

Habitat Assessment and Baseline Surveys for the Western Spadefoot (*Spea hammondi*) and the Western Pond Turtle (*Emys marmorata*) on the Irvine Ranch Land Reserve

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Prepared for:

The Nature Conservancy
The Irvine Company

Habitat Assessment and Baseline Surveys for the Western Spadefoot (*Spea hammondi*) and the Western Pond Turtle (*Emys marmorata*) on the Irvine Ranch Land Reserve

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EXECUTIVE SUMMARY

Recent conservation planning for Orange County identifies the western spadefoot (*Spea hammondi*) and western pond turtle (*Emys marmorata*) as species requiring protection (NCCP/HCP, 1995). The western spadefoot is listed as a federal species of concern, a California Department of Fish and Game (CDFG) species of special concern, Bureau of Land Management (BLM) sensitive species and Natural Community Conservation Plan (NCCP) County of Orange target species. The western pond turtle is listed as a federal species of concern, a CDFG species of special concern, a BLM sensitive species, and a United States Forest Service sensitive species. Initial surveys of Irvine Ranch lands for the western spadefoot (coastal reserve only) and the western pond turtle were conducted in 1995 and 1997, respectively. The United States Geological Survey (USGS) conducted surveys in 2003 and 2004 to 1) identify currently occupied habitats and 2) assess population status for these two locally rare species within the Irvine Ranch Land Reserve (IRLR). USGS surveys encompassed portions of both the IRLR coastal and central reserves. Western spadefoots were found to be widespread in the central reserve, occurring in all six surveyed areas. In the coastal reserve, western spadefoots were detected in two of the six surveyed areas. Western pond turtles were detected at 4 of the 32 surveyed area on Irvine Ranch lands, all west of Interstate 5. Western pond turtles were detected at the University of California, Irvine's (UCI's) San Joaquin Freshwater Marsh and adjacent portions of the San Diego Creek Channel. At two sites, Bonita Canyon and Strawberry Farms Golf Course only a single western pond turtle was detected. Currently the largest populations of western pond turtles within the IRLR are at the Shady Canyon turtle pond mitigation site. The success of The Irvine Company's (TIC) mitigation effort at the Shady Canyon turtle pond indicates successful turtle habitats can be created and maintained. This report summarizes USGS's habitat assessment of the baseline surveys of both the western spadefoot and western pond turtle on Irvine Ranch Land Reserve, and provides recommendations for management to conserve these species within the IRLR.

INTRODUCTION

Two aquatic species that have been identified in regional conservation planning documents (NCCP/HCP, 1995; Harmsworth, 1998) as requiring protection in central

Orange County are the western spadefoot (*Spea hammondi*) and western pond turtle (*Emys marmorata*), hereafter referred to as spadefoot and pond turtle, respectively. Spadefoots commonly breed in extremely ephemeral waters including vernal pools and road ruts, while pond turtles use more permanent aquatic habitats such as creeks and ponds. The U.S. Army Corps of Engineers (2001) reports a loss of native habitats has resulted from the channelization of creeks, fragmentation of habitat, and draining of wetlands due to the major urban and agricultural development that Orange County has experienced during the past 50 years. As a result, native aquatic species are at risk. Aquatic habitat alterations coupled with conversion of upland habitat for agriculture and urban development have reduced the available spadefoot habitat region-wide. Likewise, few aquatic areas suitable for pond turtles remain (Brattstrom and Messer, 1988; Holland, 1994; Germano and Bury, 2001; Spinks et al., 2003).

This project was initiated to determine the location and status of spadefoot and pond turtle populations within the 50,000-acre IRLR to plan for habitat management actions aimed at ensuring long-term persistence or viability of these species in the reserve. The IRLR constitutes a large portion of the central – coastal Orange County Natural Community Conservation Plan (NCCP), a regional program that seeks to conserve a wide diversity of species. The NCCP identified certain lands for multiple uses (including development, recreation, infrastructure, etc.) and others for native habitat preservation. Together, landowners, including TIC, have cooperated with local residents, city planners, biologists, and environmental groups to protect certain land as open space. Surveys conducted in the 1990's documented spadefoots and pond turtles on lands designated for both development and reserves (Holland, 1994; LSA, 1995; Harmsworth, 1998). Based on these reports/recommendations, TIC made commitments to mitigate within the reserve to offset development impact. Our current study, in addition to locating and assessing the status of remaining populations, will assist in identifying management strategies and potential mitigation sites for habitat management, enhancement, and creation. Designation of open space reserves coupled with adaptive management are a positive step toward the long-term preservation of native wildlife in urban Orange County.

Western Spadefoot

Spadefoots emerge and breed during heavy rains from winter through late spring (Jennings and Hayes, 1994; Wright and Wright, 1995; Skelly, 1997; Stebbins, 2003) (Figure 1). Aquatic breeding habitats include ephemeral ponds, vernal pools, slow streams, reservoirs, irrigation ditches, and road ruts (Stebbins, 2003). Breeding in these habitats require rapid development of tadpoles (Lannoo, 2005). Using conspicuous wedge-shaped spades on their hind feet, spadefoots burrow backwards into the soil during dry periods. Spadefoots are typically found in grasslands or other open vegetation, and require sandy or gravelly soils where they can burrow. The spadefoot is listed as a federal species of concern, a CDFG species of special concern, BLM sensitive species, and Natural Community Conservation Plan (NCCP) County of Orange target species.

Western Pond Turtle

The pond turtle is the only turtle species native to Orange County. This aquatic turtle has prominent limb scales, a uniform brown or olive carapace, a yellowish plastron, and a network of spots or lines that radiate from the center of the carapace shields distinguish this species (Figure 2). Pond turtles nest from April through August, peaking between late May and early July (Ernst and Barbour, 1989; Ernst et al., 1994; Stebbins, 2003). This species typically excavates its nests in upland habitat on the margins of streams or ponds. Nests have been reported up to 300 m from water (Rathbun et al., 1992; Holland, 1994). Hatchlings emerge in late summer or early fall, and may even overwinter in the nest and emerge the following spring (Ernst et al., 1994). The pond turtle is primarily a riparian dweller in both permanent and intermittent water bodies including impoundments, ponds, rivers, sloughs, and streams. Although pond turtles have declined throughout their historic range (Spinks et al., 2003), population losses are considered most extensive in southern California (Brattstrom and Messer, 1988; Holland, 1994; Fisher and Case, 2000; Klemens, 2000; Germano and Bury, 2001). Habitat alteration and pollution are considered the greatest threats to remaining populations (Brattstrom and Messer, 1988; Ernst et al., 1994; Holland, 1994).

Purpose of Study

In 1995, biological consultants documented the first spadefoots within the IRLR (LSA, 1995). These animals were first found in Shady Canyon, and then more extensively throughout the eastern half of the coastal reserve and at the one area surveyed in the central reserve. Prior to this, Dana Point had been the only known spadefoot locality from west of Interstate 5 in Orange County although they are now extirpated from this location. Spadefoots were also known from vernal pools in El Toro (Jennings and Hayes, 1994). Pond turtle surveys conducted in 1997 documented this species at seven sites on Irvine Ranch lands (Harmsworth, 1998). The spadefoot is a covered species in the coastal reserve under the NCCP for Orange County. Although the pond turtle was not mentioned in the NCCP and Habitat Conservation Plan (HCP) for Orange County, their populations are also at risk. An earlier regional study suggested that only six viable pond turtle populations remained south of Ventura County (Brattstrom and Messer, 1988). In order to better understand the current distribution of these two species and to build upon current efforts by TIC to ensure their persistence in the IRLR, The Nature Conservancy and TIC identified funding from the Irvine Ranch Environmental Enhancement Fund for this study.

Although recent development has impacted populations of both species in certain approved development areas, TIC has begun to implement mitigation projects to offset these losses. For example, biologists recently established a breeding population of pond turtles at the Shady Canyon turtle pond mitigation site in the coastal reserve of the IRLR (Harmsworth, 2002, 2003). This is currently the largest known population of pond turtles in Orange County. Additional habitat creation projects for both species will be needed to ensure their long-term persistence. Thus, the purpose of this study was to identify where spadefoots and pond turtles occur within the IRLR and to identify sites where habitat could be created or modified to benefit these species. The study area included both the coastal and central regions of the IRLR.

Objectives

As detailed in our original proposal for this work, the IRLR spadefoot and pond turtle project has five principal objectives: 1) evaluate existing habitat for spadefoots and pond

turtles, 2) identify viable habitats for spadefoot and pond turtle populations, 3) recommend cost-effective management practices and habitat restoration techniques to reserve managers, 4) build upon existing wildlife management planning compatible with urban development, and 5) initiate an educational component for land managers, including: The Nature Conservancy; Nature Reserve of Orange County; California State Parks; County of Orange Harbors Beaches, and Parks; and the City of Irvine, providing guidance in restoration and wildlife enhancement. These five objectives will be met over the course of five years.

METHODS

The study area for this project is the IRLR (Figure 3). All surveys occurred in the central and coastal regions of Orange County within the San Diego Creek, Santa Ana Watershed, Newport Bay Watershed, and other coastal creeks. Before commencing fieldwork, all potential aquatic habitats for spadefoots and pond turtles were mapped within the study area. We identified aquatic habitats using map resources, helicopter aerial surveys, individuals familiar with the area, and known locations from museum records and earlier reports (e.g., LSA, Harmsworth Associates). Identified habitats were then prioritized for surveys based upon the suitability of each for the targeted species. Suitability was assessed based upon type of waterbody (e.g., road ruts, vernal pools, creeks), and the potential hydroperiod (e.g., the length of time it would hold water).

Western Spadefoot

Spadefoot surveys began in February after adequate rains were received to form potential breeding pools. Surveys extended through May when the majority of the pools had dried. Surveys consisted of examining pools for any evidence of spadefoots, when present estimations of the total number of each life stage were recorded. A subset of tadpoles and metamorphs (three to six individuals) from each pool were measured and examined for abnormalities. Tadpoles and metamorphs were photographed and/or preserved in 50 ml vials containing 10% formalin. Pools containing spadefoots were photographed along with the surrounding upland area. Pool size, depth, water temperature, and notes on habitat type and vegetation in and near the pools were recorded. Pools were surveyed a minimum of two times during the field season, with the exception of the Limestone

Canyon pools. In addition to the pools identified by our pre-survey assessment, newly found or formed pools were also surveyed when detected. Based on our surveys a list of amphibian species detected at each pool was generated. Pools were sampled using the following standardized protocols designed to assess the presence and relative abundance of these species.

Visual encounter surveys for egg masses and larvae

Upon arrival at each pool of standing water, the entire shoreline was visually inspected for spadefoot activity. Spadefoot egg mass counts are used as an indicator of the level of breeding activity in each pool (Heyer et al., 1994).

Dip netting

If pools could not be completely and confidently surveyed by visual inspection alone, dip nets were used to sample for larval spadefoots. This was the primary method used to sample vegetated and muddy pools and also to capture tadpoles for identification.

Wooden handled nylon mesh dip nets and fine mesh aquarium nets (15 cm x 15 cm) were used to scoop into vegetation and other debris when sampling water bodies for spadefoots. A minimum of 10 sweeps with the dip net were made to adequately sample each potentially suitable microhabitat. Spadefoot tadpoles captured during the 10 sweeps were examined for abnormalities.

Western Pond Turtle

Pond turtles surveys began in June, when the water level was low, and continued until November when cooler weather reduced turtle activity. We identified creeks, marshes, ponds, lakes, reservoirs, golf courses and public parks with adequate sources of water as potential turtle habitat. Pond turtle surveys consisted of two parts: 1) reconnaissance surveys to assess the suitability of habitats and 2) visual encounter surveys, or trapping.

Reconnaissance surveys

All sites were visited on at least one day prior to setting out turtle traps for reconnaissance surveys. During reconnaissance surveys, we looked for turtle activity, visually assessed habitat suitability for pond turtles, and photographed the waterbody and

the surrounding area. This was a rapid habitat assessment requiring only 15-30 minutes per site. Trapping locations and the number of traps to deploy was determined for habitats suitable for trapping.

Visual encounter surveys – shallow aquatic habitats

Many riparian and creek habitats were too shallow for turtle traps to work effectively. For streams where we could not trap, we walked the reach of the stream, visually searching for suitable turtle habitat and turtle activity. For each such habitat, we walked the entire stream reach until no more water was present or until the watercourse became unsuitable (i.e., the channel was cemented).

Turtle trapping – deep water habitats

Sites were sampled using standardized protocols to determine if pond turtles currently occupied the habitat. Box and hoop traps baited with canned sardines were used to capture turtles and unbaited wire mesh minnow traps were used to document fish and exotic amphibians. We trapped most sites for four consecutive days to obtain comparable information across sites. All captured vertebrates were identified to species and recorded. Crayfish captures were also recorded. In addition, we gathered data on composition of the associated community (e.g., other turtles, amphibians, and fish).

Weight, length, width, height (measured with calipers) and gender of each individual turtle was recorded. Each pond turtle had a series of four photographs taken; carapace, plastron, side view and frontal view. Tissue was collected by clipping a small portion of the tail for future DNA analysis. A notch was filed in the left femoral of the plastron to determine if an animal is a recapture. Captured pond turtles were checked for scale notches and scanned with a PIT-tag reader. A passive integrated transponder (PIT-tag) is an injectable identification tag. We injected the PIT tag in the left hind limb of individuals. After tagging, we released pond turtles at the point of capture. Exotic turtles were permanently removed from the site and donated to the Huntington Beach Wetland and Wildlife Care Center or the Santa Ana Zoo.

RESULTS

Western Spadefoot

From December 2002 through April 2003, the Tustin-Irvine Ranch weather station #61 (TWS) recorded 12.82 inches of precipitation (Watershed & Coastal Resource Division staff, unpublished data). Orange County's average, as recorded by the TWS, averaged 13.00 inches of the past 100 years (Watershed & Coastal Resource Division staff, unpublished data). In the spring of 2003, we surveyed 92 inundated "pools" (Tables 1, 2). These pools were distributed across 12 canyon sections within the IRLR (Figure 4). Of the 92 pools surveyed we found spadefoots at 12 (Tables 3, 4). The first spadefoot tadpoles were detected on March 9, 2003 and the last ones were detected on May 14, 2003. The majority of spadefoot tadpoles were detected in April 2003. Spadefoots were found in grassland pools, flooded muddy road ruts, and a creek. See Appendix A for more detailed descriptions of the areas surveyed. These occupied habitats had maximum water depths ranging from 0.25 to 1.00 m, were approximately 0.5 to 3.0 m wide, and 1.0 to 10.0 m long. Five amphibian species were observed: three native; spadefoots, Pacific treefrogs (*Hyla regilla*), and western toads (*Bufo boreas*) and two exotic; African clawed frogs (*Xenopus laevis*) and bullfrogs (*Rana catesbeiana*) (Tables 3, 4).

Our sampling was distributed across the coastal and central reserves, covering six different watersheds in each reserve area. Although we detected spadefoots in both the coastal and central reserve, we found more occupied pools in the central reserve (Table 3). We found spadefoots in 10 of 40 surveyed pools, or 25%, in the central reserve. In the coastal reserve, we found them in only 3 of 53 pools, or 6%. Overall, we found spadefoots in five of the six central locations: Hick's Canyon, Irvine Regional Park, Limestone Canyon, Santiago Canyon, and Weir Canyon (Table 3; Figures 5, 6). In the coastal reserve, we found spadefoots at two locations: Crystal Cove State Park and Laguna Coast Wilderness Park (Table 4). We did not conduct surveys in TIC's recently created pools in Muddy Canyon; this project was still under construction. From the perspective of exotic species, pools surveyed in the central reserve contained only native amphibians, while both African clawed frogs and bullfrogs were found in some ponds, pools and creeks in the coastal area (Tables 3, 4).

In 2004, we sampled several areas not sampled or inadequately sampled in 2003. However, only 7.99 inches of rain fell from December 2003 through April 2004 (TWS weather station # 61), and we found many areas that supported standing water in wetter years to be dry throughout 2004 (Watershed & Coastal Resource Division staff, unpublished data). Still, in the coastal reserve spadefoot tadpoles were detected in three tenaja pools and three road rut pools in Laguna Coast Wilderness Park. In the central reserve spadefoot tadpoles were detected in Fremont Canyon (the one central watershed where we did not detect spadefoots in 2003), Hick's Canyon, and above Santiago Reservoir (Tables 3, 4). See Appendix A for a more detailed description of the sites where we observed spadefoots.

Western Pond Turtle

In 2003, we placed 414 traps across 32 sites (Figure 7) and conducted visual encounter surveys along 27 km of shallow creeks (Tables 5, 6; Figures 8, 9). Pond turtles were detected at 4 of the 32 sites (Tables 7, 8). Of the 106 turtles trapped, only 14 of which were pond turtles (Tables 7, 8). Seven different exotic species made up the remainder of turtle captures. Exotic turtle captures consisted of 52 red-eared sliders (*Trachemys scripta*), 31 spiny softshell turtles (*Apalone spinifera*), 3 painted turtles (*Chrysemys picta*), 2 river cooters (*Pseudemys concinna*), 2 false map turtles (*Graptemys pseudogeographica*), 1 snapping turtle (*Chelydra serpentina*), and 1 mud turtle (*Kinosternon sonoriense*).

Of the 32 sites that we surveyed in 2003, 8 (Bonita Canyon Reservoir, Big Canyon Pond, Paularino Channel, San Diego Creek, Santa Isabel Creek, Shady Canyon, Veeh Creek and Marine Corps Base Tustin) had pond turtles present during 1997 surveys (Harmsworth, 1998; USGS San Diego Field Station Staff, unpublished data). We visually detected one pond turtle in Bonita Canyon. Bobby Goodman provided photos of the single pond turtle he observed at the Marine Corps Base Tustin.

In our 2003 surveys, we detected multiple pond turtles at two sites: UCI's San Joaquin Freshwater Marsh and the adjacent San Diego Creek Channel (Table 8; Figures 10, 11). At each of these sites, we captured six pond turtles. Four of the six pond turtles captured

at UCI's San Joaquin Freshwater Marsh were subadults (carapace length < 120 mm) and the other two were adults. We did not conduct any recapture studies, so we are unable to estimate population size. Although UCI's San Joaquin Freshwater Marsh and San Diego Creek Channel supported the highest apparent density of pond turtles, these sites also contained exotics amphibians, crayfish, fish, and turtles (Tables 7, 8). More detailed descriptions of the surveyed sites are in Appendix B.

It should be noted that the largest population of pond turtles within the IRLR is at the Shady Canyon mitigation pond. This pond was modified by TIC in 2001 to accommodate pond turtles, and has been stocked with animals captured in areas outside the IRLR that were approved for development. Although we did not trap at this site, reports from the consultants responsible for the project indicate that the population there consists of 40-60 pond turtles and no exotic turtles or amphibians (Harmsworth, 2002, 2003). Of the animals captured in May 2003 there were 33 locally-born neonate and juvenile turtles, indicating that successful reproduction at this site is greater than at any site we surveyed (Harmsworth, 2003).

DISCUSSION

The management, creation, and enhancement of habitat to improve the reproductive success and survivorship of spadefoots and pond turtles is critical to their long-term persistence within the IRLR. While completed and future planned habitat creation efforts for these two species by TIC are a positive step in this direction, additional habitat creation and enhancement efforts are needed. To plan confidently for the management of these species, an initial assessment of their current distribution and status was essential. By conducting surveys in several locations throughout the reserve we were able to assess the current distribution of spadefoots and pond turtles and compare this with information from earlier studies. Our surveys indicate that, although both spadefoots and pond turtles persist within the IRLR, the situation for these two species is very different.

Populations of spadefoots exist in both the central and coastal reserve areas. In both areas populations have been detected in natural (in-stream pools, tenajas and vernal pools) and man-made (road ruts, flooded excavations) habitats. Although spadefoots

remain widespread, in both 1995 and 2003 most surveyed pools did not support breeding. Less than 20% of pools visited revealed evidence of breeding activity. Even in areas with known spadefoot populations nearby pools are often unoccupied and many existing pools appear to be unsuitable. Ultimately, increasing the numbers of suitable and occupied breeding pools (e.g., by habitat creation and enhancement) will improve this species long-term prospects within the reserve. African clawed frogs represent an additional and potentially growing threat to this and other species, especially within the coastal reserve. Limiting their distribution and abundance should also be a goal.

Compared to spadefoots, pond turtles are more narrowly distributed in the IRLR. This species is currently only known to occur at six sites in the coastal reserve, and substantial populations only exist in two areas: the UCI's San Joaquin Freshwater Marsh/San Diego Creek Channel and the Shady Canyon turtle pond. At this point, the Shady Canyon turtle pond is the most productive pond turtle habitat within the IRLR, suggesting that other viable habitats could be created. Although small numbers of pond turtles persist on Irvine Ranch lands adjacent to development and other unsuitable land uses, observations of single individuals do not indicate viable populations. At this point, the best course of action to ensure the long-term persistence of pond turtles is to establish additional populations in created or restored habitats within the IRLR. Below we discuss the current status and management recommendations for each of these species in detail.

Western Spadefoot

The natural history of spadefoots makes them challenging to study. Eggs and larvae are detectable in pools for a few months each year and after metamorphosis spadefoots are primarily underground and undetectable. As a result, pool surveys for eggs and tadpoles are the most efficient means to detect populations. However, detection is dependent upon breeding activity, and breeding is dependent upon precipitation. In 1995 when LSA, Inc. conducted their surveys, according to TWS, 21.36 inches of precipitation fell from December 1994 through April 1995 (Watershed & Coastal Resource Division staff, unpublished data). During this same period in 2003, TWS recorded 12.81 inches of precipitation (Watershed & Coastal Resource Division staff, unpublished data). Since spadefoots bred over roughly the same area of the reserve in 1995 and 2003, we feel that

our 2003 results represent their general distribution within the surveyed areas of the reserve. We urge against interpreting smaller numbers of occupied pools in a single year, especially a relatively dry year, as evidence of localized or regional population declines. This last year is an extreme example. From December 2003 through April 2004 the TWS recorded only 7.99 inches of precipitation. Many known “pools” were never found to contain standing water (Watershed & Coastal Resource Division staff, unpublished data). Thus, our failure in 2004 to detect spadefoots in the Quail Hill region south of Interstate 405, where they were detected in 1995, should be interpreted cautiously.

The areas where we have essentially overlapping surveys and can draw the most valid comparison between 1995 and 2003 are the regions of Crystal Cove State Park and Laguna Coast Wilderness Park west of Interstate 73. In this area in 1995 spadefoots were found in 55% of the 11 pools sampled. In 2003, we sampled 17 pools and detected spadefoots in 18%. In both 1995 and 2003, all occupied pools in these areas were flooded road ruts or other man-made depressions or excavations. Because the Global Positioning Systems that allow us to map pools with accuracy were not widely available in 1995, we cannot relocate the exact same points that survey visited. The difference in proportional occupancy between these two years may be due to precipitation differences or potentially declining habitat quality, unfortunately at this point it is impossible to know.

Although comparisons among years are difficult to interpret, within the 2003 dataset the differences in distribution between the coastal and central regions are worth further inspection. A much higher proportion of central reserve pools contained spadefoots. The coastal and central regions had 6% and 25% occupied pools in 2003, respectively. These data suggest that a higher proportion of the habitat within the central region is suitable, if not of high quality for this species. This may be a natural phenomenon or due to human influences on habitat features. Planned attempts to create or enhance breeding pools for spadefoots should attempt to mimic the structure of occupied pools and select locations nested in similar upland habitats. To evaluate further the status and future prospects for spadefoots within the coastal and central IRLR, we summarize the distribution of this species and the available habitat in each region separately.

Within the coastal reserve, large areas of contiguous occupied habitat have been protected, principally within Crystal Cove State Park and Laguna Coast Wilderness Park. Active breeding was observed in these areas in 1995, 2003, and 2004. The 1995 surveys also documented spadefoots in Shady Canyon, in tributaries to Sand Canyon Reservoir, and in the Quail Hill area. Although 2004 surveys in these areas detected no spadefoots, low precipitation prevents us from making any confident conclusions. In the coastal reserve a potential threat that must be acknowledged is the presence of the exotic African clawed frog in some reservoirs and ponds. Based on our observations throughout southern California, the spread of African clawed frogs represents the greatest threat to spadefoot populations within otherwise protected parcels (USGS San Diego Field Station Staff, unpublished data). African clawed frogs have been detected at sites including Sand Canyon Reservoir, Shady Canyon Golf Club, Bommer Canyon Pond, Strawberry Creek (Touré et al., 2004), and in 2004 for the first time in Moro Canyon, in Crystal Cove State Park, and in Muddy Canyon. The consistent presence of breeding spadefoots in Muddy/Los Trancos Canyon suggests that with creation or restoration of appropriately designed breeding pools, robust populations could be maintained into the future.

In the central reserve, we detected spadefoots in pools within each of the areas surveyed: Fremont Canyon, Limestone Canyon, Hick's Canyon, Irvine Regional Park (wash), Santiago Canyon and Weir Canyon (Appendix C, Table 1). Spadefoots are widespread throughout the extensive contiguous area of the central IRLR. Although spadefoots are reasonably secure in this area, most occupied pools were small and potentially vulnerable. Because many of the most conspicuous breeding pools are on or adjacent to unpaved roads, these resources may be threatened by traffic and road maintenance activities. TIC has plans to create additional larger breeding pools specifically tailored for spadefoots at locations away from roads. At this time, African clawed frogs do not appear to occur anywhere in the central reserve. Since spadefoots will breed opportunistically in any pooling water, we expect habitat creation efforts to produce rapid benefits and help secure the future status of spadefoots in both the coastal and central reserves. Monitoring these habitats over time will be essential for assessing their success and determining what management might be required and how frequent.

Western Pond Turtle

Our 2003 turtle surveys indicate that populations of pond turtles remain in two areas of the coastal IRLR; UCI's San Joaquin Freshwater Marsh/San Diego Creek Channel and the Shady Canyon turtle pond. Currently the Shady Canyon turtle pond, construction completed by TIC in 2001, supports the largest population of pond turtles within the IRLR with regular successful breeding has been documented here (Harmsworth, 2002, 2003). We also observed single pond turtles at Bonita Reservoir and Strawberry Farm Golf Pond. Bobby Goodman detected one pond turtle at Marine Corps Base Tustin (per. comm.). Pond turtles were not detected at several sites where they had been detected in 1997 (Harmsworth, 1998). These sites (Big Canyon Pond, Paularino Creek Channel, San Diego Creek, Santa Isabel Creek, Shady Canyon, and Veeh Creek Channel) are all adjacent to extensive development or land uses making them less than ideal for the long-term persistence of this species. Surveys of six central reserve ponds or reservoirs did not detect pond turtles in that region.

In addition to the threat of development of adjacent lands, the establishment of exotic turtle and game fish populations reduces habitat value for pond turtles. We found exotic turtles and fish at most sites in the central and coastal reserve. Work in San Diego County indicates that these turtle populations are composed predominantly of released pets and are much more likely to be present at sites with open public access (USGS San Diego Field Station unpublished report). Interestingly, at the UCI's San Joaquin Freshwater Marsh and San Diego Creek Channel, where we captured 12 pond turtles, we also captured exotic fish and turtles. Most of these exotics were captured in the San Diego Creek Channel. Three of the four subadult pond turtles were captured within UCI's San Joaquin Freshwater Marsh; this site appears suitable for reproduction. Based on a simple comparison to data from the Shady Canyon turtle pond, some improvements can be made to improve the habitat quality. The Shady Canyon turtle pond which was constructed in 2001 and contained at least 33 locally born juvenile and neonate turtles in May 2003, contains no exotic species and public access is restricted (Harmsworth, 2003).

Additional habitat creation or restoration will be necessary to secure the long-term persistence of this species within the IRLR. Very generally, ideal turtle habitats contain

areas of both deep and shallow permanent waters, basking locations with access to deep water, few or no exotic species, and a wide buffer of undisturbed upland habitat with suitable nesting substrates. The success of the Shady Canyon turtle pond indicates that habitat creation and restoration can have the positive impacts. At this point key goals include identifying suitable sites to establish additional populations and formalizing methods for stocking created habitats. Of the remaining occupied habitats in the coastal reserve, UCI's San Joaquin Freshwater Marsh is the best candidate for habitat enhancement. However, existing roads and development severely limit the potential for dispersal of turtles between this site and other points in the coastal reserve. Sand Canyon Reservoir could also potentially become a productive pond turtle habitat. The only central reserve sites where we did not capture exotic turtles or game fish were Rattlesnake Reservoir and Baker Canyon pond. Siphon Reservoir might be a good candidate if the game fish could be removed.

Assuming that efforts to promote the pond turtle continue, protocols for the translocation of turtles should be formalized to avoid introducing pathogens or inappropriate genetic types. To stock the Shady Canyon turtle pond, turtles were captured from nearby Bommer Canyon and Sand Canyon Reservoir (Harmsworth, 2002). However, for introductions to the central reserve, an appropriate source population would need to be identified. Because pond turtles are known to persist in the Cleveland National Forest (CNF), in the mountain drainages above the central reserve, candidates for introduction should be compared genetically with CNF pond turtles. Another potential source of turtles for population establishment is the arboretum waterway of California State University Fullerton (CSUF). In 1990, LSA, Inc. and Robert Fisher translocated 24 pond turtles from a development site on Marine Corps Base Tustin to the arboretum waterway (Art Homroghausen, unpublished data). As with any translocation, these animals should be screened for disease and appropriate genetics prior to release. Due to the occasional encounter of pond turtles and crews working in urban creek channels a set of standard guidelines for the capture, transportation, health screening and release of these animals would ensure that they are moved to appropriate protected habitats within the IRLR and that they benefit the larger conservation effort.

MANAGEMENT RECOMMENDATIONS

Populations of both spadefoots and pond turtles face a variety of threats throughout southern California, mostly linked to habitat alteration and widespread exotic species invasions. It is our intention to provide management protocols that can be used to enhance wildlife populations within the IRLR and other regions of the county and state. Although we are optimistic about the conservation of these spadefoot and pond turtles within the IRLR, controlling threats will require cooperation among the diverse parties involved. To enhance the distribution and abundance of these species, we recommend a program focused on habitat protection, enhancement and creation, a key component of which is land manager education. Efforts to control populations of exotic fishes, frogs and turtles through habitat management would also benefit these and other native species. To facilitate the cooperation necessary to achieve these goals, we recommend that a single unified aquatic habitats management plan be developed that parties responsible for land and water management on Irvine Ranch lands could use to coordinate consistent efforts.

Western Spadefoot Recommendations:

- Continue to protect habitat values and connectivity within and among reserve areas known to support spadefoots. Minimize disturbance of upland habitats, avoid fragmentation of habitat by new roads, and route trails away from pools.
- Based on survey data, identify the best areas to create additional spadefoot breeding habitats, preferably in areas known to have either recently or historically supported this species. To the extent possible, pool creation should be away from roads and areas with heavy public visitation pressure.
- Continual monitoring of spadefoots to get a better understanding of the spadefoot population size on the IRLR. These surveys should be conducted in spring in years with average or above average precipitation.
- Create new breeding pools, with associated upland habitat enhancements if necessary. We recommend creating these pools in the following locations: Laguna Coast Wilderness Park, Crystal Cove State Park, Hick's Canyon, Limestone Canyon, Fremont Canyon and Weir Canyon. These areas provide natural habitat features suitable for spadefoots.

- Implement pool creation as a management experiment. Little is known about the reasons for success or failure in most restoration efforts. We strongly suggest that this effort be conducted in an experimental framework. Among the research questions that this program could address are 1) is the hydroperiod of created pools similar to natural pools 2) what regular maintenance of created pools is necessary 3) will spadefoots naturally colonize created pools, and 4) at what stage should spadefoots be translocated to maximize survival to metamorphosis and probability of population establishment. These experiments may include translocation of spadefoots from fragmented or suboptimal habitats near development to newly created pools.
- Design educational programs to inform and train responsible parties (reserve managers, park rangers, city and county agencies, and wildlife volunteers) on the ecology and natural history of spadefoots within the IRLR and cost-effective ways to increase the amount of suitable breeding habitats in the landscape.
- Track TIC's recent habitat creation efforts for the spadefoot, and incorporate lessons learned into future habitat enhancement efforts for this species.

Western Pond Turtles Recommendations:

- Conduct trapping effort in UCI's San Joaquin Freshwater Marsh to recapture enough pond turtles to estimate current population size and reduce the population of exotic turtles
- Remove exotic species that prey on and compete with pond turtles from sites identified for habitat enhancement.
- Construct new wetlands or enhance existing unoccupied ponds or creeks at sites with abundant suitable upland habitat nearby and restricted general public access. We suggest that Santiago Creek, Fremont Canyon, Limestone Canyon, and Weir Canyon are the best potential sites for pond creation, and that UCI's San Joaquin Freshwater Marsh, Shady Canyon Golf Club, and Siphon Reservoir are the best potential enhancement sites.

- Implement educational programs to inform and instruct reserve managers, park rangers, city and county agencies, and wildlife volunteers on conservation and management practices to prevent continued loss of pond turtle populations.
- Survey the genetic structure of pond turtles from the coastal reserve, turtles from Marine Corps Base Tustin that now reside in the CSUF arboretum waterway, and upstream from the central reserve in the Cleveland National Forest. This task should be completed before turtles are relocated to the central reserve.
- Track TIC's recent habitat creation efforts for the pond turtle, and incorporate lessons learned into future habitat enhancement efforts for this species.

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Table 1. Western spadefoot sites, locations, and date(s) surveyed in 2003 and 2004 in the central reserve within the Irvine Ranch Land Reserve.

AREA	SITE	LATITUDE ¹	LONGITUDE ¹	SURVEY DATE
Fremont Canyon	FRE01	N 33.82390	W 117.70410	April 25, 2003
				May 15, 2003
				May 22, 2003
				April 20, 2004
	FRE02	N 33.82645	W 117.70054	April 25, 2003
				May 15, 2003
				May 22, 2003
				April 20, 2004
	FRE03	N 33.83002	W 117.69512	April 25, 2003
				May 15, 2003
				May 22, 2003
				April 20, 2004
	FRE04	N 33.78792	W 117.70881	April 25, 2003
				May 15, 2003
				May 22, 2003
				April 15, 2004
FRE05	N 33.80099	W 117.70871	May 15, 2003	
			May 22, 2003	
FRE06	N 33.80054	W 117.70820	May 15, 2003	
			May 22, 2003	
FRE07	N 33.80080	W 117.70883	May 15, 2003	
			May 22, 2003	
FRE08	N 33.79865	117.72093	April 20, 2004	
Hicks Canyon	HH01	N 33.73061	W 117.72510	May 1, 2003
				March 9, 2003
	HH02	N 33.74000	W 117.70589	February 24, 2004
	HH03	N 33.73547	W 117.71685	March 25, 2004
	HH04	N 33.73567	W 117.71690	April 2, 2004
	HH05	N 33.74595	W 117.71080	April 2, 2004
	HH06	N 33.72128	W 117.72703	April 4, 2004
HH07	N 33.73467	W 117.71988	April 4, 2004	
Irvine Regional Park	IRP01	N 33.79030	W 117.72786	April 24, 2003
				April 30, 2003
	IRP02	N 33.79557	W 117.73632	April 24, 2003
				April 30, 2003
				May 22, 2003
	IRP03	N 33.79644	W 117.73646	April 24, 2003
				April 30, 2003
	IRP04	N 33.79658	W 117.73633	April 24, 2003
				April 30, 2003
	IRP05	N 33.79559	W 117.73693	April 24, 2003
				April 29, 2003
	IRP06	N 33.79947	W 117.75982	April 29, 2003
				May 14, 2003
				April 19, 2004
	IRP07	N 33.80028	W 117.75570	April 23, 2003
				April 29, 2003
May 14, 2003				
April 1, 2005				
IRP08	N 33.80041	W 117.75682	April 29, 2003	
			May 14, 2003	

¹ Coordinates recorded in WGS84, decimal, degrees

Table 1 (continued). Western spadefoot sites, locations, and date(s) surveyed in 2003 and 2004 in the central reserve within the Irvine Ranch Land Reserve.

AREA	SITE	LATITUDE ¹	LONGITUDE ¹	SURVEY DATE
Irvine Regional Park	IRP09	N 33.80050	W 117.75748	April 29, 2003
				April 30, 2003
				May 14, 2003
	IRP10	N 33.80023	W 117.75497	April 29, 2003
				May 19, 2003
				April 10, 2004
	IRP11	N 33.80548	W 117.75797	April 19, 2004
	IRP12	N 33.80538	W 117.75800	April 19, 2004
	IRP13	N 33.8053	W 117.75833	April 19, 2004
IRP14	N 33.80523	W 117.758567	April 19, 2004	
IRP15	N 33.79522	W 117.72957	April 20, 2004	
IRP16	N 33.79517	W 117.72957	April 20, 2004	
Limestone Canyon	LIM01	N 33.7371	W 117.67181	May 1, 2003
	LIM02	N 33.73548	W 117.67065	May 1, 2003
	LIM03	N 33.73542	W 117.6704	May 1, 2003
				May 25, 2003
	LIM04	N 33.71521	W 117.65891	May 1, 2003
	LIM05	N 33.73725	W 117.67177	May 1, 2003
	LIM06	N 33.7371	W 117.67181	May 1, 2003
	LIM07	N 33.73659	W 117.67194	May 1, 2003
	LIM08	N 33.73548	W 117.67065	May 1, 2003
	LIM09	N 33.73531	W 117.67024	May 1, 2003
	LIM10	N 33.71521	W 117.65891	May 1, 2003
	LIM11	N 33.72012	W 117.65020	May 1, 2003
	LIM12	N 33.71622	W 117.66060	May 25, 2003
LIM13	N 33.72057	W 117.64935	May 25, 2003	
Santiago Canyon	SC01	N 33.77465	W 117.74021	April 24, 2003
				April 30, 2003
	SC02	N 33.77690	W 117.74055	April 24, 2003
				April 30, 2003
SC03	N 33.77734	W 117.74008	April 24, 2003	
			April 30, 2003	
SC04	N 33.77832	W 117.74031	April 24, 2003	
Weir Canyon	WEIR01	N 33.83016	W 117.73743	April 30, 2003
				May 14, 2003
	WEIR02	N 33.83113	W 117.73743	April 30, 2003
				May 14, 2003
				April 14, 2004
				April 19, 2004
	WEIR03	N 33.83552	W 117.73434	April 30, 2003
				May 14, 2003
	WEIR04	N 33.83571	W 117.73443	April 1, 2004
				April 30, 2003
	WEIR05	N 33.82154	W 117.74597	May 14, 2003
	WEIR06	N 33.82469	W 117.74379	April 1, 2004
	WEIR07	N 33.82980	W 117.73892	April 19, 2004
	WEIR08	N 33.82992	W 117.73893	April 19, 2004
WEIR09	N 33.84003	W 117.72160	April 19, 2004	
WEIR10	N 33.83420	W 117.73117	April 19, 2004	

¹ Coordinates recorded in WGS84, decimal, degrees

Table 2. Western spadefoot sites, locations, and date(s) surveyed in 2003 and 2004 in the coastal reserve within the Irvine Ranch Land Reserve.

AREA	SITE	LATITUDE ¹	LONGITUDE ¹	SURVEY DATE
Bommer Canyon	BOM01	N 33.63110	W 117.80613	April 9, 2003
				May 14, 2003
	BOM02	N 33.63062	W 117.80650	April 9, 2003
				May 14, 2003
	BOM03	N 33.62994	W 117.80629	April 9, 2003
				May 14, 2003
Coyote Canyon	COY01	N 33.62953	W 117.83890	May 8, 2003
				May 23, 2003
	COY02	N 33.62247	W 117.83511	May 8, 2003
				May 23, 2003
	COY03	N 33.62967	W 117.84063	May 8, 2003
				May 23, 2003
Crystal Cove State Park	CC01	N 33.58822	W 117.78555	April 22, 2003
				May 13, 2003
	CC02	N 33.58249	W 117.78878	April 22, 2003
				May 13, 2003
	CC03	N 33.57610	W 117.79436	April 22, 2003
				May 13, 2003
	CC04	N 33.56957	W 117.80013	April 22, 2003
				May 13, 2003
	CC05	N 33.57613	W 117.80950	April 22, 2003
				May 13, 2003
	CC06	N 33.57495	W 117.80800	May 13, 2003
				May 15, 2003
	CC07	N 33.57463	W 117.80790	May 28, 2003
				May 28, 2003
	CC08	N 33.56127	W 117.79720	May 29, 2003
				June 2, 2003
	CC09	N 33.56117	W 117.79750	May 29, 2003
				June 2, 2003
	CC10	N 33.59795	W 117.82190	May 13, 2003
				May 13, 2003
CC11	N 33.57740	W 117.81040	May 28, 2003	
			May 28, 2003	
CC12	N 33.57779	W 117.81050	May 13, 2003	
			May 28, 2003	
CC13	N 33.57787	W 117.81040	May 13, 2003	
			May 28, 2003	
CC14	N 33.57792	W 117.8103	May 13, 2003	
			May 28, 2003	
CC15	N 33.57558	W 117.81003	April 8, 2004	
CC16	N 33.57318	W 117.80930	April 8, 2004	
CC17	N 33.56128	W 117.79736	April 8, 2004	
CC18	N 33.56093	W 117.79765	April 8, 2004	
CC19	N 33.58553	W 117.81747	April 14, 2004	
CC20	N 33.58550	W 117.81652	April 14, 2004	
Laguna Coast Wilderness Park	LCWP01	N 33.59543	W 117.78441	April 22, 2003
				May 13, 2003
	LCWP02	N 33.59630	W 117.78701	April 22, 2003
				May 13, 2003
	LCWP03	N 33.59929	W 117.79070	May 7, 2003
				June 2, 2003
LCWP04	N 33.59926	W 117.79080	May 7, 2003	
			June 2, 2003	

¹ Coordinates recorded in WGS84, decimal, degrees

Table 2 (continued). Western spadefoot sites, locations, and date(s) surveyed in 2003 and 2004 in the coastal reserve within the Irvine Ranch Land Reserve.

AREA	SITE	LATITUDE ¹	LONGITUDE ¹	SURVEY DATE
Laguna Coast Wilderness Park	LCWP05	N 33.59915	W 117.79090	May 7, 2003
				June 2, 2003
	LCWP06	N 33.59917	W 117.79110	May 7, 2003
				June 2, 2003
	LCWP07	N 33.59920	W 117.79144	May 7, 2003
				June 2, 2003
	LCWP08	N 33.59921	W 117.79150	May 7, 2003
				June 2, 2003
	LCWP09	N 33.59919	W 117.79160	May 7, 2003
				June 2, 2003
	LCWP10	N 33.59916	W 117.79170	May 7, 2003
				June 2, 2003
	LCWP11	N 33.59936	W 117.79182	May 7, 2003
				June 2, 2003
LCWP12	N 33.59795	W 117.82190	May 28, 2003	
LCWP13	N 33.59498	W 117.78378	April 13, 2004	
LCWP14	N 33.59107	W 117.76820	April 13, 2004	
Muddy/Los Trancos Canyon	MUD01	N 33.62339	W 117.82337	April 22, 2003
				May 13, 2003
	MUD02	N 33.64201	W 117.82394	May 7, 2003
				June 2, 2003
	MUD03	N 33.63342	W 117.81368	May 7, 2003
				June 2, 2003
	MUD04	N 33.64329	W 117.82337	May 7, 2003
June 2, 2003				
MUD05	N 33.59758	W 117.82230	May 12, 2003	
			May 28, 2003	
MUD06	N 33.59795	W 117.82190	May 28, 2003	
San Diego Creek	SDC01	N 33.63503	W 117.73720	April 21, 2003
				May 30, 2003
	SDC02	N 33.63505	W 117.73956	April 21, 2003
				May 30, 2003
	SDC03	N 33.63505	W 117.73956	April 21, 2003
				May 30, 2003
	SDC04	N 33.63550	W 117.73237	April 21, 2003
				May 30, 2003
	SDC05	N 33.63549	W 117.73257	April 21, 2003
	SDC06	N 33.63543	W 117.73297	April 21, 2003
				May 30, 2003
	SDC07	N 33.63554	W 117.74388	April 23, 2003
				April 29, 2003
	SDC08	N 33.63566	W 117.74357	April 23, 2003
April 29, 2003				
SDC09	N 33.63544	W 117.74333	April 23, 2003	
			April 29, 2003	
SDC10	N 33.63485	W 117.74588	April 23, 2003	
			April 29, 2003	
SDC11	N 33.63400	W 117.74616	April 23, 2003	
			April 29, 2003	
SDC12	N 33.63063	W 117.74472	April 23, 2003	
			April 29, 2003	
SDC13	N 33.63033	W 117.74474	April 23, 2003	
			April 29, 2003	
SDC14	N 33.62906	W 117.74490	April 23, 2003	
			April 29, 2003	

¹ Coordinates recorded in WGS84, decimal degrees

Table 3. Amphibian detections at western spadefoot survey locations for 2003 and 2004 surveys in the central reserve within the Irvine Ranch Land Reserve. Dashes (—) indicate where no detections were made for that species.

AREA	SITE	NATIVE AMPHIBIANS			EXOTIC AMPHIBIANS	
		Pacific treefrog <i>Hyla regilla</i>	Western spadefoot <i>Spea hammondi</i>	Western toad <i>Bufo boreas</i>	African clawed frog <i>Xenopus laevis</i>	Bullfrog <i>Rana catesbeiana</i>
Fremont Canyon	FRE01	—	—	—	—	—
	FRE02	—	—	—	—	—
	FRE03	X	X	—	—	—
	FRE04	—	—	X	—	—
	FRE05	—	—	—	—	—
	FRE06	—	—	X	—	—
	FRE07	—	—	—	—	—
	FRE08	—	—	—	—	—
Hicks Canyon	HH01	X	X	—	—	—
	HH02	—	X	—	—	—
	HH03	—	—	—	—	—
	HH04	—	—	—	—	—
	HH05	—	—	—	—	—
	HH06	—	—	—	—	—
	HH07	—	—	X	—	—
Irvine Regional Park	IRP01	—	X	—	—	—
	IRP02	X	X	—	—	—
	IRP03	X	—	X	—	—
	IRP04	X	X	X	—	—
	IRP05	—	—	—	—	—
	IRP06	—	—	—	—	—
	IRP07	X	—	X	—	—
	IRP08	X	—	X	—	—
	IRP09	—	—	X	—	—
	IRP10	X	—	X	—	—
	IRP11	—	—	—	—	—
	IRP12	—	—	—	—	—
	IRP13	—	—	—	—	—
	IRP14	—	—	—	—	—
	IRP15	—	—	—	—	—
	IRP16	—	—	—	—	—
Limestone Canyon	LIM01	X	—	—	—	—
	LIM02	X	—	X	—	—
	LIM03	—	—	X	—	—
	LIM04	—	—	—	—	—
	LIM05	X	—	X	—	—
	LIM06	—	—	—	—	—
	LIM07	X	—	—	—	—
	LIM08	—	—	—	—	—
	LIM09	X	—	—	—	—
	LIM10	—	X	X	—	—
	LIM11	—	—	—	—	—
	LIM12	—	—	—	—	—
	LIM13	—	—	—	—	—
Santiago Canyon	SC01	X	X	—	—	—
	SC02	X	X	—	—	—
	SC03	X	X	—	—	—
	SC04	X	X	—	—	—
Weir Canyon	WEIR01	X	—	—	—	—
	WEIR02	—	—	—	—	—
	WEIR03	—	X	—	—	—
	WEIR04	—	X	—	—	—
	WEIR05	—	—	—	—	—
	WEIR06	X	—	—	—	—
	WEIR07	—	—	—	—	—
	WEIR08	—	—	—	—	—
	WEIR09	—	—	—	—	—
	WEIR10	—	—	—	—	—
TOTALS	58	19	13	13	0	0

Table 4. Amphibian detections at western spadefoot survey locations for 2003 and 2004 surveys in the coastal reserve within the Irvine Ranch Land Reserve. Dashes (—) indicate where no detections were made for that species.

AREA	SITE	NATIVE AMPHIBIANS			EXOTIC AMPHIBIANS	
		Pacific treefrog	Western spadefoot	Western toad	African clawed frog	Bullfrog
		<i>Hyla regilla</i>	<i>Spea hammondi</i>	<i>Bufo boreas</i>	<i>Xenopus laevis</i>	<i>Rana catesbeiana</i>
Bommer Canyon	BOM01	—	—	X	X	—
	BOM02	—	—	X	X	—
	BOM03	—	—	X	X	—
Coyote Canyon	COY01	X	—	—	X	—
	COY02	X	—	X	—	—
	COY03	—	—	—	—	—
Crystal Cove State Park	CC01	—	—	X	—	—
	CC02	—	—	—	—	—
	CC03	—	X	—	—	—
	CC04	—	—	—	—	—
	CC05	—	—	—	—	—
	CC06	X	—	—	—	—
	CC07	X	—	—	—	—
	CC08	X	—	X	—	—
	CC09	X	—	X	—	—
	CC10	X	—	—	—	—
	CC11	X	—	—	—	—
	CC12	X	—	X	—	—
	CC13	X	—	X	—	—
	CC14	X	—	X	—	—
	CC15	—	—	X	—	—
	CC16	X	—	—	—	—
	CC17	—	—	—	—	—
	CC18	—	—	—	—	—
	CC19	—	—	—	—	—
	CC20	—	—	—	—	—
Laguna Coast Wilderness Park	LCWP01	X	X	—	—	—
	LCWP02	—	X	—	—	—
	LCWP03	X	—	—	—	—
	LCWP04	X	—	X	—	—
	LCWP05	X	X	X	—	—
	LCWP06	—	—	—	—	—
	LCWP07	—	—	—	—	—
	LCWP08	X	—	—	—	—
	LCWP09	X	—	—	—	—
	LCWP10	X	X	X	—	—
	LCWP11	—	—	—	—	—
	LCWP12	X	—	X	—	—
	LCWP13	—	X	—	—	—
	LCWP14	X	—	—	—	—
Muddy/Los Trancos Canyon	MUD01	—	—	—	—	—
	MUD02	—	—	—	—	—
	MUD03	—	—	—	—	—
	MUD04	—	—	—	—	—
	MUD05	—	—	—	—	—
	MUD06	—	—	—	—	—
San Diego Creek	SDC01	—	—	—	—	—
	SDC02	—	—	—	—	—
	SDC03	—	—	—	—	—
	SDC04	X	—	—	—	X
	SDC05	—	—	—	—	—
	SDC06	—	—	—	—	—
	SDC07	—	—	—	—	—
	SDC08	—	—	X	—	—
	SDC09	X	—	X	—	—
	SDC10	X	—	X	—	—
	SDC11	—	—	—	X	—
	SDC12	—	—	—	—	—
	SDC13	—	—	—	—	—
	SDC14	—	—	—	—	—
TOTALS	60	24	6	18	5	4

Table 5. Western pond turtle sites, locations, and date(s) surveyed in 2003 and 2004 in the central reserve within the Irvine Ranch Land Reserve.

AREA	SURVEY TYPE	LATITUDE ¹	LONGITUDE ¹	SURVEY DATE	TRAP DAYS ²
Baker Canyon (1)	Box	33.75433	117.67755	July 14 - 18, 2003	40
Irvine Lake (2)	Hoop, Minnow	33.77458	117.72225	September 29 - October 3, 2003	80
Peters Canyon Wash (3)	Visual	33.76167	117.77130	October 20, 2003	0
Peters Canyon Reservior (4)	Box, Hoop	33.77977	117.76123	July 14 - 18, 2003	48
				June 22 - 24, 2004	
Rattlesnake Reservoir (5)	Hoop, Minnow	33.72913	117.74177	October 6 - 10, 2003	36
Siphon Reservoir (6)	Hoop, Minnow	33.70938	117.73012	October 6 - 10, 2003	36

¹Coordinates recorded in WGS84, decimal degrees

²Trap days are the total number of traps used multiplied by the number of days the site was trapped

Table 6. Western pond turtle sites, locations, and date(s) surveyed in 2003 and 2004 in the coastal reserve within the Irvine Ranch Land Reserve.

AREA	SURVEY TYPE	LATITUDE ¹	LONGITUDE ¹	SURVEY DATE	TRAP DAYS ²
Barbara's Lake (7)	Hoop, Minnow	33.61043	117.75712	September 22 - 26, 2003	64
Big Canyon (8)	Hoop, Minnow	33.62895	117.87862	October 14 - 17, 2003	12
Big Canyon Country Club (9)	Hoop, Minnow	33.62068	117.86812	October 7 - 10, 2003	21
Bommer Canyon (10)	Hoop, Minnow	33.63167	117.88457	September 2 - 5, 2003	9
Bonita Canyon (11)	Hoop, Minnow, Visual	33.63210	117.84962	August 20 - 25, 2003	5
				October 30, 2003	
Heritage Park (12)	Box, Hoop, Minnow	33.70038	117.77853	September 2 - 5, 2003	102
Jamboree Pond (13)	Hoop, Minnow	33.70422	117.79998	October 14 - 17, 2003	3
Laguna Reservoir (14)	Hoop, Minnow	33.64173	117.75832	September 22 - 26, 2003	36
Laguna Lakes (15)	Box, Hoop, Minnow	33.61043	117.75712	August 4 - 7, 2003	66
Marine Corps Base Tustin (16)	Visual	33.69722	117.82413	May 3, 2004	0
Mason Regional Park (17)	Hoop, Minnow	33.65557	117.83497	November 3 - 6, 2003	15
Newport Beach Country Club (18)	Box, Hoop, Minnow	33.62253	117.88153	October 6 - 10, 2003	20
Paularino Creek Channel (19)	Box, Hoop, Minnow	33.67775	117.90223	September 15 - 19, 2003	38
				November 3 - 6, 2003	
Peters Canyon Creek (20)	Visual	33.69176	117.82285	October 20, 2003	0
San Diego Creek (21)	Box, Hoop, Minnow, Visual	33.64988	117.75528	September 8 - 12, 2003	55
				October 6, 2003	
				May 24 - 26, 2004	
San Diego Creek Channel (22)	Box, Hoop, Minnow	33.65173	117.85948	September 15 - 19, 2003	245
				September 22 - 26, 2003	
				September 29 - October 3, 2003	
				October 6 - 10, 2003	
San Joaquin Wildlife Sanctuary (23)	Hoop, Minnow	33.66087	117.84663	October 14 - 17, 2003	75
				October 27 - 31, 2003	
Sand Canyon Reservoir (24)	Hoop, Minnow	33.64778	117.79612	October 14 - 15, 2003	4
Santa Isabel Creek Channel (25)	Visual	33.64585	117.89327	September 16, 2003	0
Shady Canyon Golf Club (26)	Hoop	33.62638	117.79450	October 6 - 10, 2003	24
Strawberry Farm Golf Course (27)	Hoop, Minnow	33.64778	117.79430	October 14 - 17, 2003	12
Turtle Rock Creek (28)	Hoop, Minnow	33.63320	117.80544	October 20-24, 2003	4
Turtle Rock Pond (29)	Hoop, Minnow	33.63373	117.80544	October 20-24, 2003	8
UCI's San Joaquin Freshwater Marsh (30)	Hoop, Minnow	33.65370	117.84928	October 6 - 10, 2003	40
Veeh Creek Channel (31)	Hoop, Minnow	33.62738	117.72440	October 27 - 31, 2003	12
Woodbridge Lakes (32)	Hoop, Minnow	33.68407	117.79092	November 3 - 6, 2003	24

¹Coordinates recorded in WGS84, decimal degrees

²Trap days are the total number of traps used multiplied by the number of days the site was trapped

Table 7. Species detections at western pond turtle survey locations for 2003 and 2004 surveys in the central reserve within the Irvine Ranch Land Reserve. Dashes (—) indicate where no species were detected.

AREA	NATIVE TURTLES		EXOTIC TURTLES										OTHER EXOTICS			
	COMMON NAME	Western Pond Turtle	False map	Painted	Red-eared slider	River cooter	River cooter species	Slider	Snapping	Sonoran mud	Spiny softshell	Yellow-bellied slider	Crayfish	Fish	African clawed frog	Bullfrog
	SCIENTIFIC NAME	<i>Emys marmorata</i>	<i>Graptemys pseudogeographica</i>	<i>Chrysemys picta</i>	<i>Trachemys scripta elegans</i>	<i>Pseudemys concinna</i>	<i>Pseudemys</i> species	<i>Trachemys scripta</i>	<i>Chelydra serpentina</i>	<i>Kinosternon sonoriense</i>	<i>Apalone spiniferus</i>	<i>Trachemys scripta scripta</i>	<i>Procambarus clarkii</i>		<i>Xenopus laevis</i>	<i>Rana catesbeiana</i>
Baker Canyon (1)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Irvine Lake (2)	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—	—
Peters Canyon Wash (3)	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—
Peters Canyon Reservoir (4)	—	—	X	X	—	—	X	X	X	X	—	—	—	—	—	X
Rattlesnake Reservoir (5)	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
Siphon Reservoir (6)	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
TOTAL	0	0	1	1	0	0	1	1	1	1	0	4	0	0	1	

Table 8. Species detections at western pond turtle survey locations for 2003 and 2004 surveys in the coastal reserve within the Irvine Ranch Land Reserve. Dashes (—) indicate where no species were detected.

AREA	COMMON NAME	NATIVE TURTLES	EXOTIC TURTLES										OTHER EXOTICS			
		Western Pond Turtle	False map	Painted	Red-eared slider	River cooter	River cooter species	Slider	Snapping	Sonoran mud	Spiny softshell	Yellow-bellied slider	Crayfish	Fish	African clawed frog	Bullfrog
		<i>Emys marmorata</i>	<i>Graptemys pseudogeographica</i>	<i>Chrysemys picta</i>	<i>Trachemys scripta elegans</i>	<i>Pseudemys concinna</i>	<i>Pseudemys</i> species	<i>Trachemys scripta</i>	<i>Chelydra serpentina</i>	<i>Kinosternon sonoriense</i>	<i>Apalone spiniferus</i>	<i>Trachemys scripta scripta</i>	<i>Procambarus clarkii</i>		<i>Xenopus laevis</i>	<i>Rana catesbeiana</i>
Barbara's Lake (7)	—	—	—	X	—	—	—	—	—	—	—	X	X	—	X	
Big Canyon (8)	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—	
Big Canyon Country Club (9)	—	—	—	—	—	—	—	—	—	—	—	X	X	—	X	
Bommer Canyon (10)	—	—	—	—	—	—	—	—	—	—	—	X	X	—	X	
Bonita Canyon (11)	X ¹	—	—	—	—	—	—	—	—	—	—	—	—	—	X	
Heritage Park (12)	—	—	X	X	—	—	—	—	—	X	—	—	X	—	—	
Jamboree Pond (13)	—	—	—	—	—	—	—	—	—	X ¹	—	—	—	—	—	
Laguna Lakes (14)	—	—	—	—	—	—	—	—	—	—	X	—	—	X	—	
Laguna Reservoir (15)	—	—	—	X	—	—	—	—	—	—	—	X	X	—	X	
Marine Corps Base Tustin (16)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Mason Regional Park (17)	—	X	—	X	—	—	X	—	—	—	—	—	—	—	—	
Newport Beach Country Club (18)	—	—	X	—	—	—	—	—	—	—	—	X	X	—	—	
Paularino Creek Channel (19)	—	—	X	—	—	—	—	—	—	—	—	—	X	—	—	
Peters Canyon Creek (20)	—	—	—	—	—	—	—	—	—	—	—	X	X	—	—	
San Diego Creek (21)	—	—	X	X	—	—	—	—	—	—	—	X	X	X	X	
San Diego Creek Channel (22)	X	—	—	X	—	—	—	—	—	X	—	X	X	—	—	
San Joaquin Wildlife Sanctuary (23)	—	—	—	X	—	—	—	—	—	X	—	X	X	X	—	
Sand Canyon Reservoir (24)	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	
Santa Isabel Creek Channel (25)	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	
Shady Canyon Golf Club (26)	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	
Strawberry Farm Golf Course (27)	X ¹	—	—	—	—	—	—	—	—	—	—	X	—	—	—	
Turtle Rock Creek (28)	—	—	—	X	—	—	—	—	—	—	—	—	—	X	—	
Turtle Rock Pond (29)	—	—	—	X ¹	—	—	—	—	—	—	—	—	—	X	—	
UCI's San Joaquin Freshwater Marsh (30)	X	—	—	X	—	—	—	—	—	—	—	X	X	X	—	
Veeh Creek Channel (31)	—	—	—	—	—	—	—	—	—	—	—	X	X	X	—	
Woodbridge Lakes (32)	—	—	—	X	X	X	X	—	—	—	—	X	X	—	—	
TOTAL	4	1	4	11	1	1	2	0	0	4	1	15	15	9	6	

¹ Visual observation only

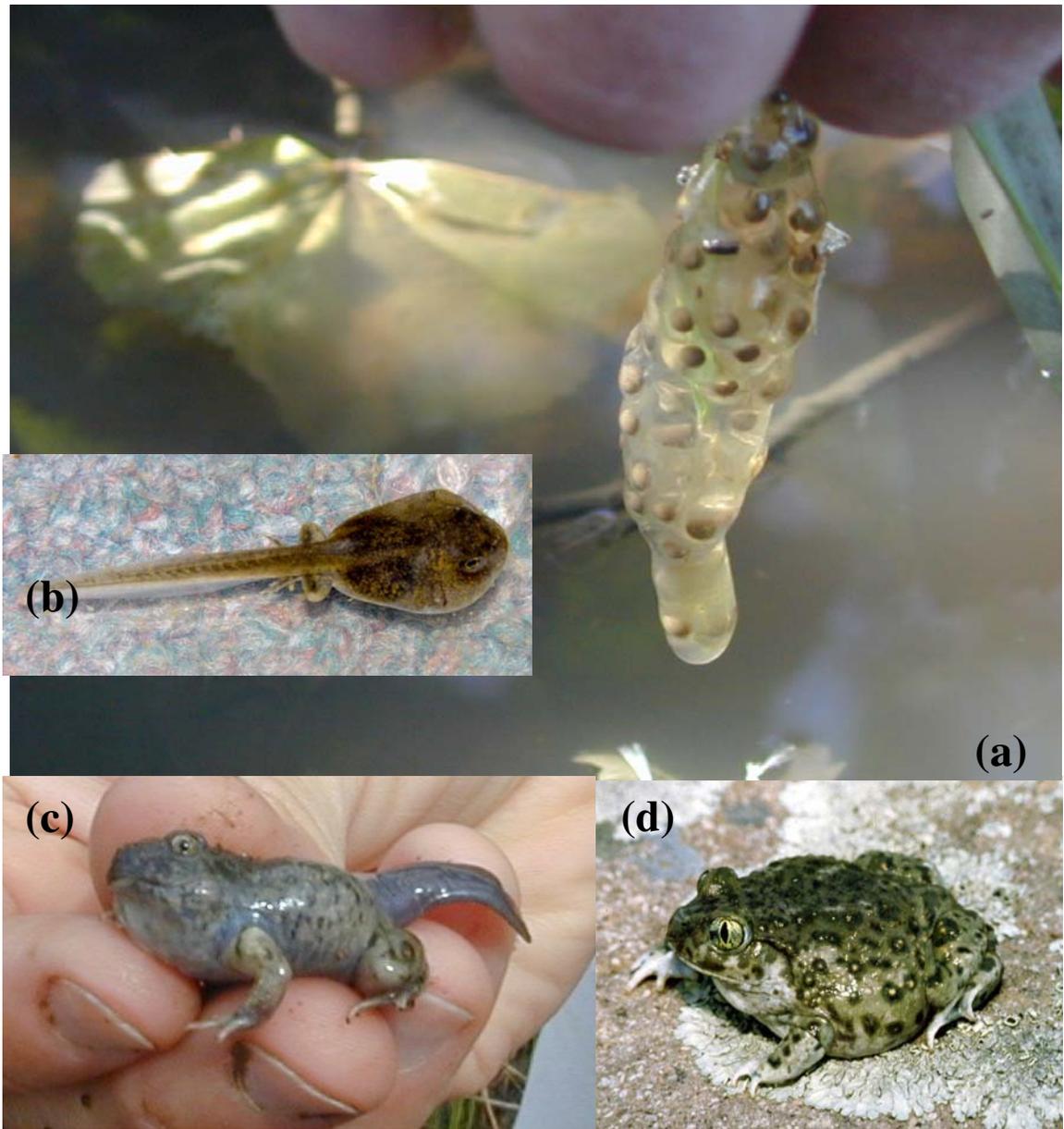


Figure 1. Western spadefoot life stages: (a) egg mass, (b) tadpole, (c) metamorph, and (d) adult.

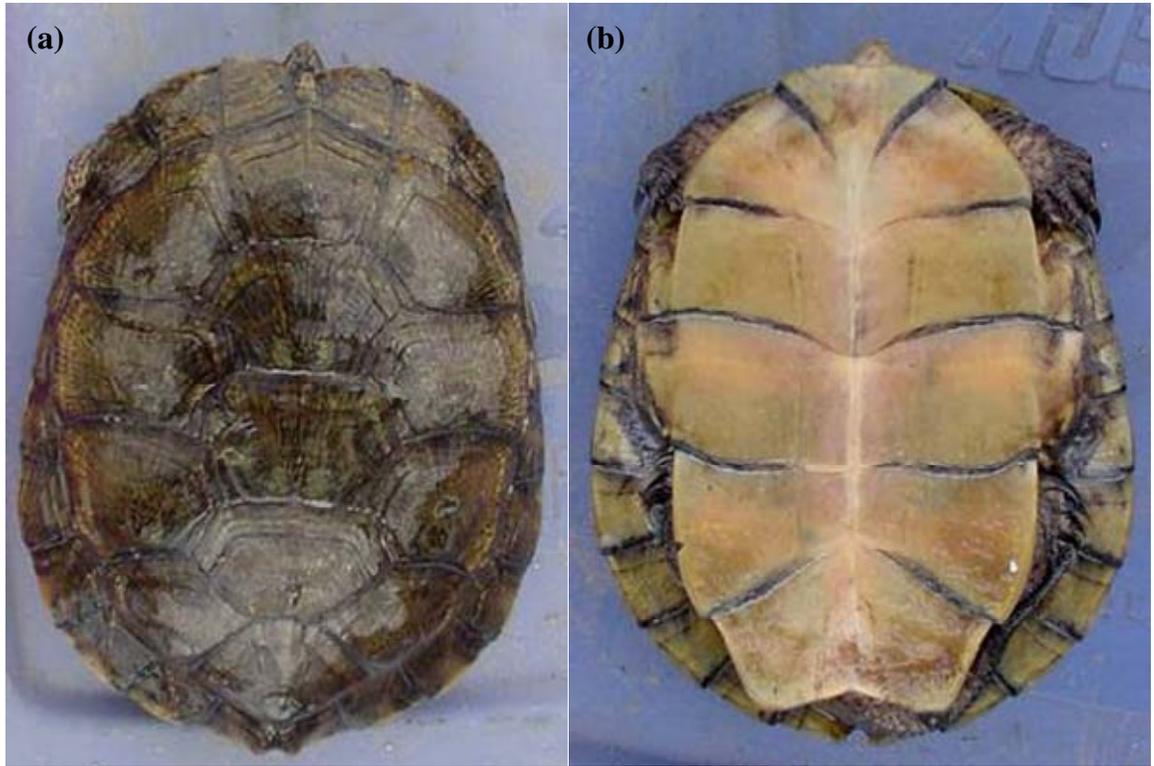


Figure 2. Western pond turtle: (a) carapace and (b) plastron.

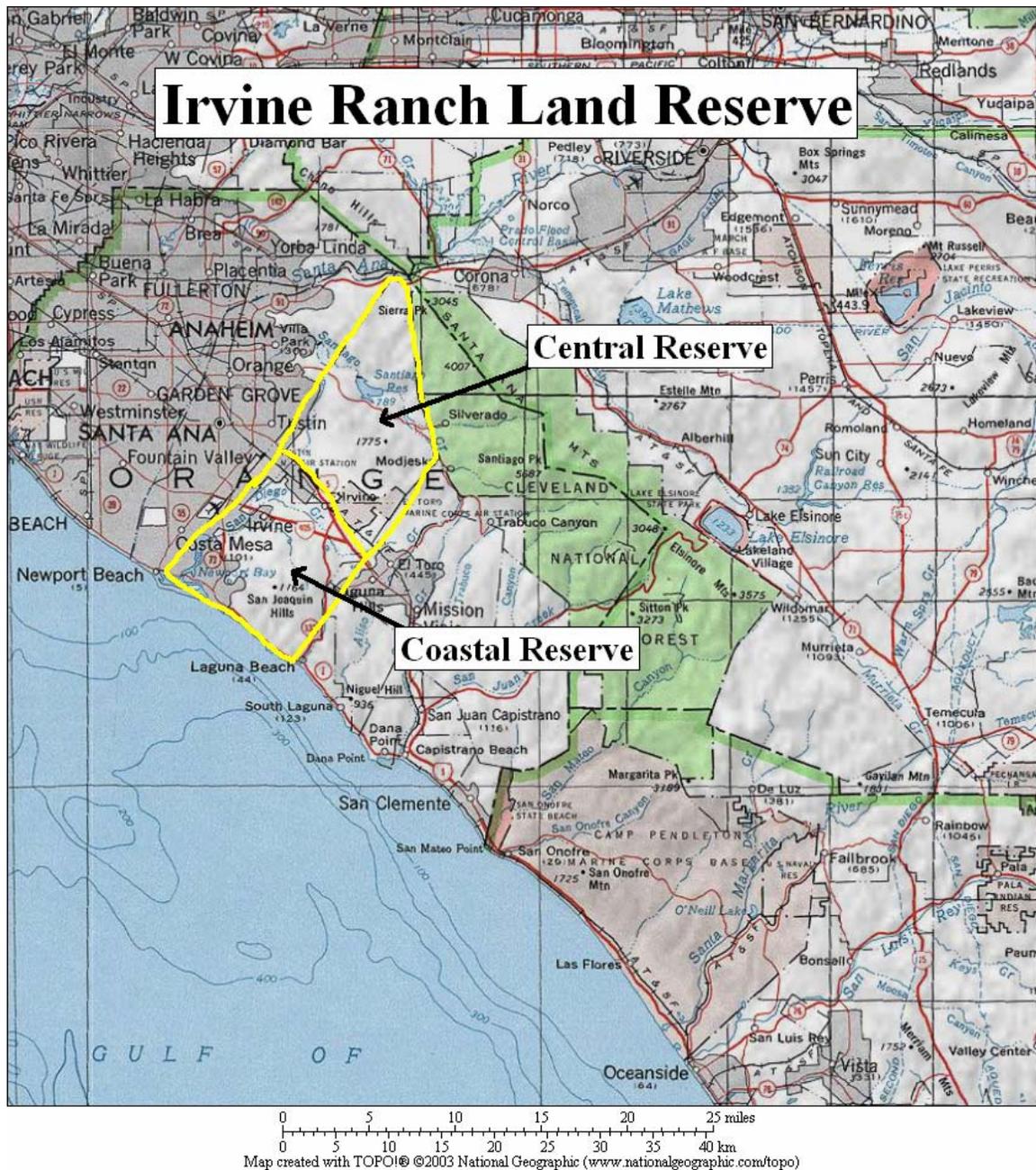


Figure 3. Western spadefoot and western pond turtle study area on the Irvine Ranch Land Reserve.



Figure 4. Western spadefoot survey locations for 2003 and 2004 in the central and coastal reserves within the Irvine Ranch Land Reserve.



Figure 5. Hicks Canyon pool 1, western spadefoot habitat in grassland.



Figure 6. Irvine Regional Park pool 1. Lower left inset shows western spadefoot tadpoles at this site.

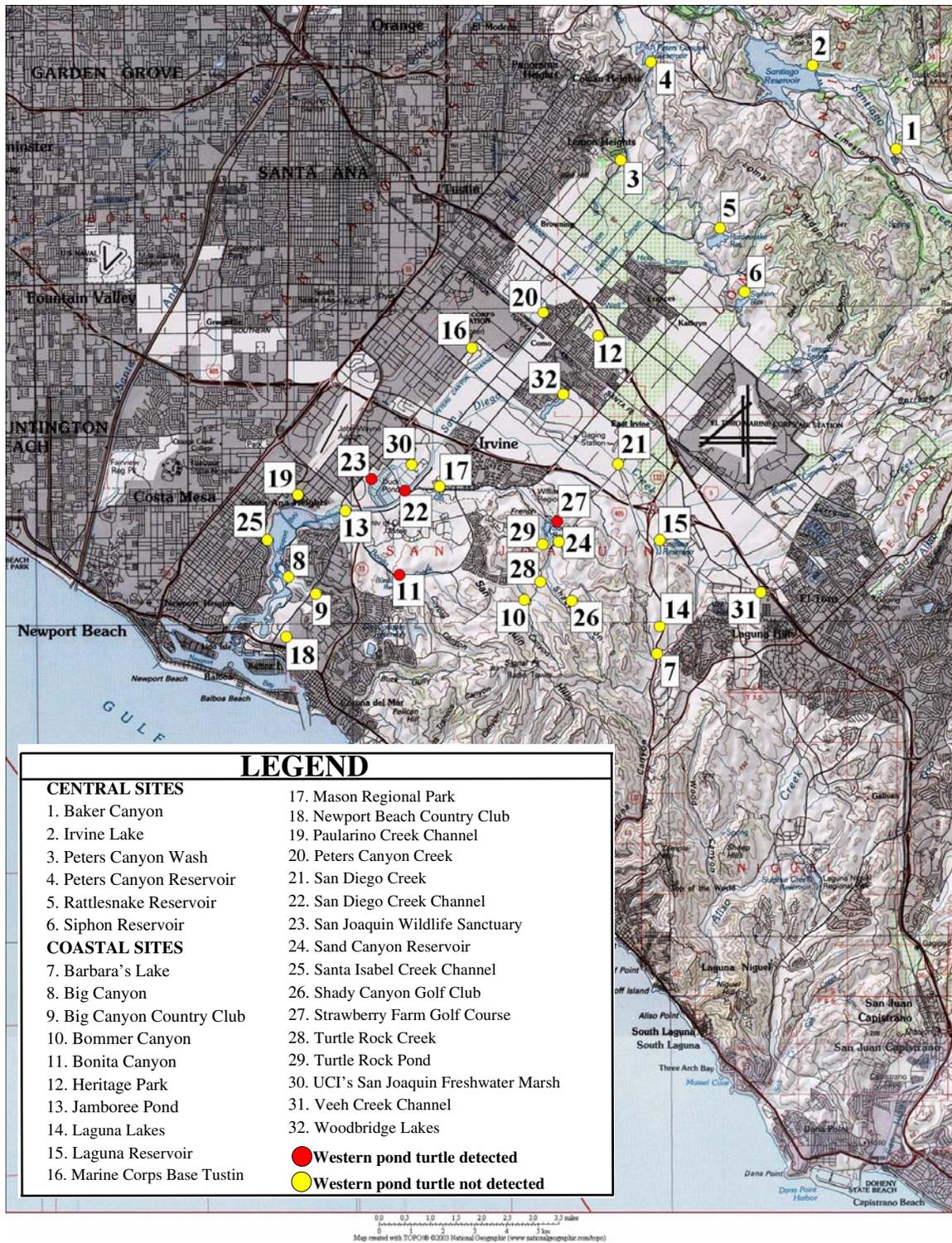


Figure 7. Western pond turtle survey locations for 2003 and 2004 in central and coastal reserves within the Irvine Ranch Land Reserve.

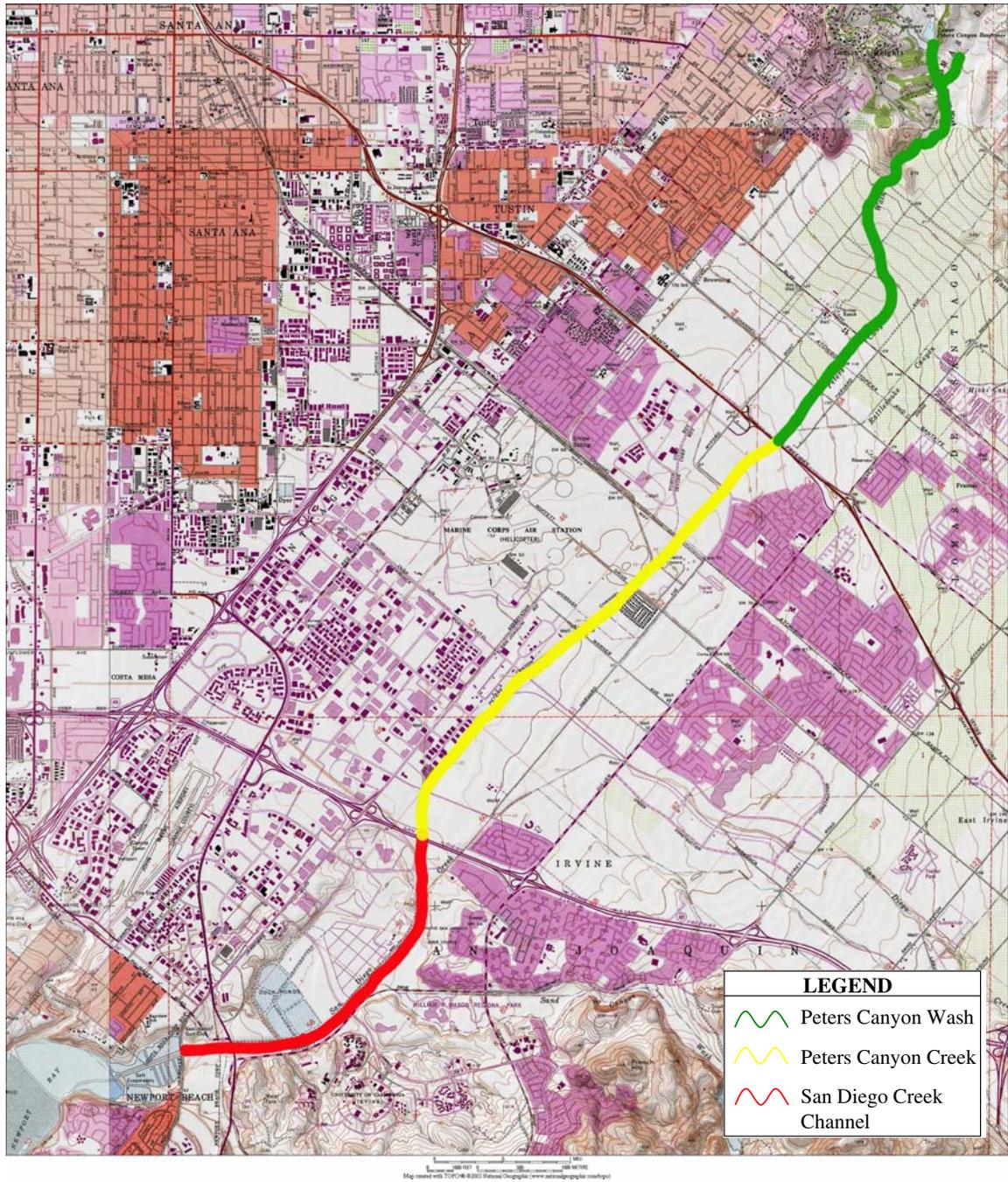


Figure 8. Visual encounter survey locations for western pond turtles in San Diego Creek Channel, Peters Canyon Creek, and Peters Canyon Wash.

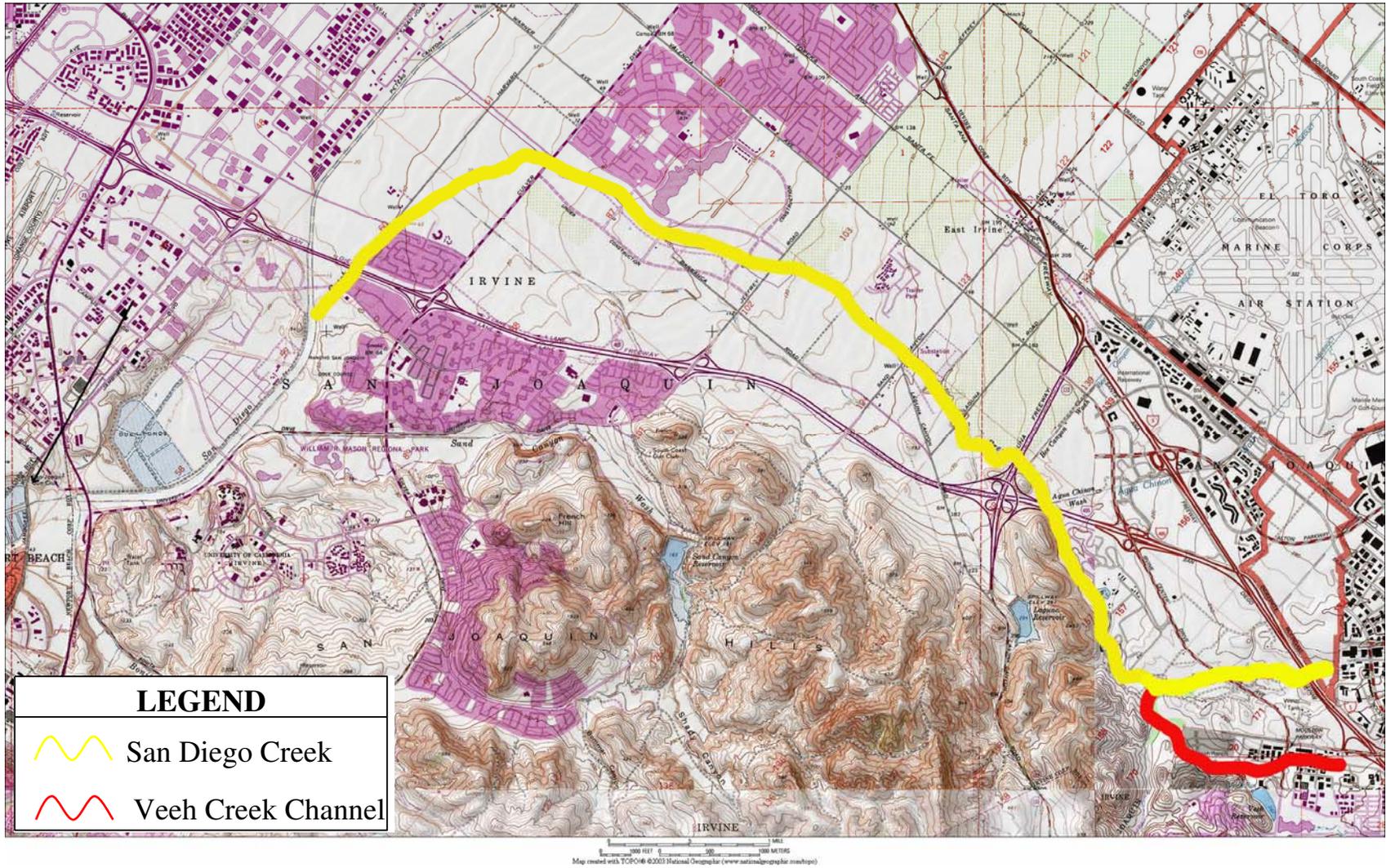


Figure 9. Visual encounter survey locations for western pond turtles in San Diego and Veeh Creeks.



Figure 10. UCI's San Joaquin Freshwater Marsh, western pond turtle habitat.



Figure 11. San Diego Creek Channel, western pond turtle habitat.

APPENDIX A. Summary of spadefoot sites and observations. All references are from results of surveys, except where noted. For all sites, refer to Tables 3 and 4.

Central Reserves

Fremont Canyon (1) — This 8,500-acre open space reserve is comprised of riparian, oak woodland, grasslands along with steep slopes supporting coastal sage scrub and chaparral habitat. Of the eight pools surveyed in 2003 there were no spadefoots detected, however, in 2004 we detected spadefoot tadpoles in one pool. We also detected the Pacific treefrog and western toad in Fremont Canyon.

Hick's Canyon (2) — Located within Lomas Ridge, a 3,200-acre open space, comprised of oak woodland, grassland, coastal sage scrub and chaparral habitat. There was only seven pools surveyed and spadefoots were documented at two (Figure 5).

Irvine Regional Park (3) — This 477-acre regional park is situated among oak and sycamore trees with rolling foothills of chaparral and coastal sage scrub. Of the 16 pools surveyed, spadefoot tadpoles were documented at two intermittent pools in the sandy wash. Spadefoot tadpoles were also found in one pool in the same area in 2004 (Figure 6).

Limestone Canyon (4) — This 7,600-acre open space reserve is comprised of riparian, oak woodland, grasslands along with steep ridges supporting coastal sage scrub and chaparral habitat. Of the 13 pools surveyed, only one had spadefoot tadpoles documented. The Pacific treefrog and western toad were also present.

Santiago Canyon (5) — Located adjacent the Santiago Landfill in a disturbed sloped grassland. The area has ephemeral pools created by previous motor-cross usage and subsequent construction of the adjacent landfill. All four pools surveyed had spadefoot egg masses, tadpoles and metamorphs in these earthen depressions. Pacific treefrogs were also detected.

Weir Canyon (6) — This 1,575-acre open space reserve is comprised of riparian, oak woodland, and grasslands along with steep slopes supporting coastal sage scrub and

chaparral habitat. Of the 10 pools surveyed, spadefoot tadpoles were detected in 2 road rut pools. Pacific treefrog tadpoles were also documented.

Coastal Reserves

Bommer Canyon (7) — This 950-acre open space reserve is comprised of grasslands and coastal ridges supporting sage scrub, willows, mulefat and other native vegetation. Of the three pool locations surveyed, no spadefoots were detected; although, the western toad and exotic African clawed frog were present.

Coyote Canyon (8) — Located in San Joaquin Hills adjacent the 73 Transportation Corridor and Newport Coast Drive in Irvine. Of the three pools surveyed, there were no spadefoots detected; while, the Pacific treefrog, western toad, and the non-native African clawed frog were present. The 1995 surveys of pools in this region also detected no spadefoots (LSA, 1995).

Crystal Cove State Park (9) — This site was the second largest site surveyed with 2,800 acres of reserve land. The area includes coastal canyons, riparian, oak woodland, grassland and steep ridges supporting coastal sage scrub and chaparral habitat. Of the 20 pools surveyed, only one had spadefoot tadpole activity documented in an earthen depression.

Laguna Coast Wilderness Park (10) — This 6,400-acre open space reserve is comprised of coastal canyons, riparian, oak woodland, grassland and steep ridges supporting coastal sage scrub and chaparral habitat. Of the 14 pools surveyed, five had spadefoots tadpoles documented.

Muddy/Los Trancos Canyon (11) — This site is part of the Laguna Coast Wilderness park, located along the edges of urban development (less than 150 m away from roads, housing or other development). Natural habitats in the area include riparian, grassland and steep ridges supporting coastal sage scrub and chaparral. In the six pools surveyed, we detected no amphibians of any kind.

San Diego Creek (12) — This creek runs through the central portion of the Irvine Ranch lands. The creek crosses I-405 twice between the I-5 and California State Route 73 and transitions into a riparian system as it approaches the San Diego Creek Channel. Intermittent pools, formed after precipitation, were surveyed along and adjacent to the creek. Of the 14 pools surveyed, there were no spadefoots detected; the Pacific treefrog, western toad, non-native bullfrog and non-native African clawed frog were detected.

APPENDIX B. Summary of western pond turtle sites and observations. All references are from results of surveys, except where noted. For all sites, refer to Tables 7 and 8.

Central Reserve

Baker Canyon (1) — This pond is situated in the 1,125-acre open space reserve at the mouth of Baker Canyon which includes riparian, oak woodland, grassland, coastal sage scrub and chaparral habitats. There were no turtles or other vertebrates captured at this site.

Irvine Lake (2) — Formerly known as Santiago Reservoir, this lake stores approximately 28,000 acre-feet of water. There were no turtles captured here but crayfish and a wide variety of exotic game fish (black crappie, blue-gill sunfish, channel catfish, and largemouth bass) were documented.

Peters Canyon Wash (3) — This wash runs through the western portion of the IRLR. The creek runs south from Peters Canyon Reservoir, adjacent the 261 Transportation Corridor and drains into Peters Canyon Creek (Figure 8). There were no turtles or exotics captured or observed at this site.

Peters Canyon Reservoir (4) — This reservoir is situated within the 354-acres Peters Canyon Regional Park along with native vegetation including coastal sage scrub and riparian habitat. We captured no pond turtles at this site but did capture exotic turtles.

Rattlesnake Reservoir (5) — This reservoir is situated in the middle of an avocado orchard. We captured exotic crayfish here, but no native or exotic turtles, fish or amphibians.

Siphon Reservoir (6) — This reservoir is situated in a 214-acre site comprised of preserved and re-vegetated coastal sage scrub which was formerly agricultural land. There were no turtles captured; although, exotic blue-gill sunfish, channel catfish, and largemouth bass were documented.

Coastal Reserve

Barbara's Lake (7) — This lake is located in the Dilley Greenbelt Preserve east of Laguna Coast Wilderness Park. The lake is situated south of the Laguna Reservoir and east of Laguna Lakes. There were no pond turtles captured here, but a red-eared slider, bullfrog and channel catfish were captured or observed.

Big Canyon (8) — This canyon consist of a creek and pond. The creek runs through a small riparian area that drains into Big Canyon Pond located adjacent Newport Back Bay. There were no turtles observed at this site, but we did document exotic African clawed frogs and crayfish in the pond. In 1997, Harmsworth Associates captured three pond turtles at this site (Harmsworth, 1998).

Big Canyon Country Club (9) — This site is a 150-acre golf course consisting of five artificial ponds. It has large rolling greens surrounded on all sides by housing and roads. There were no turtles captured, however, exotic African clawed frog, crayfish, fathead minnows, and mosquito fish were detected.

Bommer Canyon (10) — This is a catchment pond situated at the base of Bommer Canyon and surrounded by native vegetation consisting of willows and mulefat. The pond drains an approximately 950-acre area including coastal sage scrub habitat. A single unidentified turtle was visually observed here, along with African clawed frogs, crayfish, and mosquito fish.

Bonita Canyon (11) — This canyon consists of a creek and reservoir. The creek runs through the open space reserve of Bonita Canyon and is located between San Joaquin Hills and Newport Bay. There were no turtles or exotics observed in this creek. The reservoir is situated between San Joaquin Hills and Newport Bay in the open space reserve of Bonita Canyon. Harmsworth Associates captured three pond turtles at this site in 1997 (Harmsworth, 1998). During our current trapping surveys of the reservoir, we visually observed one pond turtle. We also found African clawed frogs at this site.

Heritage Park (12) — This public park has a pond situated at its center. There were no pond turtles captured here, but channel catfish, painted turtles, red-eared sliders, and spiny softshell turtles were documented.

Jamboree Pond (13) — This pond is located adjacent the San Diego Creek Channel, situated between Jamboree Road and the 73 Transportation Corridor. Only African clawed frogs and spiny softshell turtles were observed here.

Laguna Lakes (14) — Two natural lakes lie within the 2,000-acre open space reserve of Laguna Coast Wilderness Park. These lakes are located across California State Route 133, west of Laguna Reservoir and Barbara's Lake. There were no turtles captured here, but we did visually document African clawed frogs.

Laguna Reservoir (15) — This reservoir is situated adjacent to an agricultural field and California State Route 133. We captured no pond turtles here, but did capture blue-gill sunfish, bullfrogs, crayfish, and red-eared sliders.

Marine Corps Base Tustin (16) — This 84.5-acre open space area was formerly the Tustin U.S. Marine Corps Air Station. The base is adjacent the San Diego Creek Channel and has ephemeral pools along the intersection of Jamboree Road and Barranca Parkway. We were unable to visit this site prior to drying.

Mason Regional Park (17) — This pond and adjacent natural creek are situated within a recreational public park consisting of 345-acres of open space grassy knolls. We captured no pond turtles here, but did document the presence of a false map turtle and red-eared slider in the pond. No turtles or exotics were observed in this creek.

Newport Beach Country Club (18) — This 192-acre golf course includes one pond set amid large rolling greens surrounded by planted native vegetation. Blue-gill sunfish, crayfish, and one painted turtle were captured.

Paularino Creek Channel (19) — Also known as Santa Ana Delhi this creek channel has only a few sections accessible by the public and is located north of Upper Newport Bay, in the Upper Newport Bay Ecological Preserve and Regional Park. Fathead minnows were the only species detected. Pond turtles were detected here in 1997 (Harmsworth, 1998).

Peters Canyon Creek (20) — After Peters Canyon Wash meets up with this creek it continues south beneath the I-5, draining into the San Diego Creek Channel (Figure 8). No pond turtles were captured, but we did capture or observe several exotic species: African clawed frogs, crayfish, mosquito fish, and spiny softshell turtles.

San Diego Creek (21) — This creek runs through the central portion of the Irvine Ranch lands. The creek crosses I-405 twice between the I-5 and California State Route 73 and transitions into a riparian system as it approaches the San Diego Creek Channel. We captured no pond turtles but did capture the following exotic species; bullfrogs, crayfish, mosquito fish, painted turtles, and red-eared sliders (Figure 9).

San Diego Creek Channel (22) — This is the widest section of the San Diego Creek as it runs adjacent the San Joaquin Wildlife Sanctuary and UCI's San Joaquin Freshwater Marsh before entering the Upper Newport Bay Ecological Reserve (Figure 10). We captured and PIT-tagged six pond turtles and also captured red-eared sliders, spiny softshell turtles and several exotic fishes in this section.

San Joaquin Wildlife Sanctuary (23) — This 275-acre wetland marsh is dominated by native vegetation and situated adjacent to the San Diego Creek Channel. A major road separates this site from the UCI's San Joaquin Freshwater Marsh. We captured no pond turtles here, but we did capture a diverse array of exotic species; including African clawed frogs, blue-gill sunfish, common carp, crayfish, red-eared sliders, and spiny softshell turtles.

Sand Canyon Reservoir (24) – This reservoir is situated in the middle of the Strawberry Farms Golf Course. No pond turtles, only African clawed frogs were detected in 2003.

Pond turtles were documented at the site in 2001. Biologists trapped 14 adult pond turtles here in 2001, which were relocated to the Shady Canyon turtle pond (Harmsworth, 2002).

Santa Isabel Creek Channel (25) — This creek channel is not easily accessible by the public and is located northwest of the Upper Newport Bay Ecological Preserve near the intersections of Santa Isabel Road and Irvine Avenue at the Costa Mesa and Newport Beach junction. There were no pond turtles detected only crayfish were documented.

Shady Canyon Golf Club (26) — Two ponds situated on a 300-acre golf course containing land with a natural riparian area and foothill slopes. The ponds are adjacent to the Shady Canyon Open Space Reserve and surrounded by coastal sage scrub habitat. There were no turtles, but exotic African clawed frogs were present.

Strawberry Farm Golf Course (27) — The pond is located on a 6,700-yard golf course set amid Shady and Bommer Canyons. It has large rolling greens surrounded and natural vegetation and hillsides studded with granite boulders and an artificially created waterfall. Only crayfish were captured, however, one pond turtle was visually detected.

Turtle Rock Creek (28) — Situated in the middle of Turtle Rock Community Center, a public park, this creek (which is the downstream continuation of Bommer Canyon) is openly accessible by the general public and runs into Turtle Rock Pond. Because of its small size and lack of deep water, we had to use box traps which captured one red-eared slider and one African clawed frog.

Turtle Rock Pond (29) — This pond is situated on five acres of land in The Irvine Open Space Preserve Nature Center, which is located at the base of San Joaquin Hills. The Nature Center serves as both wildlife habitat and an outdoor educational center. The pond is surrounded by native vegetation consisting of oaks, willows, and mulefat. We observed no pond turtles, but did visually document three exotic red-eared sliders and African clawed frogs.

UCI's San Joaquin Freshwater Marsh (30) — This 202-acre marsh is adjacent to the San Diego Creek Channel (Figure 11). The marsh is a remnant of the historic natural wetland ecosystem that existed near the confluence of the Santa Ana River and San Diego Creek, and is still largely dominated by native vegetation. We captured six pond turtles here along with red-eared sliders, African clawed frogs, crayfish, and fathead minnows.

Veeh Creek Channel (31) — This creek is openly accessible by the general public and is located south of Lake Forest Road and west of I-5 (Figure 10). There were no pond turtles detected here, but African clawed frogs, blue-gill sunfish, and crayfish were documented.

Woodbridge Lakes (32) — Two man-made lakes are situated in the middle of this 2,000-acre residential community with a walking trail bordering sections of the lakes. We captured no pond turtles but did document a variety of exotic species including: blue-gill sunfish, red-eared sliders, and river cooters.