



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
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Dear Ms. Kim Smith and Dr. Preston,

This letter transmits the U.S. Geological Survey (USGS) Western Ecological Research Center's San Diego Pond Turtle Monitoring and Restoration Effort January-December 2023. This work was completed under agreement number 548642.

Please note that this information is preliminary or provisional and is subject to revision. It is being provided to meet the need for timely best science. The information has not received final approval by the USGS and is provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the unauthorized use of this draft data for interpretation or resource decision-making.

Please direct any questions to me at (619) 206-5686.

Sincerely,

Principal Investigator



San Diego Pond Turtle Monitoring and Restoration Effort, January 2023-December 2023



San Diego Pond Turtle Monitoring and Restoration Effort, January 2023-December 2023

By: Jeremy Sebes, Chris Brown, and Robert N. Fisher

U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

Data Summary

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Scientific Collecting Permit (Entity) and MOU: SCP838

San Diego Field Station
USGS Western Ecological Research Center
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Cover photograph: Pond turtle basking at Upper San Diego River, by Jeremy Sebes. Juvenile pond turtle at Hauser Canyon, by Jeremy Sebes. Pond turtles basking at TNC Wheatley Preserve, by Chris Brown. Pond turtle at Hauser Canyon, by Jeremy Sebes

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INTRODUCTION

The western pond turtle (*Actinemys pallida*, formerly *A. (Emys) marmorata*) is California's only extant native freshwater turtle (Thomson et al. 2016). Until 2014 this turtle was considered a single species (Spinks et al. 2014). Recently the species has undergone taxonomic revisions with different agencies using variations of the taxonomy for the southern clade. The U.S. Fish and Wildlife Service recognizes the southern group as *Actinemys marmorata pallida* and the California Department of Fish and Wildlife recognizes it as *Emys marmorata*. Following the taxonomic revision to recognize two distinct species, it will be referred to as the southwestern pond turtle (*Actinemys pallida*; pond turtle) in this document (Turtle Taxonomy Working Group 2021). This species has been declining throughout its range and has been extirpated from much of coastal southern California (Bury and Germano 2008, Thomson et al. 2016). Historically, the pond turtle inhabited coastal draining streams, ponds, and lakes, fed primarily on small aquatic invertebrates and vegetation, and had no native aquatic predators (Bury and Germano 2008). However, threats to the pond turtle now include altered hydrology (dams and diversions), habitat fragmentation, direct mortality from roads and development, and predation by nonnative aquatic species (NAS) including American bullfrogs (*Lithobates catesbeianus*, bullfrog) and largemouth bass (*Micropterus salmoides*) (Brattstrom and Messer 1988, Stephenson and Calcarone 1999). Due to recent declines, the pond turtle was identified as a Species of Special Concern by the California Department of Fish and Wildlife (CDFW) in 1994 (Jennings and Hayes 1994, Thomson et al. 2016), was petitioned for listing by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act in 1992, petitioned again for listing in 2012 (Center for Biological Diversity 2012), and it is currently proposed for listing as threatened in 2023 (USFWS). In 1997, the pond turtle was included as one of the 75 species that the San Diego Multiple Species Conservation Program (MSCP) aims to conserve within coastal San Diego County (City of San Diego 1998). The San Diego Management and Monitoring Program (SDMMP) supports the MSCP and has developed the Management Strategic Plan to define the management area (the western portion of San Diego County; MSPA) with distinct management units (11 management units grouping preserves and preserve complexes; MU) within the MSPA to assist with prioritizing management actions to conserve the 75 species covered by the MSCP, including the pond turtle (SDMMP 2013).

The USGS conducts research on the natural history of and threats and impacts to reptiles and amphibians in coastal southern California to understand the demography of rare and listed taxa in the region, which includes the MSPA. The research aims to study the responses of the pond turtle to large-scale threats, such as drought and wildfire, as well as localized threats, such as from nonnative taxa. Specifically, USGS research seeks to understand the causes of decline of the pond turtle on conserved lands within the MSPA and how the populations respond to management actions including pond turtle translocations and NAS removal.

Translocations of pond turtles and removal of nonnative species have been the primary tools used for restoration of pond turtle populations within the MSPA of San Diego County, CA (Brown et al. 2015) since 2009. In 2009, the USGS partnered with San Diego Zoo and CDFW to study the effects of removing NAS and headstarting (raising hatchlings in a controlled environment before releasing them to the wild) pond turtles at CDFW's Sycuan Peak Ecological Reserve (SPER). In 2014, the USGS began to study translocations of adult pond turtles as a

conservation tool, and 18 pond turtles were translocated from private ponds in the Pine Valley Creek watershed to ponds at CDFW's Rancho Jamul Ecological Reserve (RJER) to evaluate the potential to restore the pond turtle to the Otay River watershed. In 2019, the USGS translocated 12 pond turtles in the San Dieguito watershed from Black Canyon to a pond near the headwaters of Scholder Creek at The Nature Conservancy's Wheatley Preserve. In 2023, the USGS translocated two additional pond turtles from Black Canyon to the Wheatley Preserve, continued evaluating restoration efforts at San Dieguito River Park Joint Powers Authority's (JPA's) Santa Ysabel Gorge Preserve, experimented with other NAS removal techniques at RJER, and conducted surveys on other conserved lands to find additional translocation study sites.

This 2023 effort builds on the previous work by the USGS and its partners in support of pond turtle restoration and management in the MSPA (Brown et al. 2020a and 2020b). This report summarizes the search for new pond turtle populations, continued monitoring of translocated individuals, and removal of NAS from 1 January 2023 to 31 December 2023. This work was completed as part of SANDAG agreement 548642. Specific activities are summarized in Table 1. This work is part of a larger USGS study to assess the pond turtle population in southern California. Pond turtle translocations and habitat restoration efforts have been collaborative between the USGS and partners: San Diego Zoo, CDFW, SDMMMP, San Diego Association of Governments (SANDAG), City of San Diego (City), County of San Diego (County), U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), Endangered Habitats Conservancy (EHC), Department of Defense (DOD) and The Nature Conservancy (TNC).

STUDY AREA

The study area included the following nine coastal watersheds in San Diego County: Santa Margarita, San Luis Rey, Escondido, San Dieguito, Los Peñasquitos, San Diego, Sweetwater, Otay, and Tijuana watersheds (Table 1, Figure 1).

METHODS

Site Selection

Within these watersheds, 30 sites were selected to survey for pond turtle presence (Figure 2). One site was part of our San Diego long-term monitoring program on DOD property, four sites were part of the USGS/SANDAG pond turtle restoration program, and 24 sites were on conserved lands within the MSPA. Sites generally had water present, historical pond turtle records, and habitat features known to be associated with pond turtle presence. This report covers pond turtle surveys as well as NAS species removal surveys at RJER, SPER, TNC Wheatley Preserve, and San Dieguito River Park JPA's Santa Ysabel Gorge Preserve.

Survey Overview

Surveys for native and NAS were conducted following the USGS protocols for aquatic species in the south coast ecoregion (USGS 2006a–d). Semi-aquatic species were also included in these methods and results since they are commonly detected in aquatic environments during these surveys. Survey methods included daytime visual encounter surveys, nighttime visual encounter surveys for bullfrogs, timelapse and motion-triggered cameras, and trapping. Daytime visual encounter surveys were used to determine species presence and activity as well as to remove

bullfrogs if they were detected. Trapping was used to assess native and NAS presence and to capture turtles to assess their health.

When NAS were removed from the traps or detected/removed on visual encounter surveys, we followed the guidelines set by the American Veterinary Medical Association (Leary et al. 2020) and a joint committee of American Fisheries Society, the American Institute of Fishery Research Biologists, and the American Society of Ichthyologists and Herpetologists (Jenkins et al. 2014) to euthanize. These guidelines were approved by the USGS Western Ecological Research Center (WERC) Institutional Animal Care Use Committee (IACUC). These guidelines are designed to minimize pain and distress for the animals. For field application we placed the NAS in a plastic bag with 0.5 mg/L clove oil until breathing ceased and then put the animal on ice before ultimately placing it into a -20°C freezer at the lab.

Daytime Visual Encounter Surveys

Daytime visual encounter surveys were conducted to assess riparian and aquatic habitats and determine presence of aquatic species. Surveys were conducted by walking the creek and pond perimeter and recording any native or nonnative amphibians or reptiles encountered in accordance with the USGS stream survey protocol (USGS 2006a). Dip-nets, seine nets, snorkeling and opportunistic hand-capture were used to detect species underneath aquatic vegetation, floating material, and overhanging banks and tree roots.

Nighttime Visual Encounter Surveys

Nighttime visual encounter surveys were conducted at four sites, Wheatley Preserve, Rancho Jamul Ecological Reserve, Sycuan Peak Ecological Reserve, and Santa Ysabel Gorge Preserve following the USGS protocols for aquatic species (USGS 2006d). These surveys involved slowly walking along the creeks and pond shorelines searching with headlamps, spotlights, and binoculars. Surveys typically began at twilight when reflected eyeshine became detectable and nocturnal activity began to increase. When time permitted, multiple passes of the site were made until activity began to wane. These surveys augment the trapping and daytime visual encounter surveys, often providing earliest detection of juvenile aquatic species at the sites (e.g., pond turtles, red-legged frogs, and arroyo toads).

Detected species were recorded, noting age, sex, and behavior. Target species were captured, checked for pit tags, measured, and photographed. Native species were marked, if not already marked, and released at the site of capture. Nonnative aquatic species were collected and returned to the lab for gut analysis (Smith et al. 2024). Methods of capture included using hand capture, dip nets, and seines nets. For nonnative bullfrogs, .22 caliber rimfire rifles with lead free frangible ammunition were used. A gunshot wound to the brain is within the guidelines set by the AVMA to euthanize (Leary et al. 2020). Bullfrogs were disposed of at the USGS laboratory following SDSU Foundation protocols if recovery was possible.

Camera Surveys

Trail cameras were deployed at monitoring sites to detect different age classes of pond turtles. Cameras were set to take motion-triggered photos and timelapse photos every 5 to 15 minutes depending on camera type. When supported, cameras were set to take infrared photos from dusk to midnight to capture nighttime activity of pond turtles and potential NAS.

Trapping Surveys

Trapping surveys were used to capture pond turtles and other native and NAS. Trapping surveys were useful for removing NAS including red swamp crayfish (*Procambarus clarkii*) (Appendix C), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), African clawed frogs (*Xenopus laevis*), and bullfrog larvae. Methods followed Madden-Smith et al. (2005) and the “USGS western pond turtle (*Actinemys pallida*) trapping survey protocol for the south coast ecoregion” (USGS 2006b). Trapping surveys used up to three different size funnel traps to increase the probability of capturing the various aquatic species that could be present. Our large turtle traps are custom sized Turtle Nets from Memphis Net & Twine with 20” hoops and 1.5” mesh. These are flat mouthed traps with floats to leave an air space for trapped turtles to breathe. Our small turtle traps are Promar TR-503 collapsible live bait traps modified with floats to provide an air space. We also employ Gee’s galvanized G-40 minnow traps to detect smaller fishes, invertebrates, and African clawed frogs.

Traps were baited with freshly frozen commercial mackerel or canned sardines. The traps work by forcing the animals to enter the funnel opening to get the bait and once inside they can’t escape. Turtle traps were deployed with floats to provide an area for trapped animals to surface and breathe. Traps were visited daily to check for animals and to change bait. Traps were left from one to five days in the water depending on amount of available habitat, weather conditions, initial capture rates, and access. We considered the number of “trap nights” for a site to be equal to the number of traps set (regardless of type), multiplied by the number of nights the traps were left in the environment.

RESULTS

Overview

Watershed and site names, site locations, and number of trap nights were summarized (Table 1). Species detected at each site were tallied and categorized into native or NAS groupings (Table 2). Overall number of turtles, total number of individuals trapped, and age classes detected were summarized for each site (Table 3, Table 4). Total number of NAS detected/removed from pond turtle restoration sites was also summarized (Table 5). Number of pond turtles ranged from 1 to 17 during our 2023 surveys at 12 of the 30 sites and six of the nine watersheds. Most of the sites had water but one was dry. NAS were detected at 24 of the 30 sites.

Santa Margarita Watershed

Naval Weapons Station Fallbrook

On 28–31 March 2023, USGS assisted U.S. Navy researchers in a pond turtle trapping survey. Fifteen turtle traps were placed in a tributary to the Santa Margarita River at Naval Weapons Station Fallbrook (Figure 3). There were six new pond turtles captured in the traps in a location that USGS reported on in 2022. The other species detected included western toad (*Anaxyrus boreas*), green sunfish, and red swamp crayfish.

San Luis Rey Watershed

West Fork San Luis Rey

At a USGS restoration site upstream from Lake Henshaw, 10 large turtle traps and 19 small turtle traps were deployed (Figure 4) (Appendix A). From 18–21 September 2023 one pond turtle was caught over four trapping nights. Other species detected were the California treefrog (*Pseudacris cadaverina*) (Appendix B), Baja California treefrog (*Pseudacris hypochondriaca*), arroyo chub (*Gila orcutti*), brown bullhead (*Ameiurus nebulosus*), and common carp (*Cyprinus carpio*).

Kumpohui Creek Tributary

There are two ponds at the TNC Wheatley Preserve that flow into Kumpohui Creek, which flows into the San Luis Rey watershed. These ponds are close to the Scholder Creek restoration site, which is in the San Dieguito River watershed. Two daytime and four nighttime visual encounter surveys were performed at these two ponds between 11 April 2023 and 14 December 2023. The species detected in the two ponds included the western toad and Baja California treefrog.

Escondido Watershed

Sage Hill Preserve

One daytime visual encounter survey was performed on 20 July 2023 in the canyon running through Sage Hill Preserve. This creek flows into Escondido Creek (Figure 5). There was very little pooling in the creek during the survey, although the creek was flowing. A small stock pond surrounded by rushes is on the creek. The pond is difficult to access for a visual survey because of the surrounding rushes. Species detected were Baja California treefrog and western mosquitofish (*Gambusia affinis*).

San Dieguito Watershed

Scholder Creek (Wheatley Preserve)

As a pond turtle restoration site in San Dieguito watershed, ten nighttime and four daytime visual encounter surveys were conducted to check on the presence of bullfrogs in the 1-kilometer area of Scholder Creek and the TNC Wheatley Pond on Scholder Creek (Figure 6). On a nighttime visual encounter survey on 14 September 2023, two juvenile bullfrogs were collected in Scholder Creek before they reached the pond. The barrier fencing and camera monitoring may have helped to keep these and other bullfrogs from entering the restoration site from neighboring properties (Figure 18). During a daytime visual encounter survey, three adult pond turtles were detected at the main pond basking on one of the logs placed to enhance the pond for turtles (Figure 19). Two individuals from Lower Santa Ysabel Creek in Black Canyon were translocated to the pond turtle population at the main pond at Scholder Creek. This brings the total number of turtles translocated to 20. Other species detected were two-striped gartersnake (*Thamnophis hammondi*), western toad, Baja California treefrog, and California red-legged frog (*Rana draytonii*).

Scholder Creek – Kennel Pond

At this private pond adjacent to the TNC Wheatley Preserve restoration site, eight nighttime visual encounter surveys were conducted between 7 May 2023 to 2 November 2023. Nine bullfrogs were collected in 2023 which is lower than previous survey efforts at this site that

began in 2021. Other species detected were western toad, Baja California treefrog, brown bullhead, and western mosquitofish.

Santa Ysabel Gorge Preserve

There are a series of three stock ponds that are tributaries to Santa Ysabel Creek on this property owned by the San Dieguito River Park. In 2022 NAS removal for pond turtle restoration activities began, and 232 bullfrogs were detected/removed. This year six nighttime and one daytime visual encounter surveys were conducted with 43 bullfrogs being detected/removed. Other species detected were two-striped gartersnake, western toad, Baja California treefrog, green sunfish, and largemouth bass.

Temescal Creek (Santa Ysabel)

Ten reaches in Temescal Creek were surveyed during three daytime visual encounter surveys, including two stock ponds that are in the higher elevation upper reaches of the creek. The two ponds contained bullfrogs. A seine was used to detect bullfrog tadpoles and adult bullfrogs were visually identified. Baja California treefrogs and California treefrogs were detected throughout the creek.

Black Canyon

Four traps were set in Black Canyon Creek for one night of trapping in support of the TNC Wheatley Preserve restoration effort. No turtles were caught. Species detected were California treefrog, Baja California treefrog, and green sunfish.

Lower Santa Ysabel Creek

Twelve traps were set on Lower Santa Ysabel Creek in Black Canyon for one night of trapping. This is a donor site in support of the TNC Wheatley Preserve restoration effort upstream on Scholder Creek. One juvenile and one adult pond turtle were caught in the traps and brought to the TNC Wheatley Pond on Scholder Creek. California treefrogs and Baja California treefrogs were detected at the site. The NAS detected were bullfrogs, green sunfish, and koi (*Cyprinus rubrofuscus*) (Appendix C).

Ramona Grasslands County Preserve

Five large turtle traps and 19 small turtle traps were set over four reaches of Santa Maria Creek in Ramona Grasslands for four nights of trapping (Figure 7). The traps captured 17 individual pond turtles and five of those were juvenile. There is a stock pond on one of the tributaries to Santa Maria Creek. A daytime visual encounter survey was performed at the pond and a deeper section of the creek. A seine was used during the survey to aid in detections. A two-striped gartersnake was detected. The NAS detected were bullfrog, mosquitofish, green sunfish, and red swamp crayfish.

San Pasqual Valley

A daytime visual encounter survey was performed at two ponds in San Pasqual Valley by America Sod Farms. One of the ponds was dry and the other was full of water. One edge of this pond at the overflow channel was accessible enough to be seined. Bullfrogs, common carp, mosquitofish, green sunfish, fathead minnow (*Pimephales promelas*), and red-swamp crayfish were detected. A red-eared slider (*Trachemys scripta elegans*) was detected in the middle of the pond during the survey. During the subsequent trapping effort, five large turtle traps, two small

turtle traps, and two Gee traps were placed at this same pond. A total of 10 red-eared sliders were detected in the traps. Bluegill were also detected during trapping. Just north of Old Milky Way Road, a second pond and an accessible reach of the adjacent unnamed creek by San Pasqual Road were also trapped during this time. In the pond north of Old Milky Way Road, bullfrog, prickly sculpin (*Cottus asper*), common carp, green sunfish, and red swamp crayfish were detected. In the unnamed creek, common carp, green sunfish, and red swamp crayfish were detected. No native species were detected in the two ponds or the creek.

Los Peñasquitos Watershed

Los Peñasquitos Canyon Preserve

A daytime visual encounter survey was performed at the pond near the adobe ruins and the adjacent 1-km section of creek running east from Sorrento Valley Road (Figure 8). Pond turtles had been recorded from this area in 2002–2003. On a 2019 trapping survey it was determined that red-eared sliders were prevalent in this system. During 2023 surveys red-eared sliders, African clawed frogs, mosquitofish, largemouth bass, and red swamp crayfish were detected.

San Diego Watershed

Johnson Creek Ponds

Daytime visual encounter surveys were performed at three tributary ponds and a large stock pond on Johnson Creek (Figure 9). Western toad juveniles were detected around two of the tributary ponds. Bullfrogs and largemouth bass were detected in the large stock pond on Johnson Creek and the largest of the tributary ponds.

Upper San Diego River

Upper San Diego River has been a long-term monitoring site since 2008. This site was surveyed using daytime visual encounter only due to difficult access. Surveys on 6–7 June 2023 and 27–28 June 2023 targeted the arroyo toad (*Anaxyrus californicus*). The surveys spanned from the Cedar Creek Falls trailhead at San Diego Country Estates to the Inaja Memorial Park. Thirty-two pond turtles were detected in the river during the two surveys. Other species detected were two-striped gartersnake, arroyo toad, California treefrog, and Baja California treefrog.

Temescal Creek

In Upper San Diego River, the first 250-meter reach of Temescal Creek was surveyed. At the beginning of the reach near the confluence with the San Diego River a pond turtle was hand-captured. The other species detected were California treefrog.

Forester Creek

Four reaches were surveyed during a daytime visual encounter survey near the City of Santee (Figure 10). The area is urbanized, and the creek is partially channelized with numerous people inhabiting the area. The species detected were bullfrogs, mosquitofish, and red swamp crayfish.

Sweetwater Watershed

Crestlake

Crestlake is an artificial lake along Galloway Valley that flows into Harbison Canyon. Harbison Canyon flows into the Sweetwater River in the Dehesa area (Figure 11). A shallow part of Crestlake was seined during a daytime visual encounter survey on 6 September 2023. It was later trapped from 10 October to 12 October 2023. Native species were not detected. On the survey in 2022, Crestlake was dry. The NAS species detected were red-eared slider, barred tiger salamander (*Ambystoma mavortium*), bluegill, largemouth bass, fathead minnow, and red swamp crayfish.

Sweetwater River above Loveland Reservoir

A daytime visual encounter survey was performed at Sweetwater River upstream from the Loveland Reservoir in 2023. Adult California treefrogs were the only native species detected. Largemouth bass were detected in all pools in the five reaches surveyed.

Sweetwater Falls

This site in the Sweetwater River below Loveland Reservoir is next to Sycuan Peak Ecological Reserve. A daytime visual encounter survey was performed on 18 August 2023 and there were only two pools holding water. Hundreds of juvenile and one adult bullfrog were detected around these pools. Field crews returned on 2–5 October 2023 and set five small turtle traps in these two pools. During the trapping survey, 12 new pond turtles and one adult bullfrog were caught. Three daytime visual encounter surveys and one nighttime visual encounter survey were performed on Sweetwater Falls in 2023. Since this property is next to SPER extra time was spent to detect/remove the bullfrogs. A total of 547 bullfrogs, 5 African clawed frogs, 22 green sunfish, and 1 red swamp crayfish were detected/removed in the small pools.

Sycuan Peak Ecological Reserve

This year there were two major disturbances to the reserve. The first disturbance was a significant sediment load during heavy rains from Lawson Creek. It filled up the main bedrock pools on Sweetwater River in SPER (Figure 15). Yearly USGS surveys have documented pond turtles in these pools since 2009 (Brown et al. 2012, 2015, 2020a, 2020b; Molden et al. 2022). These pools have held water during drought when the pools pond turtles occupy upstream are dry. The trapping surveys from 2–5 October 2023 were located mostly above the confluence with Lawson Creek. Ten large and 10 small turtle traps were set in the remaining pools. The traps yielded 15 individual pond turtles. The second disturbance was bullfrog migration. For the first time since 2017, bullfrogs were detected on the reserve. Five daytime and three nighttime visual encounter surveys were conducted. A total of 53 bullfrogs, 789 African clawed frogs, 165 green sunfish, and 545 red swamp crayfish were detected/removed. During daytime visual encounter surveys, two more individual pond turtles were detected. Camera stations at the pools continue to document pond turtles (Appendix D). The other native species detected during the surveys at SPER were western toad, California treefrog, and Baja California treefrog.

Otay Watershed

Rancho Jamul Ecological Reserve

Fifteen daytime and 14 nighttime visual encounter surveys were performed over 18 reaches at RJER (Figure 12). A total of 91 bullfrogs, 1594 African clawed frogs, 34 brown bullheads, and 540 red swamp crayfish were collected. No pond turtles were captured during a trapping survey

of the Pump Pond and Jamul Creek on 24–26 October 2023. There was a sighting of at least one pond turtle in the pond from a camera station run by CDFW personnel (Figure 16). The native species detected were two-striped gartersnake, western toad, Baja California treefrog, and western spadefoot toad.

Tijuana Watershed

Antone Canyon

One daytime visual encounter survey was performed in the creek of Antone Canyon (Figure 13). This section of the forest is remote and steep. The water was moving fast, and no aquatic species were detected in the three reaches by our survey efforts.

Indian Creek

This is a tributary to the higher elevation Pine Valley Creek. A daytime visual encounter survey was performed on five reaches to the confluence with Upper Pine Valley Creek. The species detected were two-striped gartersnake and California treefrogs.

Noble Canyon

A small fire burned this area at some point since the last USGS survey in 2020 (Figure 17). During a brief trapping event on 17 July 2023 with nearby Pine Valley Creek two traps were deployed for one night in a pool where a pond turtle was previously caught. A new individual pond turtle was caught during this trapping session. No other species were detected.

Pine Valley Creek

Eight reaches of Pine Valley Creek upstream from the confluence with Noble Canyon were visually surveyed on 11 July 2023. A pond turtle was encountered on the daytime visual encounter survey. Eight small turtle traps were placed to confirm the sighting and check for other turtles. The traps confirmed a pair of adult pond turtles in a small pool that was 2 meters deep. The other native species detected were two-striped gartersnake, arroyo toad, California treefrog, and Baja California treefrog.

Horsethief Canyon

A daytime visual encounter survey on 28 July 2023 detected no aquatic species. The water levels were very low in the five reaches of the survey.

Hauser Canyon

Wells and Turnbull (1998) documented pond turtles in 1997 in Hauser Canyon. This is the first data USGS has acquired on pond turtles here and previous data on juveniles was lacking. The habitat around Cottonwood Creek in Hauser Canyon is thick and rugged. This made detectability of turtles a challenge during the daytime visual encounter survey (Figure 14). After concluding the visual survey, eight traps were deployed in two pools overnight. In one pool below a large weir, eight pond turtles were captured. The traps downstream near a smaller weir captured red swamp crayfish only.

Star Ranch

There is a large pond toward the southern end of the reserve that holds perennial water on Star Ranch, which is a newly acquired county property. A daytime visual encounter survey was performed at this pond on 11 September 2023. A seine was used to detect, bullfrogs, channel catfish, and red swamp crayfish. On 27 September 2023, 21 large turtle traps were deployed for one night of trapping. The traps yielded four adult bullfrogs and red swamp crayfish.

Potrero Creek

This area around Barrett Junction had burned in the 2022 Border 32 fire. A daytime visual encounter survey was performed on 14 July 2023 on Bureau of Land Management property just east of Barrett Junction resulting in no detections of pond turtles despite, being present close by in Cottonwood Creek below Barrett Dam. The species detected at this site were arroyo toad and California treefrog.

DISCUSSION

In 2023, pond turtles were detected at 12 of 30 sites surveyed. At Sycuan Peak Ecological Reserve there were two significant disturbances. These included a sedimentation event and the detection of bullfrogs. Sediment flow from Lawson Creek filled in the pools typically inhabited by pond turtles in Sweetwater River downstream from the confluence. During drought the other pools upstream are dry (Brown et al. 2012). Upstream from the confluence, the remaining turtle habitat was wet throughout 2023. Fifteen individual pond turtles were detected here; however, bullfrogs were detected at SPER in 2022 for the first time since 2017. A total of 44 bullfrogs were detected/removed in 2023 and the study includes continued survey efforts for 2024. In 2011 the bullfrog population was eradicated to help support the pond turtle captive breeding program that was a collaboration with San Diego Zoo (Brown et.al. 2012). Bullfrog absence at this site has continued, aside from four individuals removed between 2011 and 2017. This year a significant number of bullfrogs was detected/removed at the Sweetwater Authority-owned property of Sweetwater Falls and CDFW owned SPER totaling 591 individuals. In two small pools on Sweetwater Falls, there were ten new individual pond turtles which, is encouraging.

The barrier fencing on Scholder Creek is expected to reduce the new arrival of bullfrogs onto the site from downstream. Juvenile red-legged frogs have moved from the main pond on Scholder Creek, where red-legged frogs have been introduced, to the barrier fencing downstream. The barrier fencing does require occasional maintenance to be effective as mammals occasionally dig under the fencing and create a way for the bullfrogs to gain access to the other side. Heavy stream flow also necessitates fence maintenance. The camera monitoring and visual encounter surveys at Wheatley Preserve have been the tools used to monitor the restoration in 2023.

In 2023, two of the of three eggs from the pond turtle nest detected in 2022 hatched successfully. The improved habitat by the USFWS Partners for Fish and Wildlife Program is expected to help hatchling pond turtles avoid predation on their way to the pond. Two more pond turtles were translocated to the main pond from Lower Santa Ysabel Creek in Black Canyon which should aid to strengthen the pond turtle population at TNC Wheatley Preserve.

Pond turtles were not detected at RJER during the 2023 trapping and visual encounter surveys, but there is camera station evidence at the main Pump Pond supporting pond turtle presence at

RJER. The timing and cooler than expected weather may have contributed to not detecting a turtle during the trapping survey. Data collected from previous years would suggest the pond turtle population at this site appears to be stable but juvenile pond turtles have not been detected as of 2023. Some different techniques were experimented with to evaluate effective removal of NAS in the ponds at RJER, however, adult bullfrogs persist in the ponds and creeks at RJER. Santa Ysabel Creek Gorge is the latest restoration site and USGS has been exploring the response of pond turtles here since 2022. In 2023, USGS detected/removed 43 bullfrogs, but this site continues to be heavily affected by NAS. There are arroyo toads on-site and a population of pond turtles upstream. The conservation goal at this site is to restore the three ponds and creeks.

The visual survey at Los Peñasquitos Preserve did not detect pond turtles. Monitoring will continue in the future to determine where they are if they are still present. This site is heavily impacted by urbanization and NAS. The NAS are red-eared sliders, bullfrogs, African clawed frogs, largemouth bass, and red swamp crayfish.

At Ramona Grasslands, 17 pond turtles of adult and juvenile age classes were detected spread out on the 1-km stretch of Santa Maria Creek. Previously in 2015, only one adult pond turtle was detected here. This site still has a large presence of bullfrogs, so finding this many pond turtles especially juveniles was encouraging.

The Upper San Diego River continues to have a large population of pond turtles. On the two surveys this year 32 turtles of all age classes were detected along the approximately 10-km section of the river with minimal searching. There was also a turtle in Temescal Creek near the confluence with the San Diego River. Hand-capture was used for a few pond turtles, but no time-intensive noodling was done.

Sweetwater River above Loveland Reservoir was explored again this year using a visual survey. There was more water than the 2022 trapping survey. Finding pond turtles in this section of Sweetwater River is still possible, but this site may be affected by the presence of NAS that migrate through the river during seasonal waterflow. There were largemouth bass in every pool that could serve as pond turtle habitat on the visual survey and no other animals were detected in the water.

Pine Valley Creek has long been a large population of pond turtles as evidenced by long-term monitoring of the creek south of Interstate-8. This year two pond turtles were trapped in the higher elevation (1245 m) section of the creek that is usually dry. No pond turtles have been previously recorded this far up Pine Valley Creek. In 2021, a pond turtle was detected as high up in elevation as Noble Canyon (1145 m). That pool has burned since then and this year a new pond turtle was detected in that pool.

In Hauser Canyon within the Tijuana watershed, there is a turtle population that USGS had little data for. During visual encounter surveys in 2019 and 2022, turtles were not detected. The USFS did detect pond turtles in 1997 on visual surveys in Hauser Canyon (Wells and Turnbull 1998). Trapping is a good way to locate turtles here as USGS caught eight pond turtles in one night of trapping, including four juveniles. More data on this population will be collected in the future.

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Bureau of Land Management, California Department of Fish and Wildlife, City of San Diego Park and Recreation Department, City of San Diego Public Utilities Department, Corte Madera Ranch, County of San Diego, Endangered Habitats Conservancy, Marine Corps Base Camp Pendleton, Naval Weapons Station Fallbrook, San Diego River Park Foundation, San Dieguito River Park Partners, Sweetwater Authority, The Wildlands Conservancy, U.S. Border Patrol, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Navy, Vista Irrigation District, Judy and Chuck Wheatley and The Nature Conservancy have provided and coordinated access to the reserves.

LITERATURE CITED

- Brattstrom, B.H. and D.F. Messer. 1988. Current status of the southwestern pond turtle, *Clemmys marmorata pallida*, in southern California. Final report for California Department of Fish and Game contract c-2044. California State University, Fullerton, CA. 48 pp.
- Brown, C., S.A. Hathaway, and R.N. Fisher. 2012. Data Summary for the TransNet Environmental Mitigation Program grant agreement 5001140 regarding western pond turtle restoration at Sycuan Peak Ecological Reserve, March 2012. U.S. Geological Survey data summary prepared for the TransNet Environmental Mitigation Program, San Diego, CA. 20 pp.
- Brown, C., A.A., M.C. Madden, A.N. Aguilar Duran, and R.N. Fisher. 2015. Western Pond Turtle (*Emys marmorata*) Restoration and Enhancement in San Diego County, CA, 2013-2015. Data Summary. Prepared for San Diego Association of Governments, San Diego Management and Monitoring Program, and California Department of Fish and Wildlife, San Diego, CA. 119 pp.
- Brown, C.W., E. Grolle, C.J. Hitchcock, and R.N. Fisher 2020a. Draft final: western pond turtle response to translocation and nonnative aquatic species removal, March 2017-March 2018. Draft unpublished data prepared for San Diego Association of Governments, San Diego Management and Monitoring Program, and US Fish and Wildlife Service Conservation Partnerships Program. 35pp.
- Brown, C.W., D.R. Clark, C.J. Hitchcock, and R.N. Fisher 2020b. Draft final: western pond turtle response to translocation and nonnative aquatic species removal, March 2018-March 2019. Draft unpublished data prepared for San Diego Association of Governments, San Diego Management and Monitoring Program, and US Fish and Wildlife Service Conservation Partnerships Program. 35pp.
- Bury, R.B. and D.J. Germano. 2008. *Actinemys marmorata* (Baird and Girard 1852)– western pond turtle, Pacific pond turtle. In: Rhodin, A.G.J., Pritchard, P.C.H., vanDijk, P.P., Saumure, R.A., Buhlmann, K.A. and Iverson, J.B. (Eds.). Conservation Biology of Freshwater Turtles and Tortoises: a compilation project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs No. 5, pp. 001.1-001.9, doi:10.3854/crm.5.001.marmorata.v.1.2008, <http://www.iucn-tftsg.org/cbftt>.
- Center for Biological Diversity. 2012. Petition to list 53 amphibians and reptiles in the United States as threatened or endangered species under the Endangered Species Act. To the

- U.S. Fish and Wildlife Service, USA.
- City of San Diego. 1998. Final multiple species conservation program MSCP plan. Prepared by City of San Diego. 278 pp.
- Jenkins, J.A., H.L. Bart, J.D. Bowker, P.R. Bowser, J.R. MacMillan, J.G. Nickum, J.W. Rachlin, J.D. Rose, P.W. Sorensen, B.E. Warkentine, and G.W. Whitledge 2014. Guidelines for Use of Fishes in Research-Revised and Expanded. Fisheries, 39(9), 415-416. <https://doi.org/10.1080/03632415.2014.924408>
- Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final report submitted to the California Department of Fish and Game, Rancho Cordova, CA. 260 pp.
- Leary, S., W. Underwood, R. Anthony, S. Cartner, T. Grandin, C. Greenacre, S. Gwaltney-Brant, M. McCrackin, R. Meyer, D. Miller, J. Shearer, T. Turner, and R. Yanong. 2020. AVMA guidelines for the euthanasia of animals: 2020 edition. Schaumburg, IL: American Veterinary Medical Association.
- Madden-Smith, M.C., E.L. Ervin, K.P. Meyer, S.A. Hathaway, and R.N. Fisher. 2005. Distribution and status of the arroyo toad (*Bufo californicus*) and western pond turtle (*Emys marmorata*) in the San Diego MSCP and surrounding areas. Report to County of San Diego and California Department of Fish and Wildlife, San Diego, California. 190 pp.
- Molden, J., C.W. Brown, and R.N. Fisher 2022. Draft Final: San Diego Western Pond Turtle Monitoring and Recovery Effort January 2020-December 2021. Draft unpublished data prepared for San Diego Association of Governments, San Diego Management and Monitoring Program, and US Fish and Wildlife Service Conservation Partnerships Program. 59pp.
- San Diego Management and Monitoring Program. 2013. Management strategic plan for conserved lands in western San Diego County, version 08.27.2013. http://www.sdmmp.com/reports_and_products/Management_Strategic_Plan.aspx
- Smith, N., R. Hanscom, J. Richmond, R. Fisher, and R. Clark. 2024 Variation in Dietary Ecology of Two Invasive American Bullfrog (*Lithobates catesbeianus*) Populations in Southern California. Herpetologica. 80. 241-247. Doi:10.1655/Herpetologica-D-23-00057/3424710/i1938-5099-80-3-241.pdf.
- Spinks, P.Q., R.C. Thomson, and H.B. Shaffer. 2014. The advantages of going large: genome-wide SNPs clarify the complex population history and systematics of the threatened western pond turtle. Molecular Ecology 23:2228-2241. doi:10.1111/mec.12736.
- Stephenson, J.R. and G.M. Calcarone. 1999. Southern California mountains and foothills assessment: habitat and species conservation issues. General Technical Report GTR-PSW-172. Albany, CA. 402 pp.
- Thomson, R.C., A.N. Wright, and H.B. Shaffer. 2016. California Amphibian and Reptile Species of Special Concern. University of California Press and California Department of Fish and Wildlife, Oakland, CA, 390 pp. ISBN 9780520290907
- Turtle Taxonomy Working Group [Rhodin, A.G.J., J.B. Iverson, R. Bour, U. Fritz, A. Georges, H.B. Shaffer, and P.P. van Dijk]. 2021. Turtles of the World: Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution, and Conservation Status (9th ed.). In: Rhodin, A.G.J., J.B. Iverson, P.P. van Dijk, C.B. Stanford, E.V. Goode, K.A. Buhlmann, and R.A. Mittermeier, (Eds.). Conservation Biology of Freshwater

- Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group, Chelonian Research Monographs 8:1-472. Doi:10.2854/crm.8.checklist.atlas.v. 9, 2021.
- U.S. Geological Survey. 2006a. USGS Aquatic species and habitat assessment protocol for south coast ecoregion rivers, streams, and creeks. U.S. Geological Survey protocol. San Diego, CA. 48 pp.
- U.S. Geological Survey. 2006b. USGS western pond turtle (*Emys marmorata*) trapping survey protocol for the south coast ecoregion. U.S. Geological Survey protocol. San Diego, CA. 30 pp.
- U.S. Geological Survey. 2006c. USGS western pond turtle (*Emys marmorata*) visual survey protocol for the south coast ecoregion. U.S. Geological Survey protocol. San Diego, CA. 56 pp.
- U. S. Geological Survey. 2006d. USGS protocol for nocturnal aquatic species of the south coast ecoregion rivers, streams, and creeks. U. S. Geological Survey protocol. San Diego, CA. 14 pp.
- Wells, J. and J. Turnbull. 1998. 1997 Sensitive Species Survey Results for Pine Creek and Hauser Canyon Wilderness Areas, Descanso Ranger District, Cleveland National Forest, San Diego County, California. Survey Report to USDA Forest Service, San Diego, CA. 28 pp.

Table 1. Pond turtle sites surveyed from 1 January 2023 to 31 December 2023. This table includes the number of trap nights, visual encounter daytime surveys, and visual encounter nighttime surveys.

Watershed	Site Name	Start Date	End Date	Surveys			Reaches	Start ³		End ³	
				Trap Nights ¹	Day VE ²	Night VE ²		Latitude	Longitude	Latitude	Longitude
Santa Margarita	Naval Weapons Station Fallbrook	28-Mar-23	31-Mar-23	60	0	0	3	33.3575	-117.2949	33.3595	-117.2880
San Luis Rey	West Fork San Luis Rey River	18-Sep-23	21-Sep-23	116	0	0	5	33.2896	-116.7579	33.2975	-116.7603
	Kumpohui Creek Tributary	11-Apr-23	14-Dec-23	0	2	4	2	33.2005	-116.7421	33.2010	-116.7444
Escondido	Sage Hill Preserve	20-Jul-23	20-Jul-23	0	1	0	3	33.0852	-117.1796	33.0905	-117.1800
San Dieguito	Scholder Creek	6-Apr-23	14-Dec-23	0	4	10	4	33.1985	-116.7610	33.1971	-116.7530
	Scholder Creek Kennel Pond	11-Apr-23	14-Dec-23	0	0	10	1	33.2019	-116.7603	33.2019	-116.7603
	Santa Ysabel Gorge Preserve	4-May-23	10-Aug-23	0	1	6	7	33.1228	-116.7248	33.1244	-116.7149
	Temescal Creek (Santa Ysabel)	25-Jul-23	1-Sep-23	0	3	0	10	33.1989	-116.8415	33.2159	-116.8129
	Black Canyon	30-Aug-23	31-Aug-23	4	0	0	2	33.1217	-116.8081	33.1287	-116.8016
	Lower Santa Ysabel Creek	30-Aug-23	31-Aug-23	12	0	0	4	33.1217	-116.8081	33.1257	-116.8062
	Ramona Grasslands County Preserve	11-Sep-23	14-Sep-23	72	2	0	5	33.0554	-116.9458	33.0390	-116.9467
Los Peñasquitos	San Pasqual Valley	25-Sep-23	2-Nov-23	53	1	0	3	33.0858	-117.0178	33.0990	-117.0180
	Los Peñasquitos Canyon Preserve	8-Sep-23	8-Sep-23	0	1	0	6	32.9074	-117.2121	32.9147	-117.2030
San Diego	Johnson Creek Ponds	28-Jul-23	28-Jul-23	0	1	0	4	32.9812	-116.6543	32.9858	-116.6582
	Forester Creek	26-Jul-23	26-Jul-23	0	1	0	4	32.8378	-116.9958	32.8319	-116.9860
	Temescal Creek	6-Jun-23	27-Jun-23	0	2	0	1	33.0561	-116.6914	33.0557	-116.6890
	Upper San Diego River	25-Jul-23	1-Sep-23	0	2	0	6	32.9958	-116.7325	33.0838	-116.6707
Sweetwater	Crestlake	6-Sep-23	12-Oct-23	47	1	0	1	32.8463	-116.8214	32.8463	-116.8214
	Sweetwater River-Loveland	6-Sep-23	6-Sep-23	0	1	0	5	32.8316	-116.6439	32.8388	-116.6386
	Sweetwater Falls	18-Aug-23	20-Dec-23	18	4	1	4	32.7738	-116.7944	32.7805	-116.7924
	Sycuan Peak Ecological Reserve	27-Aug-23	28-Nov-23	225	5	3	8	32.7712	-116.8182	32.7734	-116.7947
Otay	Rancho Jamul Ecological Reserve	6-Apr-23	13-Dec-23	56	15	14	18	32.6945	-116.8687	32.6640	-116.8506
Tijuana	Antone Canyon	28-Sep-23	28-Sep-23	0	1	0	3	32.7804	-116.4165	32.7851	-116.4156
	Indian Creek	17-Aug-23	17-Aug-23	0	1	0	5	32.8990	-116.5126	32.8973	-116.5046
	Noble Canyon	17-Jul-23	18-Jul-23	2	0	0	1	32.8638	-116.5174	32.8638	-116.5174
	Pine Valley Creek	11-Jul-23	18-Jul-23	8	1	0	7	32.8817	-116.5239	32.8935	-116.5280
	Horsethief Canyon	28-Jul-23	28-Jul-23	0	1	0	5	32.7661	-116.6519	32.7748	-116.6475
	Hauser Canyon	25-Jul-23	26-Jul-23	12	1	0	3	32.6747	-116.5783	32.6732	-116.5672
	Star Ranch	26-Sep-23	27-Sep-23	21	1	0	2	32.6179	-116.4995	32.6192	-116.5011
Grand Total	Potrero Creek	14-Jul-23	14-Jul-23	0	1	0	5	32.6045	-116.6828	32.5975	-116.6601
				706	54	48	137				

¹Trap nights equals number of traps put out at a site (regardless of trap type) multiplied by the number of days the traps were left in the water.

²VE = visual encounter survey.

³Locations obtained in WGS84 datum in decimal degrees.

Table 2. Species detections during pond turtle surveys from 1 January 2023 to 31 December 2023 in San Diego County.

Watershed	Site	Native										Nonnative														Total Species Observed
		Pond turtle	Two-striped gartersnake	Western toad	Arroyo toad	California treefrog	Baja California treefrog	California red-legged frog	Western spadefoot	Arroyo chub	Red-eared slider	American bullfrog	African clawed frog	Barred tiger salamander	Brown bullhead	Prickly sculpin	Common carp	Koi	Western mosquitofish	Channel catfish	Green sunfish	Bluegill	Largemouth bass	Fathead minnow	Red swamp crayfish	
Santa Margarita	Naval Weapons Station Fallbrook	6		1																	1				23	31
San Luis Rey	West Fork San Luis Rey	1				1	10			59					1		3				1					76
	Kumpohui Creek Tributary			2036			11																			2047
Escondido	Sage Hill Preserve						2												1							3
San Dieguito	Scholder Creek	3	9	845			25	131				3														1016
	Scholder Creek Kennel			4			2					15			1				3							25
	Santa Ysabel Gorge Preserve		1	7			6					116									1		1			132
	Temescal Creek (Santa Ysabel)					7	408					3														418
	Black Canyon					2	1														5					8
	Lower Santa Ysabel Creek	2				4						2						1			7					16
	Ramona Grasslands County Preserve	21	2									13							3		5				84	128
	San Pasqual Valley										10	20				2	16		5		65	2		2	75	197
Los Peñasquitos	Los Peñasquitos Canyon Preserve										1		21						2				2		3	29
San Diego	Johnson Creek Ponds			2								2											2			6
	Forester Creek											3							13						1	17
	Temescal Creek	1				5																				6
	Upper San Diego River	32	7		12	17																				68
Sweetwater	Crestlake									1				1								41	14	15	32	104
	Sweetwater River-Loveland					5																	5			10
	Sweetwater Falls	12										937	5								38				1	993
	Sycuan Peak Ecological Reserve	17		2		5	8					53	789								165				545	1584
Otay	Rancho Jamul Ecological Reserve		25	10311			47	9				135	11763		39				37						879	23245
Tijuana	Antone Canyon																									0
	Indian Creek		1			3																				4
	Noble Canyon	1																								1
	Pine Valley Creek	3	5		2	4	2																			16
	Horsethief Canyon																									0
	Hauser Canyon	8																							92	100
	Star Ranch						1					5								1					25	32
	Potrero Creek				6	5																				11

Table 3. Total number of pond turtles detected by age class during 2023 surveys in San Diego County.

Watershed	Site	Age			Total
		Adult	Hatchling	Juvenile	
Santa Margarita	Naval Weapons Station Fallbrook	4	1	1	6
San Luis Rey	West Fork San Luis Rey	1			1
San Dieguito	Scholder Creek	3			3
	Lower Santa Ysabel Creek	1		1	2
	Ramona Grasslands County Preserve	13		8	21
San Diego	Temescal Creek	1			1
	Upper San Diego River	27		5	32
Sweetwater	Sweetwater Falls	7		5	12
	Sycuan Peak Ecological Reserve	11		6	17
Tijuana	Noble Canyon	1			1
	Pine Valley Creek	3			3
	Hauser Canyon	4		4	8
Grand Total		76	1	30	107

Table 4. Total number of verified individual pond turtles detected by age class during 2023 surveys in San Diego County.

Watershed	Site	Age			Total
		Adult	Hatchling	Juvenile	
Santa Margarita	Naval Weapons Station Fallbrook	4	1	1	6
San Luis Rey	West Fork San Luis Rey	1			1
San Dieguito	Scholder Creek	3			3
	Lower Santa Ysabel Creek	1		1	2
	Ramona Grasslands County Preserve	12		5	17
San Diego	Temescal Creek	1			1
	Upper San Diego River	23		5	28
Sweetwater	Sweetwater Falls	7		5	12
	Sycuan Peak Ecological Reserve	10		5	15
Tijuana	Noble Canyon	1			1
	Pine Valley Creek	2			2
	Hauser Canyon	4		4	8
Grand Total		69	1	26	96

Table 5. Total number of NAS detected/removed from pond turtle restoration sites during 2023 surveys in San Diego County.

Site	American bullfrog	African clawed frog	Brown Bullhead	Green sunfish	Red swamp crayfish	Total
Scholder Creek	2					2
Scholder Creek Kennel Pond	9					9
Santa Ysabel Gorge Preserve	43					43
Sweetwater Falls	547	5		22	1	575
Sycuan Peak Ecological Reserve	44	754		164	540	1502
Rancho Jamul Ecological Reserve	91	1594	34		540	2259
Grand Total	736	2353	34	186	1081	4390

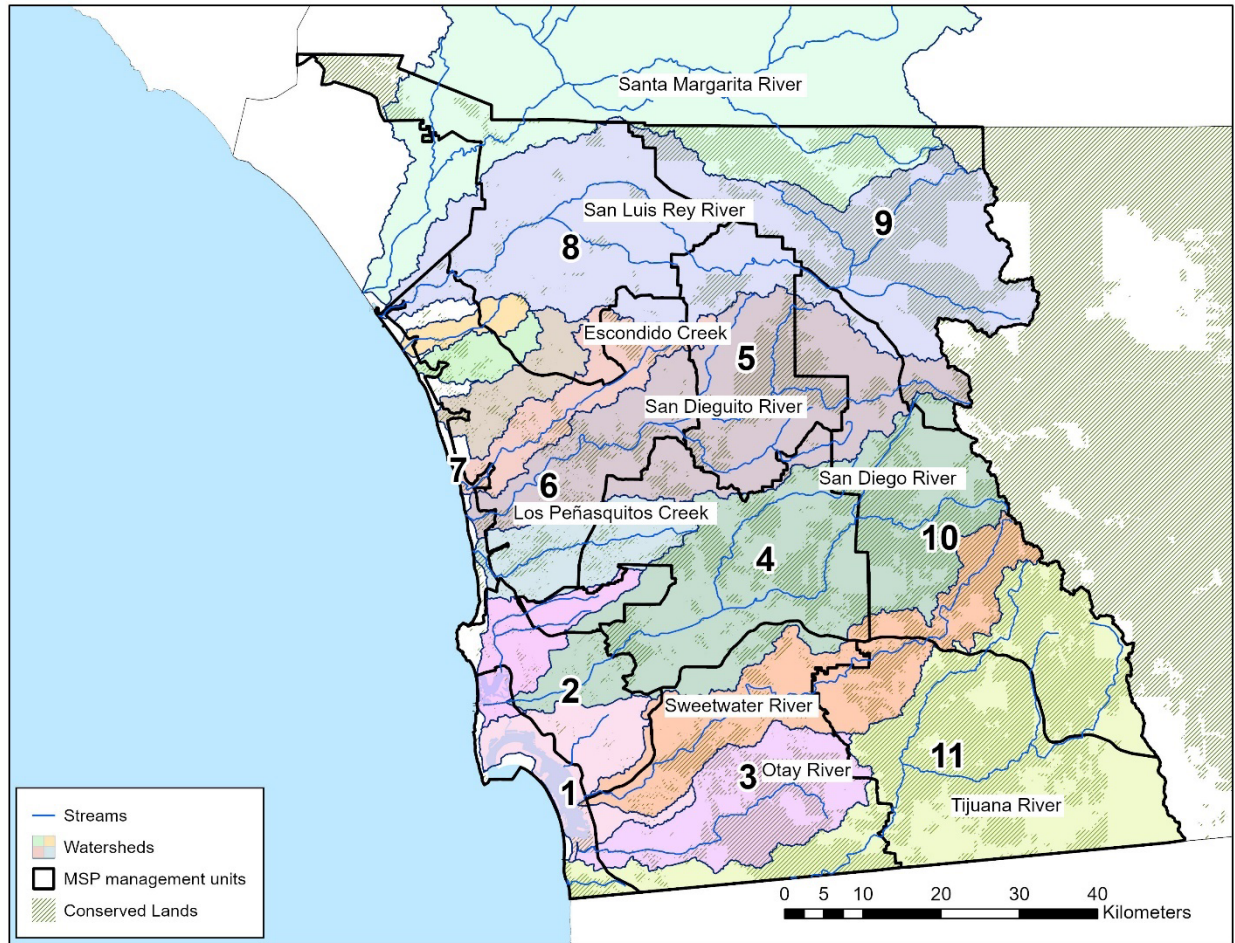


Figure 1. Map showing watersheds surveyed for pond turtles from 1 January 2023 to 31 December 2023, in San Diego County. Included in this study were the Santa Margarita, San Luis Rey, Escondido, San Dieguito, Los Peñasquitos, San Diego, Sweetwater, Otay, and Tijuana watersheds.

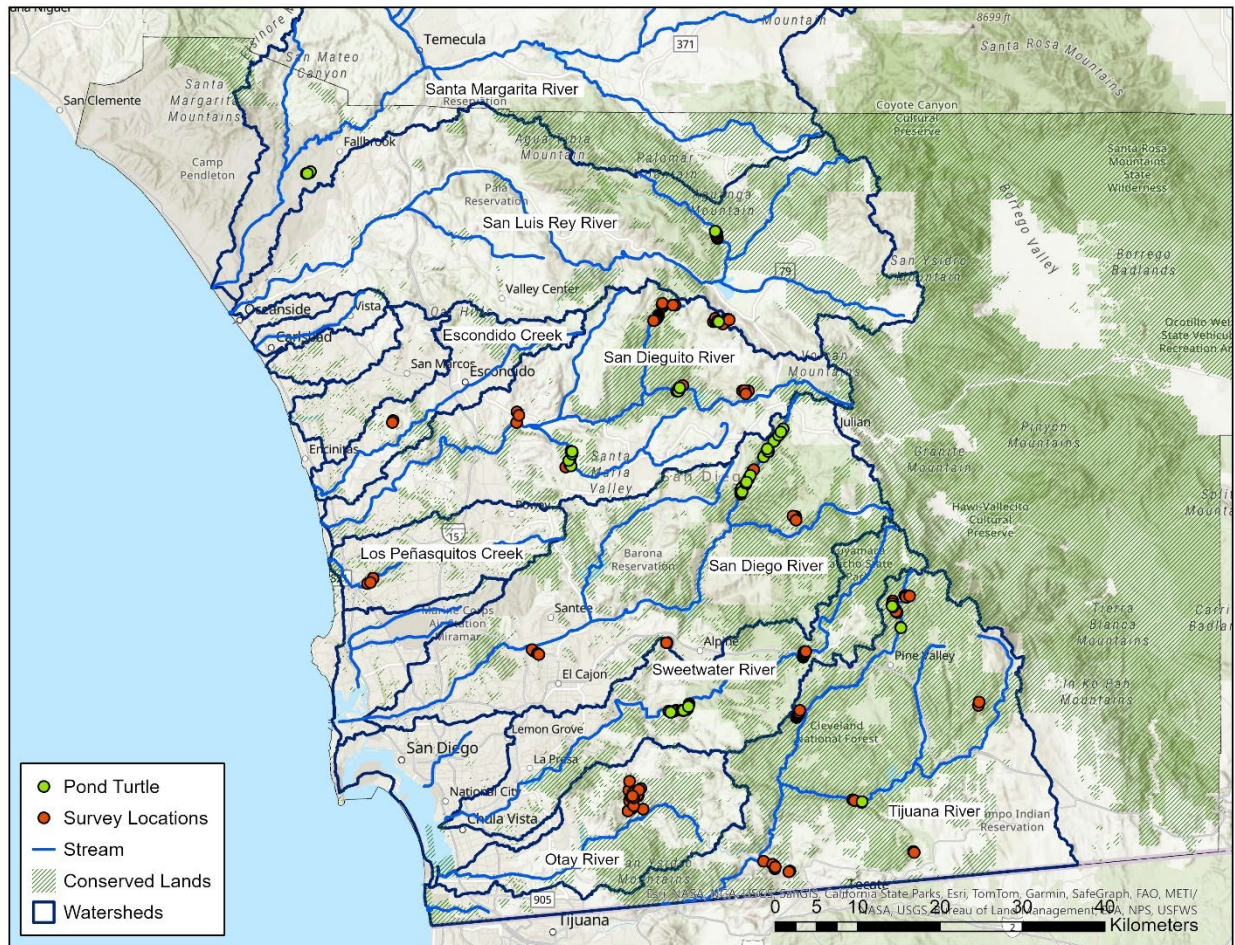


Figure 2. Map showing survey locations for pond turtles in San Diego County watersheds from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

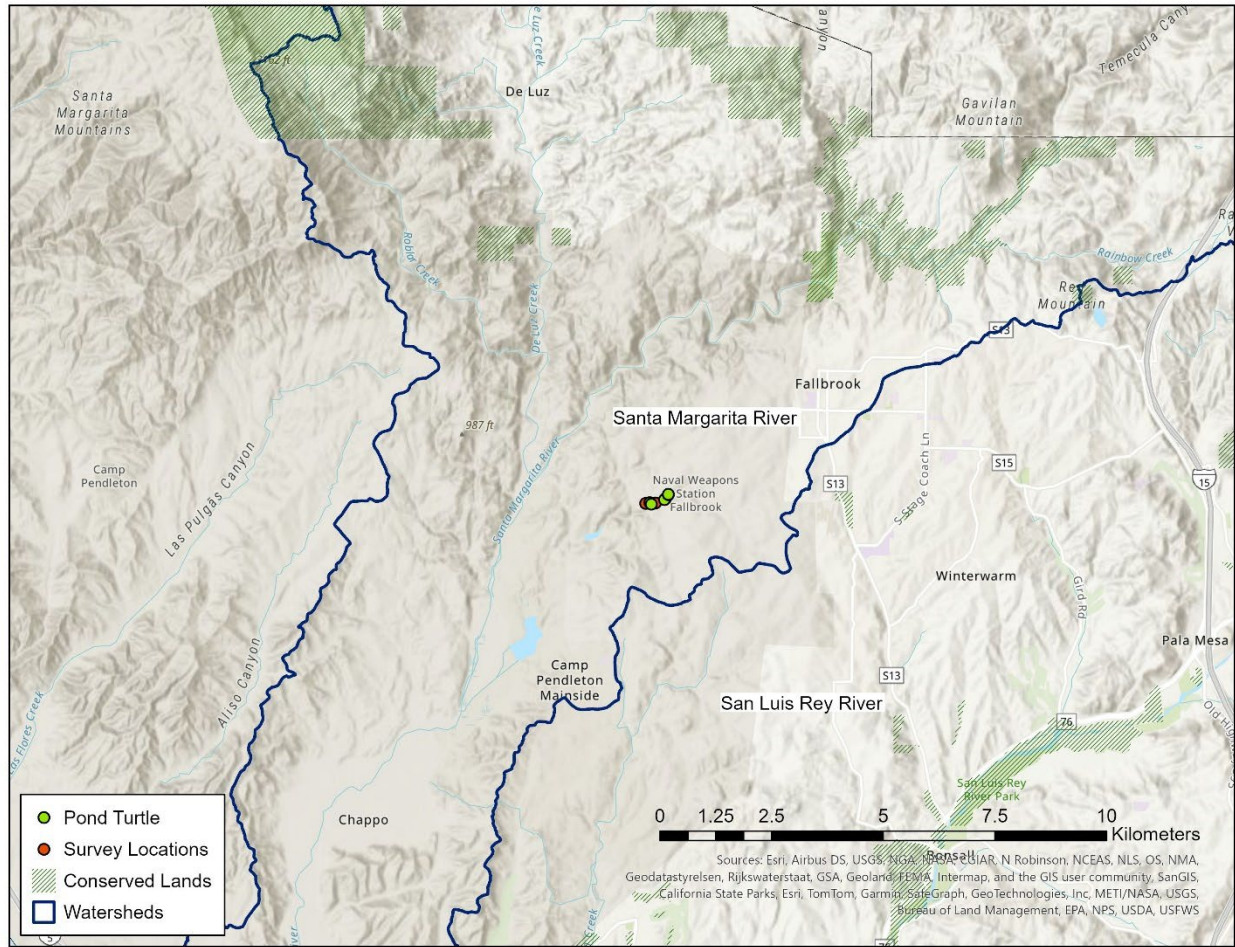


Figure 3. Map showing survey locations for pond turtles at Naval Weapons Station Fallbrook in the Santa Margarita watershed from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

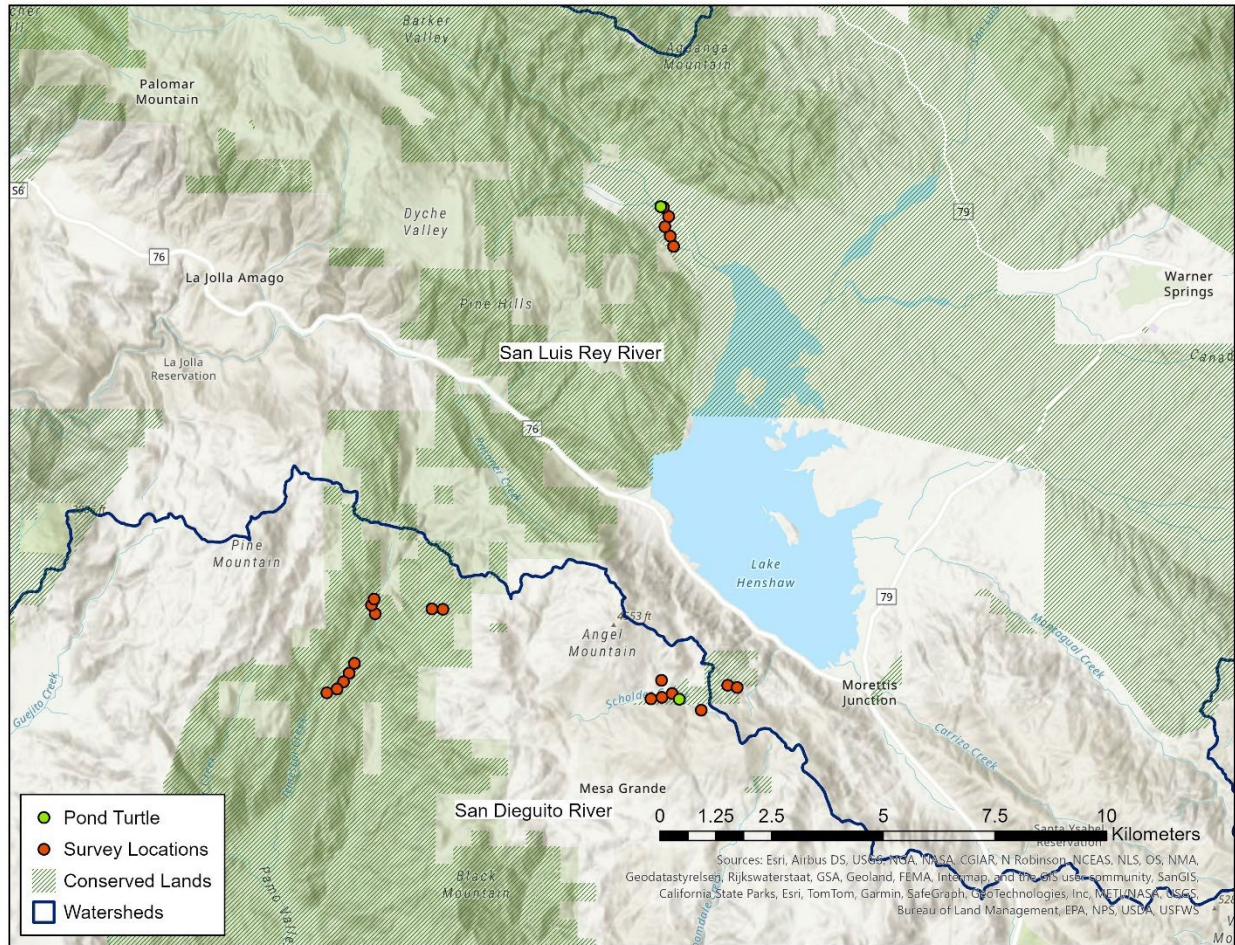


Figure 4. Map showing West Fork San Luis Rey River and Kumpohui Creek Tributary survey locations for pond turtles in San Luis Rey watersheds from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

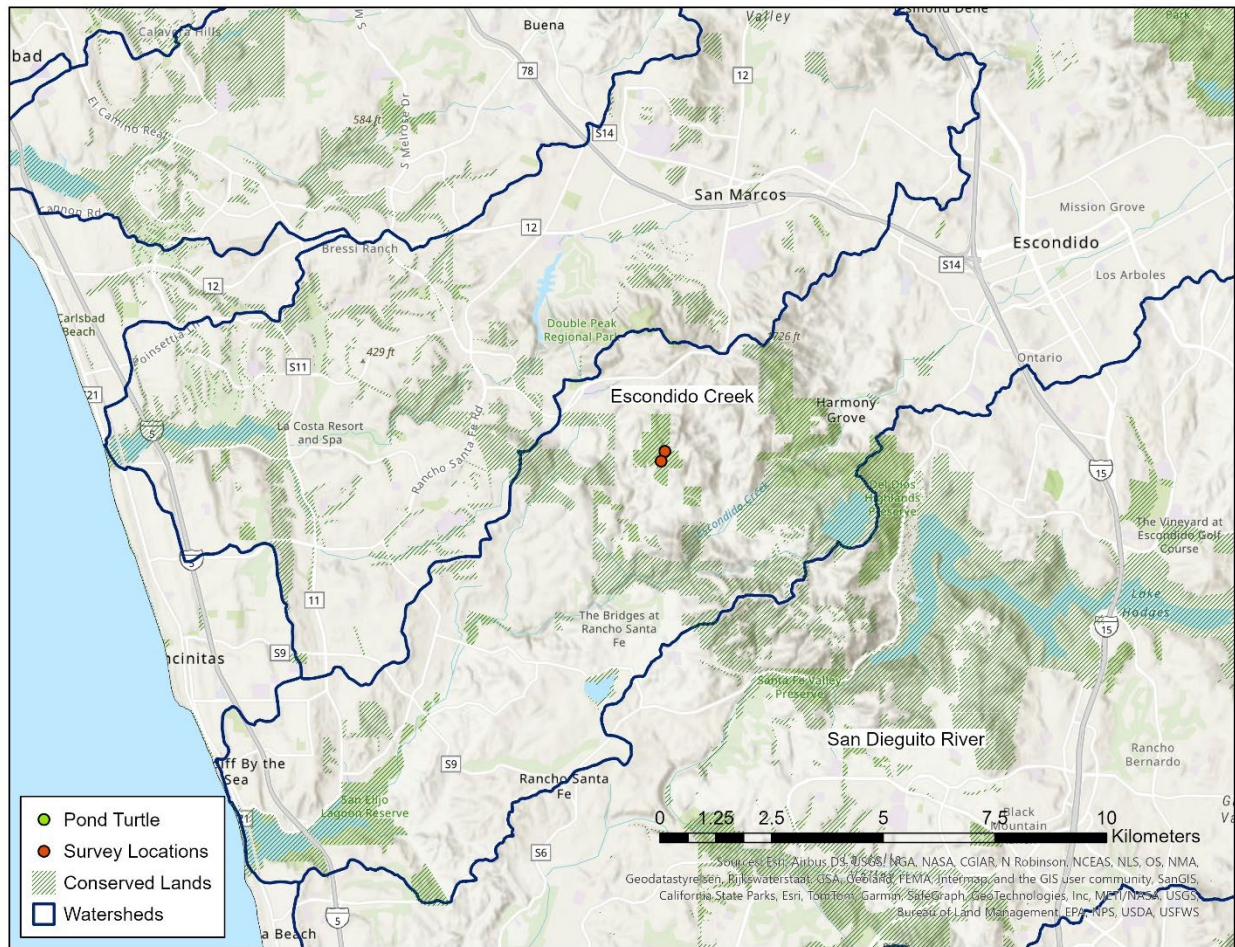


Figure 5. Map showing Sage Hill Preserve survey locations for pond turtles in Escondido Creek watershed from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

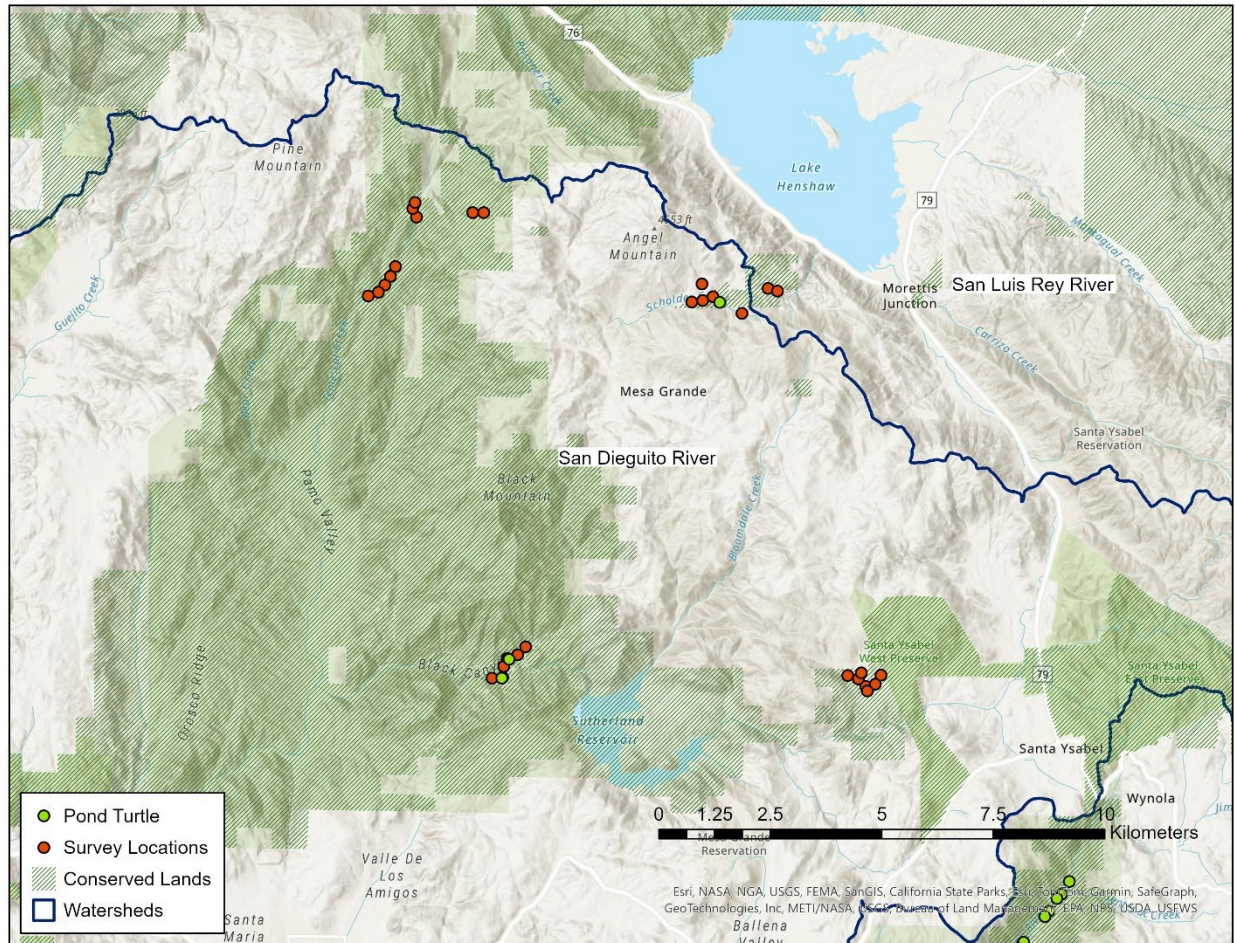


Figure 6. Map 1 of 2 for San Dieguito River watershed showing Wheatley Preserve on Scholder Creek, Temescal Creek, Santa Ysabel Gorge Preserve, and Black Canyon survey locations for pond turtles from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

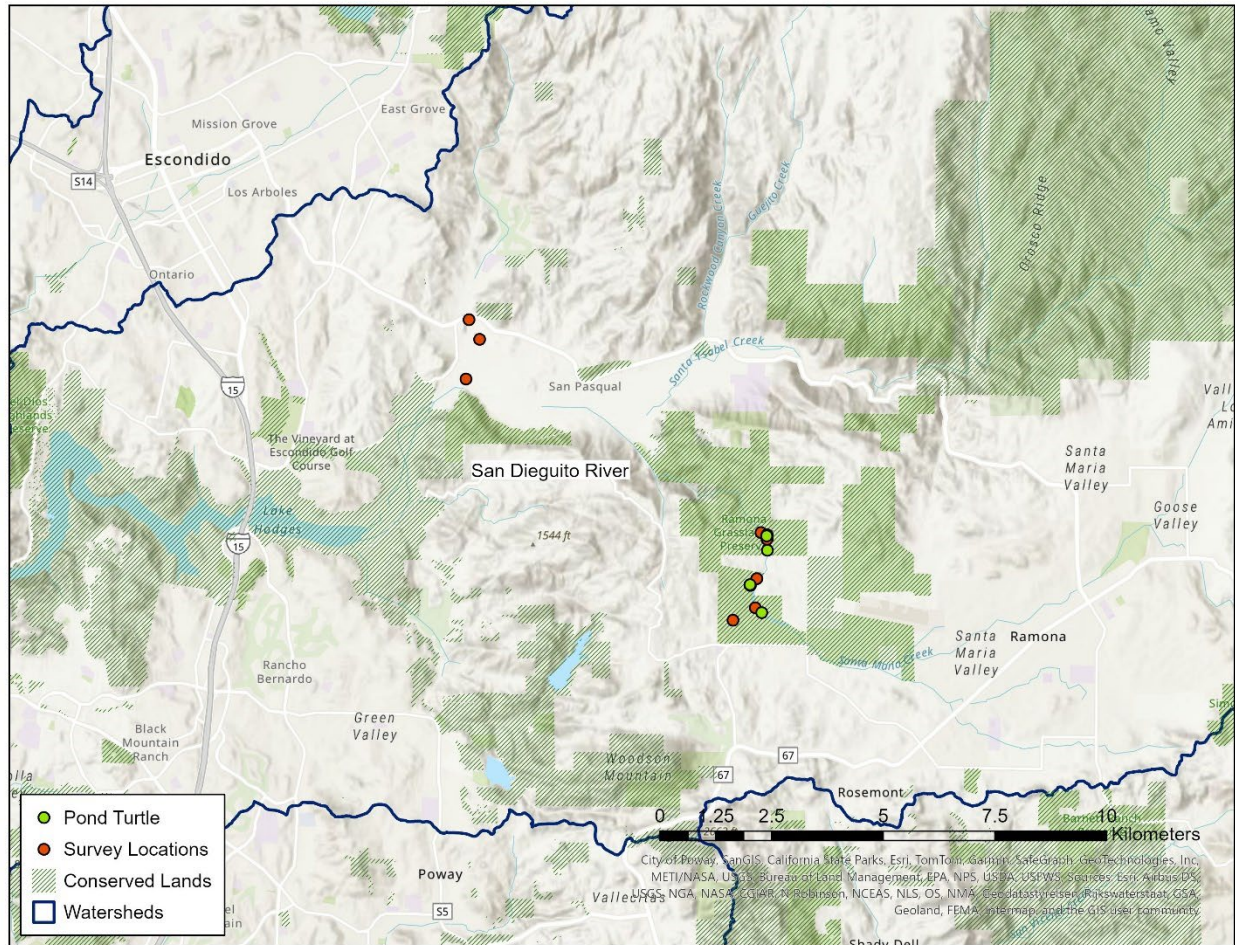


Figure 7. Map 2 of 2 for San Dieguito River watershed showing Ramona Grasslands Preserve and San Pasqual Valley pond turtle survey locations from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.



Figure 8. Map showing survey locations for pond turtles in Los Peñasquitos Creek watershed from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

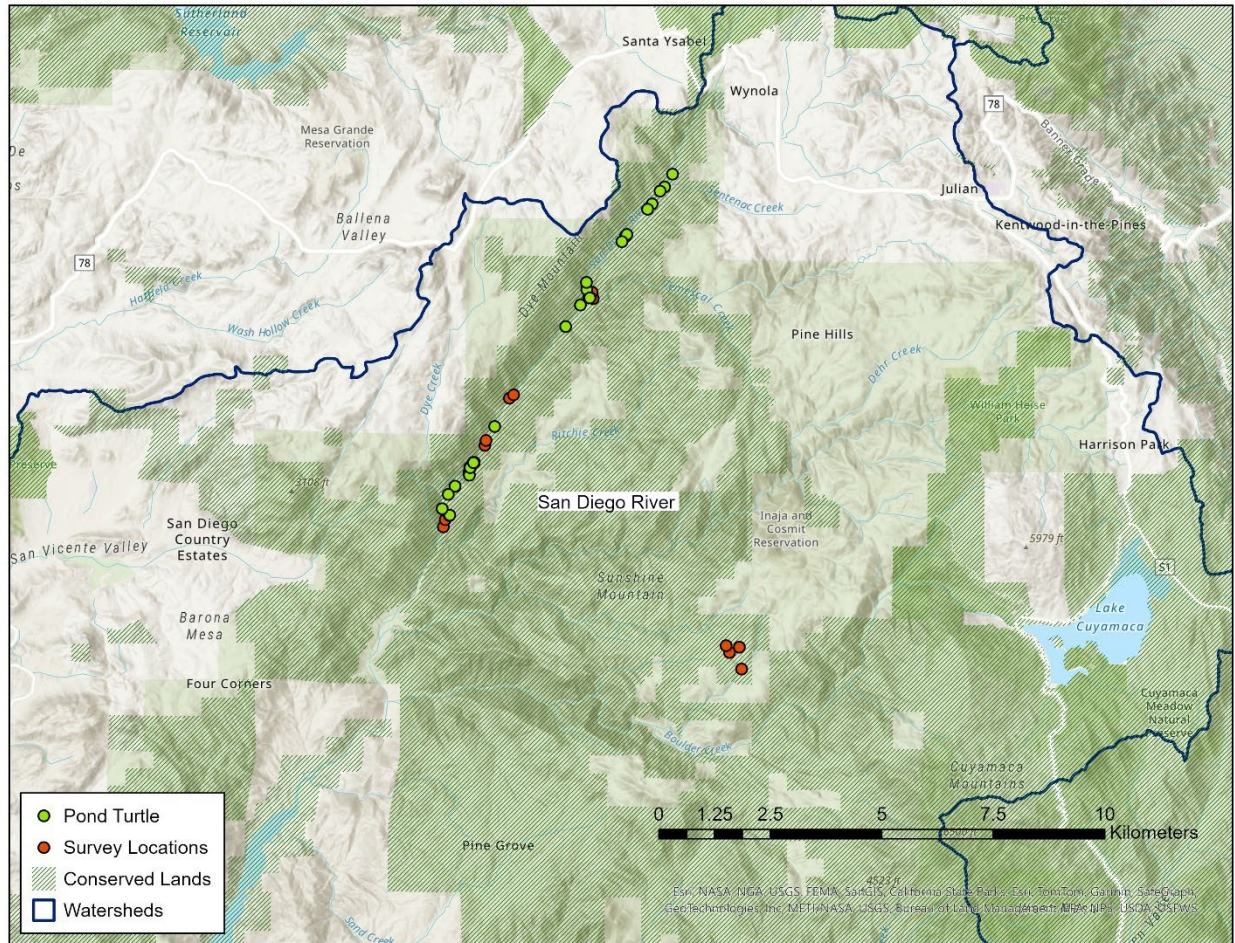


Figure 9. Map 1 of 2 for San Diego River watershed showing Upper San Diego River and Johnson Creek survey locations for pond turtles from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

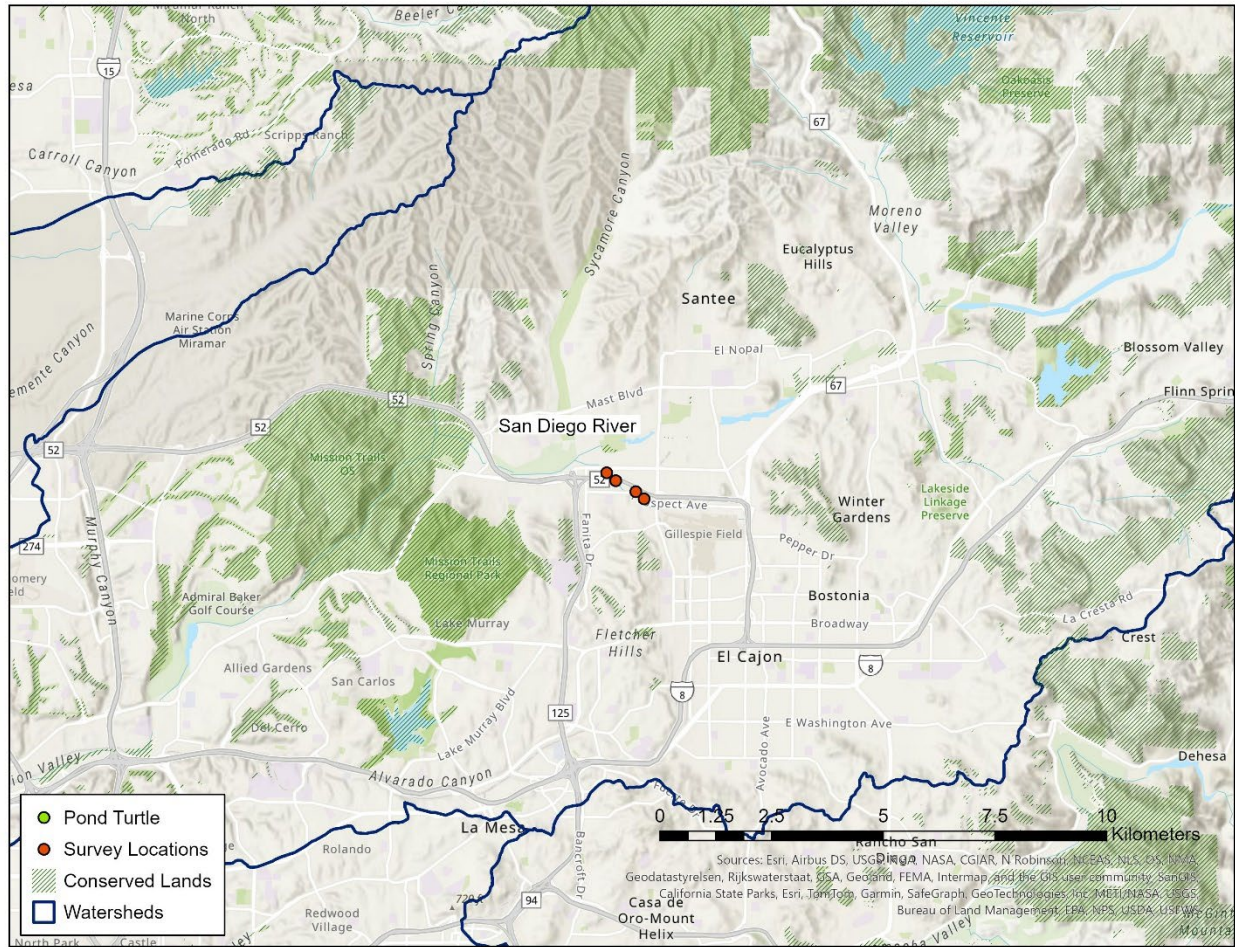


Figure 10. Map 2 of 2 for San Diego River watershed showing Forester Creek survey locations for pond turtles from 1 January 2023 to 31 December 2023. Red dots represent survey locations and green dots represent pond turtle records.

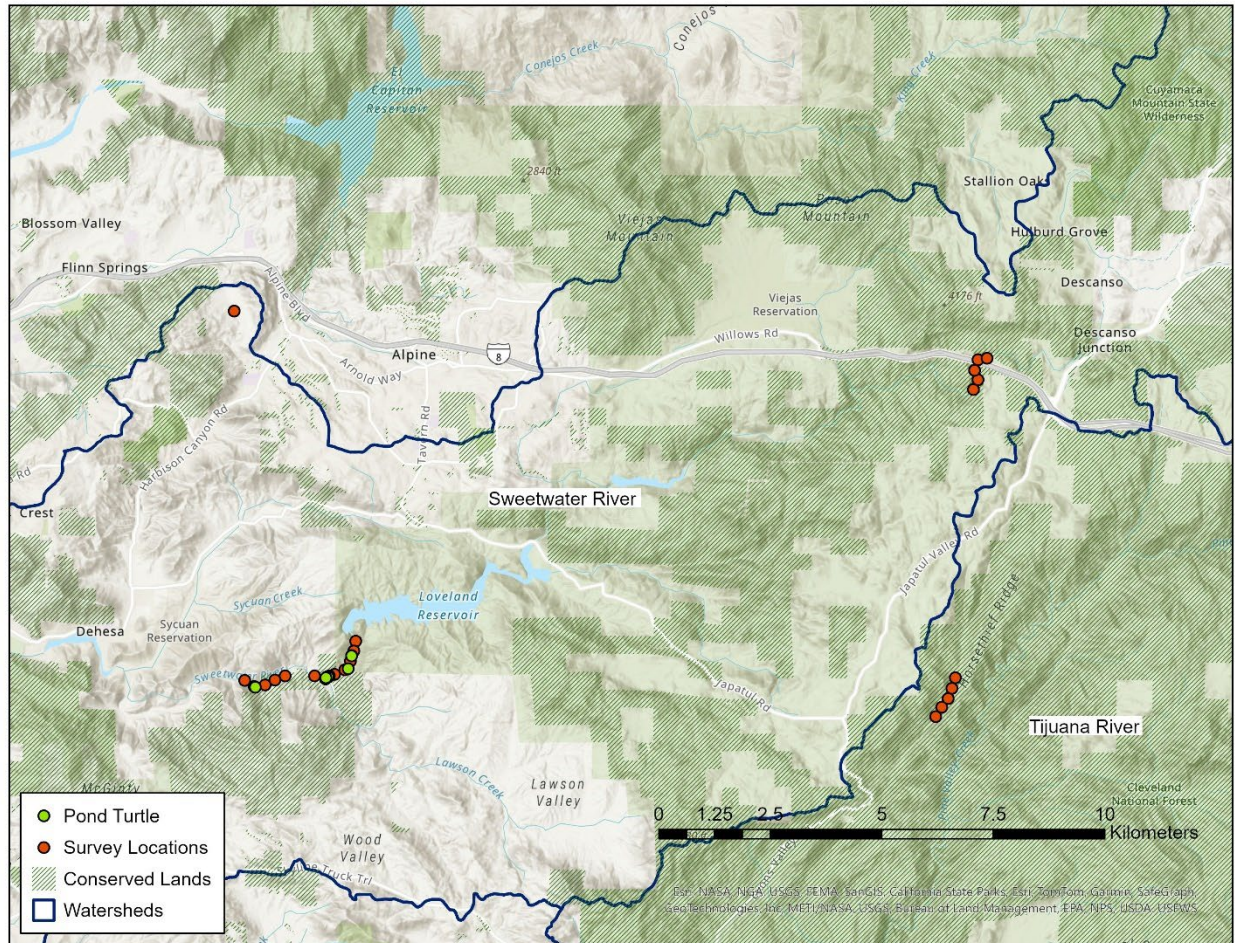


Figure 11. Map showing survey locations in Sweetwater River watershed. Locations include Crestlake, Sweetwater River above Loveland Reservoir, Sweetwater Falls, and Sycuan Peak Ecological Reserve. Red dots represent survey locations and green dots represent pond turtle records.

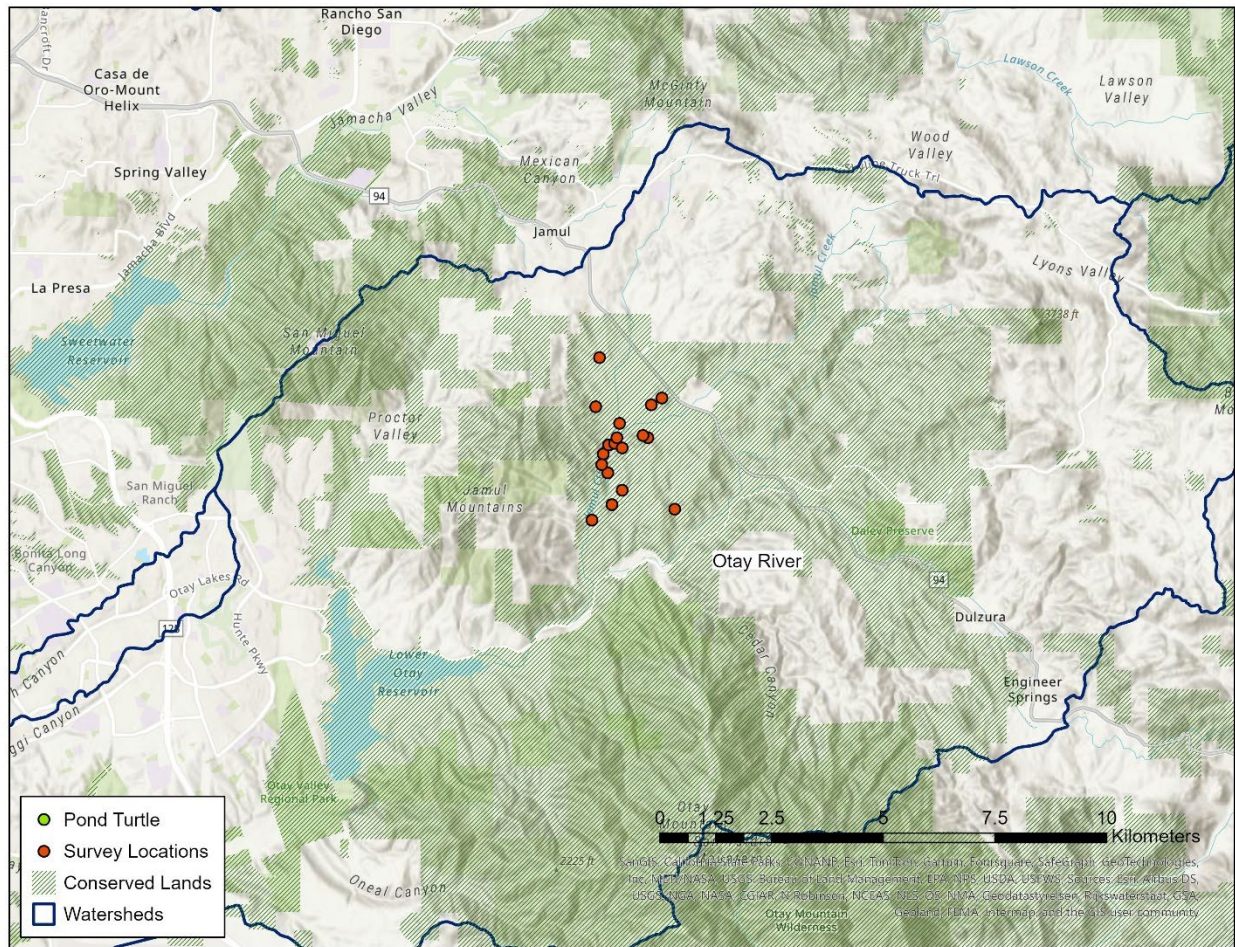


Figure 12. Map showing survey locations on Rancho Jamul Ecological Reserve in Otay River watershed. Red dots represent survey locations and green dots represent pond turtle records.

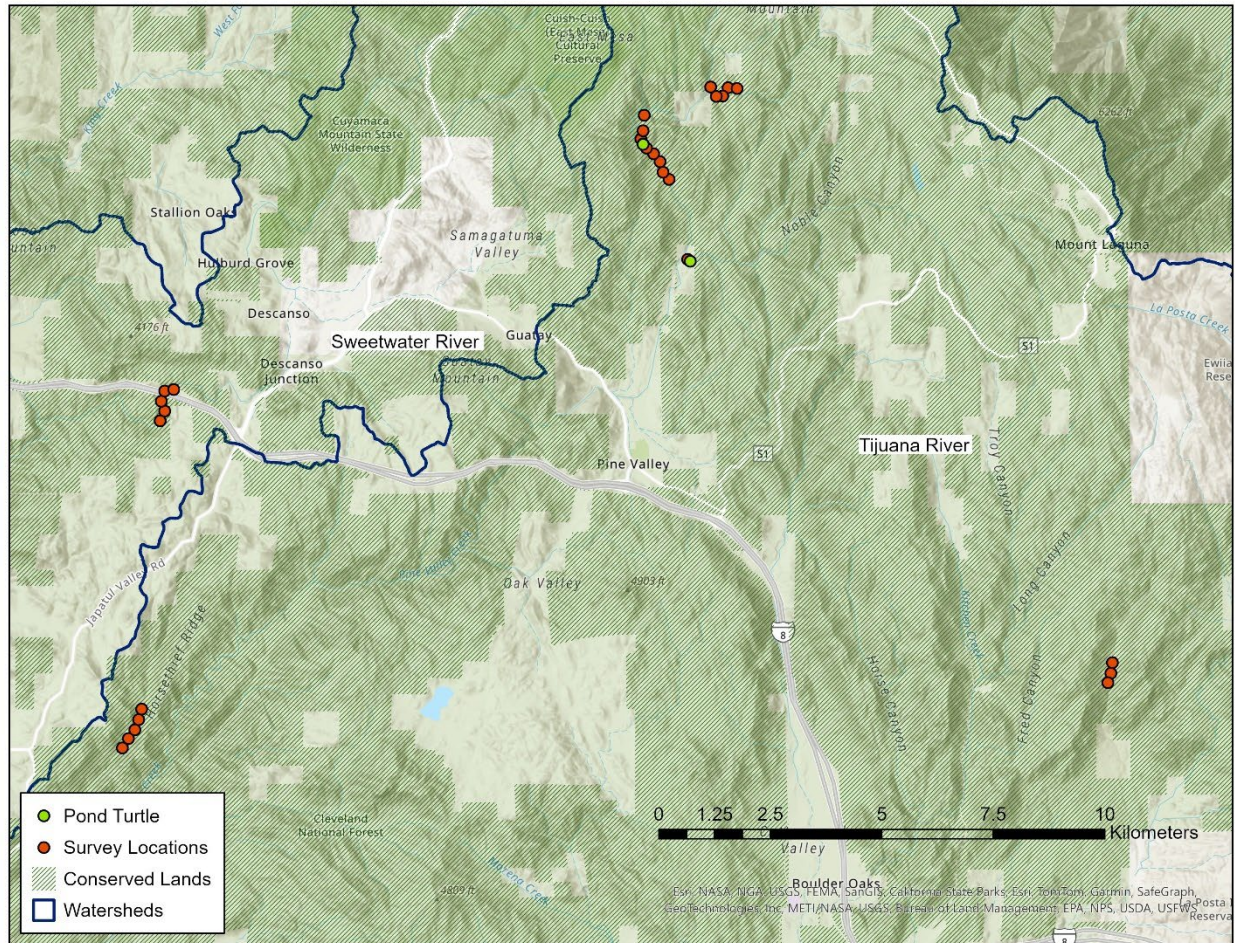


Figure 13. Map 1 of 2 showing survey locations in Tijuana River watershed. The survey locations included are Indian Creek, Pine Valley Creek, Noble Canyon, Antone Canyon, and Horsethief Canyon. Red dots represent survey locations and green dots represent pond turtle records.

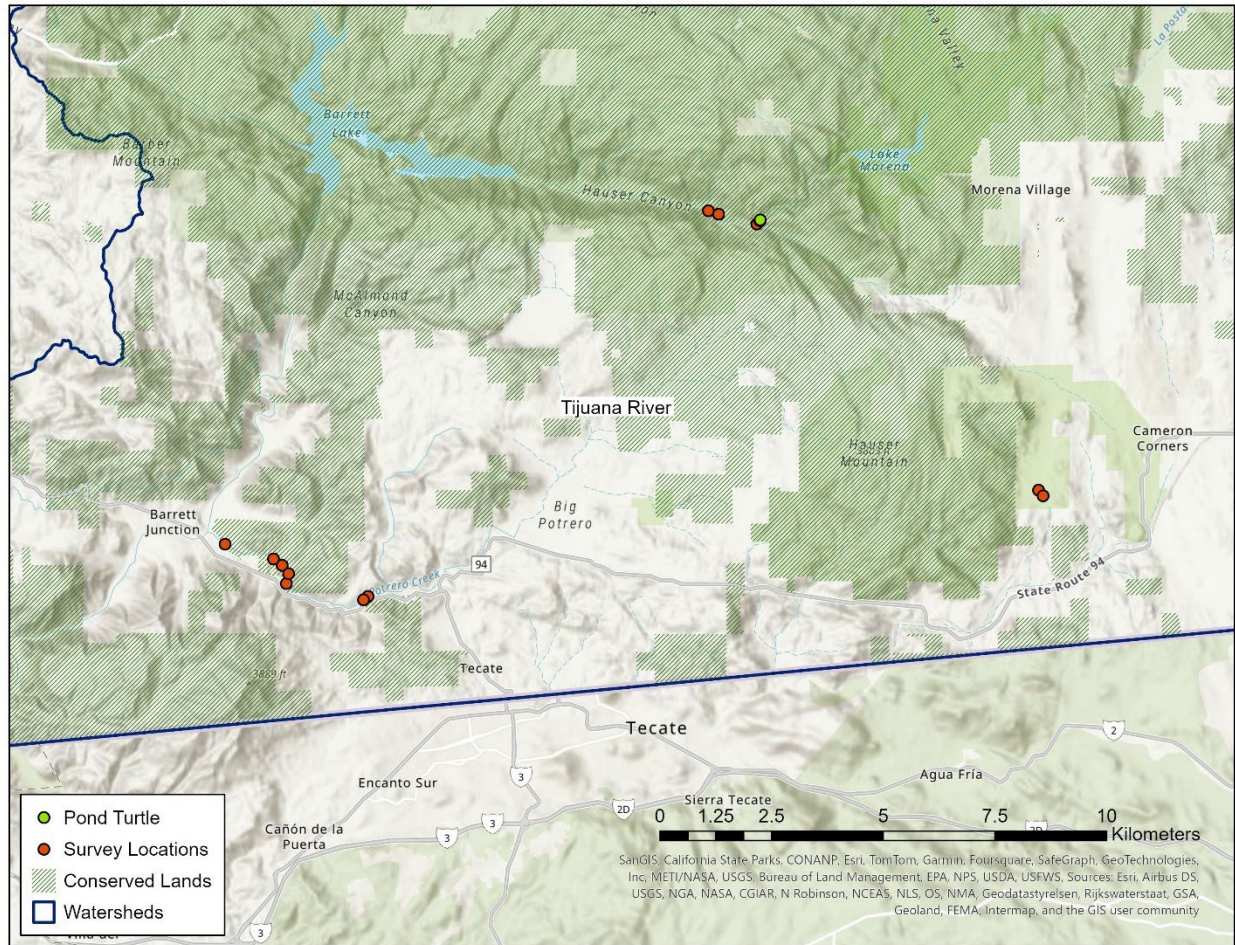


Figure 14. Map 2 of 2 showing survey locations in Tijuana River watershed. The survey locations include Hauser Canyon, Star Ranch, and Potrero Creek. Red dots represent survey locations and green dots represent pond turtle records.



Figure 15. Sediment-filled bedrock pool at Sycuan Peak Ecological Reserve on Sweetwater River downstream from the confluence with Lawson Creek. The pool was filled in with sediment from winter rains and typically holds water in times of drought when other pools are dry. Photograph by Chris Brown.



a.



b.

Figure 16. Pond turtle basking on tree at Pump Pond at Rancho Jamul Ecological Reserve (a). Pond turtle walking on bank of Pump Pond (b). Photograph by Camilla Estes.



Figure 17. Recently burned pond turtle habitat in Noble Canyon Creek near the confluence with Pine Valley Creek. Photograph by Jeremy Sebes.



Figure 18. Barrier fencing that is used to reduce the amount of NAS from entering the main pond at TNC Wheatley Preserve on Scholder Creek. The fencing is close to the property boundary. Photograph by Chris Brown.



Figure 19. Pond turtles basking on log enhancement structures at the main pond at TNC Wheatley Preserve. Photographs by Chris Brown.

Appendix A. Habitat photos from 2023 surveys in San Diego County.



West Fork San Luis Rey River, photograph by Jeremy Sebes



Sage Hill Preserve, photograph by Jeremy Sebes



Scholder Creek, photograph by Jordyn Ochoa



A pond on Temescal Creek in San Dieguito River Watershed, photograph by Jeremy Sebes



Black Canyon, photograph by Jeremy Sebes



Lower Santa Ysabel Creek, photograph by Jeremy Sebes



Ramona Grasslands County Preserve, photograph by Jeremy Sebes



Pond in San Pasqual Valley, photograph by Jeremy Sebes



Pond at Los Peñasquitos Canyon Preserve, photograph by Jeremy Sebes



Upper San Diego River, photograph by Jeremy Sebes



Johnson Creek Pond, photograph by Jeremy Sebes



Forester Creek, photograph by Dhafir Williams



Crestlake, photograph by Jeremy Sebes



Sweetwater River upstream from Loveland Reservoir, photograph by Jeremy Sebes



Sweetwater Falls, photograph by Jeremy Sebes



Sycuan Peak Ecological Reserve, photograph by Jeremy Sebes



Pump Pond at Rancho Jamul Ecological Reserve, photograph by Jeremy Sebes



Pine Valley Creek, photograph by Jeremy Sebes



Pond at Star Ranch, photograph by Jeremy Sebes



Hauser Canyon, photograph by Jeremy Sebes



Potrero Creek, photograph by Jeremy Sebes

Appendix B. Photos of native species from 2023 surveys in San Diego County.



Two-striped gartersnake (*Thamnophis hammondi*), photograph by Chris Brown



Western toad (*Anaxyrus boreas*), photograph by Jordyn Ochoa



Arroyo toad (*Anaxyrus californicus*), photograph by Jeremy Sebes



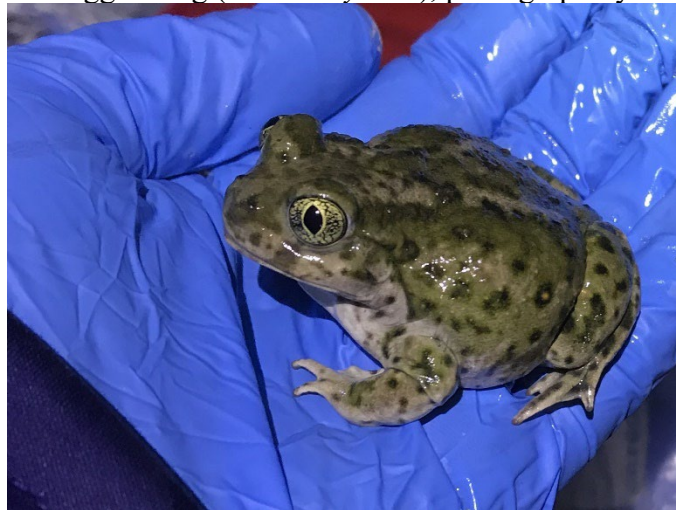
California treefrog (*Pseudacris cadaverina*), photograph by Jeremy Sebes



Baja California treefrog (*Pseudacris hypochondriaca*), photograph by Jordyn Ochoa



California red-legged frog (*Rana draytonii*), photograph by Jordyn Ochoa



Western spadefoot (*Spea hammonii*), photograph by Jordyn Ochoa



Arroyo chub (*Gila orcutti*), photograph by Jeremy Sebes

Appendix C. Photos of NAS from 2023 surveys in San Diego County.



Red-eared slider (*Trachemys scripta elegans*), photograph by Dhafir Williams



American bullfrog (*Rana catesbeianus*), photograph by Jeremy Sebes



African clawed frog (*Xenopus laevis*), photograph by Jeremy Sebes



Barred tiger salamander (*Ambystoma mavortium*), photograph by Jeremy Sebes



Brown bullhead (*Ameiurus nebulosus*), photograph by Jeremy Sebes



Prickly Sculpin (*Cottus asper*), photograph by Jeremy Sebes



Common carp (*Cyprinus carpio*), photograph by Dhafir Williams



Koi (*Cyprinus rubrofuscus*), photograph by Jeremy Sebes



Western mosquitofish (*Gambusia affinis*), photograph by Brad Wineholt



Green sunfish (*Lepomis cyanellus*), photograph by Jeremy Sebes



Bluegill (*Lepomis macrochirus*), photograph by Jeremy Sebes



Largemouth bass (*Micropterus salmoides*), photograph by Jeremy Sebes



Fathead minnow (*Pimephales promelas*), photograph by Jeremy Sebes



Red swamp crayfish (*Procambarus clarkii*), photograph by Jeremy Sebes

Appendix D. Photos from camera stations.



Pond turtles basking at Sycuan Peak Ecological Reserve



Pond turtles basking at Sycuan Peak Ecological Reserve



Pond turtles basking at Sycuan Peak Ecological Reserve



Western toad (*Anaxyrus boreas*) at TNC Wheatley Preserve



California red-legged frog (*Rana draytonii*) at TNC Wheatley Preserve



Two-striped gartersnake (*Thamnophis hammondi*) at TNC Wheatley Preserve



Bobcat (*Lynx rufus*) at TNC Wheatley Preserve



Wild turkey (*Meleagris gallopavo*) at TNC Wheatley Preserve



Mountain lion (*Puma concolor*) at TNC Wheatley Preserve