properties 2003 habitat assessment surveys were conducted across a network of unnamed 1st- and 2nd-order headwater streams that can be characterized as hydrologically ‘flashy’ (attaining peak discharge shortly after rainstorm begins and declining shortly after the storm ends) that contained little evidence of natural post-flow pools (i.e., dried algae mats, water-stained rocks). The L5R–North streams drain through CRSP to either the San Diego River system, via the Cuyamaca Lake basin, or the Sweetwater River system in upper Green Valley. While all streams in the L5R–South property drain through CRSP to the Sweetwater River system in upper Green Valley.

Lucky 5 Ranch–North property:

- Streams A – J, totaling approx. 9.6 km (5.97 mi.) in length.

Lucky 5 Ranch–South property:

- Streams K – M, totaling approx. 2.8 km (1.73 mi.) in length.

A total 12.4 km (7.7 mi.) of ephemeral headwater streams were hiked/surveyed and assessed for arroyo toad habitat quality on the L5R properties. All stream channels surveyed qualified as poor quality in terms of arroyo toad habitat (Table 1). Consequently, no arroyo toad-specific follow-up nocturnal presence surveys were conducted. However, because the goals of the surveys on the L5R properties was to assess habitat quality for the arroyo toad as well to start a species list for the newly-acquired state park property, general nocturnal visual encounter searches for aquatic-associated amphibian and reptile species were conducted. The only aquatic species observed within either L5R property were the western toad and Pacific treefrog, both of which were observed on several occasions, at the pond along drainage K. Both of these species are ecological generalists and are common and widespread in the wetlands of southwest California. However, during the spring and summer seasons under wetter conditions additional native amphibian and reptile species may be found within the L5R such as the California treefrog, two-striped garter snake (*Thamnophis hammondi*), and the yellow-bellied racer. It should be noted that the flashy nature of the streams and the limited availability of semi-permanent wetlands limit the opportunity for other aquatic-associated species to invade and become established.

Nocturnal presence surveys

In CRSP in 2002 a total of 14 focused nocturnal presence surveys were conducted at Sites 1-4, the only sites that rated as high quality during the assessment phase (Table 2). Twelve surveys were conducted from May to July and two additional late-season surveys took place in early September. Despite rigorous searching efforts, only two arroyo toad adults (and no egg strings or larvae) were detected during the 14 nocturnal surveys conducted (Table 5). On 20 June 2002 we located an adult arroyo along the Sweetwater River channel at the southwest park boundary at Site 4 (Hulburt Grove) (Table 5). On 10 September CRSP received 1.5 cm (0.6 in.) of rain during a late-summer storm. While this is outside the presumed optimal time of year to detect toads we took advantage of this opportunity and conducted a single late-season survey for arroyo toads. On 11 September 2002 we located an adult arroyo toad approximately 150 m (~ 492 ft.) away from the river channel on a dry paved road in oak woodland (Table 5). At that time this individual served as an elevation record (1182 m.; 4114 ft.) for the Sweetwater River watershed (Campbell et al. 1996; USFWS database – Carlsbad Field Office). The total number of arroyo toad observations was very low during our 2002 surveys despite the amount of habitat identified as high quality for the toad due to the low rainfall overall during this year. For the months of March through September only two adult arroyos toad were observed. No male arroyo toads were heard producing an advertisement call and no arroyo toad egg strings or metamorphs were observed. The limited number of observations is probably related to the unfavorable environmental conditions (cold/dry) in the spring/summer of 2002.

In CRSP in 2003 a total of 13 focused nocturnal presence surveys were conducted at Sites 1-4 (Table 2). Surveys were conducted in June, July, and August, because during the 2002 surveys we found that the arroyo toads in this high-elevation population were active much later in the season compared to the local coastal and foothill populations (Ervin et al. 2003). At Sites 1-4, a total of 43 arroyo toad ‘observations’ (including all life history stages) were

made in 2003 compared to only two observations in 2002. Each individual adult and metamorph, and each pool of tadpoles, were counted as single observations (Figure 5; Table 5).

In regards to phenology of the breeding population of arroyo toads, no male arroyo toads were heard producing an advertisement call and no arroyo toad egg strings were observed this year. Tadpoles were first observed, at two separate locations, during the first 2003 nocturnal presence survey at Site 1 on 9 June and were estimated to be approximately ten day old (Figures 9, 10, 11 and 12). In addition, during the first 2003 nocturnal presence survey at Site 3 tadpoles were first observed at two separate locations, on 17 June and were estimated to be less than two weeks old. These observations suggest that adults probably migrated to breeding pools sometime in May, and courtship, amplexus, and oviposition would have occurred in early June of this year for both Site 1 and Site 3. The first metamorphic individual was observed on 20 August at Site 3 and the second was observed on 21 August at Site 1 (Figures 13 and 14). These data representing ‘late season breeding’ support the idea that arroyo toads breed later at higher elevations compared to population in lower elevations within the same region (San Diego County) (this report; USGS unpub. data).

The increase in the number observations, and the documentation of successful recruitment, of arroyo toad in 2003 are likely the result of two factors: a greater amount of rainfall received in the local mountains in 2003, potentially increasing surface activity of the toads, and the shifting of our nocturnal presence surveys to later in the spring/summer survey season when the adult arroyo toads of this high-elevation population are most active (Ervin et al. 2003).

Adult arroyo toads and larvae were not individually marked so it is probable that some individuals within each survey site were observed more than once on different nights. In addition, three adult arroyo toads were observed at early dusk at the very end of a daytime site visit on 17 June 2003. These data are included in the arroyo toads observed survey results (Table 5) but the survey is considered to be a daytime survey.

In 2003, two of the four sites were surveyed each night in the following combinations (with the 9 June survey as the only exception) (Table 2):

09 June	Site: 1
17 June	Sites: 2, 3
23 June	Sites: 1, 4
16 July	Sites: 2, 4
22 July	Sites: 1, 3
20 Aug.	Sites: 4, 3
21 Aug.	Sites: 1, 2

Non-sensitive herpetofauna species observed during the nocturnal presence surveys included the adult and larval phase of the western toad, arroyo toad, Pacific treefrog, California treefrog, and an adult California kingsnake (*Lampropeltis getula*), and one juvenile and one adult southern Pacific rattlesnake (*Crotalus viridis*). In addition, one two-striped gartersnake,

which is listed by California Department of Fish and Game (CDFG) as a species of special concern, was also observed (Table 3).

Variability in the detection of arroyo toads

Five consecutive years (1998/1999 – 2002/2003) of below normal rainfall resulted in drought conditions in the mountains of our region. In addition, during rain year 2001/2002 we received the lowest rainfall on record (R. Minnich pers. comm.). Consequently, surface activity by native amphibian species in 2002 was limited, resulting in a significant reduction in their detectability. Because of unfavorable environmental conditions (cold/dry) (Campbell et al. 1996), it is unlikely that the arroyo toad bred within the CRSP during the 2002 breeding season (estimated May – August). If they had bred, it is unlikely that calling males, egg strings, larvae, and/or metamorphs, would have gone undetected during both the daytime habitat assessment and the focused nocturnal presence survey phases. This conclusion was confirmed in 2003 when we observed adult toads at all four of the *high quality* sites (1-4) compared to only two sites (1 and 4) in 2002, and a greater total number of adult toads in 2003 than were observed in 2002. Additionally, we found arroyo toad larvae and metamorphs in 2003 at Sites 1 & 3, where none were observed in 2002.

Records of arroyo toads in Cuyamaca Rancho State Park

The first report of arroyo toads within the CRSP appeared in Wright & Wright (1933) as an excerpt of a natural history journal entry dated 5 May 1930. The excerpt is as follows: "Collected at Green Valley Falls Public Campground on Sweetwater River (creek) [sic]. Just above water crossing, found two fresh compliments of *Bufo*. They are more or less in double arrangement. Files or strings with a continuous gelatinous encasing. One [vitelline] envelop present. We both suspect they are *Bufo californicus*, the form we so often sought in vain." Subsequently, this egg string from Green Valley Falls Campground location was included in a more detailed account and became the reference 'type' used to describe the spawn of *Bufo californicus* (Livezey and Wright 1947). This original description is still recognized as the standard reference (Stebbins 1985).

A more recent observation of the arroyo toad occurring within the CRSP is noted in the Recovery Plan for the arroyo southwestern toad (USFWS 1994, pg. 29). However, no details were provided regarding the specific location or the date this observation was made. Arroyo toads were also observed along the Sweetwater River in the spring of 1982, approximately 3/4 mile downstream from Green Valley Falls in the area of South Boundary Fire Road crossing (i.e., Site 2) (M. Mills pers. comm.). On 23 September 1999, Edward L. Ervin (USGS) and John R. Stephenson (USFWS) observed 32 adult arroyo toads along the Sweetwater River channel at the southwest park boundary at Hulburd Grove (i.e., Site 4) (USFWS database – Carlsbad Field Office).

Impacts potentially affecting the arroyo toad

Based on our 2002 and 2003 surveys within CRSP we determined that there are several human related issues that may have negative effects on the arroyo toad populations within the park. These issues are divided into several categories that are discussed below. In regards to the L5R properties, no suitable arroyo toad habitat or arroyo toads were observed during the 2003 surveys.

Human impacts

Many human-related activities have resulted in the loss or degradation of seasonal breeding and upland arroyo toad habitat, including urbanization, agriculture within and adjacent to riparian habitats, dam building and the resulting reservoirs, water diversions, sand and gravel mining, road placement across and within stream terraces, livestock grazing, introduction of non-native species, off-highway vehicle use, and the use of stream channels and terraces for recreational activities (USFWS, 1999a). Direct habitat loss in conjunction with hydrological alterations and the introduction of nonnative predatory aquatic species have caused arroyo toads to disappear from about 75% of the previously occupied habitat within the United States (Jennings and Hayes 1994).

CRSP contains the headwaters of the approximately 80 km (~50 mi.) long Sweetwater River. Approximately half of the 9988 hectares of CRSP are managed as wilderness areas where vehicles, including bicycles, are prohibited. Consequently, the upper watershed of the Sweetwater River is currently free from the majority of causes that have resulted in habitat degradation of arroyo toad riparian and upland habitats across its geographical range. Historically, cattle were grazed in Green Valley along the Sweetwater River from the mid-1800's but were removed soon after 1933 when the original 160 acre homestead was purchased by the State of California for the creation of the new park (J. Burke pers. comm.; Anon 2000).

Currently no public access has been permitted to the newly acquired L5R properties. It should be noted that during our field work in 2003 we did not see any evidence of unauthorized activities (i.e., hiking, mountain biking, horseback riding, OHV traffic, hunting/shooting, or fire wood collecting) taking place within the L5R properties. In addition, no non-indigenous aquatic and/or aquatic-associated species (fish, bullfrogs) were observed, nor are they likely to become established under the current limited available surface water and the lack of perennial aquatic habitats within the L5R properties.

Recreational impacts

Horseback and mountain bike riding, hiking, and fishing, are all currently popular forms of recreation within CRSP. Horseback riding and mountain bike riding both require the participants to remain on an established trail system, whereas hikers and fishermen are

allowed to walk along the riparian corridors where, for the most part, there is no maintained trail. These activities may lead to inadvertent trampling or crushing of burrowed adults, juveniles, and recent metamorphic individuals and if activities are concentrated in the breeding pools, activities by equestrians, mountain bikers, hikers, and fishermen can also have serious adverse effects on eggs and larvae.

Occasionally, horse droppings and hoof prints were observed off established riding trails along the sandy reaches of the Sweetwater River. However, this practice does not seem to be typical of the majority of horseback riders. In any case, it is possible that horses, bicycles, hikers, and fishermen may be disturbing or crushing arroyo toads while traversing the sandy terraces and banks (burrowing habitat) and sandy bottom pools (breeding habitat) (Griffin et al. 1999; Ross et al. 1999; USFWS 1994).

Introduced species impacts

It should be noted that many of the non-indigenous invasive species commonly found in coastal southern California wetlands that are known to have deleterious effects on native amphibian species (i.e., crayfish (*Procambarus clarki*), bullfrogs (*Rana catesbeiana*), mosquitofish (*Gambusia affinis*) and warm water game fish (e.g., largemouth bass (*Micropterus salmoides*) and green sunfish (*Lepomis cyanellus*)), were not detected during the course of our field surveys and are considered not to currently occur within the Sweetwater River system within CRSP. However, established breeding populations of introduced partially armored threespine stickleback, hatchery-stock rainbow trout, and a hybrid variety of the Rio Grande turkey do occur in and/or near the Sweetwater River within CRSP. All three of these introduced species were observed on numerous occasions during our 2002/2003 surveys in CRSP. In addition, goldfish were observed in a restricted portion of the Sweetwater River at the State Route 79 bridge crossing (Figure 6; Tables 3 and 4). The partially armored threespine stickleback, hatchery-stock rainbow trout, and the Rio Grande turkey are all considered to be established within CRSP. None of these species were recorded within the L5R properties in 2003. Individual accounts, which include brief discussions on possible effects on native fauna, are provided for these four introduced species.

Cuyamaca Lake, on the northern border of the park (owned by Helix Water District and operated by Cuyamaca Lake Recreation and Park District), is managed as a recreational fishery and is stocked with warm-water game fish on a regular basis (CDFG 1994–1998, 2003). A community of introduced species, having presumably washed over the spillway, has become established in Boulder Creek that traverses CRSP for a short distance along the northern park border. These species include crayfish, bullfrogs, black bullhead (*Ameiurus melas*), hatchery-stock rainbow trout, and green sunfish (USGS & TAIC 2002). There is no suitable arroyo toad habitat along Boulder Creek within CRSP (USGS & TAIC 2002).

Partially Armored Threespine Stickleback

The partially armored threespine stickleback (stickleback) is a diminutive fish (3-5 cm, total length) native to coastal southern California. The population in CRSP, in the Sweetwater

River, is considered to be an introduced population (Swift et al. 1993) and presumably incidental with the stocking of hatchery fish. In the wild, stickleback specializes in feeding on a rather limited number of organisms (e.g., chironomid larvae, ostracods) (Moyle 2002). Currently, there is no evidence that indicates the diet of this stickleback include amphibian eggs and or larvae.

During 2002 stickleback were observed in pools at Site 1 and at the State Route 79 bridge crossing. During 2003 stickleback were observed at State Route 79 bridge and Site 2. Stickleback were not detected at Site 3 or Site 4 during either 2002 or 2003 surveys. Since the 2002 and 2003 surveys were conducted during below-normal rainfall rain years (July 1 – June 30), and the fifth consecutive year of drought conditions, it is likely that the distribution of stickleback would expand under higher flow conditions upriver to Site 1, as well as down river to and beyond Site 4 at the southern park boundary (Figure 6).

Rainbow Trout

Hatchery-stock rainbow trout (trout) are being introduced into the Sweetwater River within CRSP by the CDFG as part of an ongoing program to create recreational fishing opportunities within the state park. CDFG has described the location of their trout stocking as occurring in the general area of Green Valley Falls Campground and at the State Route 79 highway overpass (CDFG 2002). The most recent trout stocks have taken place in 1994 (n= 870), 1995 (n= 760 & 1510), 1996 (n= 1720), 1997 (n= 1880), 1998 (n= 2370), and 2003 (n= 48) (CDFG 1994-1998, 2003). Subsequent trout stocking was halted with the onset of the current five-year drought that began in rain year 1998-1999.

During 2002 trout were observed at four locations: Site 1, State Route 79 bridge, up river from Site 2 in the vicinity of Green Valley Falls, and Site 2 (Figure 6). During 2003 trout were observed at three locations: the State Route 79 bridge crossing, Site2, and Site 4 (Figure 6). The trout were not detected at Site 3 during either 2002 or 2003 surveys. Since the 2002 and 2003 surveys were conducted during below-normal rainfall rain years (July 1 – June 30), and the fifth consecutive year of drought conditions it is likely that the distribution of trout would expand under higher flow conditions; upriver to recolonize Site 1, as well as down river to beyond Site 4 at the southern park boundary.

Rainbow trout are known to prey on native amphibian larvae and have the ability to completely eliminate them from small pools (Cooper et al. 1996). The placement of hatchery-stock rainbow trout into streams and rivers that were previously fishless has been shown to negatively affect native amphibians at the population level (Backlin et al. 2002; Bradford et al. 1993; Fisher and Shaffer 1996). Tadpoles are particularly vulnerable to predatory fish when they do not possess effective anti-predatory mechanisms (Bradford 1989; Hecnar and Closkey 1997; Sexton and Phillips 1986) this has been demonstrated to be the case with arroyo toad larvae (Sweet 1992). Consequently, successful recruitment could be significantly reduced in the presence of hatchery-stock rainbow trout, thus resulting in artificially lowering the abundance of local populations of arroyo toads and the other aquatic breeding amphibian species (i.e., western toad, Pacific treefrog, California treefrog).

An additional concern is the health of the introduced trout originating from hatcheries. Fish raised in environmentally constant conditions are more susceptible to diseases and may act as a vector of them upon introduction into wild habitats. Infections include, but are not limited to, iridoviruses and the protozoan commonly referred to as white spot disease, or 'Ich' (*Ichthyophthirius multiliis*) (Mao et al. 1999; Scholz 1999). As part of a separate research project investigating parasites in the fish fauna in southern California, 10 introduced fish (five stickleback and five hatchery-stock rainbow trout) were collected by USGS from the Sweetwater River at the State Route 79 bridge on 5 October 2001 and transported live to San Diego State University for analysis. One of the five stickleback collected was found to be infected with a mature trophont (free-living cyst under the epithelium) of the exotic parasite *I. multiliis* and one of the five rainbow trout collected contained *Crepidostomum farionis*, a native fish parasite (Warburton et al. 2002). The presence of white spot disease on wild stickleback is troubling because amphibians and fish are not as immune from one another's pathogens as previously thought. Recent studies have demonstrated that iridoviruses and the protozoan *I. multiliis* can be transmitted between different taxonomic classes [i.e., fish ↔ amphibians] (Mao et al. 1999; Moody and Owens 1994; Gleeson 1999).

A recent study of fish communities in the wild has shown a strong correlation between the occurrence of hatchery-stock rainbow trout and *I. multiliis* infections in native fish species (Warburton et al. 2002). In light of *I. multiliis* outbreaks being a common occurrence in fish hatcheries, hatchery-stock rainbow trout planted in the Sweetwater River in CRSP may not only be infected with *I. multiliis* but may in fact be acting as a vector to the other fish and amphibian species. Although outbreaks of *I. multiliis* infections have been reported in wild fish and amphibian larva in the past, it is currently unknown what the effect of this infection has at the population level (Scholz 1999; Gleeson 1999).

In an effort to investigate the general health of three fish species occurring in CRSP live specimens of hatchery-stock rainbow trout, stickleback, and goldfish were collected on 20 August 2003 from the Sweetwater River immediately above and below the State Route 79 bridge. A total of 21 partially armored threespine stickleback, five hatchery-stock rainbow trout and six goldfish were collected with seine nets.

Below is a summary of the findings by the USFWS California Nevada Fish Health Center who performed the examinations (USFWS – CNFHC 2003):

Report dated: 10/01/2003

Live fish were submitted for fish health examination on August 21, 2003. All fish arrived alive, except for 4 of the sticklebacks, the remainder were moribund and in poor condition. Skin abrasions and lesions were apparent and fish exhibited respiratory distress. The fish were examined for major fish pathogens under the standardized procedures of the National Wild Fish Health Survey (NWFHS).

Virology is negative for all species submitted.

Rainbow trout tested positive for the bacterium causing Bacterial Kidney Disease (*Renibacterium salmoninarum*) and an opportunistic bacterium *Aeromonas hydrophilia*. RBT were negative for the Whirling Disease myxozoan (*Myxobolus cerebralis*); low numbers of external parasites were detected by microscopic examination on the skin and gills. Overall the RBT appeared normal and without significant health problems.

Carp were positive for the bacterium causing Bacterial Kidney Disease (*Renibacterium salmoninarum*) and *Aeromonas hydrophilia*. The skin and gills were moderately parasitized by ciliates including *Chilodonella* and *Ichthyophthirius*, and monogenean trematodes (*Gyrodactylus* spp). Overall the carp were moderately parasitized. Ciliates and monogenetic trematodes do not pose a significant health problem at this level of infection, but can become epizootic at higher numbers.

Sticklebacks were too small to perform all laboratory assays due to the limited quantity of kidney tissue in this size fish. On microscopic examination, these fish were heavily infested with parasites; predominantly with the ciliate *Chilodonella piscicola* and monogenean trematodes (*Gyrodactylus* spp). The numbers of *Chilodonella* on the gill and skin were significant enough to impact overall health, primarily by impairing normal respiratory function and maintenance of ionic balance.

For the full report refer to Appendix 2. It should be noted that common goldfish are closely related to carp (*Cyprinus*) and in the pathology report the Ca/Nv Fish Health Center uses 'Common Goldfish' as the common species name but uses *Cyprinus carpio* for the scientific name. The specimens of goldfish that we captured and submitted to the Ca/Nv Fish Health Center lacked barbells on their mouths indicating that these fish were specifically *Carassius auratus*.

Goldfish

Goldfish were only observed during the 2003 surveys and were restricted to a series of quiet pools in the Sweetwater River at the State Route 79 bridge crossing. Our detection of the goldfish on 15 May 2003 closely corresponds to report of the date of their introduction in early May 2003 (see Daytime habitat assessment surveys section above). Goldfish are one of the most popular fish in the pet industry and are often liberated into the wild environs. As a result populations have become established in many parts of California (Moyle 2002). A recent study (Monello and Wright 2001) has demonstrated that the goldfish can and will consume amphibian eggs and larvae despite the variety of natural defenses a particular amphibian species may use to protect their spawn (i.e., noxiousness, unpalatability, and/or toxicity). Their results also showed that each fish had the ability to ingest large quantities of eggs, despite any chemical defense, in a short amount of time leading to the hypothesis that goldfish have the potential to significantly reduce, if not eliminate, recruitment by consumption of reproductive output of aquatic breeding amphibians. In addition, there is also an indirect effect to the presence goldfish. They can serve as vectors for the transmission of novel parasites and diseases to other fish, and under some circumstances, to amphibian larvae creating a larger reservoir for the parasites and diseases (Warburton et al. 2002). See Rainbow Trout section above for extended discussion.

Wild Turkey

Since the 1930's, translocated wild turkeys have been periodically released into oak woodlands and associated habitats on private ranches and on National Forest lands of San Diego County extending from the foothills to the mountains (CDFG 1995a). As a result of introductions close to CRSP, turkeys have migrated into the park and have become a common sight day or night (this report). Turkeys do not provide a recreational opportunity for hunters within CRSP because hunting is not permitted within California State Parks. In terms of diet, turkeys have been shown to consume a great variety of food types such as hard mast (acorns, seeds from grasses and forbs), soft mast (grasses, sedges, and various forbs), and a variety of invertebrate and vertebrates, including insects, snails, crayfish, salamanders, frogs, tadpoles, and lizards (Hurst 1992; CDFG 1995a). However, it was determined that vegetation comprises the majority of their diet in all four seasons. Additional data on wild turkey food habitats was collected from local turkeys in the Descanso Ranger District of the Cleveland National Forest and CRSP. From May 1999 to October 2000 wild turkey fecal samples were periodically collected and analyzed. Plant material composed the majority of the diet (*Avena*, *Bromus*), however animal matter was not reported (CDFG 2002).

During the 2002 and 2003 arroyo toad surveys in CRSP turkeys were found to co-occur (through direct observation, footprints and/or droppings) with the arroyo toad on open sandy stream benches and terraces along the Sweetwater River in CRSP. The turkeys were documented at Sites 1-3, but not at Site 4. The presence of turkeys in these areas adjacent to arroyo toad breeding habitat may increase vulnerability of toads to predation. Arroyo toads are naturally subject to predation in various stages of their development, including egg masses, tadpoles, juveniles, and adults. It is during the juvenile phase that the arroyo toad would become most vulnerable to predation by turkeys. One of the most distinctive characteristics of the arroyo toad is the tendency for metamorphic individuals to remain on the open sand benches at the margins of the natal pool rather than dispersing. The metamorphs may occupy the sandy benches and bars, if conditions permit, for up to 4 months (from late June well into October) and grow to 30-35 mm (Sweet 1992). Although the toads are more vulnerable to predation by remaining near the natal pool, this may be offset by the opportunity for rapid growth afforded by abundant insect prey and elevated body temperatures (Sweet 1992). It is also possible that predation by turkeys and introduced rainbow trout may be having an additive negative effect on arroyo toad populations at these sites by reducing population numbers.

No evidence of turkeys was found within L5R during the 2003 studies. The lack of turkey observations on L5R may be a result of their true absence because of the dryer conditions and sparse oak woodland habitats as compared to that of the adjacent CRSP or possibly that they are present but their abundance is much lower making detection less likely. There is likely a temporal component to the expansion and contraction of their populations as a direct result of wet and dry seasons and/or years. Consequently, turkeys may possibly occupy the L5R properties during periods of higher rainfall and wetter conditions.

RECOMMENDATIONS

We make the following recommendations to further understand the ecology and life history the arroyo toad population within Cuyamaca Rancho State Park. Additional studies of the following issues would enable California State Parks to develop specific policies (seasonal, spatial) to manage and conserve the federally endangered arroyo toad within Cuyamaca Rancho State Park and make informed management decisions regarding compatible recreational programs and activities.

- Conduct additional nocturnal presence surveys for arroyo toads in areas identified as potential habitat under more favorable environmental conditions to confirm their presence or increase confidence in their non-detection.
- Determine the distribution and estimate population size of arroyo toads within occupied areas.
- Use the environmental data collected to develop a phenologic profile for this high-elevation population.

As a result of our findings we recommend the following actions and guidelines for the protection and conservation of the arroyo toad within Cuyamaca Rancho State Park.

- Relocate established recreation trails (riding, biking, hiking) away from sandy areas identified as high quality arroyo toad habitat along the Sweetwater River, such as the adjacent sandy river channel and terraces located, above (northeast of) the State Route 79 bridge (Site 1), in the vicinity of South Boundary Fire Road crossing (Site 2), Saddleback Trail crossing (Site 3), and at the park boundary at Hulburd Grove (Site 4).
- Restrict public access to areas identified as high quality arroyo toad habitat. (breeding and upland areas). Install unobtrusive information signs informing public of restrictions.
- Study the hatchery-stock rainbow trout /arroyo toad tadpole interaction to assess the risk of predation and level of risk for disease transfer. Modify the seasonal recreational fisheries program if the trout are shown to be preying on arroyo toad tadpoles or carrying diseases the arroyo toad larvae may acquire.
- Study wild turkey predation on arroyo toad metamorphs. If wild turkeys are found to have a detrimental impact on the arroyo toad population in CRSP, park officials may wish to develop effective methods of removing turkeys from Cuyamaca Rancho State Park or develop measures to exclude them from arroyo toad habitat.

- Conduct periodic surveys of the Sweetwater River for introduced species (crayfish, bullfrogs, goldfish) at places easily accessed by park visitors such as Green Valley Falls Campground and the State Route 79 bridge crossing. Initiate efforts to capture and remove the animals before they become established and more widely distributed within CRSP. Install unobtrusive information signs in key locations (i.e., at places easily accessed by park visitors) informing public of restrictions on releasing animals into the park.

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Table 1. Daytime habitat assessment survey results.

Cuyamaca Rancho State Park (Fig. 1)	Overall Quality	Length (km)	% slope	Gradient ≤ 3 %	Sandy Substrate	Sandy Terraces	Channel Braiding
upper Sweetwater River (entire)	Marginal	6.09	1.9	Y	Y	N	N
upper Sweetwater River (sub reach = Site 1) See Fig. 3	High	2.99	1.7	Y	Y	Y	Y
Stonewall Creek	Poor	2.99	5.2	N	N	N	N
Harper Creek	Poor	2.19	3.3	N	N	N	N
middle Sweetwater River	Marginal	3.31	1.2	Y	N	N	N
Cold Stream	Poor	3.74	4.1	N	N	N	N
Japacha Creek	Poor	4.12	5.0	N	N	N	N
Juaquapin Creek	Poor	3.61	5.8	N	N	N	N
lower Sweetwater River (entire)	Marginal	6.42	2.2	Y	Y	N	N
lower Sweetwater River (sub reach = Site 2) See Fig. 3	High	0.49	2.9	Y	Y	Y	Y
lower Sweetwater River (sub reach = Site 3) See Fig. 3	High	0.60	0.5	Y	Y	Y	Y
lower Sweetwater River (sub reach = Site 4) See Fig. 3	High	0.25	2.4	Y	Y	Y	Y
Descanso Creek	Poor	2.95	7.1	N	N	N	N

Lucky 5 Ranch / Anza-Borrego Desert State Park (Fig. 2)

drainage - A	Marginal	0.65	0.5	Y	Y	N	N
drainage - B	Marginal	2.97	2.6	Y	Y	N	N
drainage - C	Poor	1.16	9.0	N	N	N	N
drainage - D	Poor	0.40	0.5	Y	N	N	N
drainage - E	Poor	0.40	4.5	N	N	N	N
drainage - F	Poor	0.65	9.8	N	N	N	N
drainage - G	Poor	0.66	9.5	N	N	N	N
drainage - H	Poor	1.51	5.8	N	N	N	N
drainage - I	Poor	0.63	16.7	N	N	N	N
drainage - J	Poor	0.55	15.4	N	N	N	N
drainage - K	Poor	0.78	8.3	N	N	N	N
drainage - L	Poor	1.25	5.1	N	N	N	N
drainage - M	Poor	0.79	6.1	N	N	N	N

Table 2. Chronology of surveys in Cuyamaca Rancho State Park and Lucky 5 Ranch, in Anza-Borrego Desert State Park (2002 / 2003).

Date	Survey location *	Daytime habitat assessment survey	Nighttime arroyo toad presence survey	Personnel
8/21/2003	Sweetwater River - Site 2		✓	E. Ervin, D. Clark, w/ K. Marsden (Ca SP)
8/21/2003	Sweetwater River - Site 1		✓	E. Ervin, D. Clark, w/ K. Marsden (Ca SP)
8/20/2003	Sweetwater River - Site 3		✓	E. Ervin, D. Clark, w/ K. Marsden (Ca SP)
8/20/2003	Sweetwater River - Site 4		✓	E. Ervin, D. Clark, w/ K. Marsden (Ca SP)
8/20/2003	Sweetwater River - Site 1 (fish coll.)			E. Ervin, D. Clark, w/ K. Marsden (Ca SP)
8/19/2003	Lucky 5 Ranch - So. Property		✓	E. Ervin, D. Clark, L. Pardy
8/19/2003	Lucky 5 Ranch - No. Property		✓	E. Ervin, D. Clark, L. Pardy
7/22/2003	Sweetwater River - Site 3		✓	E. Ervin, M. Mendelson, L. Pardy
7/22/2003	Sweetwater River - Site 1		✓	E. Ervin, M. Mendelson, L. Pardy
7/17/2003	Lucky 5 Ranch - So. Property		✓	E. Ervin, D. Palmer
7/17/2003	Lucky 5 Ranch - No. Property		✓	E. Ervin, D. Palmer
7/16/2003	Sweetwater River - Site 4		✓	E. Ervin, D. Palmer
7/16/2003	Sweetwater River - Site 2		✓	E. Ervin, D. Palmer
6/26/2003	Lucky 5 Ranch - No. Property		✓	E. Ervin, L. Pardy
6/26/2003	Lucky 5 Ranch - So. Property		✓	E. Ervin, L. Pardy
6/23/2003	Sweetwater River - Site 4		✓	E. Ervin, A. Inwood
6/23/2003	Sweetwater River - Site 1		✓	E. Ervin, A. Inwood
6/17/2003	Sweetwater River - Site 3		✓	E. Ervin, D. Stokes
6/17/2003	Sweetwater River - Site 2		✓	E. Ervin, D. Stokes
6/17/2003	Sweetwater River - above Park Headquarters	✓	✓	E. Ervin, D. Stokes
6/9/2003	Sweetwater River - Site 1		✓	E. Ervin, D. Palmer
6/9/2003	Sweetwater River - below Park Headquarters	✓		E. Ervin, D. Palmer
6/9/2003	Lucky 5 Ranch - So. Property	✓		E. Ervin, D. Palmer
6/9/2003	Lucky 5 Ranch - No. Property	✓		E. Ervin, D. Palmer
5/14/2003	Sweetwater River - under SR79 bridge	✓		E. Ervin, D. Palmer
5/14/2003	Lucky 5 Ranch - No Property (surveyed)	✓		E. Ervin, D. Palmer
5/14/2003	Lucky 5 Ranch - So Property (orient./survey)	✓		E. Ervin, D. Palmer w/ J. Dice, P. Jorgensen, L. Hendrickson (Ca SP)
5/14/2003	Lucky 5 Ranch - No Property (orientation)	✓		E. Ervin, D. Palmer w/ J. Dice, P. Jorgensen, L. Hendrickson (Ca SP)

9/12/2002	Sweetwater River - Site 1		✓	E. Ervin, A. Herring
9/3/2002	Sweetwater River - Site 4		✓	E. Ervin, D. Clark
9/3/2002	Sweetwater River - at Green Valley Falls Campground	✓		E. Ervin, D. Clark
9/3/2002	Sweetwater River - above Park Headquarters	✓		E. Ervin, D. Clark
7/18/2002	Sweetwater River - Site 1		✓	E. Ervin,
7/18/2002	Sweetwater River - Site 3		✓	E. Ervin,
7/16/2002	Sweetwater River - Site 1		✓	E. Ervin, D. Clark
7/16/2002	Sweetwater River - Site 3		✓	E. Ervin, D. Clark
7/10/2002	Sweetwater River - Site 2		✓	E. Ervin, D. Clark
7/10/2002	Sweetwater River - Site 1		✓	E. Ervin, D. Clark
6/28/2002	Sweetwater River - Site 1		✓	E. Ervin w/ J. Burke (Ca SP)
6/20/2002	Sweetwater River - Site 4		✓	E. Ervin, A. Hebbert
6/13/2002	Sweetwater River - below Park Headquarters	✓		E. Ervin, A. Hebbert
6/13/2002	Sweetwater River - Site 2		✓	E. Ervin, A. Hebbert
6/13/2002	Sweetwater River - Site 4		✓	E. Ervin, A. Hebbert
5/31/2002	Descanso Creek	✓		E. Ervin, A. Hebbert
5/31/2002	Sweetwater River - Site 2		✓	E. Ervin, A. Hebbert
5/21/2002	Sweetwater River - above Park Headquarters	✓		E. Ervin
5/21/2002	Stonewall Creek	✓		E. Ervin
5/21/2002	Cold Stream	✓		E. Ervin
5/21/2002	Sweetwater River - Site 4		✓	E. Ervin
5/3/2002	Japacha Creek	✓		E. Ervin, M. Mitrovich
4/26/2002	Juaquapin Creek	✓		E. Ervin
4/16/2002	Harper Creek	✓		E. Ervin, C. Brehme
4/9/2002	Sweetwater River - Hulburt Grove to Green Valley Falls	✓		E. Ervin, A. Hebbert
4/4/2002	Sweetwater River - below Park Headquarters	✓		E. Ervin, C. Brehme

*

Site 1: Upper Sweetwater River
Site 2: South Boundary Fire Road crossing
Site 3: Saddleback Trail crossing
Site 4: Park Boundary at Hulburt Grove

Table 3. Observations of species at Cuyamaca Rancho State Park and Lucky 5 Ranch, Anza-Borrego Desert State Park.

SPECIES	Cuyamaca Rancho State Park 2002 – 2003			Cuyamaca Rancho State Park 2002						Lucky 5 Ranch 2003	
	<i>upper Sweetwater River</i>	<i>middle Sweetwater River</i>	<i>lower Sweetwater River</i>	<i>Stonewall Creek</i>	<i>Harper Creek</i>	<i>Cold Stream</i>	<i>Japacha Creek</i>	<i>Juaquapin Creek</i>	<i>Descanso Creek</i>	<i>North Property</i>	<i>South Property</i>
Fish:											
Rainbow Trout ¹ <i>Oncorhynchus mykiss</i>	2002, 2003	2002, 2003	2003								
Partially Armored Threespine Stickleback ² <i>Gasterosteus aculeatus microcephalus</i>	2002	2002, 2003	2002, 2003								
Goldfish ³ <i>Carassius auratus</i>		2003									
Amphibians:											
Western Toad <i>Bufo boreas</i>			2002, 2003								2003
Arroyo Toad ⁴ <i>Bufo californicus</i>	2002, 2003	2003	2002, 2003								
Pacific Treefrog <i>Hyla regilla</i>	2002, 2003	2002, 2003	2002, 2003				2002				2003
California Treefrog <i>Hyla cadaverina</i>		2002	2002, 2003				2002				
Reptiles:											
Southern Alligator Lizard <i>Elgaria multicarinatus</i>		2003									
Two-striped Garter Snake ⁵ <i>Thamnophis hammondi</i>			2002								
California Kingsnake <i>Lampropeltis getula</i>	2002									2003	
Western Yellow-bellied Racer <i>Coluber constrictor</i>		2002									
Southern Pacific Rattlesnake <i>Crotalus viridis</i>	2002										

¹ Introduced hatchery raised stock-trout

² Native fish to southern California, introduced into upper Sweetwater River

³ Introduced non-indigenous species

⁴ Endangered species (U.S. Fish and Wildlife Service)

⁵ Species of special concern (California Department of Fish and Game)

Table 4. Introduced species detected along Sweetwater River and their occurrence within each of the four areas identified as high quality arroyo toad habitat (see Figure 4).

Site	Rainbow Trout	Partially Armored Threespine Stickleback	Wild Turkey	Goldfish *
Site 1: Upper Sweetwater River	✓	✓	✓	
Site 2: South Boundary Fire Road crossing	✓	✓	✓	
Site 3: Saddleback Trail crossing			✓	
Site 4: Park Boundary at Hulburd Grove	✓			

* Goldfish observed at State Route 79 bridge crossing only but not within habitat patches identified as high quality arroyo toad habitat.

Table 5. Observations of arroyo toads within Cuyamaca Rancho State Park (2002 / 2003)

Observation Number	Date	Site name	Location (WGS 84)		Age Class *	Quan.	Air C ⁰	Water C ⁰	Time
			Latitude	Longitude					
1	6/20/2002	Site 4	32.872850	-116.614560	A	1	13	—	9:50 PM
2	9/12/2002	Site 1	32.926830	-116.560090	A	1	10	—	2:19 AM
3	6/9/2003	Site 1	32.924010	-116.559420	L	~ 195	21	19	6:23 PM
4	6/9/2003	Site 1	32.922070	-116.560030	L	~ 150	20	19	7:58 PM
5	6/9/2003	Site 1	32.924750	-116.559240	A	1	8	—	9:15 PM
6	6/9/2003	Site 1	32.924900	-116.559180	A	1	9	—	9:40 PM
7	6/9/2003	Site 1	32.924500	-116.559420	A	1	9	—	9:47 PM
8	6/9/2003	Site 1	32.924500	-116.559130	A	1	6	—	10:31 PM
9	6/9/2003	Site 1	32.924460	-116.559360	A	1	5	12	11:17 PM
10	6/17/2002	Site 1	32.924460	-116.559360	L	27	15	19	6:36 PM
11	6/17/2003	Site 1	32.924310	-116.559530	A	1	15	18	8:26 PM
12	6/17/2003	Site 1	32.924410	-116.559420	A	1	15	—	8:34 PM
13	6/17/2003	Site 1	32.924550	-116.559360	A	1	15	—	8:37 PM
14	6/17/2003	Site 2	32.896890	-116.594760	A	1	15	16	9:10 PM
15	6/17/2003	Site 3	32.883333	-116.600500	A	1	11	—	11:37 PM
16	6/17/2003	Site 3	32.883450	-116.600567	A	1	11	—	11:42 PM
17	6/17/2003	Site 3	32.883433	-116.600550	L	3	11	15	11:52 PM
18	6/17/2003	Site 3	32.883467	-116.600567	A	1	11	—	11:57 PM
19	6/18/2003	Site 3	32.883467	-116.600583	A	1	11	—	12:01 AM
20	6/18/2003	Site 3	32.885533	-116.599867	L	2	9	15	12:24 AM
21	6/23/2003	Site 1	32.924050	-116.559530	A	1	13	—	9:27 PM
22	6/23/2003	Site 1	32.923920	-116.559480	A	1	12	—	9:36 PM
23	6/23/2003	Site 1	32.921960	-116.560850	A	1	10	—	9:58 PM
24	7/16/2003	Site 2	32.896840	-116.595070	A	1	20.5	—	9:12 PM
25	7/17/2003	Site 4	32.873350	-116.615110	A	1	25	—	12:19 AM
26	7/22/2003	Site 1	32.933670	-116.552500	A	1	19	—	8:54 PM
27	7/22/2003	Site 1	32.924080	-116.559520	A	1	14.5	14.5	10:56 PM
28	7/22/2003	Site 1	32.924110	-116.559500	A	1	14.5	14.5	11:06 PM
29	7/22/2003	Site 1	32.924990	-116.560080	A	1	14.5	—	11:31 PM
30	7/23/2003	Site 3	32.884850	-116.599420	A	1	13	—	1:16 AM
31	8/20/2003	Site 4	32.872270	-116.614020	A	2	20	—	10:01 PM
32	8/20/2003	Site 3	32.883440	-116.600540	M	1	15	—	11:58 PM
33	8/21/2003	Site 1	32.924290	-116.559320	A	3	17	—	8:38 PM
34	8/21/2003	Site 1	32.924010	-116.559390	A	1	16	19	8:57 PM
35	8/21/2003	Site 1	32.923780	-116.559420	A	4	16	—	9:04 PM
36	8/21/2003	Site 1	32.922100	-116.559950	M	1	15	—	9:37 PM

* Age class codes:

A - adult

L - larvae

M - metamorph

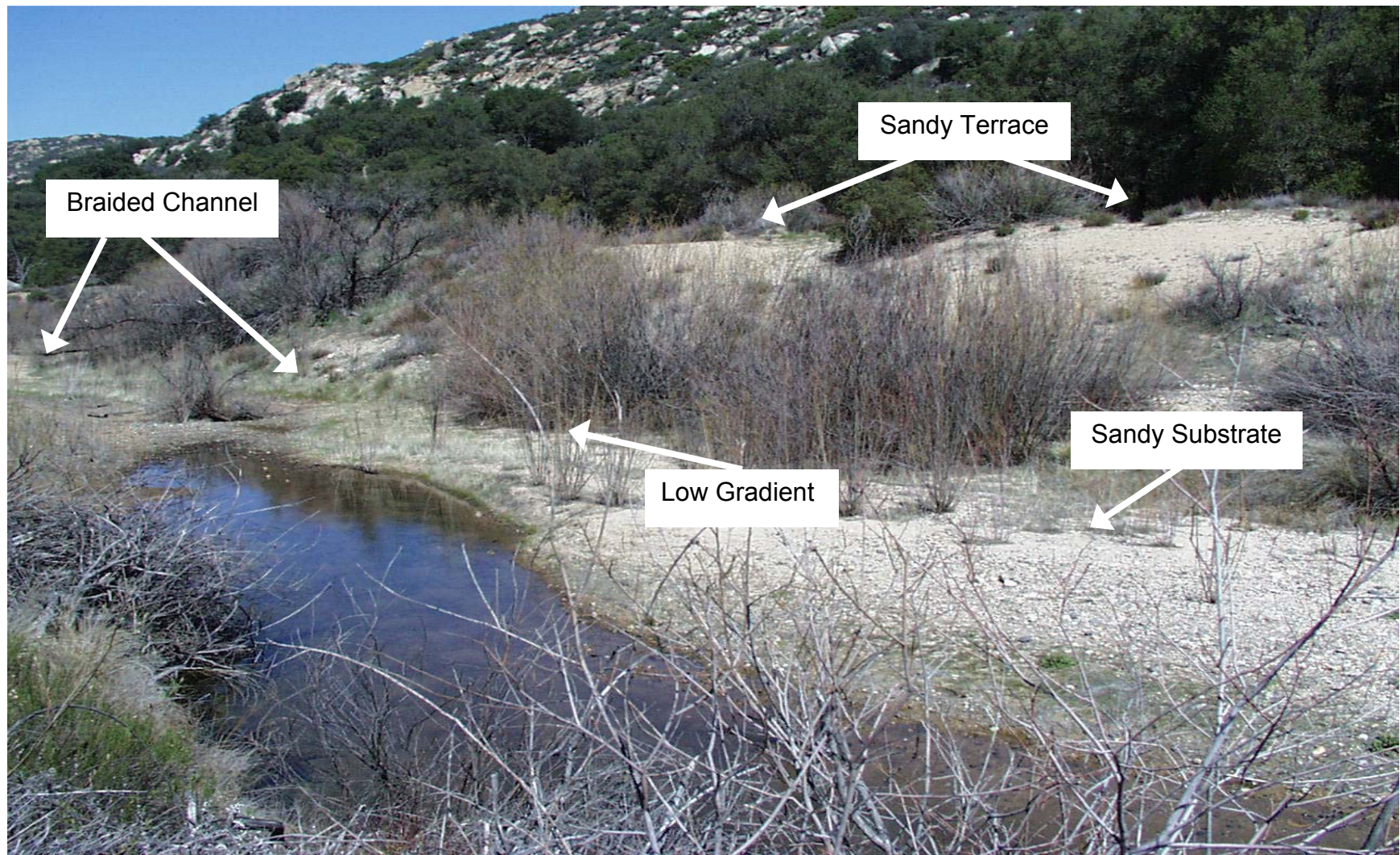


Figure 1. Site 4 (Park Boundary at Hulburd Grove) along the Sweetwater River in Cuyamaca Rancho State Park rated as high quality arroyo toad habitat. This diagram shows the four key physical features of arroyo toad habitat which include, low drainage gradient, predominately sandy substrate, adjacent sandy terraces, and braided channels.

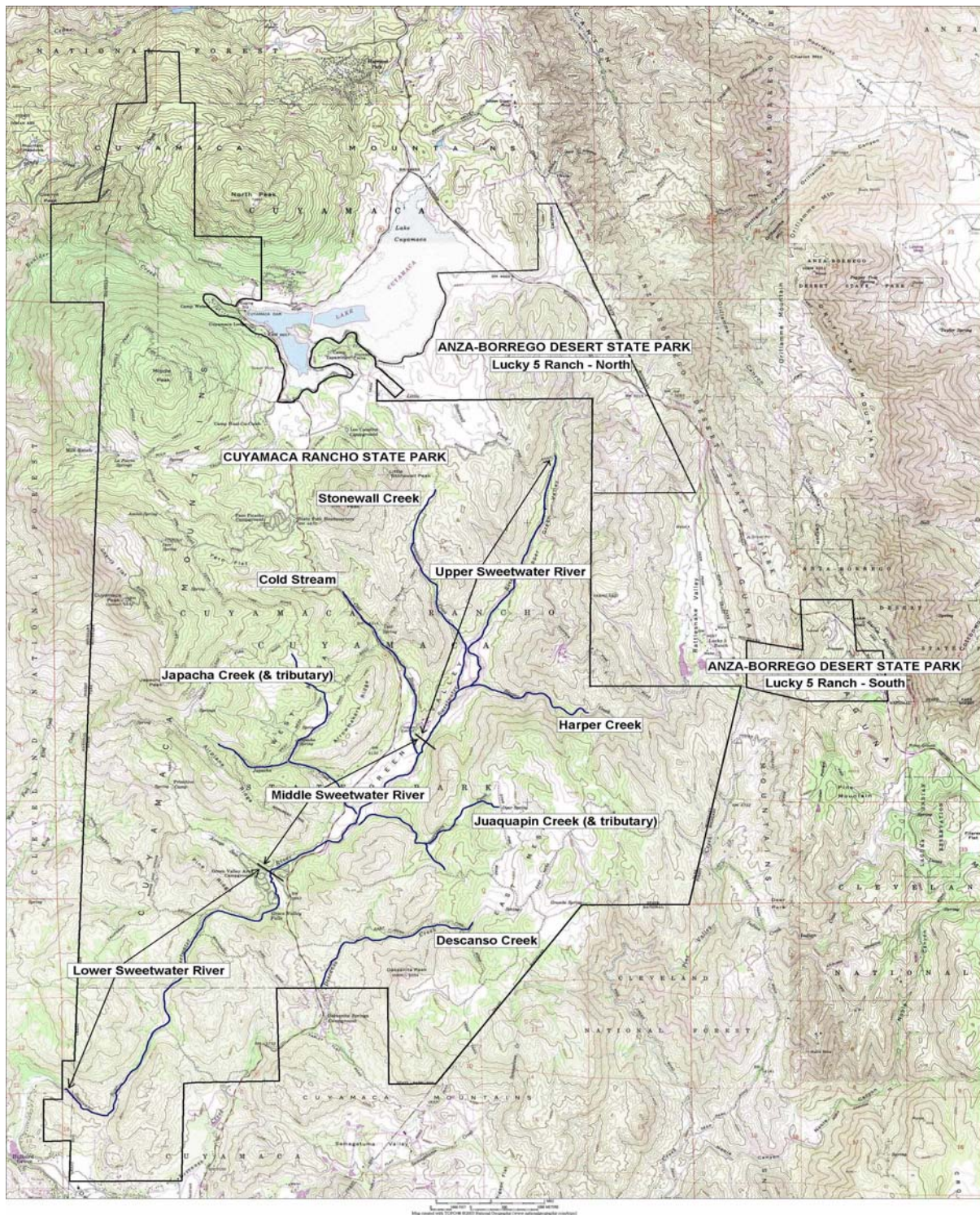


Figure 2. Drainages in Cuyamaca Rancho State Park surveyed for arroyo toad habitat suitability. Approximate boundaries of Cuyamaca Rancho State Park and the Lucky 5 Ranch, Anza-Borrego Desert State Park are shown with black lines.

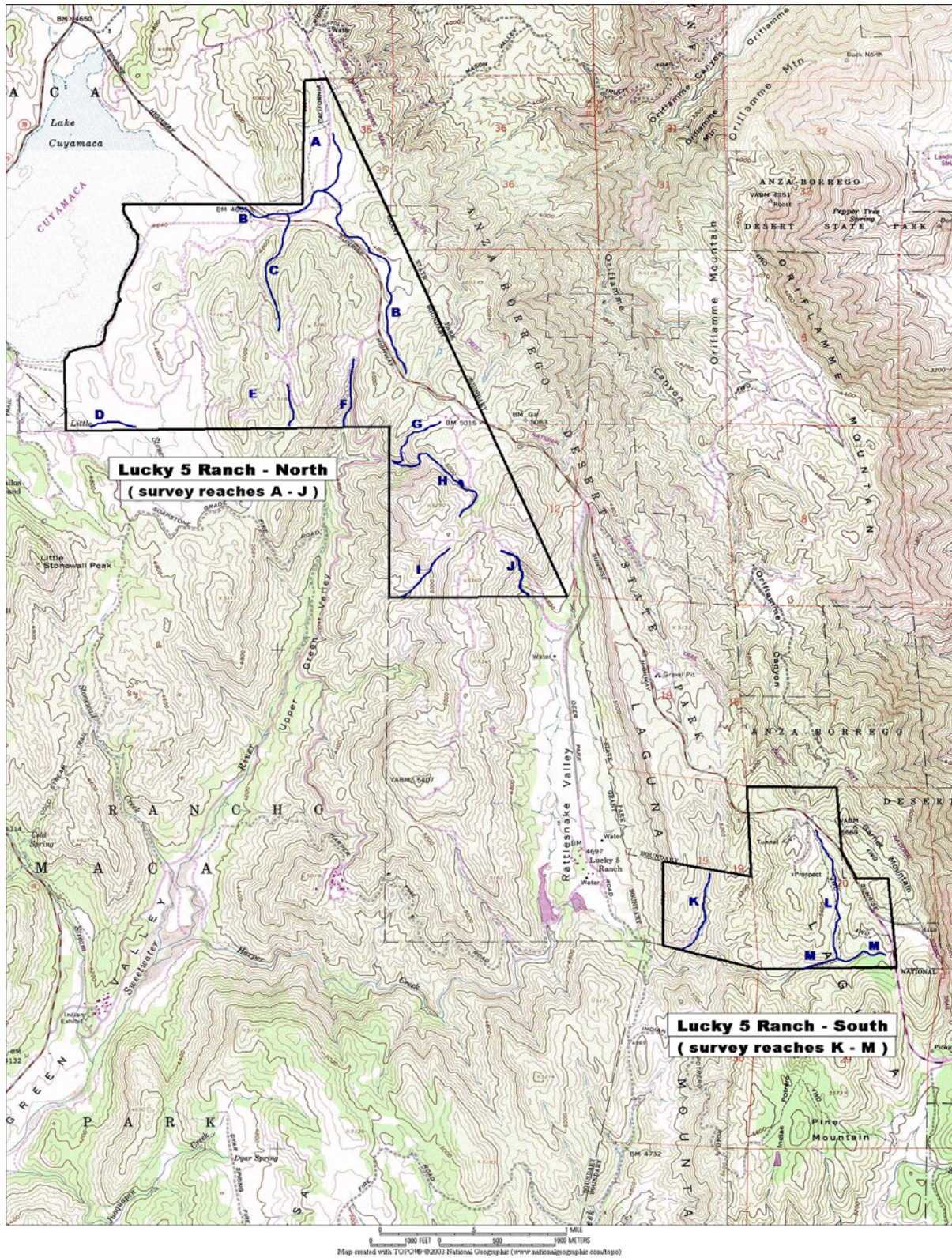


Figure 3. Drainages in Lucky 5 Ranch, Anza-Borrego Desert State Park surveyed for arroyo toad habitat suitability

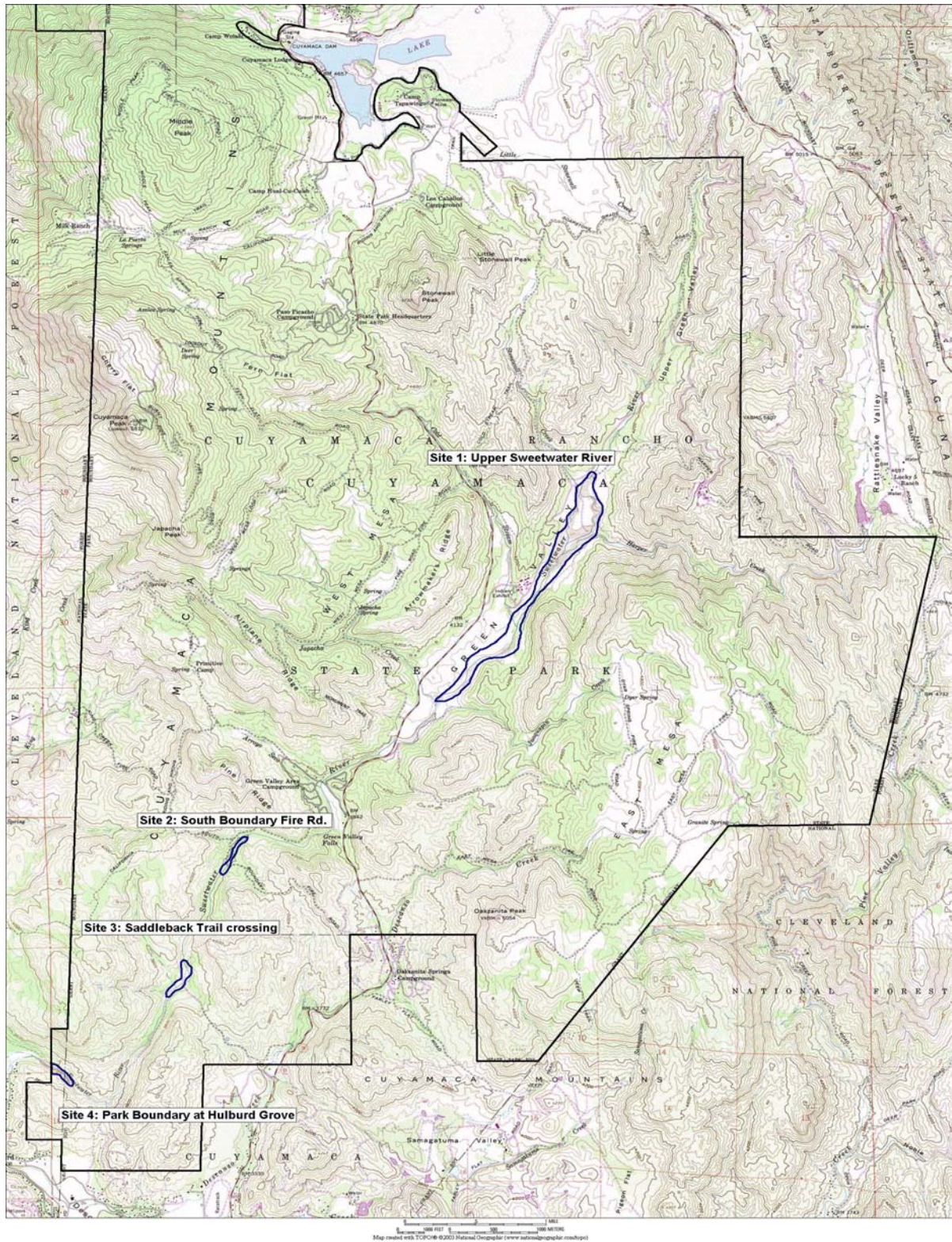


Figure 4. Location, name, and relative size of the four habitat patches identified as high quality arroyo toad habitat along the Sweetwater River within Cuyamaca Rancho State Park in 2002 (areas indicated by blue polygons).

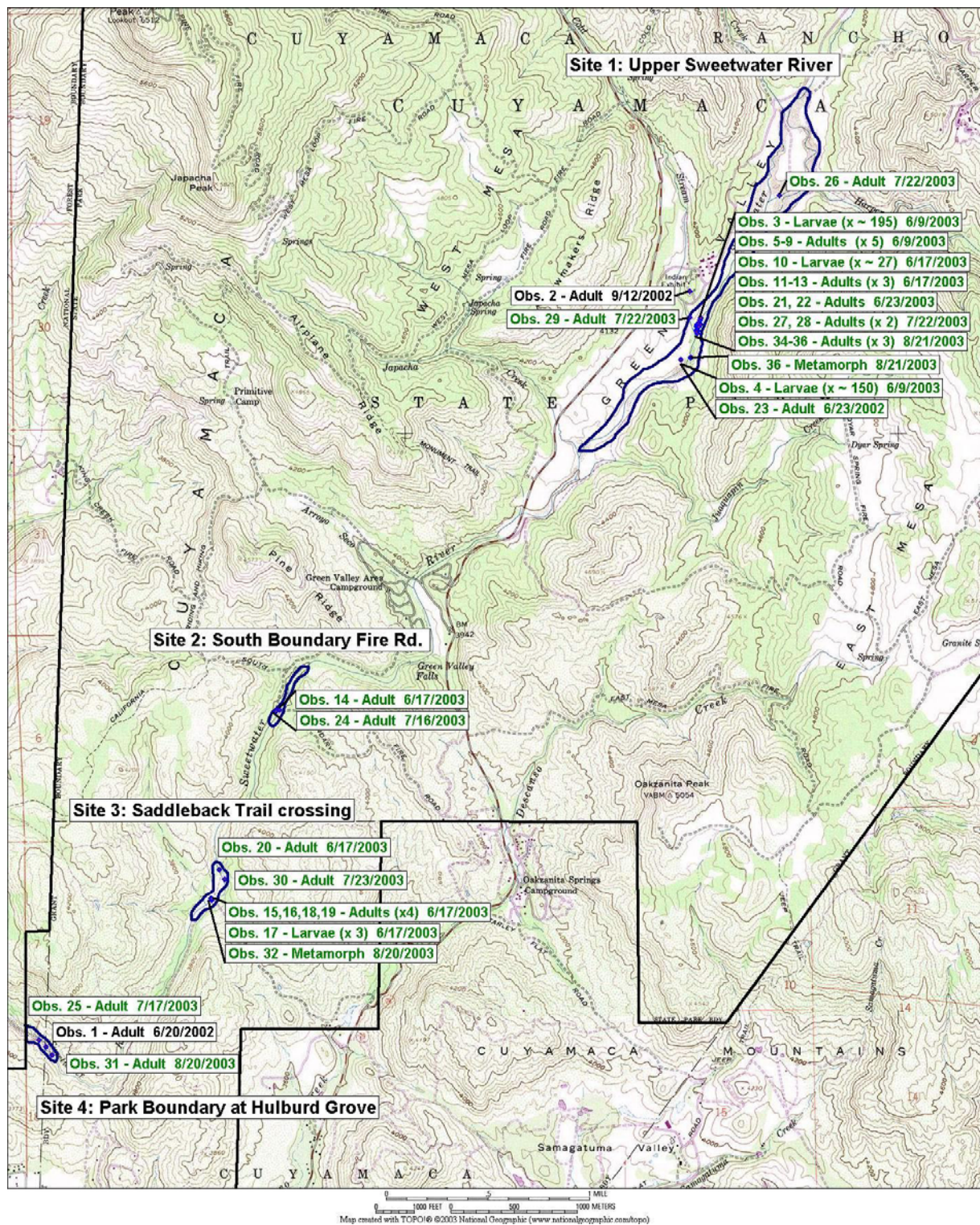


Figure 5. Location, life history stage, and date for all arroyo toad observations made in 2002 and 2003. Observations made in 2002 are presented with black letters, 2003 with green. Additional information can be found in Table 5 and cross referenced by observation numbers.

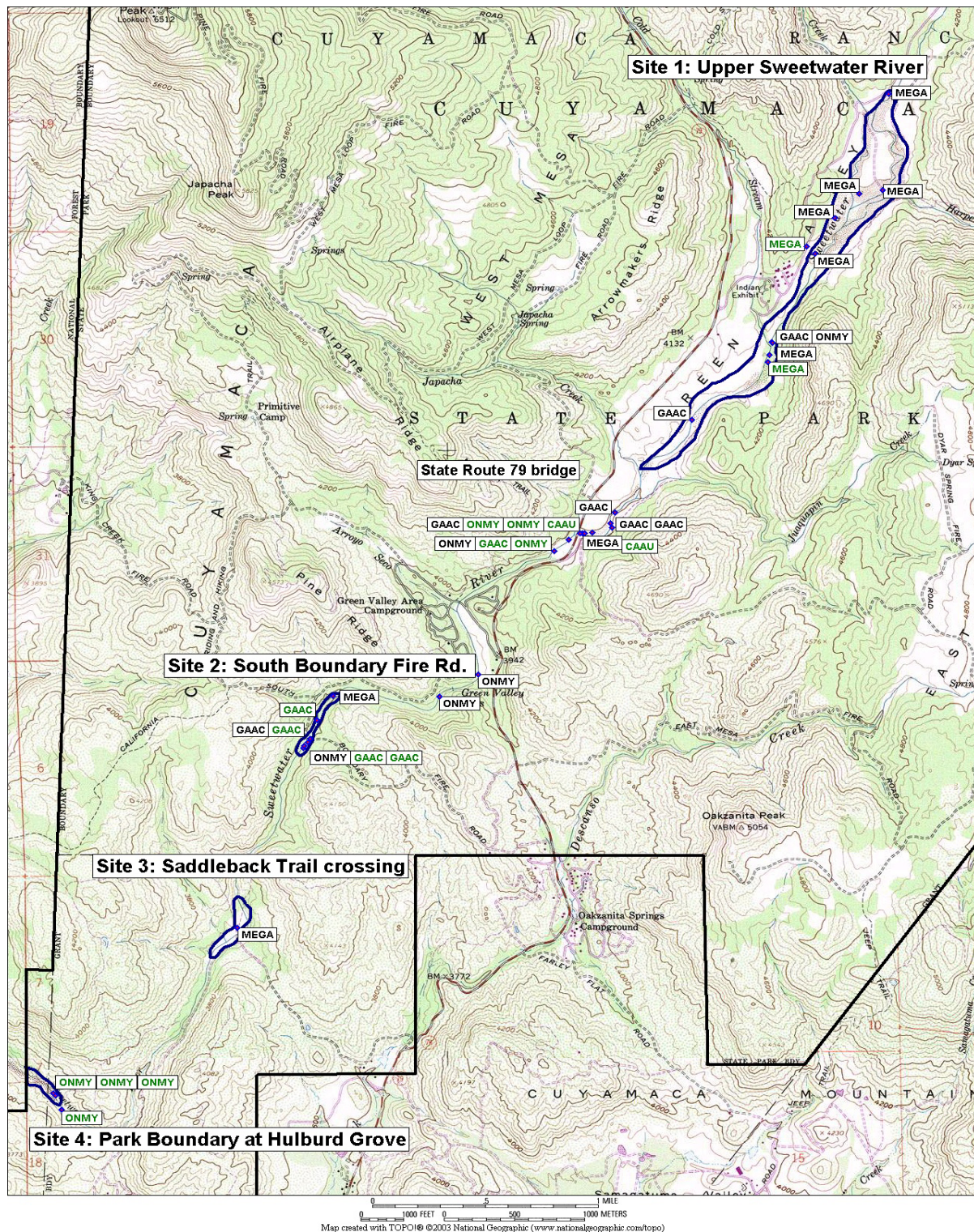


Figure 6. Non-indigenous species detected during the 2002 and 2003 surveys. Observations made in 2002 are presented with black letters, 2003 with green. Species codes: ONMY = rainbow trout, GAAC = partially armored threespine stickleback, CAU = goldfish, MEGA = wild turkey.



Figure 7. An adult rainbow trout in Sweetwater River under the State Route 79 bridge in Cuyamaca Rancho State Park.



Figure 8. Goldfish in Sweetwater River under the State Route 79 bridge in Cuyamaca Rancho State Park.



Figure 9. Pool in Sweetwater River (Site 1) in Cuyamaca Rancho State Park containing arroyo toad larvae on 9 June 2003.



Figure 10. Adult male arroyo toad in Sweetwater River (Site 1) in Cuyamaca Rancho State Park on 22 July 2003.



Figure 11. Arroyo toad larvae in Sweetwater River (Site 1) in Cuyamaca Rancho State Park on 9 June 2003.



Figure 12. Arroyo toad larvae in Sweetwater River (Site 1) in Cuyamaca Rancho State Park on 9 June 2003.



Figure 13. Recent arroyo toad metamorph observed along Sweetwater River (Site 1) in Cuyamaca Rancho State Park on 21 August 2003.



Figure 14. Recent arroyo toad metamorph observed along Sweetwater River (Site 3) in Cuyamaca Rancho State Park on 20 August 2003.

Appendix 1. A comparison of term definitions describing arroyo toad habitat qualities used in 2002 and 2003.

Terms used in 2002.

High: Portion of drainage of low gradient ($\leq 2\%$), with predominantly sandy substrate and banks, adjacent terraces with friable soils, and often having a watercourse of braided channels.

Good: Portion of drainage of relatively low gradient (2-3%) and having only one of the following characteristics; predominantly sandy substrate and banks, adjacent terraces with friable soils, and a watercourse of braided channels.

Marginal: Portion of drainage of relatively low gradient (2-3%) and lacking all three of the following characteristics; predominantly sandy substrate and banks, adjacent terraces with friable soils, and a watercourse of braided channels.

Poor: Portion of drainage with a gradient of $> 3\%$, and lacking all three of the following characteristics; predominantly sandy substrate and banks, adjacent terraces with friable soils, and a watercourse of braided channels.

Terms used in 2003.

High: Any given survey reach with a gradient of $\leq 3\%$ and with *all three* of the physical features present (channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding).

Good: Any given survey reach with a gradient of $\leq 3\%$ and with only *two* of the three physical features present (channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding).

Marginal: Any given survey reach with a gradient of $\leq 3\%$ and with *one* of the three physical features present (channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding).

Poor: Any given survey reach with a gradient of $> 3\%$, or with a gradient of $\leq 3\%$ and *none* of the three physical features present (channel substrate type being predominately composed of depositional sand and the presence of sandy banks, adjacent flat sandy terraces, channel braiding).

Appendix 2. Results of the fish examinations collected from Cuyamaca Rancho State Park.

SAMPLE SUMMARY TABLE: Sweetwater River, Cuyamaca Rancho State Park San Diego, CA

USFWS California Nevada Fish Health Center

Report Date 10/01/2003

Summary

Live fish were submitted for fish health examination on August 21, 2003. All fish arrived alive, except for 4 of the sticklebacks, the remainder were moribund and in poor condition. Skin abrasions and lesions were apparent and fish exhibited respiratory distress. The fish were examined for major fish pathogens under the standardized procedures of the National Wild Fish Health Survey (NWFHS).

Virology is negative for all species submitted.

Rainbow trout tested positive for the bacterium causing Bacterial Kidney Disease (*Renibacterium salmoninarum*) and an opportunistic bacterium *Aeromonas hydrophilia*. RBT were negative for the Whirling Disease myxozoan (*Myxobolus cerebralis*); low numbers of external parasites were detected by microscopic examination on the skin and gills. Overall the RBT appeared normal and without significant health problems.

Carp were positive for the bacterium causing Bacterial Kidney Disease (*Renibacterium salmoninarum*) and *Aeromonas hydrophilia*. The skin and gills were moderately parasitized by ciliates including *Chilodonella* and *Ichthyophthirius*, and monogenean trematodes (*Gyrodactylus* spp). Overall the carp were moderately parasitized. Ciliates and monogenetic trematodes do not pose a significant health problem at this level of infection, but can become epizootic at higher numbers.

Sticklebacks were too small to perform all laboratory assays due to the limited quantity of kidney tissue in this size fish. On microscopic examination, these fish were heavily infested with parasites; predominantly with the ciliate *Chilodonella piscicola* and monogenean trematodes (*Gyrodactylus* spp). The numbers of *Chilodonella* on the gill and skin were significant enough to impact overall health, primarily by impairing normal respiratory function and maintenance of ionic balance.

Species Submitted

Number of Fish Collected

Rainbow trout (<i>Oncorhynchus mykiss</i> var.)	5
Common Goldfish (<i>Cyprinus carpio</i>)	6
Unarmored Three-spined Stickleback (<i>Gasterosteus aculeatus microcephalus</i>)	21

General Methodology

VIROLOGY: Incidence of infection for major fish viruses in 5-fish pools of kidney and spleen tissue (K/S) tissue. Viruses include Infectious Hematopoietic Necrosis Virus (IHNV); Infectious Pancreatic Necrosis Virus (IPNV); Viral Hemorrhagic Septicemia Virus (VHSV); *Oncorhynchus* Masuo Virus (OMV) and Cutthroat Trout Virus (CTV). Tissue homogenates are inoculated on species-specific cell lines (EPC, CHSE, and FHM), incubated at 15°C for 21 days. Cell cultures are observed for viral cytopathic effects (CPE).

BACTERIOLOGY: Incidence of bacterial infection, *Renibacterium salmoninarum* (Rs-ELISA) by Enzyme Linked Immunosorbent Assay in individual kidney (KD) samples; confirmation by Quantitative Polymerase Chain Reaction (Rs-QPCR). Cultured systemic bacteria from individual kidney samples inoculated onto Brain Heart Infusion Agar (BHIA) and presumptive bacteria are further tested by appropriate biochemical tests.

PARASITOLOGY: Incidence of external parasites (Para-External) by microscopic examination of gill and skin tissues. Internal reportable parasite *Myxobolus cerebralis* (Para-Mc-TPD) by Pepsin-Trypsin Digest of cranial elements and microscopic examination for characteristic myxosporean spores.

	No. SAMPLES (POOL SIZE)	No. POS/ TOTAL	(Percent Positive)	Total FISH Sampled	Comments
VIROLOGY:					
Tissue Culture on EPC, CHSE, and FHM cell lines (IHN, IPNV, VHSV, OMV, CTV)					
RBT – K/S	1 (5-p)	0/1	(0)	5	
Carp – K/S	2 (3-p)	0/2	(0)	6	
Stickleback –K/S	7 (3-p)	0/7	(0)	21	
BACTERIOLOGY:					
Rs-ELISA* (<i>Renibacterium salmoninarum</i> . Assay detects a specific bacterial P57 protein)					
RBT – KD	5 (1-p)	5/5	(100)	5	
Carp – KD	3 (1-p)	3/3	(100)	3	Only larger fish tested
Stickleback –KD	0			0	Inadequate tissue
*Highest Optical Density (OD) value at 405nm = 0.512 indicating that these fish have moderate levels of Rs antigen present. Threshold for the assay is 2 STD above the Negative Control Tissue (NCT) or 0.098 OD.					
Rs-QPCR** (<i>Renibacterium salmoninarum</i> - Assay detects specific bacterial DNA)					
RBT – KD	3 (1-p)	2/3	(67)	3	<i>R. salmoninarum</i>
Carp – KD	3 (1-p)	2/3	(67)	3	<i>R. salmoninarum</i>
** Corroborative testing by Quantitative Polymerase Chain Reaction detected Rs DNA in both the RBT and Carp species.					
Culturable Bacteria					
RBT – KD	5 (1-p)	0/5	(0)	5	
Carp – KD	5 (1-p)	1/5	(20)	5	<i>Aeromonas hydrophila</i>
Stickleback –KD	12(1-p)	1/12	(8)	12	<i>Aeromonas hydrophila</i>
Presumptive identification of <i>Aeromonas hydrophila</i> . No obligate fish pathogens (<i>Yersinia ruckeri</i> or <i>Aeromonas salmonicida</i>) were detected.					
PARASITOLOGY:					
Para-External					<u>Genus / Severity of Infection</u>
RBT – SK/GILL	5 (1-p)	2/5	(40)	5	<i>Gyrodactylus</i> - low
Carp – SK/GILL	6 (1-p)	5/6	(83)	6	<i>Chilodonella</i> – moderate <i>Ichthyophthirius</i> - moderate <i>Gyrodactylus</i> – low
Stickleback –SK/GILL	12(1-p)	12/12	(100)	12	<i>Chilodonella</i> – severe <i>Gyrodactylus</i> – moderate
Para-Mc-TPD – <i>Myxobolus cerebralis</i>					
RBT – Heads	1 (5-p)	0/5	(0)	5	

Appendix 3: List of species recorded during the 2002 and 2003 surveys in Cuyamaca Rancho State Park and Lucky 5 Ranch, Anza-Borrego Desert State Park.

Date	Location	Species ¹	Age Class ²	Quan.	Coordinates (WGS 84)		Notes
					Latitude	Longitude	
4/4/2002	Sweetwater River, upriver from SR-79 bridge	HYRE	A	~ 50	32.911017	116.573100	~50 calling males
4/4/2002	Sweetwater River, upriver from SR-79 bridge	MEGA	A		32.911017	116.573100	4 adults
4/4/2002	Sweetwater River, upriver from SR-79 bridge	HYRE	A	~ 5	32.911683	116.571700	~ 5 calling males
4/4/2002	Sweetwater River, upriver from SR-79 bridge	GAAC	J, A	500 +	32.911683	116.571700	Common above and below this point
4/9/2002	Sweetwater River, downriver from Green Valley Falls Campground	BUBO	L	1000 - 1500	32.874180	116.616480	3 tightly clustered schools of BUBO larva (~1000-1500 tads)
4/9/2002	Sweetwater River, downriver from Green Valley Falls Campground	HYCA	A	7	32.874180	116.616480	
4/9/2002	Sweetwater River, downriver from Green Valley Falls Campground	HYRE	A	1	32.874180	116.616480	One adult
4/9/2002	Sweetwater River, downriver from Green Valley Falls Campground	ONMY	A / J	2/1	32.896300	116.595110	Two trout ~10" TL. One sm. fry.
4/9/2002	Sweetwater River, downriver from Green Valley Falls Campground	ONMY	A	1	32.899800	116.584760	
4/16/2002	Sweetwater River, Saddleback Trail crossing - SITE 3	MEGA	A	(tracks)	32.883970	116.600200	Tracks of adults observed on sandy terraces
4/16/2002	Sweetwater River, South Boundary Fire Road crossing - SITE 2	MEGA	A	(tracks)	32.899850	116.592850	Tracks of adults observed on sandy terraces.
4/16/2002	Sweetwater River, Saddleback Trail crossing - SITE 3	HYRE	A	~ 5	32.883590	116.600260	Males chorusing.
4/16/2002	Sweetwater River, between park headquarters & confluence of Harpers Creek - Site 1	MEGA	A	(tracks)	32.934500	116.550960	Observed tracks on sandy terrace
4/16/2002	Sweetwater River, South Boundary Fire Road crossing - SITE 2	HYRE	A	~ 5	32.897850	116.594290	Males chorusing.
5/3/2002	Japacha Creek above Japacha Fire Rd	HYCA	L	10 +	32.927850	116.580890	Larva in teneja
5/3/2002	Japacha Creek below Japacha Fire Rd	HYRE	E	1	32.922330	116.578590	Only one egg mass and no larva observed.
5/3/2002	Japacha Creek below Japacha Fire Rd	HYCA	L	5 +	32.922420	116.577120	No HYRE larva.
5/21/2002	Sweetwater River - SITE 1	MEGA	A	4	32.941091	116.550540	Four large adult turkeys approx. 100m east of way point. All foraging on grass mesa.
5/21/2002	Sweetwater River at State Route 79 bridge	HYRE	A	~ 5	32.910550	116.574210	Male chorus
5/21/2002	Sweetwater River, Park Boundary at Hulburd Grove - SITE 4	HYRE	L	25 +	32.873420	116.615230	Collected larvae from pool in survey reach.
5/31/2002	Sweetwater River, Green Valley Falls Camp Ground to Park Headquarters reach	GAAC	A	100 +	32.909790	116.576000	GAAC observed along entire wetted reach.
5/31/2002	Sweetwater River, Green Valley Falls Camp Ground to Park Headquarters reach	ONMY	J	~ 15	32.909790	116.576000	A series of 3 scour pools contain both trout and sticklebacks but no amphibian larvae
5/31/2002	Sweetwater River, Green Valley Falls Camp Ground to Park Headquarters reach	COCO	A	1	32.908860	116.578610	An adult COCO quickly retreated into alder root tangle on stream bank.
6/13/2002	Sweetwater River, Park headquarters down to SR79 bridge reach	MEGA	A	(tracks)	32.923200	117.558600	Tracks in sand
6/13/2002	Sweetwater River, Park headquarters down to SR79 bridge reach	HYRE	A	~ 5	32.910990	116.574180	Breeding chorus
6/13/2002	Sweetwater River, Park headquarters down to SR79 bridge reach	GAAC	A		32.924070	116.559460	Several observed in what appears to be suitable AT breeding habitat.
6/20/2002	Sweetwater River, Hulburd Grove - SITE 4	HYRE	A	10	32.872283	116.614067	
6/20/2002	Sweetwater River, Hulburd Grove - SITE 4	BUCA	A	1	32.872850	116.614567	First AT observed in during the 2002 surveys.
6/20/2002	Sweetwater River, Hulburd Grove - SITE 4	THHA	A	1	32.872550	116.613933	Small adult
6/20/2002	Sweetwater River, Hulburd Grove - SITE 4	HYCA	L	~ 30	32.872267	116.614066	
6/20/2002	Sweetwater River, Hulburd Grove - SITE 4	BUBO	A	1	32.872250	116.614050	No BUBO tads present
6/28/2002	Sweetwater, below park headquarters & above 79 - Site 1	CRVI	J	1	32.926990	116.559810	Observed juvenile crossing paved service road behind indian museum

Date	Location	Species ¹	Age Class ²	Quan.	Coordinates (WGS 84)		Notes
					Latitude	Longitude	
6/28/2002	Sweetwater, below park headquarters & above 79 - Site 1	PHCO	A	1	32.924540	116.559300	
7/10/2002	Sweetwater River, between park headquarters & the 79 bridge - SITE 1	MEGA	A	(tracks)	32.924020	116.559390	Turkey tracks on sandy bank.
7/10/2002	Sweetwater River, between park headquarters & the 79 bridge - SITE 1	CRVI	1	1	32.924940	116.598990	Coiled and resting in an ambush position at the waters edge in thick Typha.
7/10/2002	Sweetwater River, between park headquarters & the 79 bridge - SITE 1	ONMY	A	2	32.924030	116.559410	Collected 2 dead adult ONMY from small shallow pool in the process of drying down. Victims of low D.O.?
7/10/2002	Sweetwater River at State Route 79 bridge	LAGE	A	1	32.911280	116.574060	Road kill at SR79 bridge. Only tail tip preserved.
7/11/2002	Sweetwater River, South Boundary Fire Rd - SITE 2	GAAC	A	300	31.896670	116.594810	
7/11/2002	Sweetwater River, South Boundary Fire Rd - SITE 2	ONMY	A	2	31.896670	116.594810	
7/16/2002	Sweetwater River, above Park headquarters - SITE 1	MEGA	A	(tracks)	32.934270	116.552760	Tracks covering sandy terrace
7/18/2002	Sweetwater River, Saddleback Trail crossing SITE 3	URCI	A	1	32.883283	116.600183	The fox approached to within 5 meters of me even with my headlamp on
7/18/2002	Sweetwater River at State Route 79 bridge	MEGA	A	(tracks)	32.930133	116.556133	Tracks of adults covering sandy terrace
7/18/2002	Sweetwater River, above Park headquarters toward the headwaters - Site 1	MEGA	A	(tracks)	32.932583	116.554660	Tracks covering sandy terrace
7/18/2002	near State Route 79 bridge	URCI	A	1	32.909133	116.575800	Fox ran safely across SR79 in front of our vehicle
9/3/2002	Sweetwater River at Green Valley Falls Campground	ONMY	J	3	32.901317	116.581783	3 juv observed
9/3/2002	Sweetwater River at Green Valley Falls Campground	HYCA	L		32.901317	116.581783	
9/3/2002	Sweetwater River, above State Route 79 bridge	GAAC	A	1	32.911367	116.571583	Only one stickleback observed
9/3/2002	Sweetwater River, above State Route 79 bridge	GAAC	A / J	50 / 100	32.912417	116.571366	Pool in the process of drying
9/12/2002	Sweetwater River, at Park Headquarters	BUCA	A	1	32.926830	116.560090	Gravid female (62mm) found on gravel utility road at Park Headquarters
5/15/2003	Lucky 5 Ranch - South Property, Drainage 'K'	HYRE	L	~ 45	32.935210	116.503450	Tadpoles common, no egg masses observed
5/15/2003	Lucky 5 Ranch - South Property, Drainage 'K'	HYRE	A	4	32.937060	116.503280	4 adults observed along perimeter of pool. 1 of 4 found dead in water, badly decomposed, however specimen was preserved & collected.
5/15/2003	Sweetwater River at State Route 79 bridge	ELMU	A	1	32.910920	116.573760	Observed in thick brush along trail.
5/15/2003	Sweetwater River at State Route 79 bridge	CAAU	J	35	32.911010	116.573880	Observed ~ 35 small goldfish among the emergent Skirpus. Park Ranger told me that a whitens to the introduction of fish stated that 500 were dumped off bridge about one week ago.
5/15/2003	Sweetwater River at State Route 79 bridge	ONMY	A	5	32.910970	116.573710	5 adult rainbow trout observed in pool under SR79 bridge pool.
5/15/2003	Sweetwater River at State Route 79 bridge	HYRE	L		32.911060	116.574100	Several large tadpoles observed
6/9/2003	Sweetwater River - Site 1	BUCA	L	~ 150	32.922070	116.560030	~ 150 arroyo toad tadpoles counted in creek pool at the end of the survey reach. Surface flow continued beyond the survey.
6/9/2003	Sweetwater River - Site 1	BUCA	A	1	32.924750	116.559240	Observed on a sandy hiking / riding trail.

Date	Location	Species ¹	Age Class ²	Quan.	Coordinates (WGS 84)		Notes
					Latitude	Longitude	
6/9/2003	Sweetwater River - Site 1	BUCA	A	1	32.924900	116.559180	Observed on open sand / gravel patch.
6/9/2003	Sweetwater River - Site 1	BUCA	A	1	32.924500	116.559420	Observed on sandy hiking / riding trail.
6/9/2003	Sweetwater River - Site 1	BUCA	A	1	32.924500	116.559130	Observed on open sand / gravel patch.
6/9/2003	Sweetwater River - Site 1	BUCA	A	1	32.924460	116.559360	Observed on open damp sand bank.
6/9/2003	Sweetwater River - Site 1	HYRE	A	10	32.896940	116.594760	Males chorusing (~ x10)
6/9/2003	Lucky 5 Ranch - South Property, Drainage 'K'	HYRE	A	6	32.935310	116.503340	6 adults observed in thick grass along perimeter of pool.
6/17/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	BUCA	A	1	32.883333	116.600500	Observed on narrow sandy recreation trail leading down to river.
6/17/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	BUCA	A	1	32.883450	116.600567	Observed at pools edge .25m from water.
6/17/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	BUCA	A	3	32.883433	116.600550	3 larvae observed in quiet pool at trail crossing
6/17/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	BUCA	A	1	32.883467	116.600567	Observed on wet sandy bar.
6/17/2003	Sweetwater River - Site 1	BUCA	L	27	32.924460	116.559360	Only counted 27 AT larvae in Trail crossing Pool. Far fewer than observed during previous survey. ~15-20mm Total length.
6/17/2003	Sweetwater River - Site 1	BUCA	A	1	32.924310	116.559530	Observed 1.0 meter from pools edge.
6/17/2003	Sweetwater River - Site 1	BUCA	A	1	32.924410	116.559420	Observed on sandy bench on NW side of 'Trail Crossing Pool'.
6/17/2003	Sweetwater River - Site 1	BUCA	A	1	32.924550	116.559360	Observed along sandy bench on NW side of creek in leaf litter under
6/17/2003	Sweetwater River - Site 1	HYRE	A	3	32.924360	116.559420	Observed 3 adults, calling males in close proximity of pool.
6/17/2003	Sweetwater River - Site 1	HYRE	L		32.924360	116.559420	Observed tadpoles in quiet pools.
6/17/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	BUCA	A	1	32.896890	116.594760	Suitable AT breeding pools, no AT egg strings or tadpoles detected.
6/17/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	GAAC	A / J	150+ / 150+	32.896890	116.594640	Several hundred stickleback observed in quiet pools at road crossing.
6/17/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	HYRE	A	10	32.896990	116.594580	Males calling from watercress along wetted portions of creek.
6/17/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	HYRE	L		32.896990	116.594580	Large tadpoles observed.
6/18/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	BUCA	A	1	32.883467	116.600583	Observed at pools' edge .25m from water.
6/18/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	BUCA	L		32.885533	116.599867	Only 2 larvae detected on sandy pool bottom.
6/18/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	HYRE	A	~ 5	32.885517	116.599867	Several calling males.
6/18/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	HYCA	A	2	32.885700	116.600017	2 males heard calling up stream of reach end point.
6/23/2003	Sweetwater River - Site 1	BUCA	A	1	32.924050	116.559530	
6/23/2003	Sweetwater River - Site 1	BUCA	A	1	32.923920	116.559480	Observed sitting in shallow water.

Date	Location	Species ¹	Age Class ²	Quan.	Coordinates (WGS 84)		Notes
					Latitude	Longitude	
6/23/2003	Sweetwater River - Site 1	BUCA	A	1	32.921960	116.560850	First adult arroyo toad observed below the 'Trail Pool'. The adult was found on a sandy terrace adjacent to the pool where AT tadpoles were observed on previous daytime recon. survey.
6/23/2003	Sweetwater River, Hulburd Grove - SITE 4	HYCA	A	3	32.873090	116.614860	3 males heard calling up river from end of survey reach.
6/23/2003	Sweetwater River, Hulburd Grove - SITE 4	HYRE	A	5	32.873090	116.614860	5 males heard calling up river from end of survey reach.
6/26/2003	Lucky 5 Ranch - South Property, Drainage 'K'	HYRE	A	3	32.935180	116.503410	Only observed 3 males calling
7/16/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	GAAC	A / J		32.896280	116.595120	All age classes observed & collected
7/16/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	HYRE	L	~ 20	32.896280	116.595100	Larvae observed & collected
7/16/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	BUCA	A	1	32.896840	116.595070	Observed lg. ad. F in the same location as prev. visit, probably same indiv. Observed on wet sand on N side of creek on road/trail. Vehicle tracks, horse hoof prints, & human foot prints.
7/16/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	GAAC	A	3	32.898170	116.594070	3 adults observed in drying pool ~3cm deep.
7/16/2003	Sweetwater River, Hulburd Grove - SITE 4	BUBO	J	1	32.874040	116.616790	Observed yearling ~ 4 cm long.
7/16/2003	Sweetwater River, Hulburd Grove - SITE 4	BUBO	J	1	32.873990	116.616560	Observed second yearling.
7/16/2003	Sweetwater River, Hulburd Grove - SITE 4	ONMY	A	3	32.871500	116.613530	Trout observed at end of reach.
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	BUCA	A	1	32.873350	116.615110	Observed along dry river bed on damp mud of recently dried pool.
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	BUBO	M	~ 25	32.873350	116.615110	Observed ~100 metamorphs ranging in lg. from 15 mm - 50 mm. Collected & preserved a range of sizes.
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	HYCA	M	100 +	32.873350	116.615110	Collected & preserved a series.
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	HYRE	M	150 +	32.873350	116.615110	Collected & preserved a series.
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	HYCA	L	~ 50	32.873350	116.615110	
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	HYRE	L	~ 75	32.873350	116.615110	
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	ONMY	J	~ 30	32.872620	116.614210	Trout found at pool largely covered by low willow tree. Also HYRE, HYCA, BUBO, metamorphs & tads present.
7/17/2003	Sweetwater River, Hulburd Grove - SITE 4	ONMY	J	50 +	32.872460	116.614040	Collected series of trout fry. Also observed at pool HYRE, HYCA, BUBO, metamorphs & HYRE, HYCA larvae.
7/18/2003	Lucky 5 Ranch - South Property, Drainage 'K'	HYRE	M	1	32.934880	116.503550	Only one metamorph observed.
7/18/2003	Lucky 5 Ranch - South Property, Drainage 'K'	BUBO	A	1	32.934870	116.503560	First <i>B. boreas</i> observed at pond & this survey site. Digital photo very blurry, toad swam away before it could be photographed again.
7/22/2003	Sweetwater River - Site 1	MEGA	A	(tracks)	32.930650	116.556790	Observed tracks on rd.

Date	Location	Species ¹	Age Class ²	Quan.	Coordinates (WGS 84)		Notes
					Latitude	Longitude	
7/22/2003	Sweetwater River - Site 1	BUCA	A	1	32.933670	116.552500	Elevation record for the arroyo toad (1254 m) within Sweetwater River watershed.
7/22/2003	Sweetwater River - Site 1	BUCA	A	1	32.924080	116.559520	Integument: Extremely rugose, individual warts with pointed tips. Observed on damp shore of 'Trail Crossing' pool, when approached, it quickly retreated to shallow water of pool. Photographed in water.
7/22/2003	Sweetwater River - Site 1	BUCA	A	1	32.924110	116.559500	Observed on sandy bank 3 meters from pool
7/22/2003	Sweetwater River - Site 1	HYRE	L	~ 9	32.923970	116.559600	Observed 9 tadpoles
7/22/2003	Sweetwater River - Site 1	HYRE	L	~ 5	32.933890	116.550900	Observed 5 tadpoles
7/22/2003	Sweetwater River - Site 1	BUCA	A	1	32.924990	116.560080	Observed on path
7/23/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	HYRE	A	1	32.883490	116.600520	
7/23/2003	Sweetwater River, Saddleback Trail crossing - SITE 3	BUCA	A	1	32.884850	116.599420	Observed along dry riverbed in sand/cobble reach.
8/20/2003	Lucky 5 Ranch - South Property, Drainage 'K'	BUBO	A	1	32.935060	116.503390	Toad retreated to open water instead of tall grass or dense chaparral at ponds edge.
8/20/2003	Sweetwater River at State Route 79 bridge	ONMY	A	5	32.910530	116.587280	Collected fish with seine net in single pool.
8/20/2003	Sweetwater River at State Route 79 bridge	GAAC	A & J	21	32.910530	116.587280	Collected fish with seine net.
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	BUBO	J	2	32.873380	116.614780	Observed on sand/cobble stream substrate.
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	BUBO	M	5	32.872310	116.614030	Observed metamorphs in root masses along pools edge.
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	HYRE	M	3	32.873380	116.614780	Observed metamorphs in root masses along pools edge.
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	HYCA	M	3	32.872600	116.614220	Observed metamorphs in root masses along pools edge.
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	ONMY	J	5	32.872600	116.614220	Small fingerlings observed in murky water.
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	BUCA	A	2	32.872270	116.614020	Both observed in Typha cluster on damp sand.
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	BUBO	A	1	32.872270	116.614020	Observed on open wet sand substrate
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	HYRE	M	1	32.872270	116.614020	Observed on open wet sand substrate
8/20/2003	Sweetwater River, Hulburt Grove - SITE 4	HYCA	A	5	32.872270	116.614020	Observed on granite rocks and boulders within the river channel.
8/21/2003	Sweetwater River - Site 1	BUCA	A	3	32.924290	116.559320	All observed on open sandy bank. Presumably foraging.
8/21/2003	Sweetwater River - Site 1	BUCA	A	1	32.924010	116.559390	Observed at edge of pool.
8/21/2003	Sweetwater River - Site 1	BUCA	A	4	32.923780	116.559420	Observed a cluster of 4 adults on open sandy terrace. Presumably foraging.

Date	Location	Species ¹	Age Class ²	Quan.	Coordinates (WGS 84)		Notes
					Latitude	Longitude	
8/21/2003	Sweetwater River - Site 1	BUCA	M	1	32.922100	116.559950	First metamorph observed at Site 1.
8/21/2003	Sweetwater River - Site 1	MEGA	A	(tracks)	32.922700	116.559750	Feathers & footprints observed.
8/22/2003	Sweetwater River - Site 1	HYRE	M	7	32.922700	116.559750	Metamorphs observed throughout survey reach.
8/21/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	GAAC	A / J	50+ / 150+	32.896430	116.595100	Only one small pool found, in the process of drying. Collected a series of live stickleback. All age classes.
8/21/2003	Sweetwater River, South Boundary Fire Road crossing - SITE 2	HYRE	M	5	32.896890	116.594760	5 metamorphs observed hopping in the damp portion of the well shaded river channel
9/11/2003	Sweetwater River at State Route 79 bridge	ONMY	J	5	32.910530	116.575060	Collected 5 trout for shipment to Ca/Nv Fish Health Center for analysis
9/11/2003	Sweetwater River at State Route 79 bridge	GAAC	A	21	32.910530	116.575060	Collected 21 stickleback for shipment to Ca/Nv Fish Health Center for analysis
9/11/2003	Sweetwater River at State Route 79 bridge	CAAU	A	50 +	32.911010	116.574070	Observed ~ 30 individuals. Collected 6 goldfish for shipment to Ca/Nv Fish Health Center for analysis

¹ Species

ONMY = Rainbow Trout (*Oncorhynchus mykiss* var.) ^a

GAAC = Partially Armored Threespined Stickleback (*Gasterosteus aculeatus microcephalus*) ^b

CAAU = Goldfish (*Carassius auratus*) ^c

BUBO = Western Toad (*Bufo boreas*)

BUCA = Arroyo Toad (*Bufo californicus*) ^d

HYRE = Pacific Treefrog (*Hyla regilla*)

HYCA = California Treefrog (*Hyla cadaverina*)

ELMU = Southern Alligator Lizard (*Elgaria multicarinatus*)

PHCO = Coast Horned Lizard (*Phrynosoma coronatum*) ^e

COCO = Yellow Bellied Racer (*Coluber constrictor*)

THHA = Two-striped Gartersnake (*Thamnophis hammondi*) ^e

CRVI = Southern Pacific Rattlesnake (*Crotalus viridis*)

LAGE = California Kingsnake (*Lampropeltis getulus*)

MEGA = Wild Turkey (*Meleagris gallopavo*) ^c

URCI = Grey Fox (*Urocyon cinereoargenteus*)

² Age class

A = adult

J = juvenile

E = egg mass

L = larvae

M = metamorph

^a Introduced hatchery raised stock-trout

^b Native fish to southern California, introduced into upper Sweetwater River

^c Introduced non-indigenous species

^d Endangered species (U.S. Fish and Wildlife Service)

^e Species of special concern (California Department of Fish and Game)