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

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

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U.S. GEOLOGICAL SURVEY
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Data Summary

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Cover photographs: Basking western pond turtle (*Emys marmorata*) at Rancho Jamul ER and western pond turtle with transmitter at Sycuan Peak ER by Chris Brown.

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Executive Summary

Between 2013 and 2015, the United States Geological Survey (USGS) conducted four western pond turtle (hereafter referred to as pond turtle) studies related to restoring and enhancing pond turtle populations within the Management Strategic Plan Area (MSPA) of San Diego County, CA. The following studies were conducted: 1) the release and radio telemetry of head-started pond turtles at Sycuan Peak Ecological Reserve (SPER), 2) the population assessment of pond turtles at Pine Valley Creek, 3) the assessment of the upper watersheds of the San Dieguito, San Diego, Otay, and Tijuana Rivers for possible pond turtle translocation and donor sites, and 4) the release and radio telemetry of head-started pond turtles at Rancho Jamul Ecological Reserve (RJER).

The pond turtle population at SPER has approximately doubled in size since the nonnative aquatic species removal and head-starting programs began in 2009. Five head-started pond turtles were released in July 2013 and an additional five were released in July 2014. Radio telemetry and monitoring surveys for the head-started pond turtles found all ten headstarted pond turtles remained on site, continued to be active, and appeared to be in good health during monitoring.

USGS conducted surveys in 2013 to estimate the number of pond turtles in Pine Valley Creek in order to assess the potential for the translocation of pond turtles from this site to restored ponds at RJER. We made a total of 134 pond turtle observations. Ninety-three of the 134 total observations were captures (either by hand or by net). Of the 93 pond turtle captures, 81 were newly captured and marked individuals, 4 were recaptures, and 12 were released unmarked because they were either too small to PIT-tag (10) or the PIT-tags failed (2). An additional 37 pond turtles were observed visually but escaped capture. Approximately 53% (29/55) of known-sex adult captures were male and approximately 47% (26/55) were female for both sites combined. Juveniles (less than 105 millimeters) comprised 25% (20/81) of the known-age population. Using the Schnabel method (Schnabel 1938), we estimated the Pine Valley Creek pond turtle population to comprise approximately 435 individuals (95% limit: lower 188, upper 9659). Based on these results, we recommend a harvest rate of 20 individuals (<5% of the estimated population) for translocation to restoration sites.

In 2013-2015, USGS conducted assessments of the upper watersheds of the Otay, Tijuana, San Dieguito, and San Diego Rivers for possible pond turtle translocation donor and receiver sites. Out of 11 potential translocation donor and 7 potential receiver sites within the study area, we found 2 suitable donor sites and 1 suitable receiver site. No suitable donor sites and no suitable receiver sites have been fully determined within the upper San Dieguito River and upper San Diego River watersheds. One suitable receiver site has been determined within the Otay River watershed. Two suitable donor sites have been determined within the upper Tijuana River watershed. This study is ongoing so additional translocation donor and receiver sites may be identified.

RJER was chosen by USGS, California Department of Fish and Wildlife, the San Diego Zoo, and San Diego Association of Governments SANDAG as a location for pond turtle restoration. In 2014, RJER was surveyed to locate all potentially suitable pond turtle habitat and to identify sources of nonnative aquatic species. Nonnative aquatic species were then removed from areas determined suitable for pond turtle translocation. In September and October of 2014, a total of 12 western pond turtles were translocated from private ponds in the Pine Valley Creek watershed to ponds at RJER. Radio telemetry and monitoring surveys for the translocated pond turtles found the pond turtles to be active, staying at their pond, and basking frequently on many features of the pond.

Introduction to Studies

The western pond turtle (*Emys marmorata*; hereafter referred to as pond turtle) has been extirpated from much of San Diego County, with very few populations still remaining in the Management Strategic Plan Area (MSPA) designated by the San Diego Management and Monitoring Program for the San Diego Association of Governments (SANDAG) (SDMMP 2013). The rarity of the pond turtle combined with the impacts of water diversions, stream alterations, and habitat loss, creates the need for management considerations on a site by site basis, particularly when threatened by prolonged drought or nonnative aquatic species. Translocation of pond turtles in conjunction with nonnative aquatic species management has been identified as a means to restore this species to drainages from which they have been extirpated within this region. Translocation can also be used to preserve the genetic makeup of distinct populations through geographic replication, for example, securing the fate of the Tijuana River watershed genetic makeup by having restored populations in other watersheds. The Management Strategic Plan for Conserved Lands in western San Diego County (SDMMP 2013) includes objectives for nonnative aquatic species removal, head-starting of pond turtles, and translocation of pond turtles as a strategy for restoring and enhancing pond turtle populations in San Diego County. The U.S. Geological Survey (USGS) was contracted by SANDAG to help fulfill these objectives.

This report covers four pond turtle studies conducted by USGS between 2013 and 2015, with the focus of restoring and enhancing pond turtle populations within the MSPA: 1) the release and radio telemetry of head-started pond turtles at Sycuan Peak Ecological Reserve (SPER), 2) the population assessment of pond turtles at Pine Valley Creek, 3) the assessment of the upper watersheds of the San Dieguito, San Diego, Otay, and Tijuana Rivers for possible pond turtle translocation and donor sites, and 4) the release and radio telemetry of head-started pond turtles at Rancho Jamul Ecological Reserve (RJER).

In 2002-2003 surveys by USGS, the largest pond turtle population in the Multiple Species Conservation Program (MSCP), consisting of approximately 38 mature individuals and no juveniles, was determined to be in the Sweetwater River at SPER (Madden-Smith et al. 2005). With controlled access and over three kilometers to the nearest main road, the largest stressor to pond turtles at this site was nonnative aquatic species. In 2009 USGS began removing nonnative species from SPER with the goal of restoring the aquatic habitat for pond turtles and stimulating recruitment. In connection with the nonnative aquatic species removal, eggs were harvested from gravid female pond turtles to establish a captive rearing and head-starting program at the San Diego Zoo for the purpose of enhancing the pond turtle population at SPER (Brown et al. 2012). In July of 2013 and July of 2014, a total of 10 head-started pond turtles were fitted with radio transmitters and released. They were radio tracked and monitored to determine movement and health status through May of 2015.

In 2001-2003 surveys by USGS, pond turtles were absent from RJER (Hathaway et al. 2002, Madden-Smith 2005). However, the Rancho Jamul Ecological Reserve's Land Management Plan identified ponds on RJER as suitable for translocation and management of pond turtles (CDFG 2008). This site was later chosen by USGS, CDFW, San Diego Zoo, and SANDAG as a location for pond turtle translocation. In June2014, RJER was surveyed to locate all potentially suitable pond turtle habitat and to identify sources of nonnative aquatic species. Nonnative aquatic species were then removed from areas determined suitable for pond turtle translocation.

In September and October of 2014, 15 western pond turtles were translocated from private ponds in the Pine Valley Creek watershed to ponds at RJER. The pond turtles were fitted with radio transmitters before release and were radio tracked and monitored to determine movement and health status. Monitoring of pond turtles at this site is ongoing.

To support the pond turtle translocation and restoration efforts, sites with potential donor populations needed to be identified and assessed to determine the source and number of turtles that could be translocated. Pine Valley Creek was identified as a site with a large population of pond turtles that could be studied further and assessed as a donor population. In 2013, USGS added to work begun in 2010 at Pine Valley Creek including a series of visual encounter mark-recapture surveys to determine if the population is large enough to support a translocation program.

Building on the initial work at SPER, RJER, and Pine Valley Creek, USGS began to identify and assess locations in other watersheds to expand the pond turtle restoration program within conserved lands in San Diego County. From 2013 to 2015, USGS began to identify and examine 20 sites from the watersheds of the San Dieguito, San Diego, Otay, and Tijuana Rivers. These sites included potential donor population sites in the upper watersheds as well as potential receiver sites in the lower watersheds.

These four projects have been collaborative efforts of USGS and its partners: San Diego Zoo, California Department of Fish and Wildlife (CDFW), San Diego Management and Monitoring Program (SDMMP), San Diego Association of Governments (SANDAG), US Fish and Wildlife Service (USFWS), and Southwestern College. Staff members conducting surveys and animal husbandry in support of the pond turtle programs are listed here by affiliation:

<u>US Geological Survey</u>
Angelica N Aguilar Duran
Chris Brown
Denise Clark
Robert Fisher
Carlton Rochester
Sam Fisher (volunteer)
Lizzie Grolle (volunteer)
Brittany Idrizaj (volunteer)

<u>San Diego Zoo</u>
Kim Lovich
Thomas Owens
Brandon Scott
The captive rearing of head-started individuals occurred at the San Diego Zoo. The support for this part of the program came from the entire Klauber-Shaw Reptile House staff.

<u>Southwestern College</u>
Omar Guerra Salcido

<u>California Department of Fish and Wildlife</u>
Steven Choy

Chris Manzuk
Jonathan Piazza
Natalie Uriarte

Study 1: Release and Radio Telemetry of Head-started Western Pond Turtles at Sycuan Peak Ecological Reserve

Introduction

In 2009 the U.S. Geological Survey (USGS) began removing nonnative species from Sycuan Peak Ecological Reserve (SPER) with the goal of restoring the aquatic habitat for western pond turtles (*Emys marmorata*; hereafter referred to as pond turtle) and stimulating recruitment. Nonnative aquatic species removed include American bullfrogs (*Lithobates catesbeianus*), African clawed frogs (*Xenopus laevis*), sunfish (*Lepomis* spp.), largemouth bass (*Micropterus salmoides*), and crayfish (*Procambarus* spp.). In connection with the nonnatives removal, eggs were harvested from gravid female pond turtles to establish a captive rearing program at the San Diego Zoo to head-start turtles for reintroduction to the Sweetwater River (Brown et al. 2012).

Following the removal of nonnative aquatic species, the pond turtle population was monitored to determine if there were any initial beneficial effects of the removal of nonnative aquatic species. Two juvenile pond turtles were detected at SPER, one first detected in 2010 (and again in 2011) and a second juvenile detected in 2011. These were the first detections of successful recruitment of this species in the MSCP in over a decade (Madden-Smith et al. 2005, Brown et al. 2012). The presence of juveniles after nonnative removal at SPER suggests that nonnative removal has direct benefits for the pond turtle and should be a main component of pond turtle management strategies.

During 2009 and 2010, eggs were harvested from gravid female pond turtles captured during the restoration work at SPER to establish a captive rearing program at the San Diego Zoo. These eggs produced 10 juveniles that were reared in isolation and off display at the San Diego Zoo.

Five head-started pond turtles were radio-tagged and released on 07 July 2013 and the remaining five were radio-tagged and released on 31 July 2014. The pond turtles were tracked from the day they were released until 07 May 2015 with the purpose of gathering information on site fidelity and health condition. Initial radio tracking occurred three times a week slowing to weekly after one month. All 10 pond turtles survived and stayed at or near the pools where they were released.

Methods

Study Site

SPER is located along the Sweetwater River approximately one kilometer below Loveland Dam and approximately four kilometers southeast of Dehesa, San Diego, CA (Figure 1.1). The upland habitat consists of mixed sage scrub with some chaparral and the riparian is dominated by

California sycamore (*Platanus racemosa*), willow (*Salix* spp.), and live oak (*Quercus agrifolia*) with a thick understory of false indigo (*Amorpha fruticosa*) and wild grape (*Vitis girdiana*). The canopy along the stream channel is open where there is larger bedrock or sandy pools (Figure 1.2 and 1.3).

Figure 1.1. The location of Sycuan Peak Ecological Reserve, San Diego, CA. Sycuan Peak Ecological Reserve is located downstream of Loveland Reservoir along the Sweetwater River.

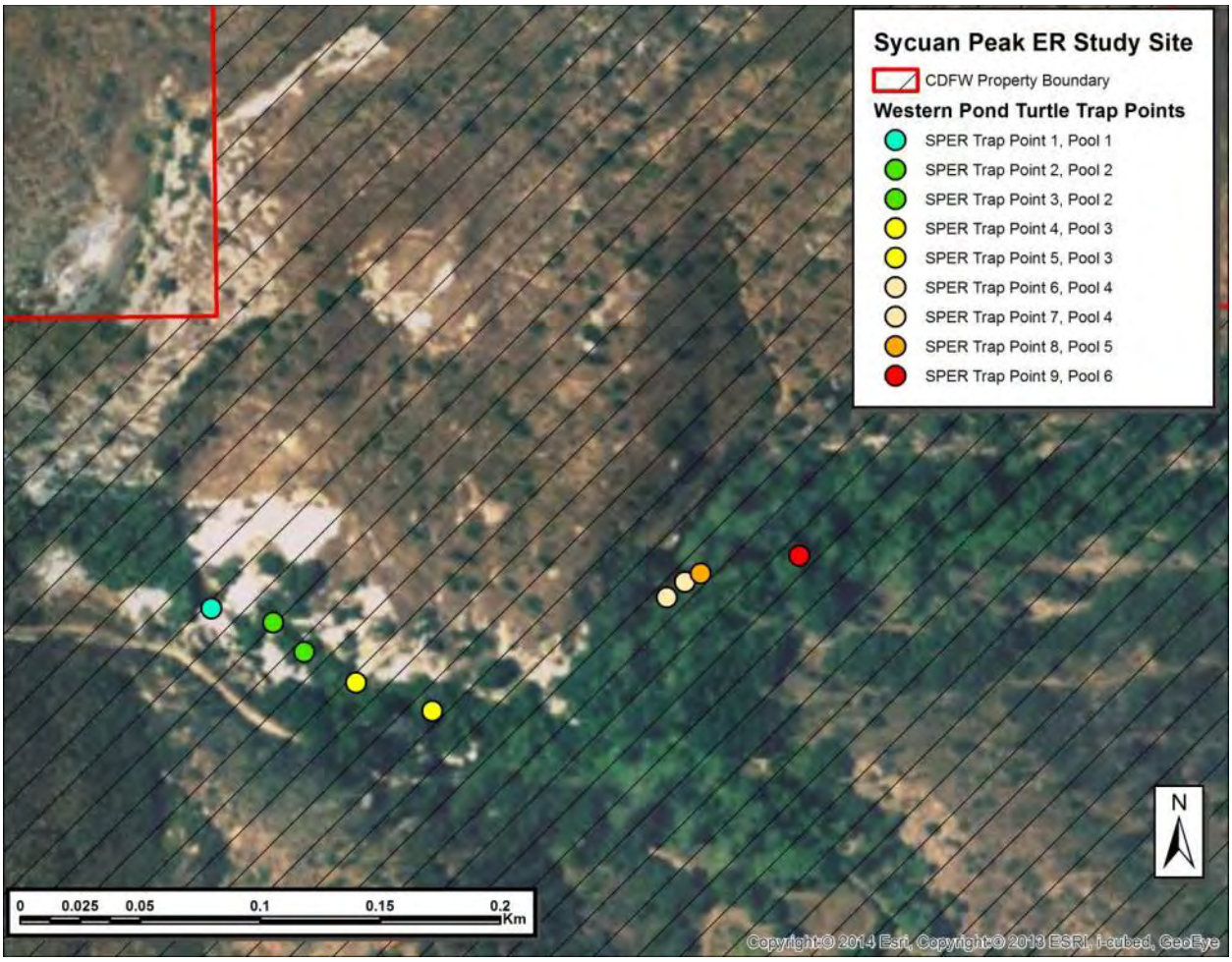

Figure 1.2. Pond turtle habitat and trapping locations at Sycuan Peak Ecological Reserve, San Diego, CA. Sycuan Peak Ecological Reserve is located downstream of Loveland Reservoir along the Sweetwater River. The most suitable pond turtle habitat occurs in six large pool complexes (Pools 1-6) within the reserve. The mapped trap locations are numbered 1-9, going from west to east and are color coded by pool.

Figure 1.3. Photographs of trapping points in suitable pond turtle habitat at Sycuan Peak Ecological Reserve.

Suitable pond turtle habitat at SPER was divided into six pool complexes based on structure and connectivity (Figure 1.2 and 1.3, Table 1.1). The lower pools, Pool 1, Pool 2, and Pool 3, were characterized by boulders and bedrock, with moderate to open canopy. Having deeper pools and a larger amount of basking and foraging areas, the lower pools support the majority of the pond turtle population at SPER. The upper pools, Pool 4, Pool 5, and Pool 6 were characterized by soft sand and gravel bottoms, more emergent vegetation and a less open canopy. These pools may

dry seasonally but still provided habitat for pond turtles. Pool 4 was the most stable of the upper, sandy bottomed pools and was considered to be semi-permanent. Pool 6 dried completely every year and was the first of the six pools to dry. When wet, pond turtles were still found to occupy all of the upper three pools.

Table 1.1. Trapping locations and brief descriptions of pools with suitable pond turtle habitat at Sycuan Peak Ecological Reserve. Coordinates are in WGS84 and represent the general trap locations.

Name	Trapping Locations	Latitude	Longitude	General Description
Pool 1	1	32.772248	-116.800807	Most downstream pool with a bedrock and sand bottom and open canopy. This pool has retained water during the duration of this study
Pool 2	2 3	32.772195 32.772084	-116.800532 -116.800395	Second most downstream pool with shallow bedrock and sandy bottom and partial canopy cover. This pool has retained water during the duration of this study.
Pool 3	4 5	32.771969 32.771861	-116.800163 -116.799825	Third most downstream pool with predominately sandy bottom and shoreline and thick canopy cover. This pool dried during 2010 but has retained water through all of 2014.
Pool 4	6 7	32.772286 32.772344	-116.798780 -116.798701	Fourth most downstream pool with predominately sandy bottom and shoreline. Shoreline vegetation is thick but the canopy is open. This pool dries completely seasonally.
Pool 5	8	32.772375	-116.79863	Fifth most downstream pool with predominately sandy bottoms and shorelines with thick vegetation and closed canopy. This pool has retained water longer than pools 4 and 5, but is prone to seasonal drying.
Pool 6	9	32.772441	-116.798191	Most upstream pool with predominately sandy bottoms and shorelines with a mostly closed canopy. This pool dries down seasonally and has been the first pool to dry completely each year.

Head-starting

During the 2009 and 2010 trapping surveys at SPER, San Diego Zoo staff assisted with pond turtle monitoring and the capture of gravid female pond turtles. Gravid females were taken to the San Diego Zoo and kept until eggs were laid, then returned to the site. The San Diego Zoo staff then incubated and hatched the eggs; juveniles were raised in isolated enclosures (Figure 1.4). Two females laid eggs in 2009; however, only one clutch was fertile and produced five hatchlings. In 2010, three females produced three fertile clutches, producing five additional hatchlings. The hatchlings were raised off exhibit at the San Diego Zoo until large enough for

release. The hatchlings were given an identification number (1-10) based on their hatching order and this number was used for identification during telemetry surveys. This component of the program was paid for by the San Diego Zoo and its employee contributions program.

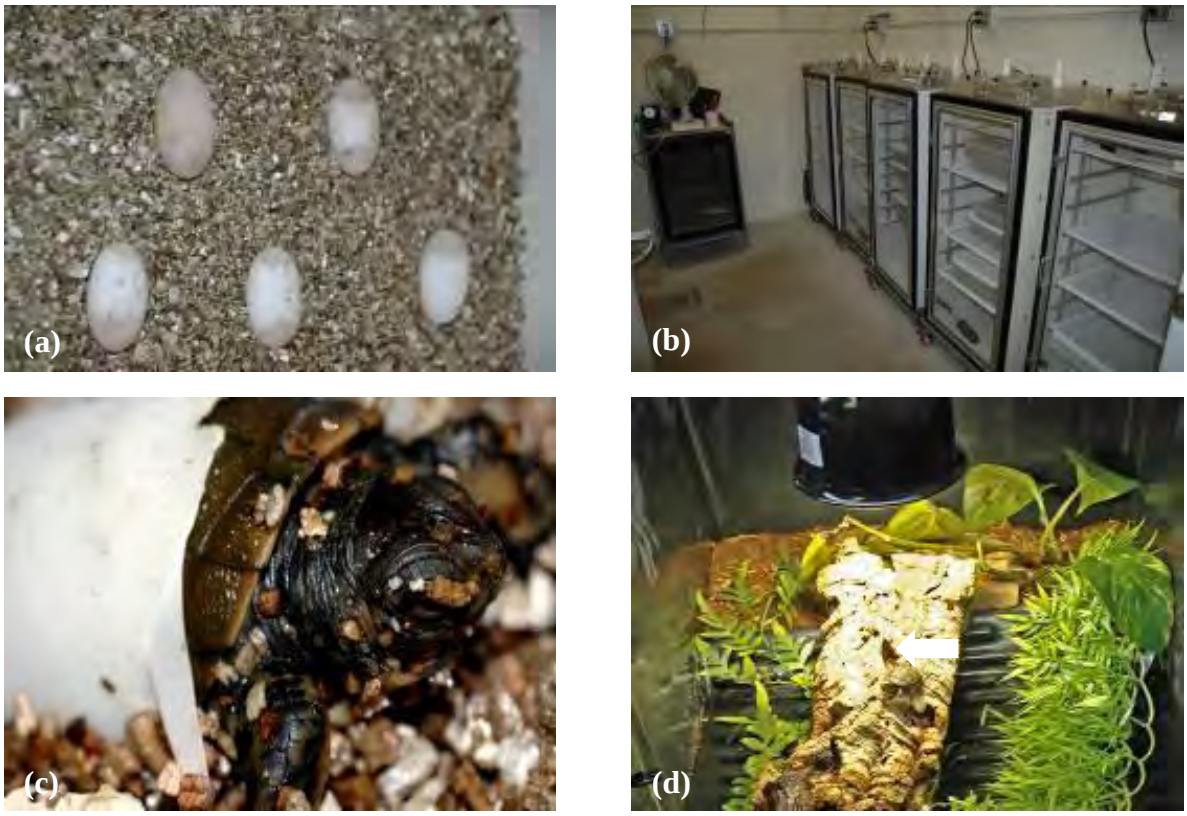

Figure 1.4. Photos of the pond turtle head-starting process at the San Diego Zoo. Eggs from gravid females from Sycuan Peak Ecological Reserve (a) were incubated in the San Diego Zoo's Klauber-Shaw Reptile House incubation facility (b). As hatchlings emerged (c) they were transferred to isolated enclosures (d).

The head-started pond turtles remained at the San Diego Zoo's Klauber-Shaw Reptile House until they were large enough to be released. The head-started turtles were monitored by telemetry, motion cameras, and visual surveys after release (Table 1.2).

Table 1.2. Pond turtle survey types, methods, dates, frequency of visits, and attending staff at the Sycuan Peak Ecological Reserve. Five head-started pond turtles were released on 17 July 2013 and five were released on 31 July 2014. They were monitored by telemetry and visual surveys through 4 May 2015.

Survey Type	Methods/Data Recorded	Survey Dates	Number/Frequency of Samples	Staff[c]
Telemetry & Visual Surveys	Determine location at pools	17 July 2013 – 4 May 2015	64	CB,DC,AA,BI ,LG,OG
Time Lapse Camera	Time lapse only photos	3 September 2011 & 26-30 September 2011	1 photo/minute	CB,DC,CR
Motion Camera	Time lapse and motion triggered photos	1 October 2014 - present	3 photos per trigger & time lapse every ½ hour[a] & 5 photos per trigger & time lapse every /¼ hour[b]	CB,AA,BI,LG, OG

[a]The camera was set at the medium setting (three photos per trigger at one frame per second) and time lapse for every 30 minutes from 1 October 2014 through 22 November 2014.
[b]The camera was set at the high setting (five photos per trigger at approximately two frames per second) and time lapse every 15 minutes from 23 November 2014 to present.
[c]CB = Chris Brown, DC = Denise Clark, AA = Angelica N Aguilar Duran, CR = Carlton Rochester, BI = Brittany Idrizaj, LG = Lizzie Grolle, and OG = Omar Guerra Salcido.

Telemetry

As soon as the head-started pond turtles were large enough to avoid being eaten by nonnative predators like bullfrogs (*Lithobates catesbeianus*), approximately 90 millimeters in length (the size of a two or three year old wild juvenile), they were considered ready for release. Five pond turtles were large enough to be released in July 2013 and an additional five were large enough in July 2014. Radio transmitters were affixed to pond turtles while still at the San Diego Zoo's Klauber-Shaw Reptile House in order to ensure the transmitters were properly secured to the turtles prior to their release. The first set of pond turtles was affixed with transmitters on 15 July 2013 and then released at Pool 1 on 17 July 2013. The second set was affixed with transmitters on 30 July 2014 and released at Pools 2 and 3 on 31 July 2014. All head-started pond turtles were monitored by radio telemetry and visual surveys until 4 May 2015 when the transmitters were removed from both sets of pond turtles.

For first set of pond turtles, we initially used Holohil 1.8g BD-2 transmitters affixed to the carapace with aquarium grade silicone sealant (Figure 1.5). The attached transmitters and silicone were then covered with a thin coat of clear quickset epoxy. The small size of these transmitters allowed for attachment to one scute without the adhesive covering the sutures between scutes to avoid impacts to the rapidly growing juveniles (Buhlmann and Tuberville 1998). The antenna of each transmitter was attached to the carapace with short segments of tubing affixed by silicone to individual scutes (Figure 1.5 A). This method left no loose antenna, but added weight and allowed for increased algal growth on the carapace. For all subsequent transmitter attachments, the antennas were left loose. As the juveniles grew, the small transmitters were replaced with larger, longer lasting 3.8g PD-2 transmitters that could now be used without covering more than a single scute. By May 2014, all head-started pond turtles were large enough to use either 3.8g PD-2 or 10g RI-2B transmitters without covering more than a

single scute or exceeding the 0.05% body weight maximum (Rathbun et al. 1992). In the second set, all of pond turtles were large enough to affix the larger transmitters at the time of release and the transmitters did not need to be replaced. We also used a simpler attachment method which reduced overall weight of the attachment by not affixing the antenna to the carapace.

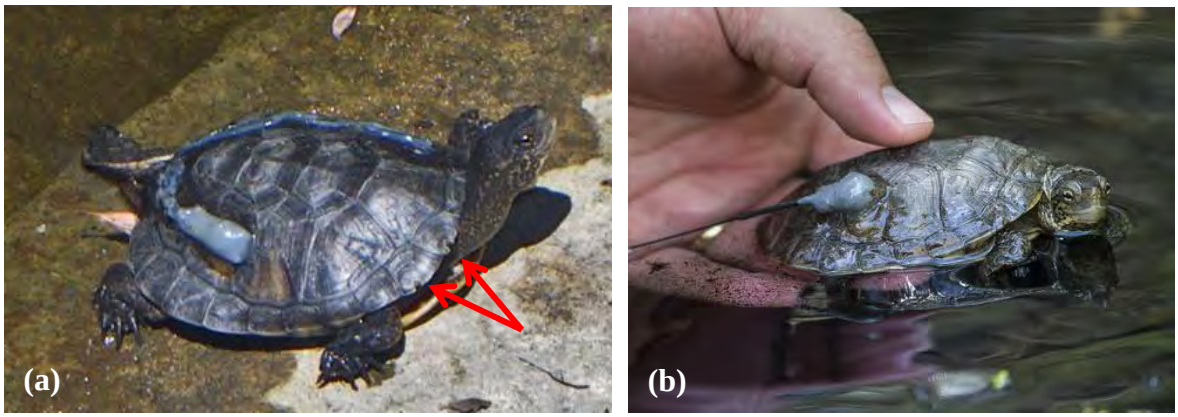

Figure 1.5. Head-started pond turtles with radio-transmitters affixed to carapace. Holohil BD-2 transmitters with the antenna attached to the carapace for the first release (a) and Holohil PD-2 transmitters with loose antennas for the second release. Uniquely identifying marginal scute notches are visible in photo (a), indicated by red arrows. Photo (a) taken on July 17, 2013 by Chris Brown, USGS and photo (b) taken on July 31, 2014, by Ken Bohn, San Diego Zoo.

The transmittered pond turtles were located by radio telemetry to make sure they did not leave the study area and to monitor their health. Initially radio telemetry surveys were conducted as frequently as three times a week. Initially they were only tracked to the pond vicinity so they could acclimate to the pond without being startled or handled. Gradually the radio telemetry surveys were conducted at increasingly longer intervals until locations were being taken on a bi-weekly schedule. The head-started turtles were tracked until the transmitters stopped broadcasting in May 2015. Trapping to remove transmitters was conducted in May 2015. Based on the healthy condition of the carapace, these methods appeared to have great success at securing the transmitters without impacting shell growth. All scutes appeared to be growing at an even rate with no obscured or misshapen scutes or sutures. A total of 19 telemetry surveys were conducted with the first set of head-started pond turtles being radio tracked 19 times from the time of their release in 2013 and the second set being radio tracked 45 times since their release in 2014 for a total of 64 visits (Table 1.2).

Motion and Time Lapse Cameras

Two Pentax Optio W60 cameras were set for time lapse photography to monitor Pools 1 and 4. The cameras were set-up to take a photo at one minute intervals and were positioned to photograph the shoreline of the pools to detect basking behavior of juvenile pond turtles too small to be captured by the hoop traps during trapping sessions. The camera at Pool 1 was set for one day on 3 September 2011 and both cameras were set during 26-30 September 2011. The photos were downloaded to a shared file management system at the USGS San Diego Field Station and were viewed by USGS staff to determine the activity of pond turtles.

Following observations of recreational disturbance in Pool 1, a RECONYX PC800 Hyperfire Professional IR motion was installed to document the types and frequency of recreational disturbances. Initially the camera was set to take three photos per trigger at one frame per second and to take a time lapse photo every 30 minutes from 1 October 2014 through 22 November 2014. The camera was then adjusted to take five photos per trigger at approximately two frames per second and to take a time lapse photo every 15 minutes from 23 November 2014 to present. Photos were downloaded bi-weekly and cataloged by site and download date in the shared file management system at USGS San Diego Field Station. Photo metadata includes date/time, temperature, time lapse or motion trigger, and photo identification number (if motion triggered). Photos were viewed by USGS staff and volunteers familiar with SPER to look for presence of animals or disturbance. Over 23,000 photos were collected.

Visual Surveys

Frequent visual surveys were used to monitor the head-started pond turtles prior to radio tracking visits. Methods followed the USGS Stream Survey protocols for visual encounter surveys, but were restricted to the pooling areas at SPER (USGS 2006). Observations of pond turtles were recorded with pool location, presence of transmitter, behavior, and identification if possible, based on transmitter frequency and/or scute markings. Visual surveys in 2013 and 2014 were conducted from the most downstream portion of Pool 1 moving upstream. In 2015, prior to radio tracking the pond turtles during a visit, visual surveys were made with binoculars from overlooking rocky outcrops in order to collect behavioral data prior to disturbing the turtles. Behavioral categories were recorded as ‘Basking’, ‘Foraging’, or ‘Other/Swimming.’

Results

Telemetry

Radio tracking surveys were conducted to ensure the head-started pond turtles were not leaving the pooling habitat at SPER. To minimize disturbance, the pond turtles were tracked only to the wetted riparian habitat during most surveys. Turtles were tracked to specific locations on 24 of the 64 radio tracking surveys (Figure 1.6). Between July 2013 and May 2014, the first five head-started turtles stayed in the pool they were released into, Pool 1. After the second group of head-started turtles was released, the turtles occupied Pool 1, Pool 2, or Pool 3, the largest and deepest of the six pools.

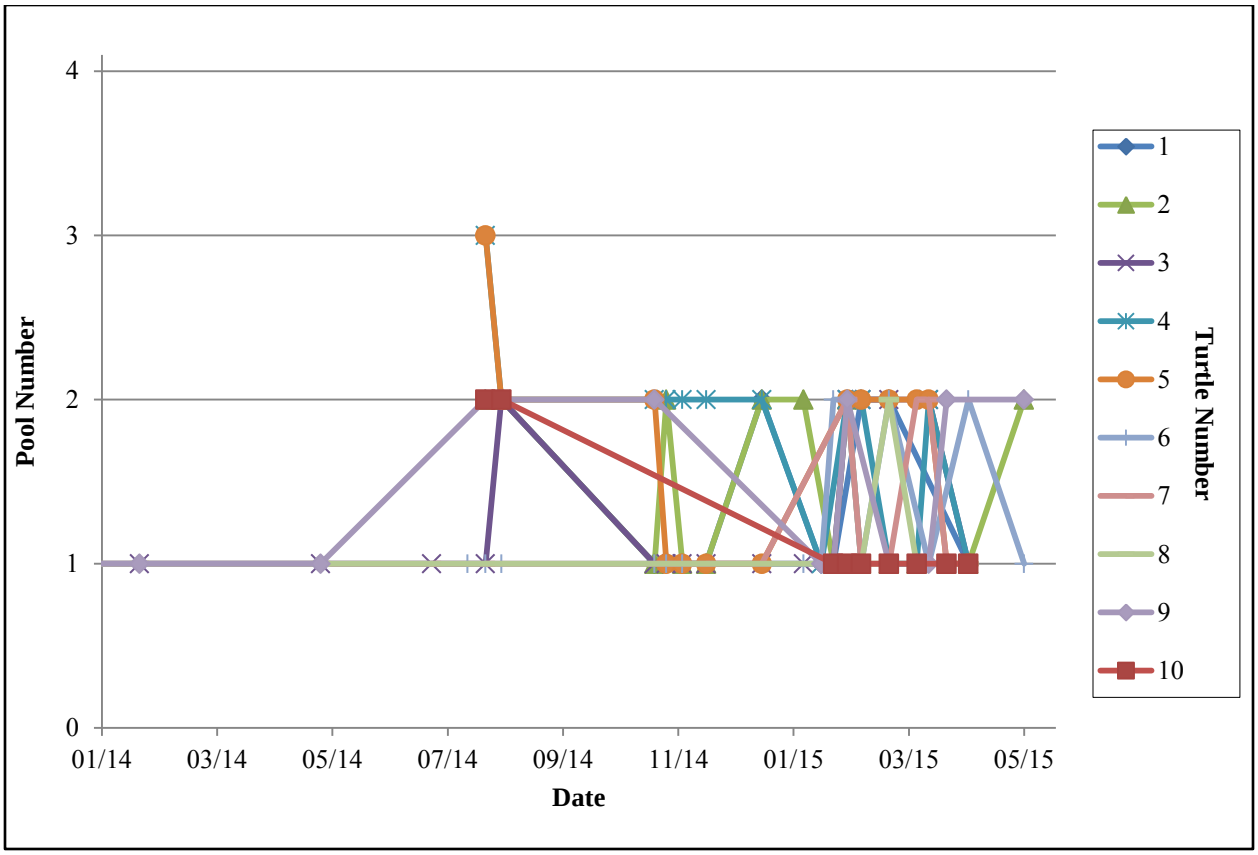

Figure 1.6. Movements of head-started pond turtles at SPER. The pond turtles are numbered according to hatching order. Pond turtles 3, 6, 7, 8, and 9 were released at Pool 1 on 14 July, 2013; 1, 4, and 10 were released at Pool 2 on 31 July 2014; 5 and 2 were released at Pool 3 on July 2014. The pond turtles stayed within Pool 1 and 2 after being released (turtle 2 and 5 moved to Pool 2 after being released at Pool 3) and were never found in Pools 4-6.

Motion and Time Lapse Cameras

In an attempt to document juvenile presence that could not be verified by trapping, we investigated using time lapse cameras. This was after one juvenile pond turtle was observed basking during the trapping session from 22 to 26 August 2011 but was not captured in the baited hoop traps. We used one time lapse camera on 3 September 2011 and three cameras during one pond turtle trapping session 26-30 September 2011. During these samples, over 7,000 photos were taken and stored by site and date on the shared file management system at USGS San Diego Field Station. Most of the photos have been reviewed for presence of pond turtles and both adult and juvenile pond turtles were documented, but in less than 1% of the photos and individuals could not be identified.

During the 26-30 September 2011 trapping session, the juvenile pond turtle (the one seen but not captured during 22 to 26 August 2011 trapping session) was successfully captured in the baited hoop traps at Pool 1. Capturing the individuals has advantages of determining identity, sex, health, and growth rate. Because of these advantages and the time required to review the images, the use of time lapse only cameras was discontinued as of 30 September 2011.

During a radio tracking survey on 16 August 2014, dogs were observed swimming in Pool 1. This prompted the use of cameras again to determine the extent and frequency of the disturbance and what impact it may have on the behavior of the head-started pond turtles. Between 16 August 2014 and October 2014, the pond turtles tended to remain at Pool 2. After 31 October 2014, the pond turtles began to move frequently between Pool 1 and Pool 2, corresponding with the human disturbances observed with the time lapse camera at Pool 1.

Through the use of the motion trigger and time lapse camera, two groups of at least three dogs have been documented to swim in Pool 1 on at least six separate occasions since the motion cameras were put to use on 1 October 2014 (Table 1.3 and Figure 1.5). One group of three dogs appears to be associated with a family, also documented to recreate at Pool 1. The second group of dogs appears to not have leashes or collars and no people have been documented at the site at the same time. These dogs may have been released, lost, or abandoned pets and there appears to be at least four different individuals. The disturbance from the dogs may also be causing the pond turtles to move from Pool 1 to Pool 2.

Table 1.3. Observations of disturbance from the motion triggered camera at SPER Pool 1, 1 October 2014-present.

Date	**Observation**	**Notes**
8 October 2014	3 people	1 person in water, same people with the first group of dogs observed 16 August 2014
14 February 2015	2 dogs	1 in the water
12 April 2015	1 dog	In the water
19 April 2015	3 dogs	All in the water
2 May 2015	3 dogs	2 in the water
6 May 2015	1 dog	In the water near turtle trap

Figure 1.7. Motion triggered photos of disturbance at SPER Pool 1. Swimmer detected on 8 October 2014 with first group of dogs (a) and second group of three dogs detected 2 May 2015 (b).

Visual Surveys

Immediately after release, the first five head-started pond turtles were easily detected when approaching Pool 1 from the downstream side and they were observed basking from the point of release. By 2014, they became much more cautious and fewer were observed basking when we approached Pool 1 from the downstream side. As we approached, we would hear a splash and often see a pond turtle swimming, and would record this behavior as 'Other/Swimming'.

During the dry summer and fall of 2014, the riparian vegetation and canopy thinned enough that Pool 1 became clearly visible from rock outcrops near the road through SPER. Beginning in spring 2015, visual surveys were conducted from the rock outcrops high above Pool 1 prior to radio tracking surveys.

Table 1.4. Head-started pond turtle visual survey observations at SPER.

Time Period	Number of Surveys	Number of Detections	Average Turtle Detections/ Survey	Number Basking	Number Foraging	Number Other/ Swimming
5 head-started pond turtles release 17 July 2013						
18 July 2013 - 31 Dec 2013	13	59	4.54	3	2	57
1 Jan 2014 - 31 July 2014	4	13	3.25	-	-	13
5 additional head-started pond turtles released 31 July 2014						
1 Aug 2014 - 31 Dec 2014	6	43	7.17	-	1	42
1 Jan 2015 - 15 July 2015	16	119	7.43	11	1	107

Discussion

The pond turtle population at Sycuan Creek Ecological Reserve (SPER) has approximately doubled in size since the nonnative aquatic species removal and head-starting programs began in 2009. Appendix B provides guidelines for monitoring and managing this population with the purpose of further increasing, or at a minimum, maintaining the current population size.

Milestones

While head-starting of pond turtles had taken place in larger stream systems in Oregon, Washington, and northern California this is the first head-starting effort for a population within a smaller stream in southern California. We found that all ten headstarted pond turtles remained on site, continued to be active, and appeared to be in good health during monitoring.

We also found that the initial five pond turtles placed in the lower Pool 1 altogether tended to stay in that pool. After the second group of five pond turtles was placed in Pools 2 and 3, all turtles began to move between pools 1 and 2. This is also close to the time we started to see the recreational swimming at Pool 1. So we cannot determine if the pond turtles began to move between pools because of the addition of their head-started cohorts or because of the disturbances.

Recommendations

Nonnative aquatic species continue to be problematic throughout the region, especially as prolonged drought dries down water resources on adjacent properties. As the nearby stream and pools are drying back, we found adult bullfrogs moving into Pools 1 and 2 at SPER. Vigilant management of immigrating bullfrogs is needed to keep the increased pond turtle recruitment on track. See Appendix B for more detailed recommendations.

Study 2: Population Assessment of Western Pond Turtles at Pine Valley Creek

Introduction

The United States Geological Survey (USGS) conducted surveys in 2013 to estimate the number of western pond turtles (hereafter referred to as pond turtle) in Pine Valley Creek within the United States Forest Service (USFS) Pine Valley Wilderness Area in order to assess the potential for the translocation of pond turtles from this site to restored ponds at the California Department of Fish and Wildlife (CDFW) Rancho Jamul Ecological Reserve (RJER). Since the 1980's the Pine Valley population of pond turtles has been considered one of the largest populations in San Diego County and was specifically discussed in Brattstrom and Messer (1988) in their widespread pond turtle study conducted for CDFW (Contract C-2044). Additionally, Wells and Turnbull (1997) surveyed Pine Valley Creek for sensitive birds, reptiles and amphibians and found a large number of pond turtles, including adults, subadults and juveniles. More recently, Madden-Smith et al. (2005) detected pond turtles during visual survey of the area. Only visual surveys were done in these three studies and thus no estimates of population were conducted. This study is the first to use mark-recapture surveys to calculate minimum estimates for this population.

Pine Valley Creek is located within the Tijuana River Watershed, the southernmost watershed within San Diego County, California, and also includes drainages south of the United States/Mexico border. In the Tijuana River Watershed within the United States, pond turtles are restricted to the tributaries of Pine Valley Creek and Cottonwood Creek, above and including Barrett Reservoir. During surveys throughout the Tijuana River Watershed in 2002-2003, USGS only detected pond turtles in Pine Valley Creek and Barrett Reservoir (Madden-Smith et al. 2005), yet USGS has extensively surveyed the Tijuana River Watershed south of Barrett Reservoir for over a decade without recording any pond turtles (Madden-Smith et al. 2005, USGS unpublished data). A genetic assessment of pond turtles throughout southern California conducted by the USGS and UC Los Angeles (Spinks et al. 2014) found the pond turtle population at Pine Valley Creek within the Tijuana River Watershed to be unique among the other populations in San Diego with a genetic signature similar to populations further south in Baja California.

There are no known populations of pond turtles within the neighboring Otay River Watershed (located north of the Tijuana River Watershed and south of the Sweetwater River Watershed). Pond turtles were not detected in extensive surveys of the Otay River Watershed conducted by Brattstrom and Messer (1988) or by USGS (Madden-Smith et al. 2005) and the last previously known historical record of pond turtles within this watershed was in early 2000 at the Upper Otay Lake (Madden-Smith et al. 2005). Even though pond turtles were not detected in this watershed, Jamul Creek, a tributary of the Otay River, was recommended as a possible mitigation site by Brattstrom and Messer

(1988), Madden-Smith et al. (2005) and by CDFW in the Rancho Jamul Ecological Reserve Land Management Plan (CDFG 2008), specifically for translocation and management of pond turtles. The Jamul Creek drainage and its associated ponds have an abundance of suitable habitat and the benefit of restricted public access within RJER.

The Pine Valley Creek pond turtle population, because of its projected size and proximity to the Otay River Watershed, is an ideal feeder population for translocating turtles to the Jamul Creek drainage within RJER with the hopes of restoring pond turtles to the Otay River Watershed and to increase the number of pond turtle populations within the San Diego Multiple Species Conservation Program (MSCP) lands,

Methods

Site Description

Pine Valley Creek is approximately 45 kilometers east of downtown San Diego. The creek stretches approximately 43 kilometers from north of the town of Pine Valley south to Barrett Reservoir where it meets Cottonwood Creek. The creek is predominately in USFS lands, starting in mixed coniferous forest and traversing through chaparral and oak and sycamore woodlands.

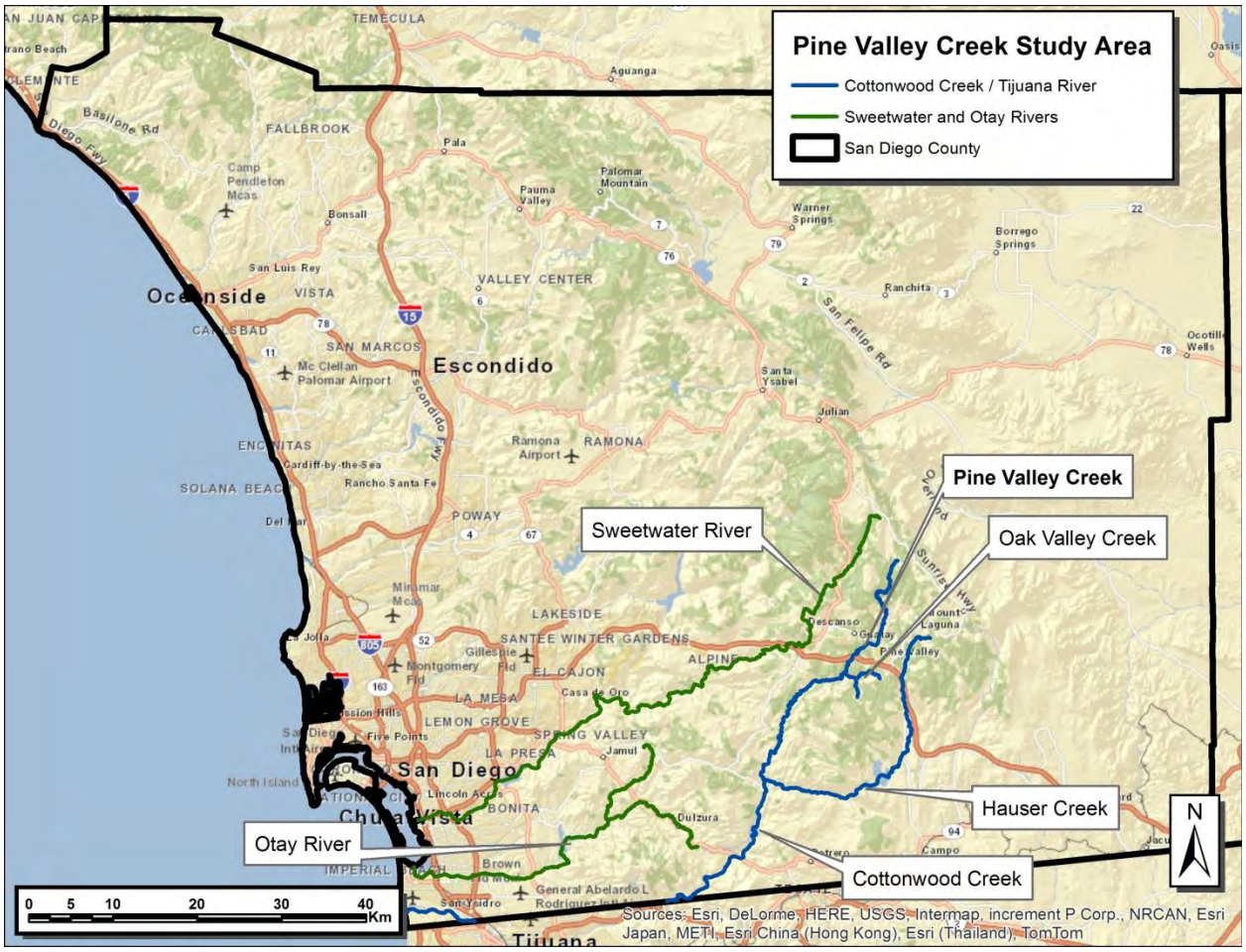

Figure 2.1. The Pine Valley Creek study area in southern San Diego County, CA. The focal area was Pine Valley Creek south of the town of Pine Valley and north of the confluence with Hauser Canyon/upper Cottonwood Creek.

The study site encompasses approximately 20% of the available pond turtle habitat in Pine Valley Creek and was divided into two reaches, lower Pine Valley Creek and upper Pine Valley Creek (Figure 2.2). The study area was divided into two reaches to facilitate effective and repeatable sampling. Both sites were accessible from either current or historic trailheads and could be sampled during a single day's activity period for the pond turtles. The lower section consists of about 1.75 kilometers of Pine Valley Creek, while the upper section consists of about 1.5 kilometers of the stream. The sections are approximately 2.5 kilometers apart from each other.

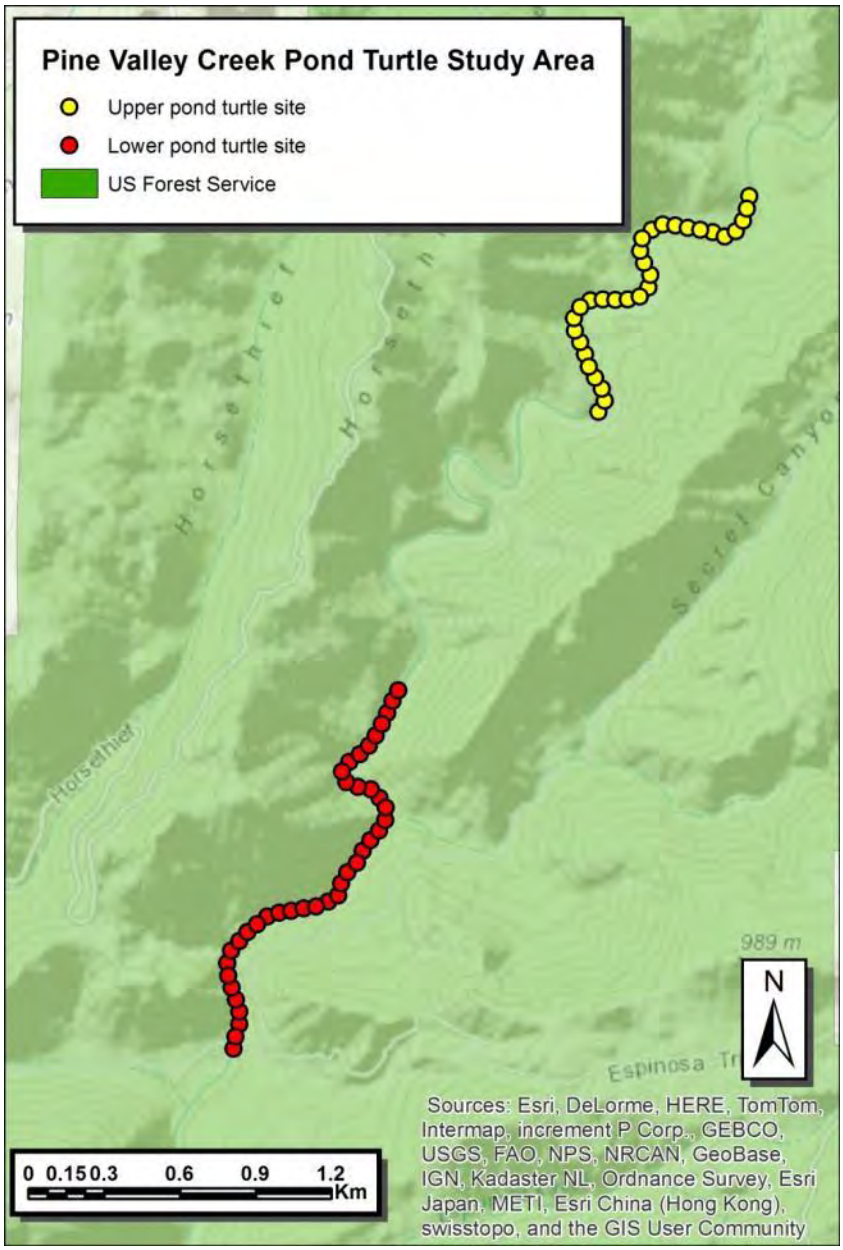

Figure 2.2. The Pine Valley Creek pond turtle mark recapture study site. Two easily sampled stream reaches were divided into 50 meter subsites (yellow and red dots) to facilitate movement and occupancy analysis.

Figure 2.3. Pine Valley Creek habitat. Top photos are from the upper Pine Valley Creek study site (April 2013). Bottom photos are from the lower Pine Valley Creek study site (April 2013).

Visual Encounter Surveys

We used visual encounter surveys for capture of pond turtles. The remoteness of the site makes the use of large numbers of traps overly burdensome. Also, visual encounter surveys were very effective at capturing turtles at this site as most of the available habitat was less than 0.5 meters in depth and not available for trapping (Fig. 2.3). For larger pools of greater depth, use of mask and snorkel was necessary.

Two preliminary visual encounter surveys were conducted to assess access, water availability, and distribution of pond turtles within the site. Based on the initial surveys, two stream reaches were defined which had wetted pond turtle habitat and access sufficiently easy to be surveyed during a single day. Each site was completely surveyed three times in 2013.

Each new pond turtle captured was sexed, measured, tissue-sampled (for genetics), and marked. Sex was determined based on morphological traits (Holland 1991). Before being released, all females were palpated to determine the presence of shelled eggs. Measurements included weight, carapace length, carapace width, carapace height, and plastron length. Upon initial capture, a small (approximately 3-5mm) tail-tip tissue

sample of each turtle was collected and stored in 95% ethanol. Tail tips were not taken from animals with damaged tail tips. Pond turtle tissue samples are being collected for future pond turtle genetics studies. All turtles were tagged with an AVID passive integrated transponder (PIT) tag (encoded with a unique identification number) and marked with a single triangular notch on the right femoral scute to indicate that the turtle had been PIT-tagged. The PIT-tag was inserted inside the body cavity anterior to the rear right leg and the notch was made with a small triangular file following methods of Rathbun et al. (1993) and Buhlmann and Tuberville (1998). Both methods will assist in future recognition of the individual. Pond turtles were released near the point of capture immediately following processing, usually within 15 minutes of capture. If multiple turtles were captured at the same time, turtles were placed in a bucket containing water in the shade until they could be processed.

Analysis

Population Estimates

We estimated pond turtle population size for the lower and upper sites separately using the Schnabel method (Schnabel 1938). The Schnabel method uses results from multiple mark-recapture surveys, specifically the number captured and the number already marked (cumulatively), and requires all new unmarked captures to be marked. After estimating pond turtle population size, we determined a 95% confidence interval based on the estimated population size and its variance.

Body size and Weight Relationships

The pond turtle, a long-lived species with high adult survivorship and low egg and hatchling survivorship, requires populations to be dominated by small/young individuals to remain stable (Congdon et al. 1993, Spinks et al. 2003). We examined the distribution of small, young (hatchling, juvenile, and subadult) pond turtles at Pine Valley Creek compared with the nearby population at Sycuan Peak ER which is very closely monitored. We plotted body weight (grams) against carapace length to compare the distribution of smaller pond turtles (less than 110 millimeters) at the two sites (Figure 2.5).

Results

Overview of Captures

In seven daytime visual encounter surveys (3 at the lower site and 4 at the upper site), we made a total of 134 pond turtle observations (53 in lower site and 81 in upper site; Tables 2.1 and 2.2). Ninety-three of the 134 total observations were captures (either by hand or

by net). Of the 93 pond turtle captures, 81 were newly captured and marked individuals (36 in lower site and 45 in upper site), 4 were recaptures (1 in lower site and 3 in upper site), and 12 were released unmarked (6 in lower site and 6 in upper site) because they were either too small to PIT-tag (10) or the PIT-tags failed (2). An additional 37 pond turtles were observed visually but escaped capture (10 in lower site and 27 in upper site). Unmarked pond turtles and those with unknown recapture status (escapees, etc.) were not included in the population estimates. During the surveys, three pond turtles were found dead and were not included in the number of observations. The overall pond turtle capture rate per day averaged 13.5 ± 1.0 at the upper site and 14.3 ± 3.8 at the lower site.

Table 2.1. Western pond turtle captures by date for mark recapture surveys, Pine Valley Creek, upper site, 2013.

	Survey Date				
	18 April 2013	09 May 2013	21 May 2013	06 June 2013	Total
New Captures, Marked	12	10	9	14	45
New Captures, Unmarked[a]	2	1	3	0	6
Recapture	0	1	2	0	3
Unknown Status	8	9	3	7	27
Total/Day	**22**	**21**	**17**	**21**	**81**

[a]Individuals that were captured but not PIT-tagged as they were too small or the PIT-tags failed.

Table 2.2. Western pond turtle captures by date for mark recapture surveys, Pine Valley Creek, lower site, 2013.

	Survey Date			
	14 April 2013	16 May 2013	05 June 2013	Total
New Captures, Marked	11	9	16	36
New Captures, Unmarked[a]	0	2	4	6
Recapture	0	0	1	1
Unknown Status	3	6	1	10
Total/Day	**14**	**17**	**22**	**53**

[a]Individuals that were captured but not PIT-tagged as they were too small or the PIT-tags failed.

Figure 2.4. Visual pond turtle detections. Visual encounter surveys were successful for detecting pond turtles where much of the habitat is too shallow for trapping and basking turtles attempt to hide in small pools (lower Pine Valley Creek, February 2015).

Population Estimates

We estimated the lower Pine Valley Creek lower site to contain 220 pond turtles (95% limit: lower 82, upper 8607) and the upper Pine Valley Creek site to contain 215 pond turtles (95% limit: lower 106, upper 1052). Thus, for the 20% of the Pine Valley Creek habitat surveyed, we estimated a pond turtle population of approximately 435 individuals. These estimates do not include 12 juvenile individuals that were captured but not PIT-tagged as they were too small or the PIT-tags failed.

Age and Sex Structure

Approximately 53% (29/55) of known-sex adult captures were male and approximately 47% (26/55) were female for both sites combined (Table 2.3). Juveniles (less than 105 millimeters) comprised 25% (20/81) of the known-age population (Table 2.3). Smaller and/or younger turtles make up a good proportion of the population at Pine Valley Creek (Figure 2.4). We compared pond turtle size at Pine Valley Creek with another population at Sycuan Peak Ecological Reserve (SPER) (Figure 2.4). Compared with SPER, the population at Pine Valley Creek has a much greater proportion of juvenile pond turtles.

Historically, the population at SPER has been impacted by nonnative aquatic predators (e.g. largemouth bass, bullfrogs). Small juvenile pond turtles (<100 grams and <80 mm) were only observed at SPER after a nonnative aquatic predator removal program was initiated

Table 2.3. Sex and age of individual western pond turtles (marked new captures only) captured during visual encounter surveys: Pine Valley Creek, 2013.

	Adults				Juveniles				
	Male	**Female**	**Unknown**	**Adult Total**	**Male**	**Female**	**Unknown**	**Juvenile Total**	**Site Total**
Upper Site	13	20	2	35	0	1	9	10	45
Lower Site	16	6	4	26	2	0	8	10	36
Total	**29**	**26**	**6**	**61**	**2**	**1**	**17**	**20**	**81**

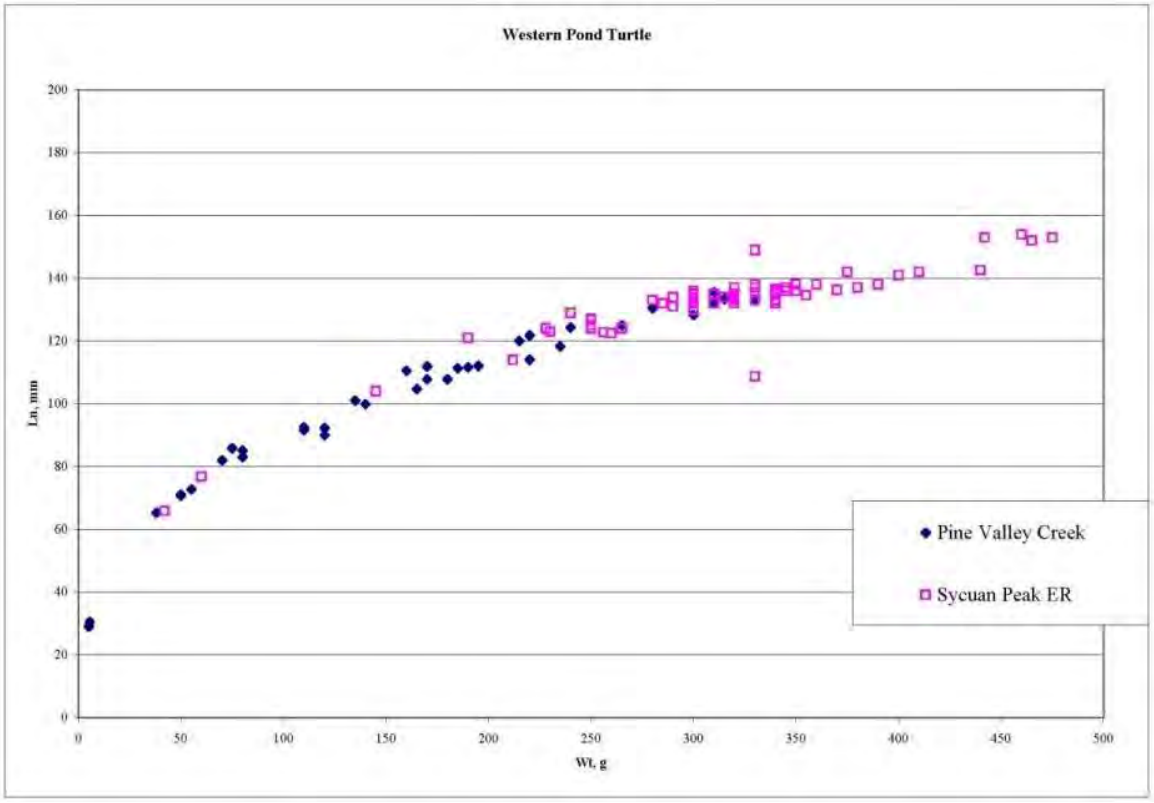

Figure 2.5. Body size and weight relationships for the Pine Valley Creek pond turtle population compared to the Sycuan Peak Ecological Reserve (SPER) population. Small juvenile pond turtles (<100 grams and <80 mm) were only observed at SPER after a nonnative aquatic predator removal program was initiated.

Discussion

The Pine Valley Creek study area is a section of stream in rugged country with low accessibility. A hiking trail crosses the creek at two points and provides some access along the length of the stream, but the difficulty of traveling across country in this region has kept disturbances low. While this has helped protect the population of pond turtles at

this locality, it also made their study difficult. Standard methods of capture, including trapping, were less suitable in these areas partly because of the remoteness and partly because of the stream structure providing few areas with large, deep pools for trapping. However, the shallow sand and bedrock pools characteristic of the site made visual detections and hand captures much more possible resulting in high numbers of detections. We were also able to detect much smaller pond turtles using visual surveys than could be detected with traps, finding hatchlings smaller than 30 millimeters in length. This has allowed us to compare the demographics of this population with the population at Sycuan Peak ER which has been historically impacted and see that much more of the younger age classes are present at Pine Valley Creek.

With this study we have only examined a very small portion of the total available pond turtle habitat within Pine Valley Creek and found a very large number of pond turtles. Continued monitoring of these two sites using mark recapture sampling will help to refine the population estimates at these sites. Surveying the stream between the upper study site and the town of Pine Valley would also help refine the total population estimate for the entire creek within the wilderness area. We have also proposed that a harvest rate of <5% of the estimated population could be used as a founder population at restoration sites, providing 10 individuals from upper Pine Valley Creek and 10 individuals from lower Pine Valley Creek.

Study 3: Assessment of the Upper Watersheds of the Otay, Tijuana, San Dieguito, and San Diego Rivers for Western Pond Turtle Translocation and Donor Sites

Introduction

The United States Geological Survey (USGS) has been working with the San Diego Association of Governments (SANDAG), California Department of Fish and Wildlife (CDFW), City of San Diego, County of San Diego, and the San Diego Zoo to enhance and restore western pond turtle (hereafter referred to as pond turtle) populations in San Diego County as part of SANDAG's pond turtle recovery plan. USGS conducted assessments of the upper watersheds of the Otay, Tijuana, San Dieguito, and San Diego Rivers for possible pond turtle translocation donor and receiver sites.

In 2013-2015, USGS assessed possible pond turtle donor sites in the upper Tijuana River watershed for translocation to the Otay River watershed. The pond turtle has likely been extirpated from the Otay River watershed (Madden-Smith et al. 2005) and the next closest donor populations are in the Tijuana River watershed. Potential donor sites in the Tijuana River watershed included Barrett Reservoir, Pine Valley Creek upstream from Barrett Reservoir and above Horsethief Canyon, Oak Valley Creek Ponds, Hauser Canyon, and the Upper Pine Valley Creek watershed. Potential receiver sites in the Otay River watershed included the Lawrence and Barbara Daley Reserve (LBDR; Dulzura and Pringle Creeks) and Rancho Jamul Ecological Reserve (RJER) ponds.

Pond turtles were not detected in extensive surveys of the Otay River Watershed conducted by Brattstrom and Messer (1988) or by USGS (Madden-Smith et al. 2005) and the last previously known historical record of pond turtles within this watershed was in early 2000 at Upper Otay Lake (Madden-Smith et al. 2005). Even though pond turtles were not detected in this watershed during the extensive surveys, Jamul Creek, a tributary of the Otay River, was recommended as a possible mitigation site by Brattstrom and Messer (1988), Madden-Smith et al. (2005) and by CDFW in the Rancho Jamul Ecological Reserve Land Management Plan (CDFG 2008), specifically for translocation and management of pond turtles. The Jamul Creek drainage and its associated ponds have an abundance of suitable habitat and the benefit of restricted public access within RJER. Nearby Pringle and Dulzura Creeks in LBDR are other possible receiver sites, because of their protected status and restricted access.

Pond turtle populations within the Tijuana River watershed are ideal donor populations for translocating turtles to the Otay River Watershed, because of their projected size, their proximity to the Otay River Watershed, and higher likelihood of genetic similarity (Fisher et al. 2014). Spinks et al (2014) found the pond turtle populations in southern San Diego to be similar in that they all had Central Coast and Baja Group admixed individuals but that the population at Pine Valley Creek was unique among the other

populations in San Diego with a genetic signature similar to populations further south in Baja California. In the Tijuana River Watershed within the United States**,** pond turtles are restricted to the tributaries of Pine Valley Creek and Cottonwood Creek, above and including Barrett Reservoir. The Pine Valley watershed populations of pond turtles have been considered the largest populations in San Diego County (Brattstrom & Messer 1988). Oak Valley Creek is a tributary to Pine Valley Creek with abundant suitable habitat for pond turtles where the Oak Valley Creek Ponds hold water all year and continued to do so even with prolonged drought. Cottonwood Creek in Hauser Canyon has been found to have good numbers of pond turtles in the past even though the terrain is more rugged and not as well suited for pond turtles as Pine Valley Creek is (Wells & Turnbull 1997).

USGS also assessed sites within the San Diego River and San Dieguito River watersheds for possible translocation donor and receiver sites. Within the San Diego River watershed, populations in the San Diego River above El Capitan Reservoir were assessed as potential donor sites, including the San Diego River in Penin Canyon, above Ritchie Creek, and at Eagle Peak Road. Possible receiver sites within the San Diego River watershed were Hanson Pond in the San Diego River, Cedar Creek, San Vicente Creek, and Boulder Oaks Preserve in the San Vicente Creek watershed. Within the San Dieguito River watershed, sites within Scholder Creek, Black Canyon and upper Santa Ysabel Creek (at Witch Creek, in Pamo Valley, and in Clevenger Canyon) were assessed as potential donor sites and Boden Canyon Ecological Reserve (BCER) and San Dieguito River Park (SDRP) below Lake Hodges were assessed as potential receiver sites.

Most pond turtles within the San Diego River watershed are found above the El Capitan Reservoir. Madden-Smith et al. (2005) only detected pond turtles in two locations downstream of the reservoir and in each case a single turtle was detected. In more recent surveys, pond turtle populations were observed during USGS visual encounter surveys in San Diego River above El Capitan Reservoir and in Cedar, Boulder, and King Creeks (Fisher et al. 2014) and were identified as potential donor populations. In addition, a suitable translocation receiver site was identified in the San Vicente Creek watershed at the Boulder Oaks Preserve (Brown & Fisher 2008). Boulder Oaks Preserve contains two large ponds that have potential for pond turtle translocation.

Few pond turtle populations exist in the San Dieguito River watershed below Pamo Valley. There is one below Lake Hodges in Lusardi Creek (Madden-Smith et al. 2005), one above San Pasqual Valley in Santa Ysabel Creek, and one in Guejito Creek (USGS unpublished data). Healthy populations have been observed recently in the upper parts of the San Dieguito River watershed, including Scholder Creek, Black Canyon and upper Santa Ysabel Creek (Fisher et al. 2014, D. Wood personal communication 2014). The current conservation and management of the San Dieguito River watershed provides opportunities for reintroduction of pond turtles to two additional locations below Pamo Valley: BCER and the SDRP below Lake Hodges. BCER is under management by CDFW for conservation and has had permanent pools with good structure below the main pond during our surveys for arroyo toads from 2008 through 2010. The reaches of the San Dieguito River in SDRP below Lake Hodges in Santa Fe Valley were recently

cleared of nonnative turtles and have large pooling habitat that may be suitable for reintroduction of pond turtles after all nonnative aquatic species have been removed.

Methods

Site Descriptions

Watersheds are discussed in order from north to south.

Upper San Dieguito River Watershed

The San Dieguito River Watershed is approximately 90,000 hectares with its headwaters along Volcan Mountain and outlet through the San Dieguito Lagoon. Much of the watershed is part of the San Dieguito River Park that stretches along 88 kilometers of riparian habitat and across multiple ownerships including CDFW, County of San Diego, City of San Diego, USFS, and San Dieguito River Park Joint Powers Authority (JPA). Pond turtles are known to occur from Lusardi Creek below Lake Hodges up to the headwaters in the Santa Ysabel Region (Madden-Smith et al. 2005, Fisher et al. 2014). We identified three possible pond turtle donor sites and six receiver sites within the San Dieguito watershed (Figure 3.1).

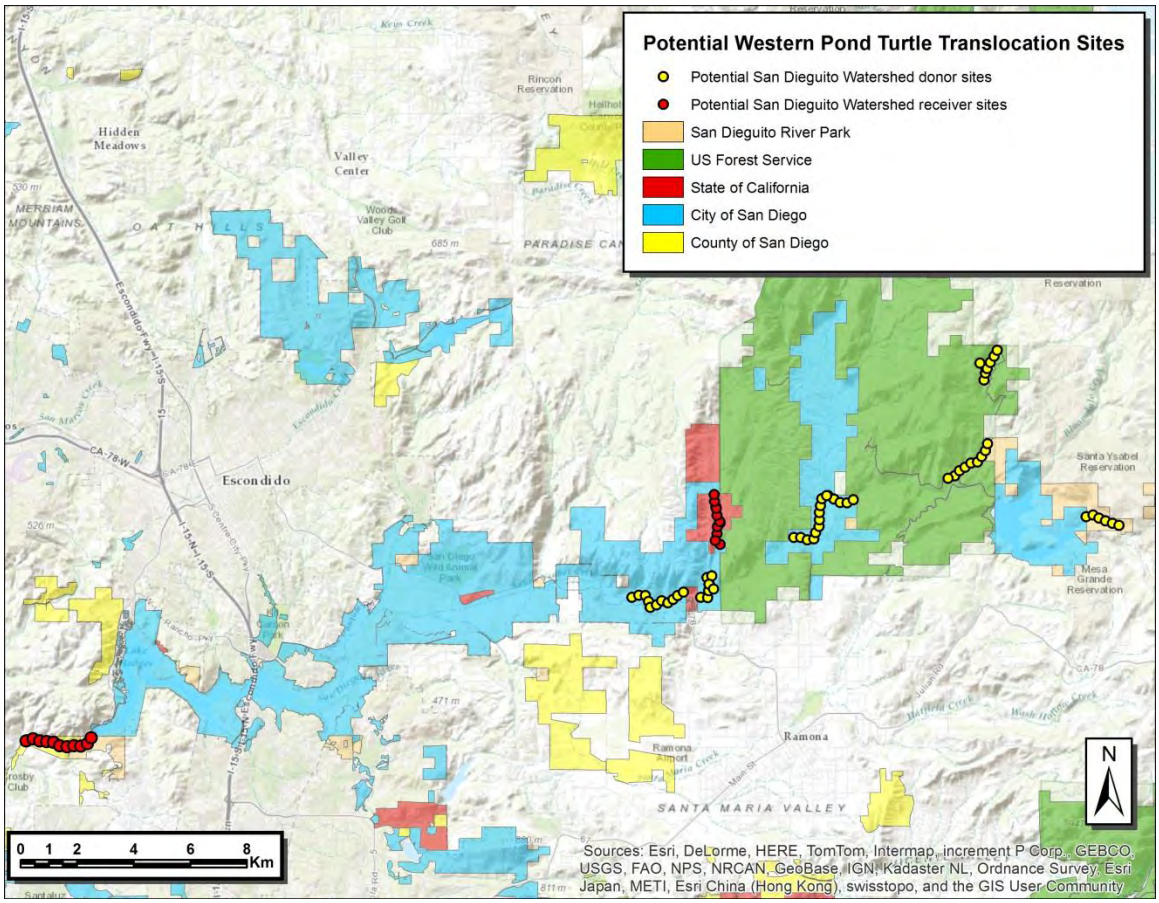

Figure 3.1. Possible pond turtle translocation receiver and donor sites within the upper San Dieguito River watershed. The yellow (donor sites) and red (receiver sites) dots represent the boundaries of the 250 meter sections surveyed within each site.

Santa Ysabel Creek at Witch Creek

Santa Ysabel Creek near the confluence with Witch Creek contains approximately 1.5 kilometers of mixed boulder/bedrock and sandy streambed within oak (*Quercus* spp.) and sycamore (*Platanus racemosa*) dominated riparian habitat (Figure 3.2). No pond turtles were detected when this area was surveyed by USGS for arroyo toads (*Anaxyrus californicus*; USGS unpublished data), but the habitat contained many large pools with abundant structure for foraging and basking suitable for pond turtles. This area is owned by San Dieguito River Park JPA and may be suitable as a potential donor site.

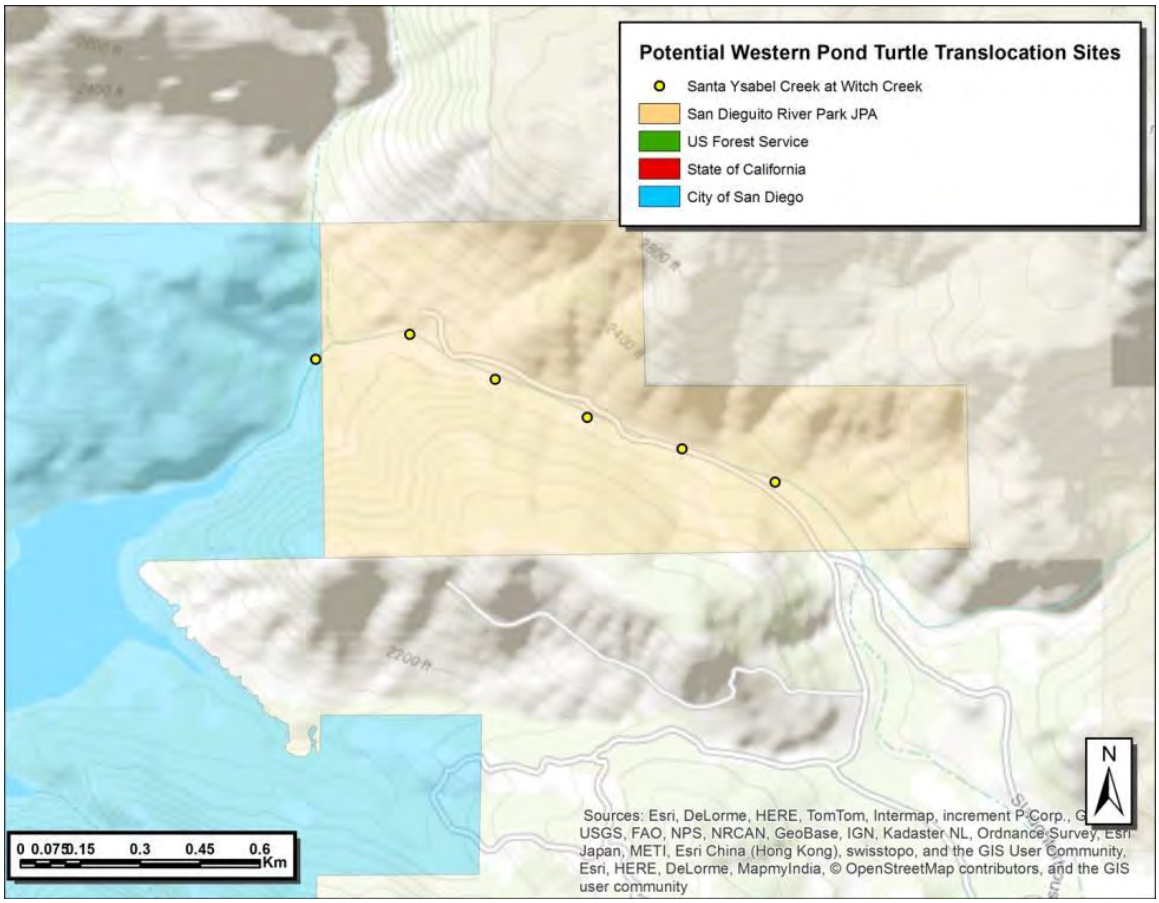

Figure 3.2. Potential pond turtle donor site in upper Santa Ysabel Creek downstream from Witch Creek. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Santa Ysabel Creek at Pamo Valley

Santa Ysabel Creek at Pamo Valley contains approximately 4.5 kilometers of mixed boulder/bedrock and sandy streambed within oak and sycamore riparian habitat with several bedrock and sandy pools (Figure 3.3). During USGS arroyo toad surveys in 2012, a juvenile pond turtle was observed at this site indicating that pond turtles are successfully recruiting at this location (USGS unpublished data). This site may be a suitable donor site.

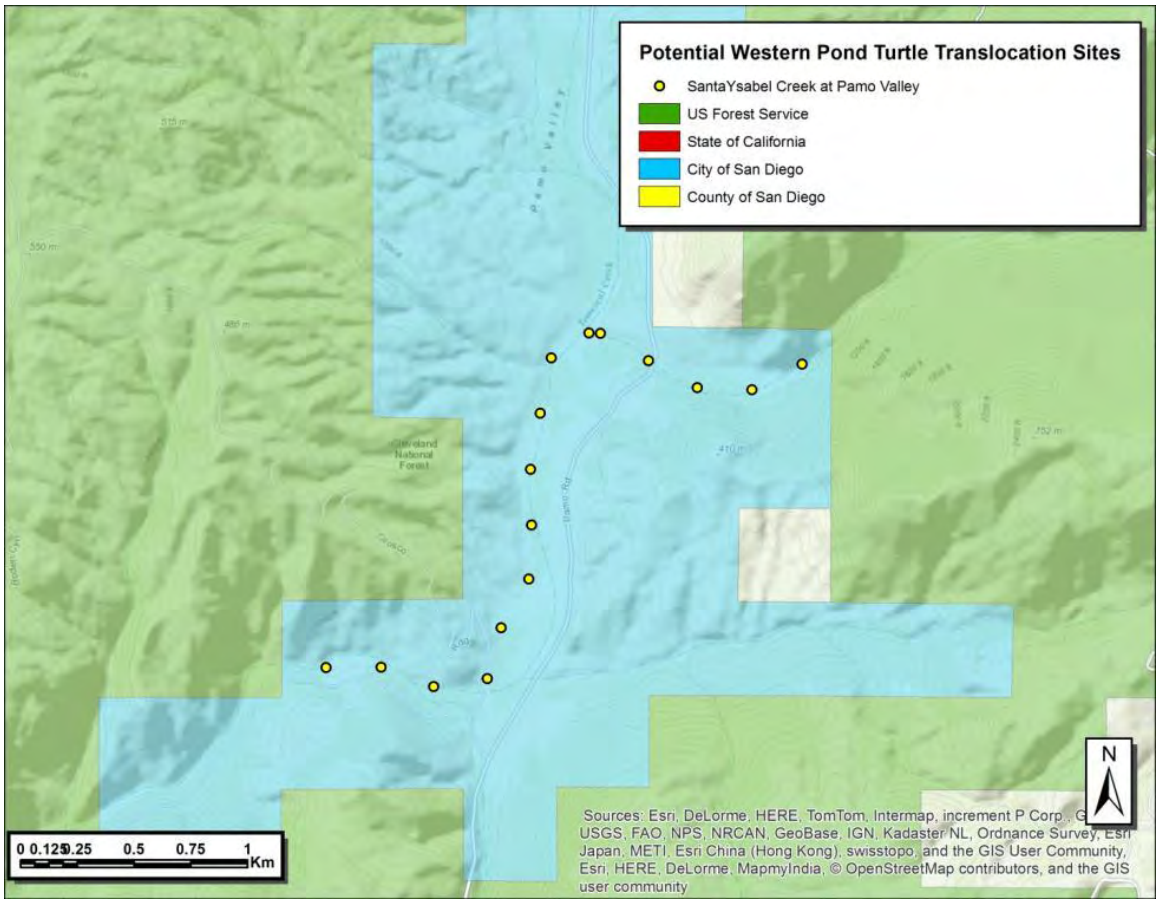

Figure 3.3. Potential pond turtle donor site in upper Santa Ysabel Creek in Pamo Valley. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Santa Ysabel Creek at Clevenger Canyon

Santa Ysabel Creek near and below Clevenger Canyon has many large, open sandy or bedrock pools within oak and sycamore dominated riparian suitable for pond turtles (Figure 3.4). During USGS arroyo toad surveys, a single adult pond turtle was observed at this site (Fisher et al. 2014). This site may be a suitable donor site.

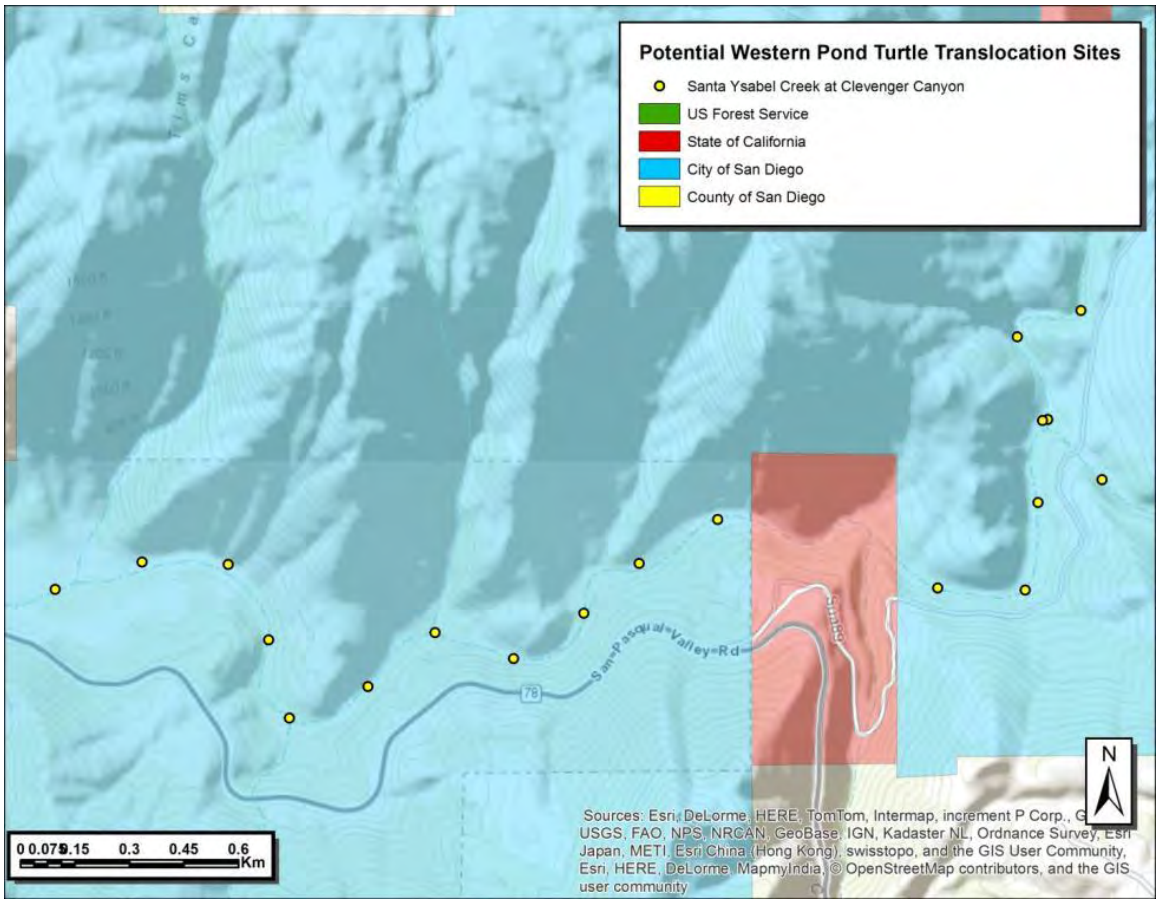

Figure 3.4. Potential pond turtle donor site in upper Santa Ysabel Creek below Clevenger Canyon. The yellow dots represent the boundaries of the250 meter sections surveyed within the site.

San Dieguito River Park Below Lake Hodges (Santa Fe Valley)

The Santa Fe Valley reserve along the San Dieguito River below Lake Hodges contains approximately 2.5 kilometers of riparian with many large boulder lined pools suitable for pond turtles (Figure 3.5). The site has been historically impacted by nonnative species but current efforts are reducing the numbers of nonnative turtles and bullfrogs (*Lithobates catesbeianus*) at the site (Jason Lopez, personal communication). This site may be a suitable receiver site.

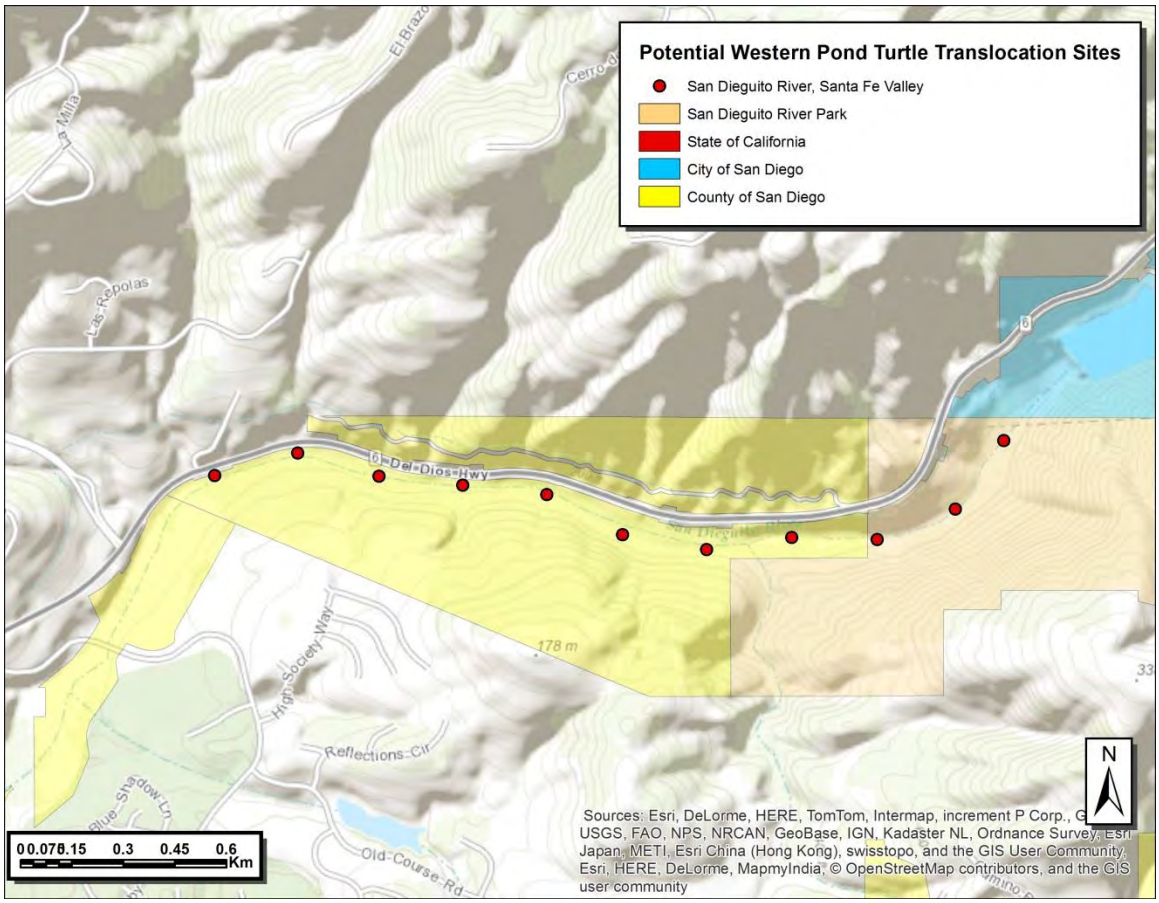

Figure 3.5. Potential pond turtle receiver site at the San Dieguito River Park below Lake Hodges (Santa Fe Valley). The red dots represent the boundaries of the 250 meter sections surveyed within the site.

Scholder Creek

Scholder Creek is tributary to Black Canyon Creek with approximately 1 kilometer of creek above the confluence with Black Canyon (Figure 3.6). Pond turtles have been found here historically (Fisher et al. 2014, Dan Holland personal communication) and are presumed to be extant in this section of Black Canyon which is more rugged than the lower reaches and is more difficult to access. This site may be a suitable donor site.

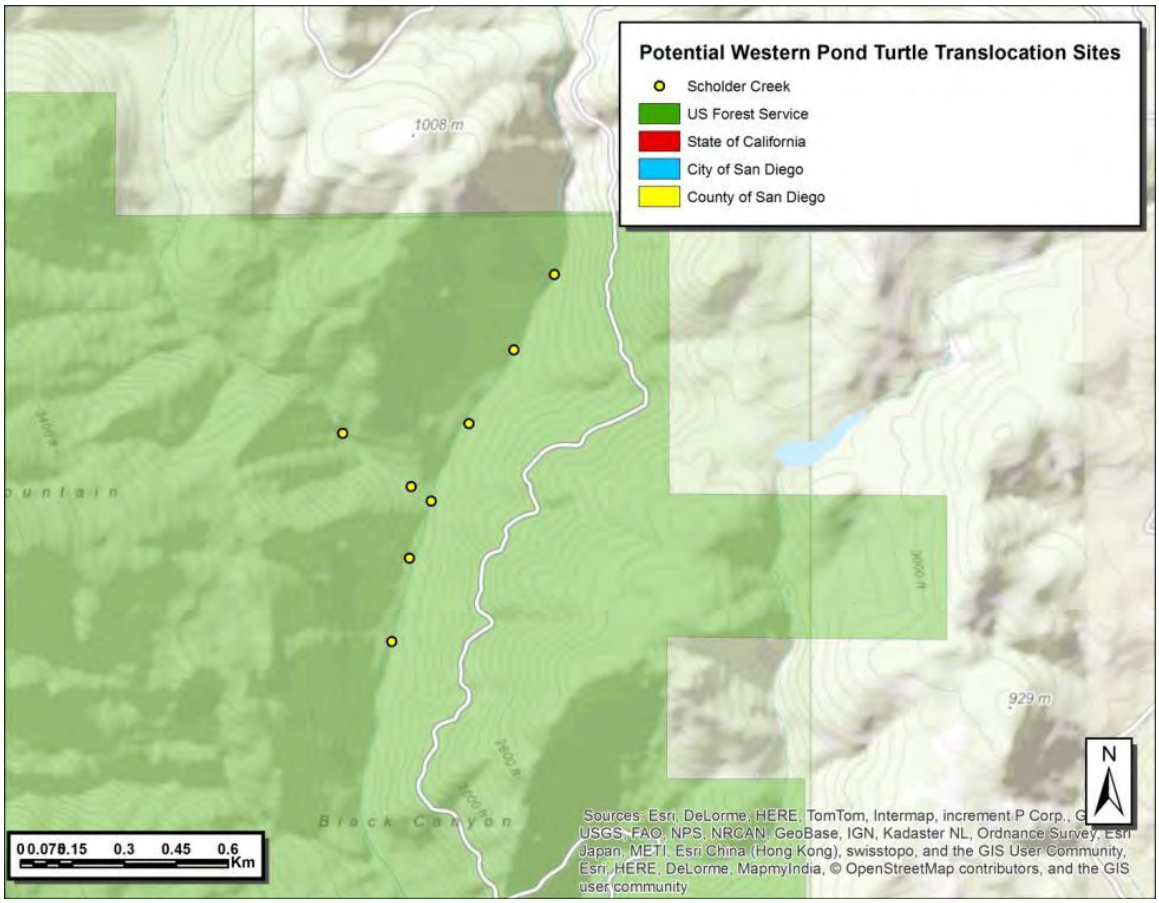

Figure 3.6. Potential pond turtle donor site in Scholder Creek in upper Black Canyon. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Black Canyon

Black Canyon Creek below the confluence with Scholder Creek contains many large bedrock pools that still support pond turtles (Figure 3.7). During recent surveys conducted by CDFW, pond turtles were readily observed in the lower section of Black Canyon, including one juvenile (Fisher et al. 2014). Even though the site is often used for recreation and is easy to access, the remoteness of the location may keep impacts to the site low enough to make this a potential donor population.

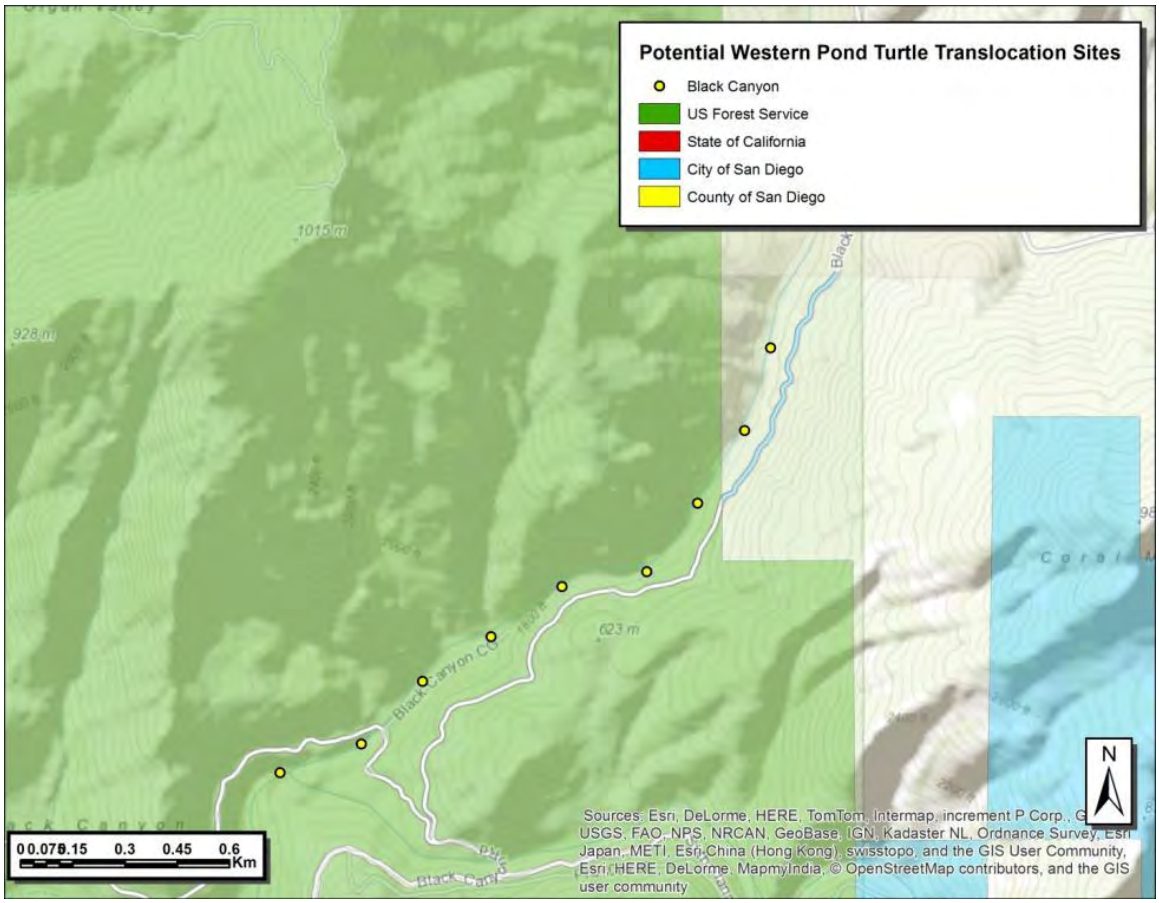

Figure 3.7. Potential pond turtle donor site in lower Black Canyon. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Boden Canyon Ecological Reserve

Boden Canyon is in large part owned and managed by CDFW with the County and City of San Diego owning portions of it (Figure 3.8). The stream and large artificial pond in the middle of the canyon have been historically impacted by nonnative aquatic predators, including bullfrogs which were removed by CDFW (Tim Hovey, personal communication). During USGS arroyo toad surveys after the wildfires of 2007, the large pond appeared to fill with sediment and eventually dried down with the current drought conditions, but permanent pools still exist below the dam (USGS, unpublished data.). This may be a suitable receiver site.

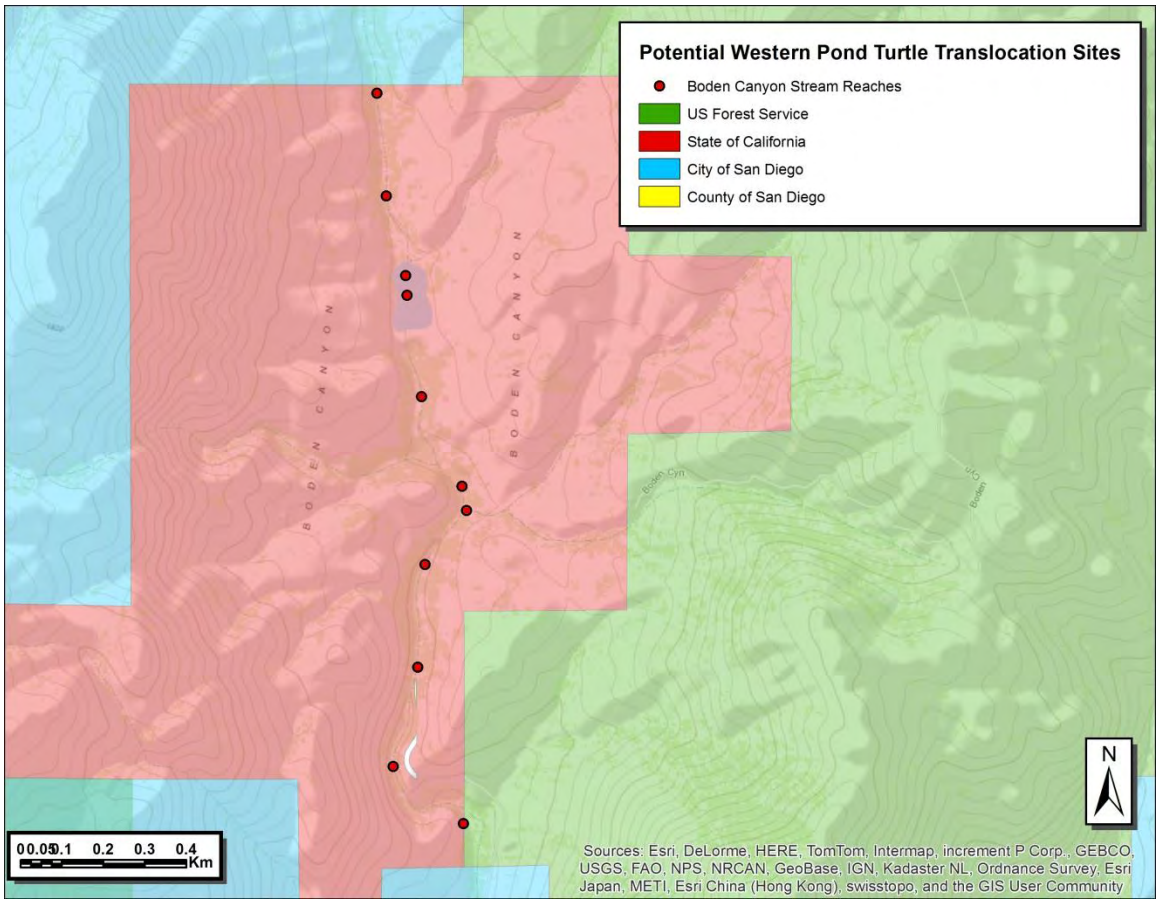

Figure 3.8. Potential pond turtle receiver site at the California Department of Fish and Wildlife Boden Canyon Ecological Reserve. The red dots represent the boundaries of the 250 meter sections surveyed within the site.

Upper San Diego River Watershed

The San Diego River watershed is approximately 114,000 hectares with its headwaters in the western Cuyamaca Mountains and outlet south of Mission Bay near Ocean Beach (Figure 3.9). While much of the lower portion of the watershed is developed, approximately 58% of the watershed remains undeveloped, much of this in the upper portions in unincorporated San Diego County. Focal landowners in this watershed are CDFW, City of San Diego, County of San Diego, Endangered Habitats Conservancy, and USFS. Several reaches of San Diego River and its tributaries above El Capitan Reservoir have been surveyed by USGS on multiple occasions for arroyo toads and other sensitive aquatic species between 2001 and 2012. During this time, pond turtles have been documented from the main stem of the San Diego River, Cedar Creek, Boulder Creek, and King Creek (Fisher et al. 2014).

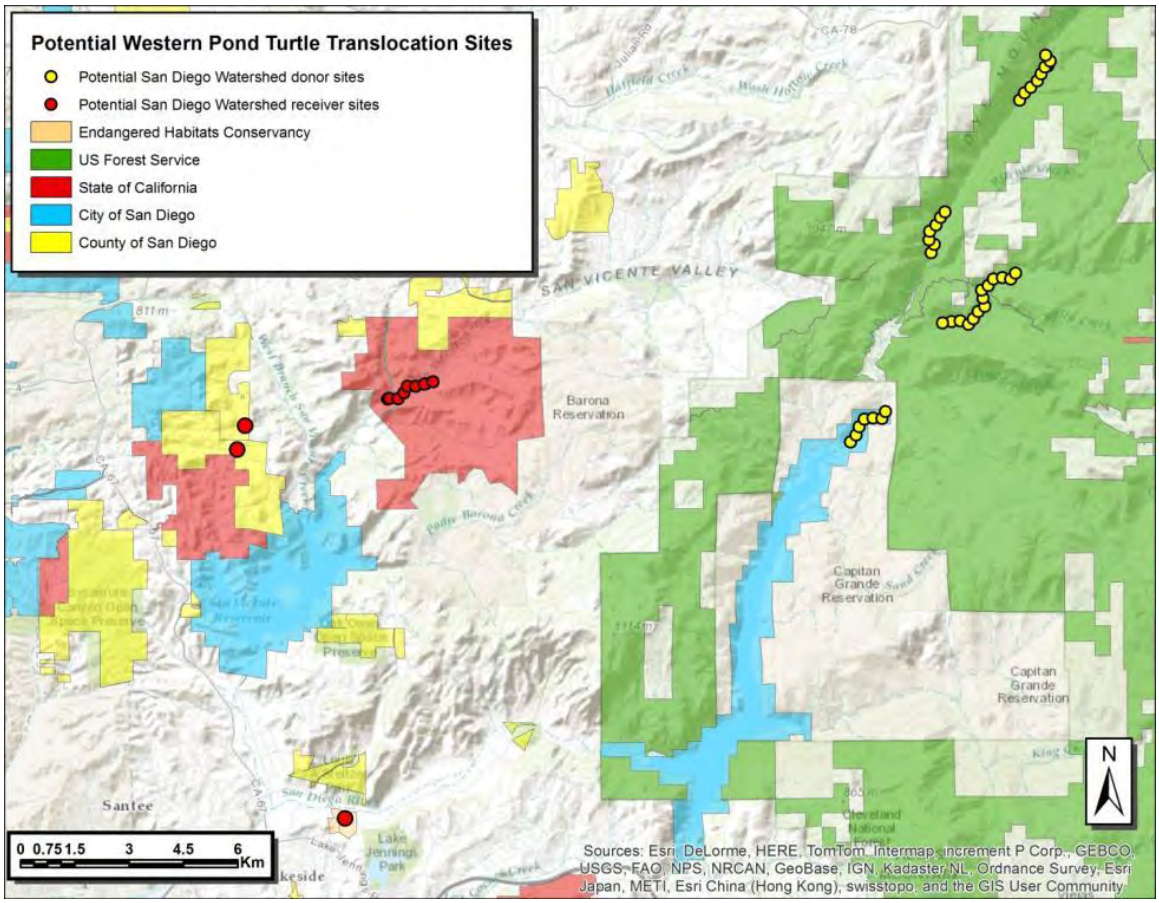

Figure 3.9. Potential pond turtle donor and receiver sites in the San Diego River Watershed. The yellow (donor sites) and red (receiver sites) dots represent the boundaries of the 250 meter sections surveyed within each site.

San Diego River at Penin Canyon

San Diego River at Penin Canyon is approximately two kilometers of mixed sand and bedrock pools within sycamore and oak dominated riparian above and below the confluence with Temescal Creek on USFS property (Figure 3.10). The upper part of the reach terminates at a large pool below one of the larger waterfalls in the San Diego River. Access to this area is difficult with over three kilometers to the nearest road and recreational impacts are very low. Several pond turtles have been observed in this site during USGS arroyo toad surveys from 2008 to 2012 (Fisher et al. 2014). This may be a suitable donor site.

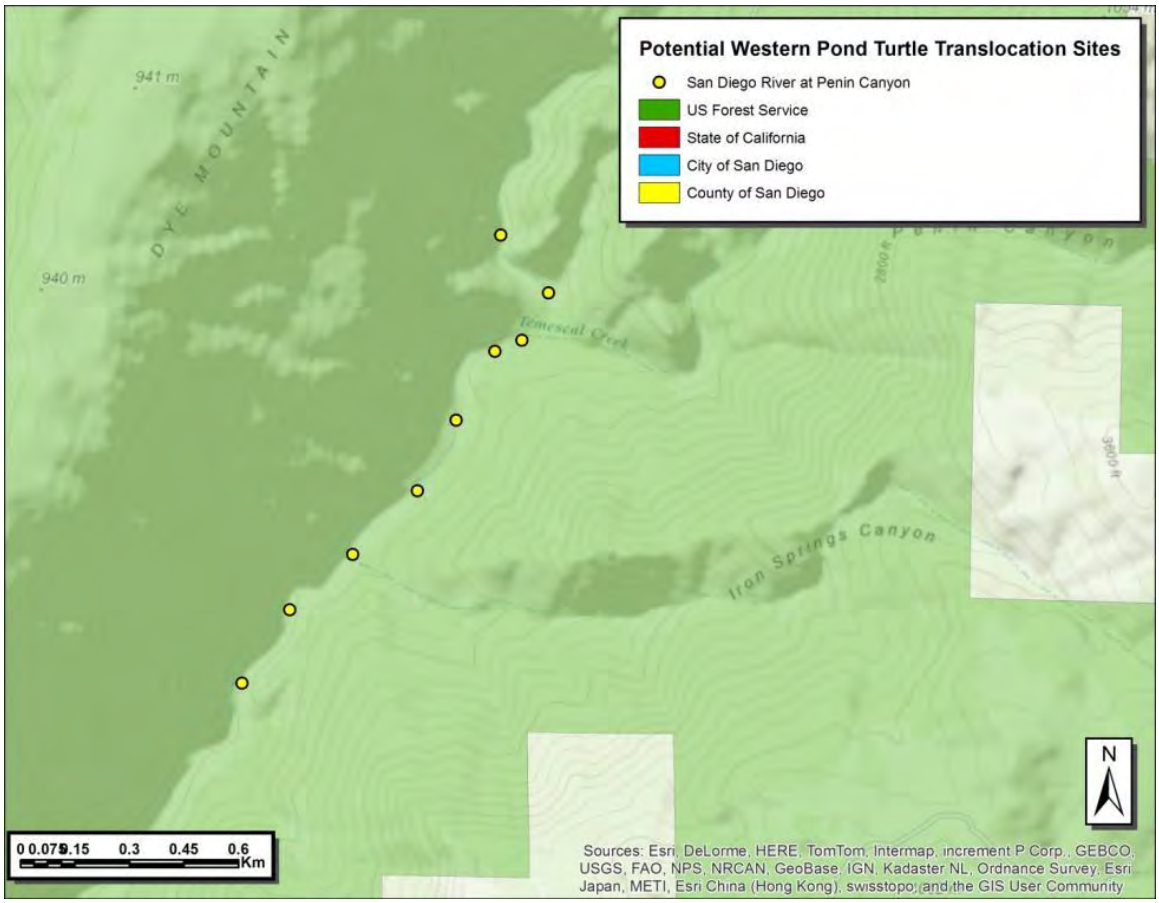

Figure 3.10. Potential pond turtle donor site in the San Diego River at Penin Canyon (Temescal Creek). The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

San Diego River Above Ritchie Creek

Above Ritchie Creek, San Diego River still consists of sand and bedrock pools with runs of boulder lined streams within sycamore and oak dominated riparian on USFS property (Figure 3.11). However, this area is more open with easier access than the section of stream at Penin Canyon. Several pond turtles have been observed in this area during USGS arroyo toad surveys from 2008 to 2012 (Fisher et al. 2014). This may be a suitable donor site.

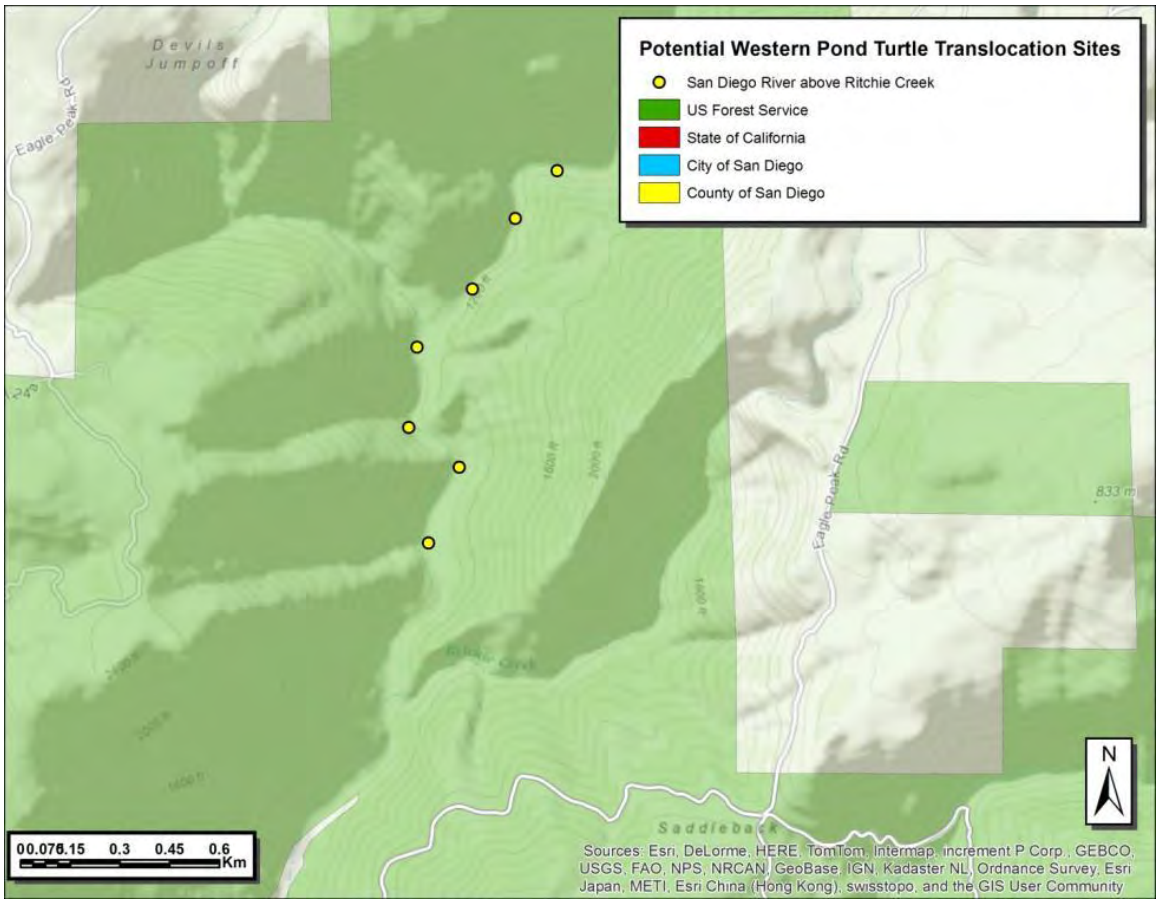

Figure 3.11. Potential pond turtle donor site in the San Diego River above Ritchie Creek. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

San Diego River at Eagle Peak Road

The lower portion of San Diego River immediately above El Capitan Reservoir is along Eagle Peak Road on City of San Diego property (Figure 3.12). This portion of the stream has the easiest access but has not been surveyed by USGS in over 10years. When surveyed by USGS for arroyo toads in 2001, this section of stream had several pools greater than 0.25 meters deep within sycamore and willow dominated riparian (USGS and TAIC 2002). This may be a suitable donor site.

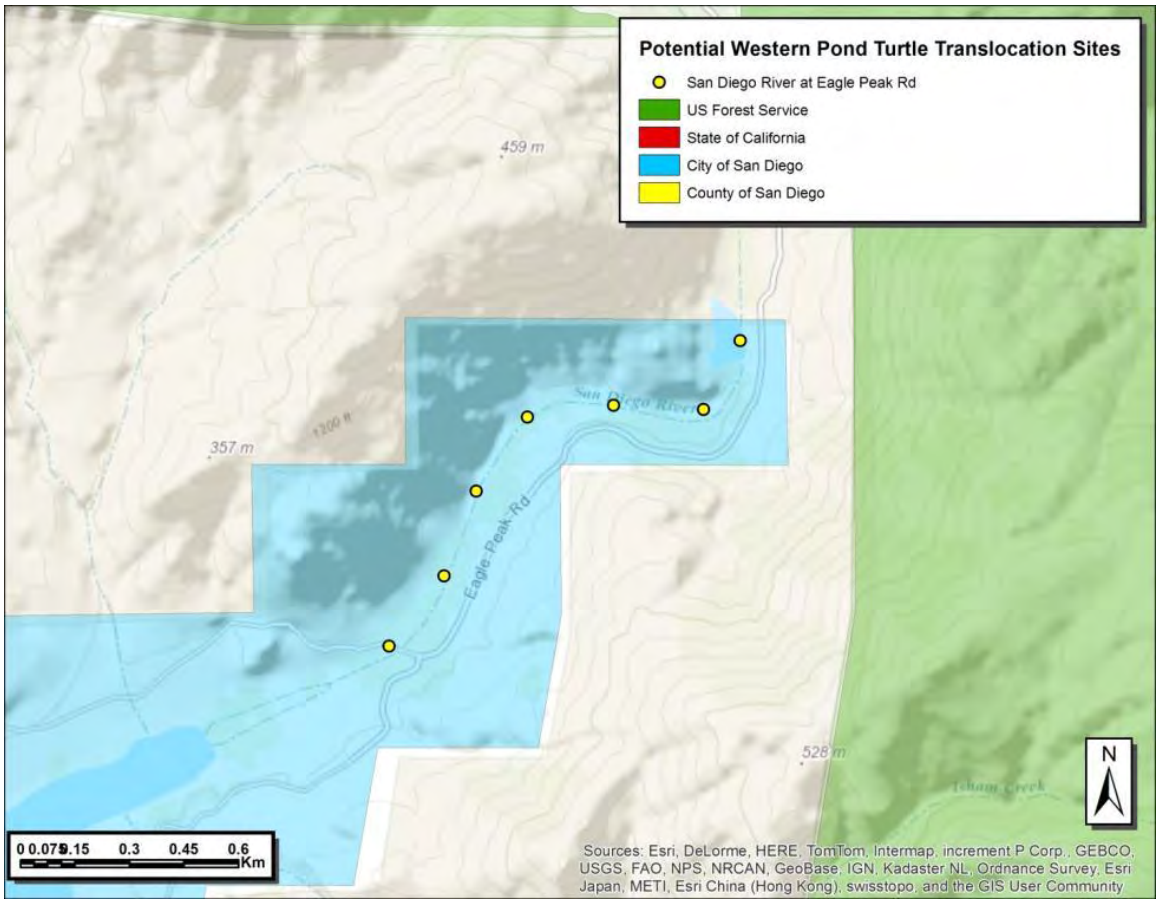

Figure 3.12. Potential pond turtle donor site in the San Diego River above El Capitan Reservoir along Eagle Peak Road. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

San Diego River Hanson Pond

The Hanson Pond along San Diego River adjacent to Lake Jennings is a former quarry that in currently owned and managed by the Endangered Habitats Conservancy for conservation (Figure 3.13). This site has not previously been surveyed by USGS but consists of approximately 50 hectares of conserved habitat with permanent water. This may be a suitable receiver site.

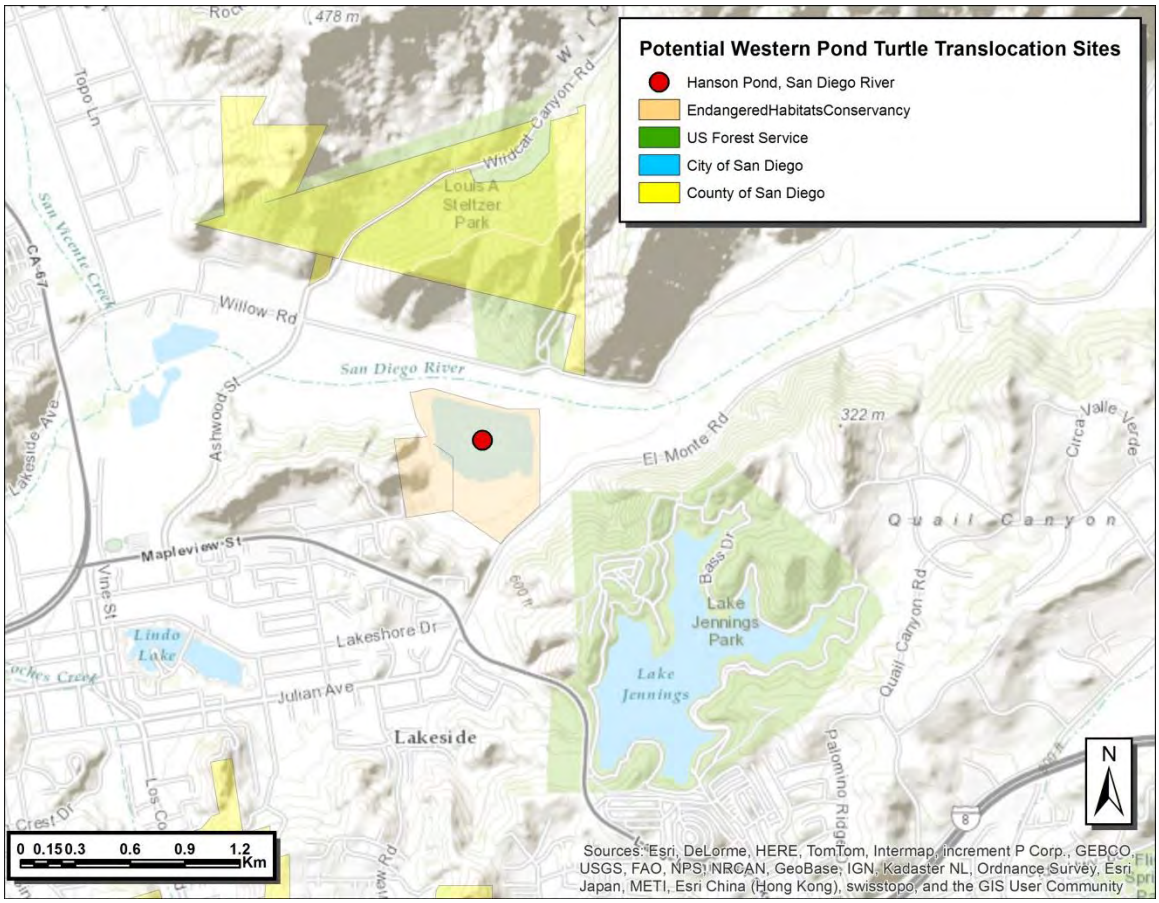

Figure 3.13. Potential pond turtle receiver site in the San Diego River at Hanson Pond.

Cedar Creek

The lower portion of Cedar Creek immediately above Cedar Creek Falls is on USFS property (Figure 3.xx). This portion of the stream has the easy access from Cedar Creek Road and was surveyed by USGS for arroyo toads from 2008 to 2010. When surveyed by USGS for arroyo toads, this section of stream had several pools greater than 0.25 meters deep within sycamore and willow dominated riparian, many of which contained pond turtles. This may be a suitable donor site.

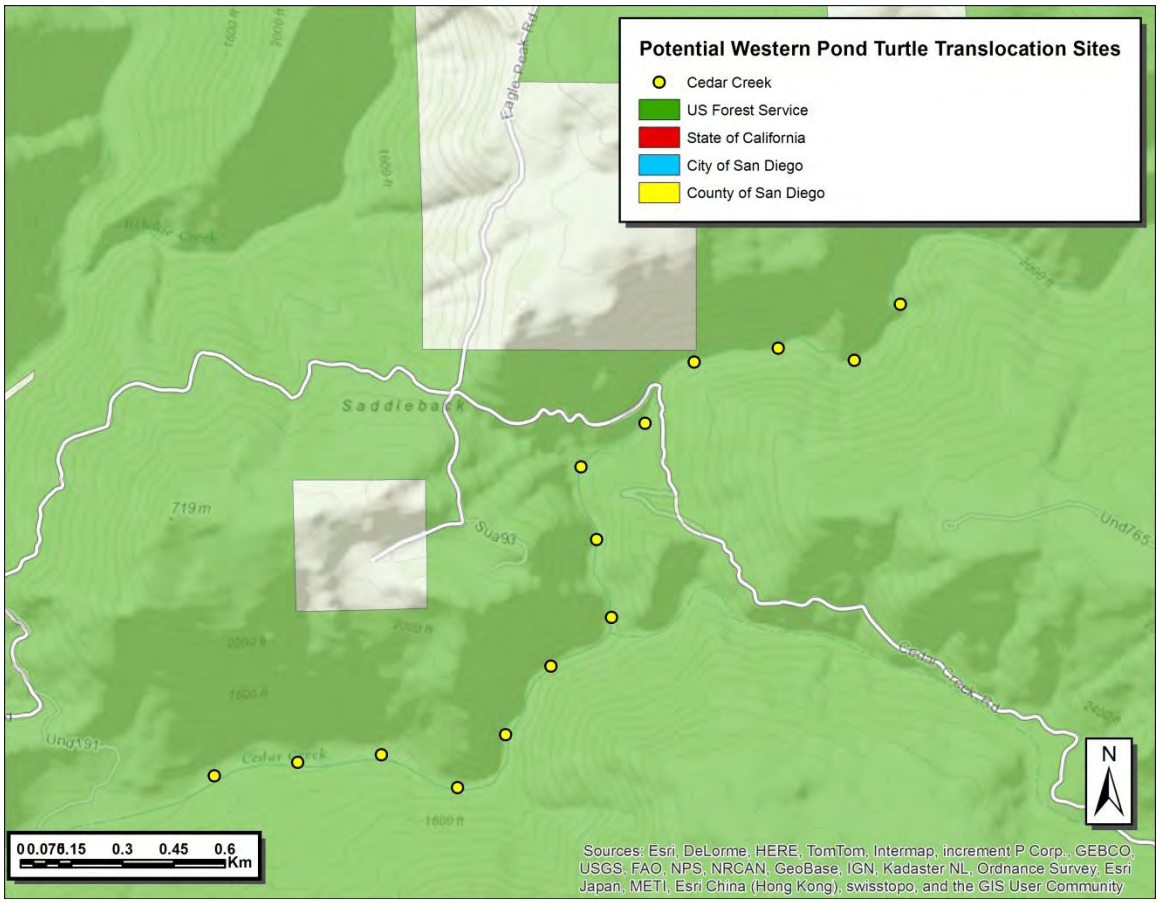

Figure 3.14. Potential pond turtle donor sites in Cedar Creek. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Cañada de San Vicente (Rancho Cañada)

The portion of San Vicente Creek between Kimball Valley and the community of Rancho San Vicente is owned and managed by CDFW (Figure 3.xx). The 2,029 hectare reserve can be accessed from San Vicente Road and was surveyed for pond turtles in 2010. This section of stream had several pools greater than 0.25 meters deep within sycamore and willow dominated riparian that were trapped for turtles but no pond turtles were observed. This may be a suitable receiver site.

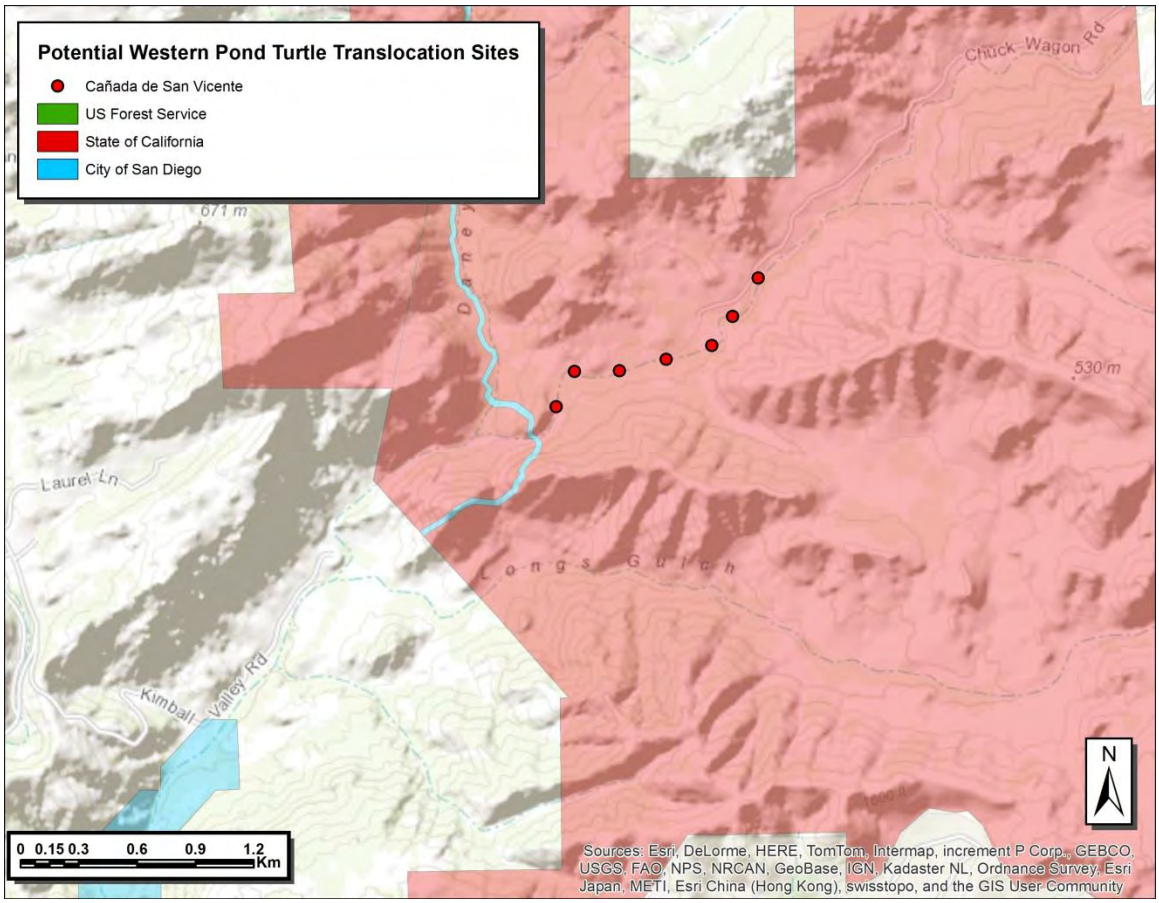

Figure 3.15. Potential pond turtle receiver sites in Cañada de San Vicente (Rancho Cañada). The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Boulder Oaks Preserve

Boulder Oaks Preserve is a San Diego County preserve along tributaries to San Vicente Creek and above San Vicente Reservoir (Figure 3.14). USGS surveyed the site in 2008 for pond turtles and none were found. The site has potential habitat, with two large ponds with riparian vegetation and structure for basking, foraging, and refugia; however, several bullfrogs were observed. With management for the bullfrogs, this may be a suitable receiver site.

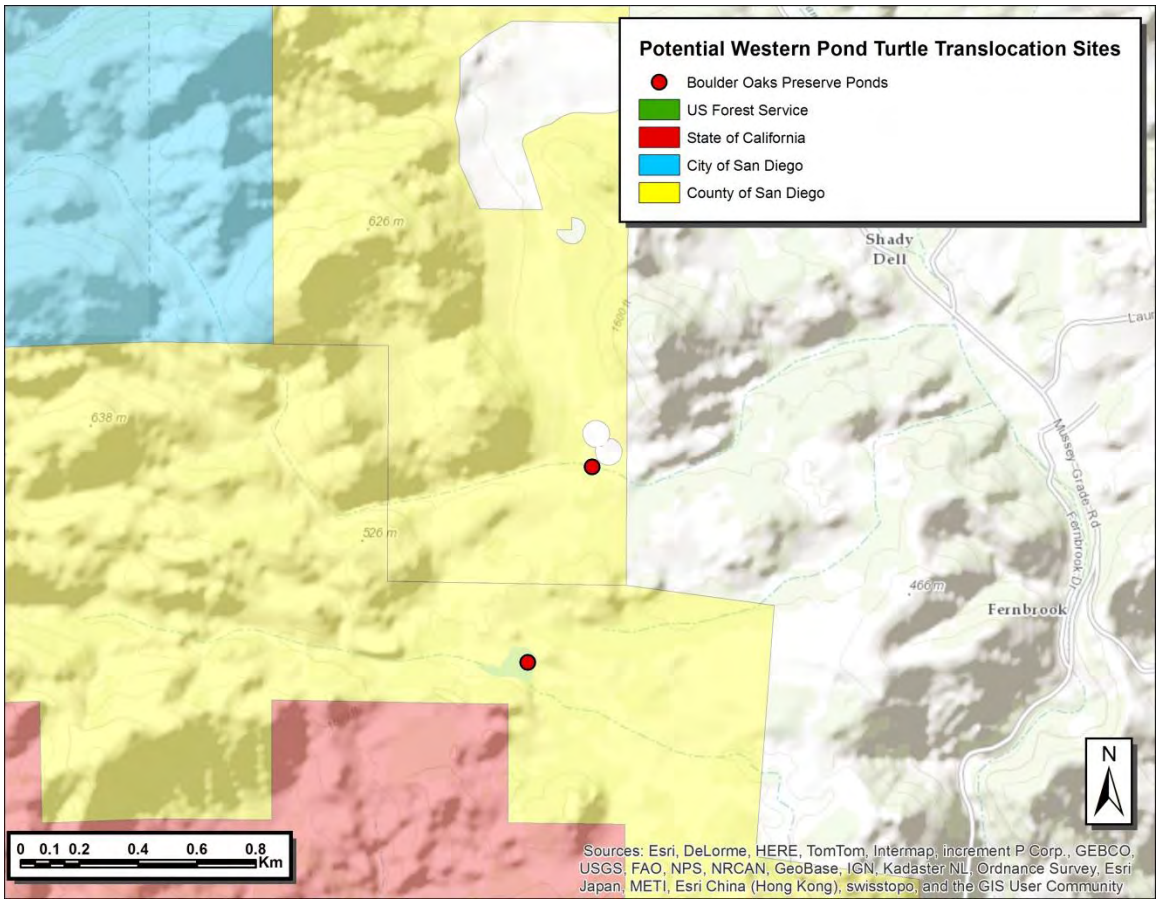

Figure 3.16. Potential pond turtle receiver site at the Boulder Oaks Preserve. The red dots represent the midpoint of the two large ponding areas at Boulder Oaks Preserve.

Upper Otay River Watershed

The Otay River watershed is approximately 42,000 hectares in size and is largely unincorporated with approximately 67% open space (Figure 3.15). The watershed stretches from the mountains around Jamul and Dulzura to the San Diego Bay near Imperial Beach. Pond turtles have not been detected in this watershed since the 1990's (Madden-Smith et al. 2005).

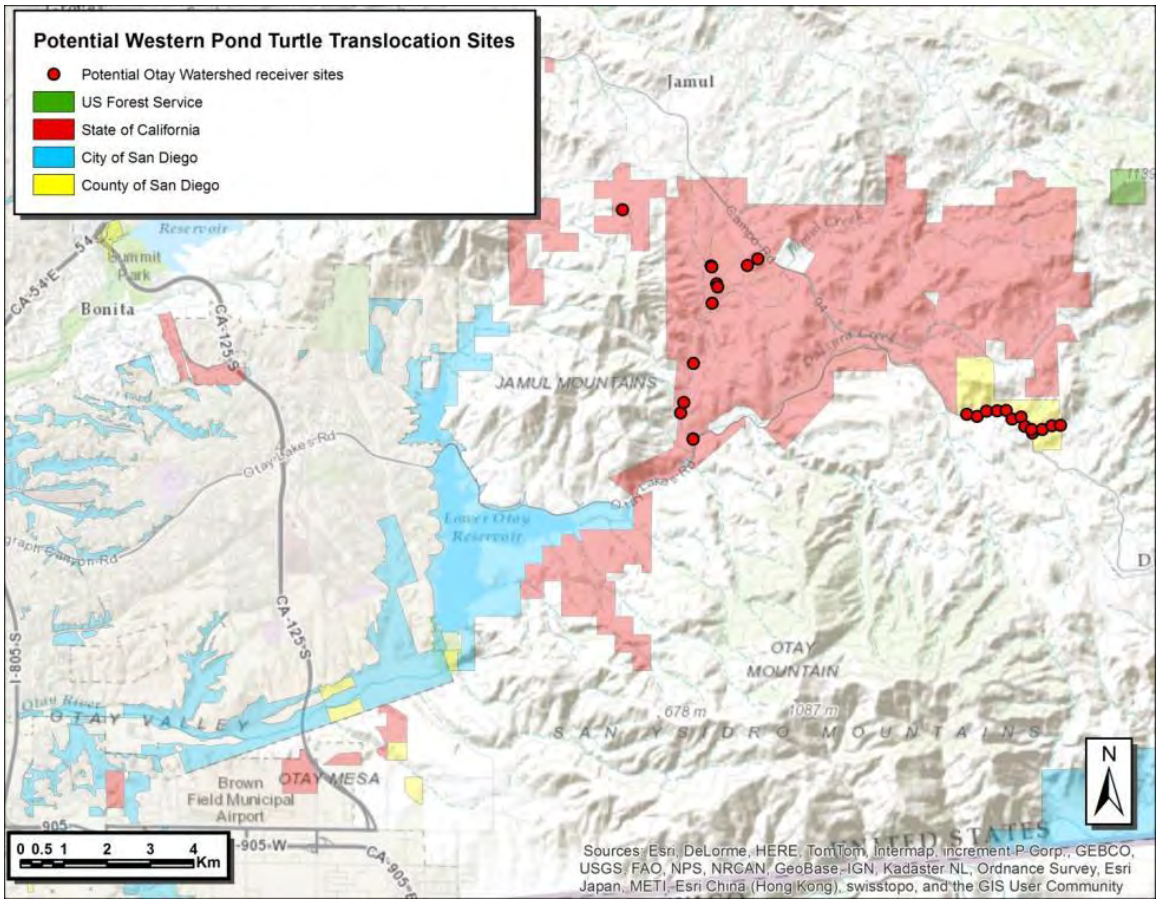

Figure 3.17. Potential pond turtle receiver sites in the Otay River Watershed. The red dots represent the boundaries of the 250 meter sections surveyed within each site.

Rancho Jamul Ecological Reserve

Rancho Jamul Ecological Reserve is a 2,266 hectare CDFW reserve along Jamul and Dulzura Creeks with a diverse range of habitats from grassland to coastal sage to willow-sycamore dominated riparian (Figure 3.16). The reserve has several natural and augmented ponding areas and Jamul Creek has reaches with permanent ponding water. Since 2001, USGS has been investigating removal of nonnative aquatic species to benefit the native riparian obligate reptiles and amphibians (Hathaway et al. 2002). Several ponding locations within the reserve may be suitable receiver sites for pond turtle translocation.

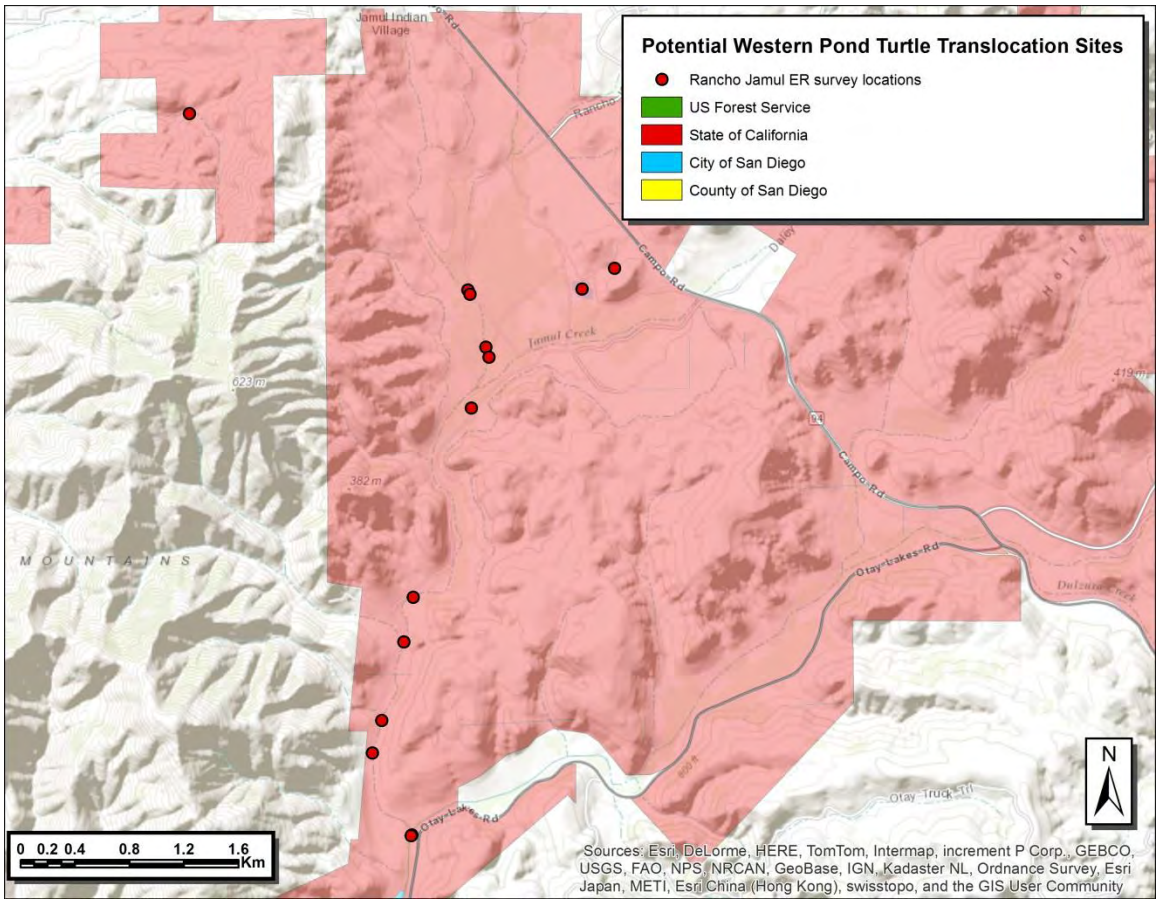

Figure 3.18. Potential pond turtle receiver sites at the California Department of Fish and Wildlife Rancho Jamul Ecological Reserve. The red dots represent the ponds or boundaries of the 250 meter sections surveyed within each site.

Lawrence and Barbara Daley Reserve

Lawrence and Barbara Daley Reserve is a 240 hectare County of San Diego reserve with predominately coastal sage habitat surrounding riparian woodland habitat along Dulzura and Pringle Creeks (Figure 3.17). USGS found pooling habitat with good structure within Dulzura Creek, but did not detect pond turtles during trapping in 2002 and 2003. This may be a potentially suitable receiver site.

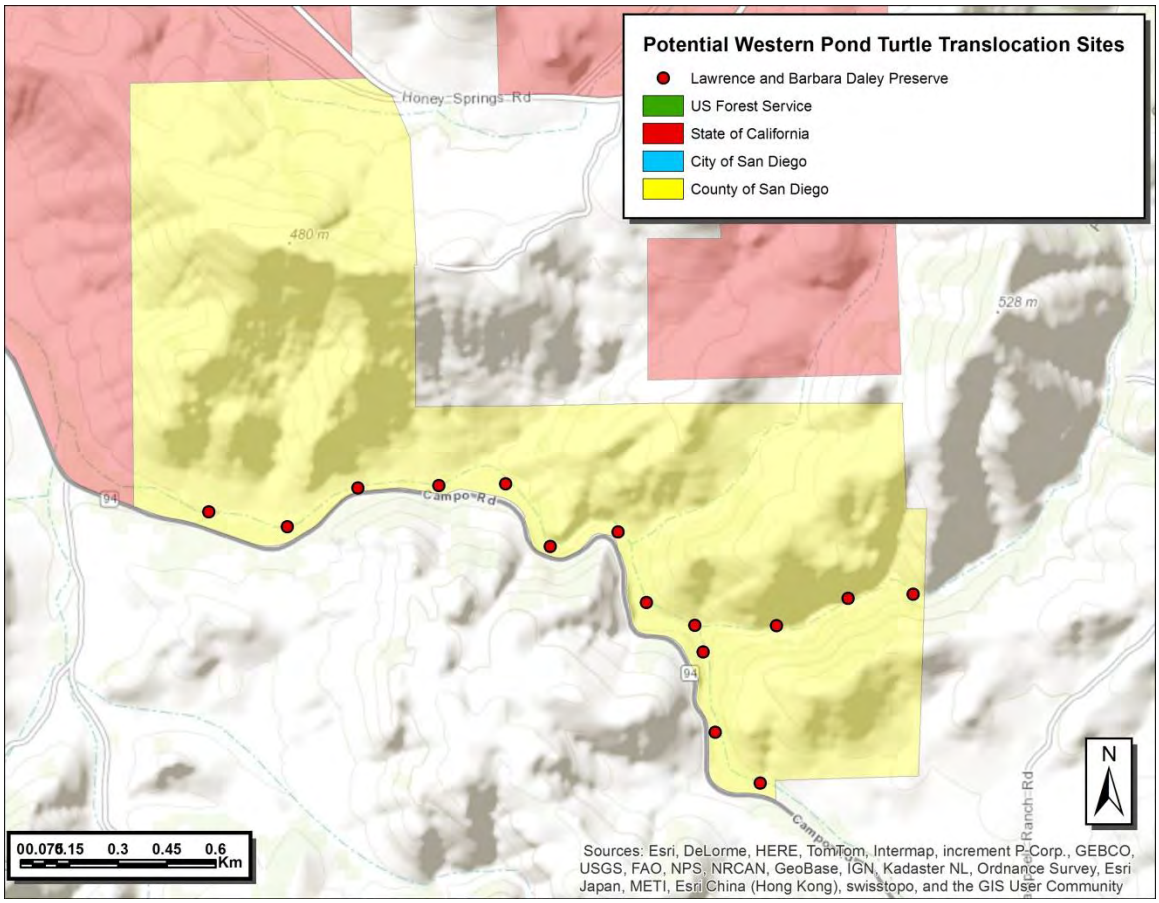

Figure 3.19. Potential pond turtle receiver site at the Lawrence and Barbara Daley Preserve. The red dots represent the boundaries of the 250 meter sections surveyed within the site.

Upper Tijuana River Watershed

The Tijuana River watershed encompasses approximately 120,000 hectares within the US and approximately 330,000 hectares in Mexico (Figure 3.18). Much of the riparian habitat in the upper watershed in the US is on USFS or City of San Diego property with some private ownership. These stream reaches have low access, few impacts, and are relatively free of nonnative aquatic species, not having bullfrogs or red-eared sliders (*Trachemys scripta elegans*). Pond turtles have been observed in Hauser and Pine Valley Creeks and in Barrett Reservoir (Wells and Turnbull 1998, Madden-Smith et al. 2005, Fisher et al. 2014).

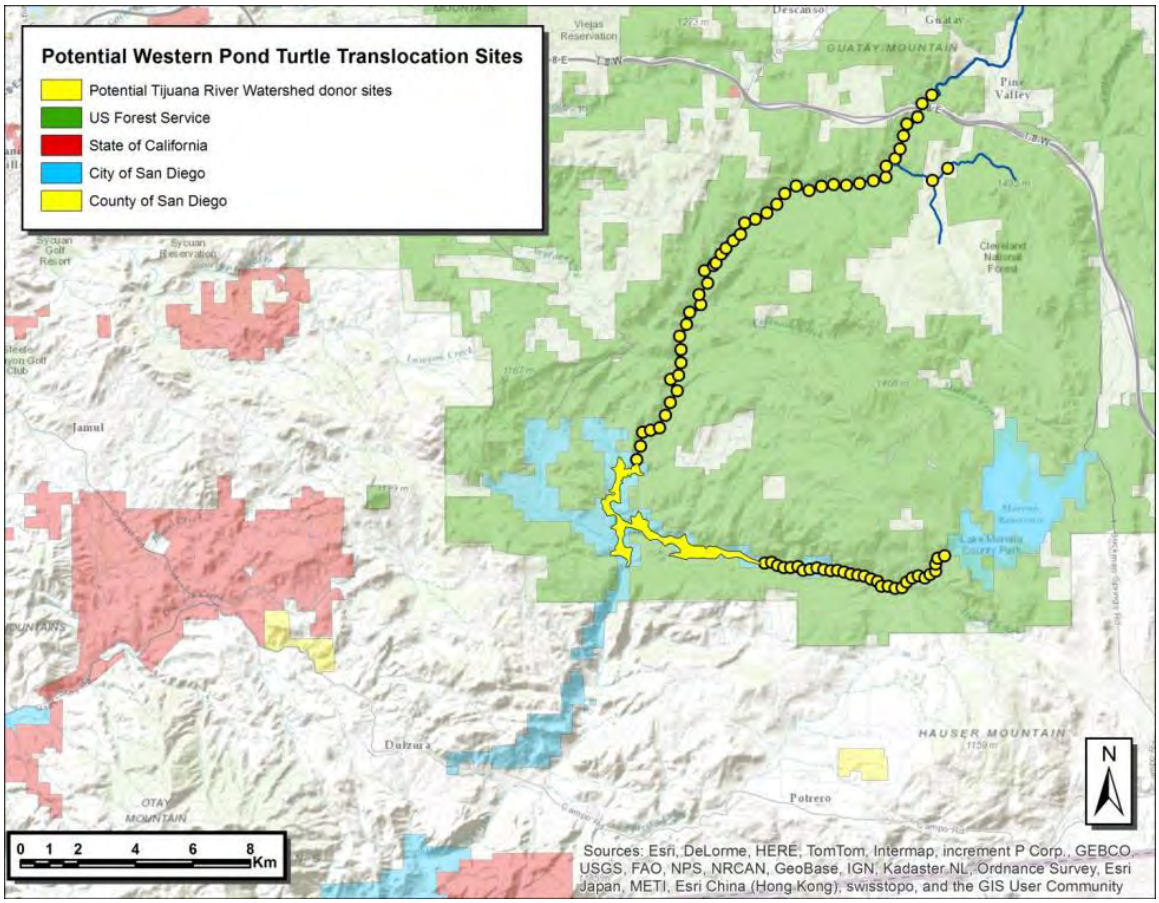

Figure 3.20. Potential pond turtle donor sites in the Tijuana River Watershed. The yellow dots represent the boundaries of the 250 meter sections surveyed within each site.

Pine Valley Creek

Pine Valley Creek between Barrett Reservoir and the town of Pine Valley consists of approximately 25 kilometers of riparian habitat ranging from open sandy wash to dense sycamore and willow dominated riparian to deeply incised bedrock and boulder lined canyons (Figure 3.19). Pond turtles are known to occur at easy access points near Barrett Reservoir, Secret Garden Trail at Horsethief Canyon, and Secret Garden Trail near the Highway 8 bridge (Wells and Turnbull 1998, Fisher et al. 2014). The size and geographic extent of the pond turtle population is unknown. This is a potential donor site.

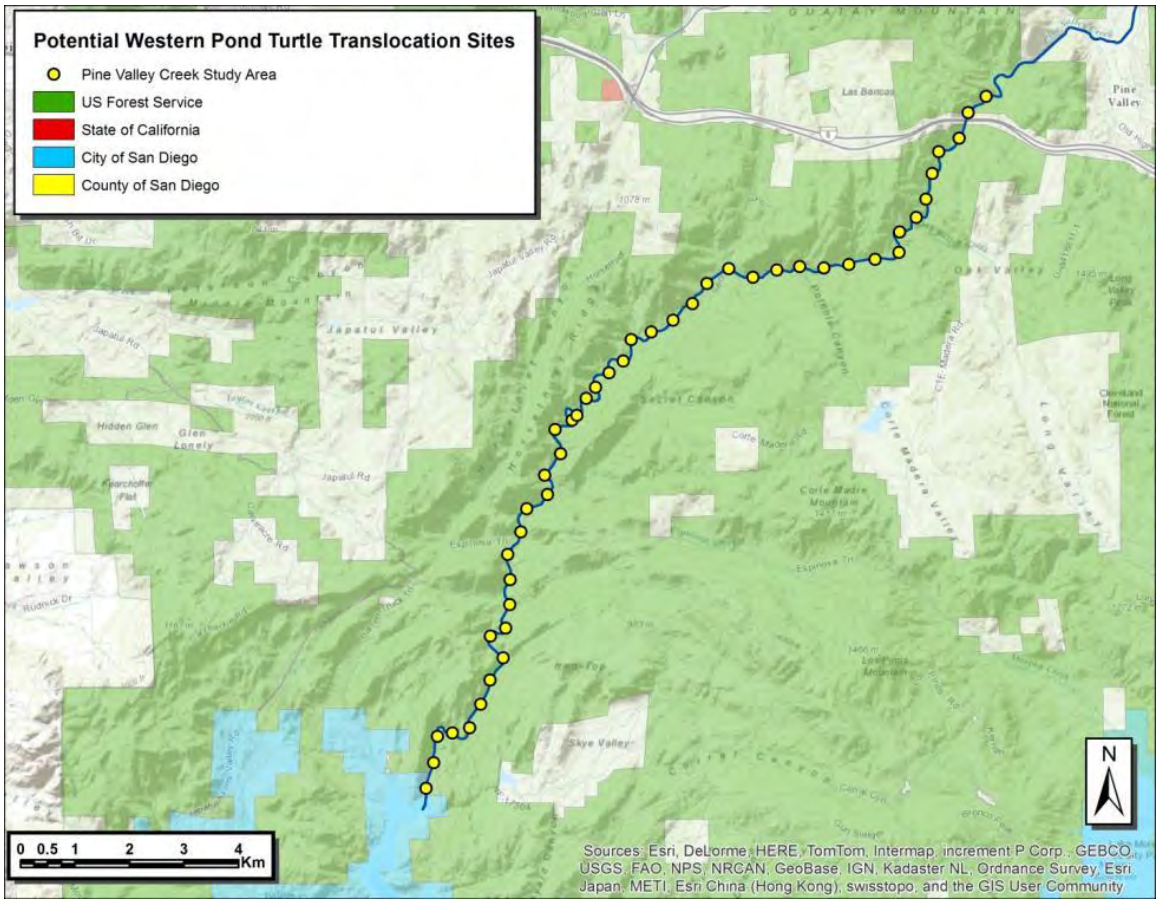

Figure 3.21. Potential pond turtle donor sites in upper Pine Valley Creek. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Oak Valley Creek Ponds

Oak Valley Creek is a tributary to Pine Valley Creek south of Highway 8 (Figure 3.20). The creek has several natural pooling locations along oak and sycamore riparian with a series of large ponds with earthen dams, two of which are permanent and contain pond turtles (USGS unpublished data). This is a potential donor site.

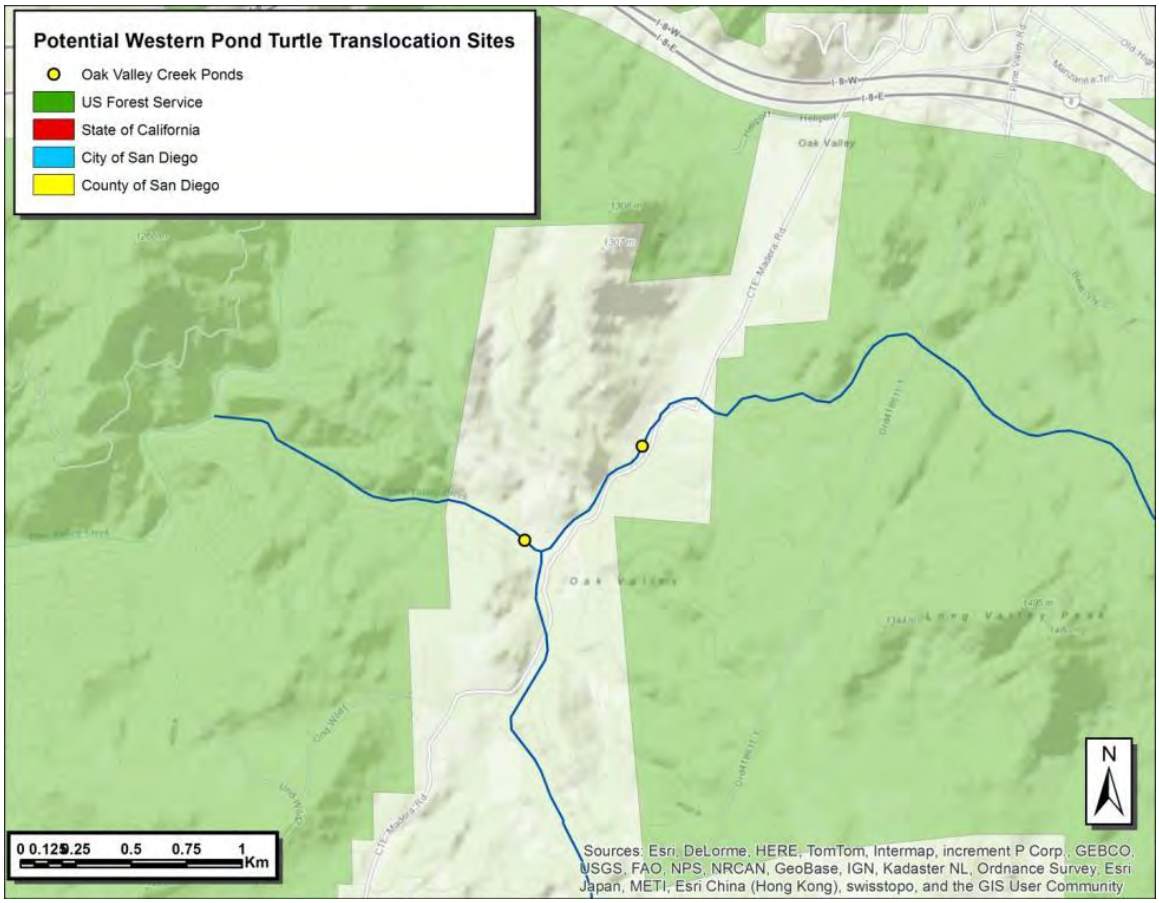

Figure 3.22. Potential pond turtle donor sites in Oak Valley Creek. The yellow dots represent the midpoint of the two largest ponds.

Hauser Canyon

Hauser Canyon consists of approximately 10 kilometers of riparian between Morena and Barrett Reservoirs (Figure 3.21). The riparian varies between open sandy wash to dense sycamore and willow dominated riparian. Pond turtles have been observed in this canyon by USFS (Wells and Turnbull 1998). This is a potential donor site.

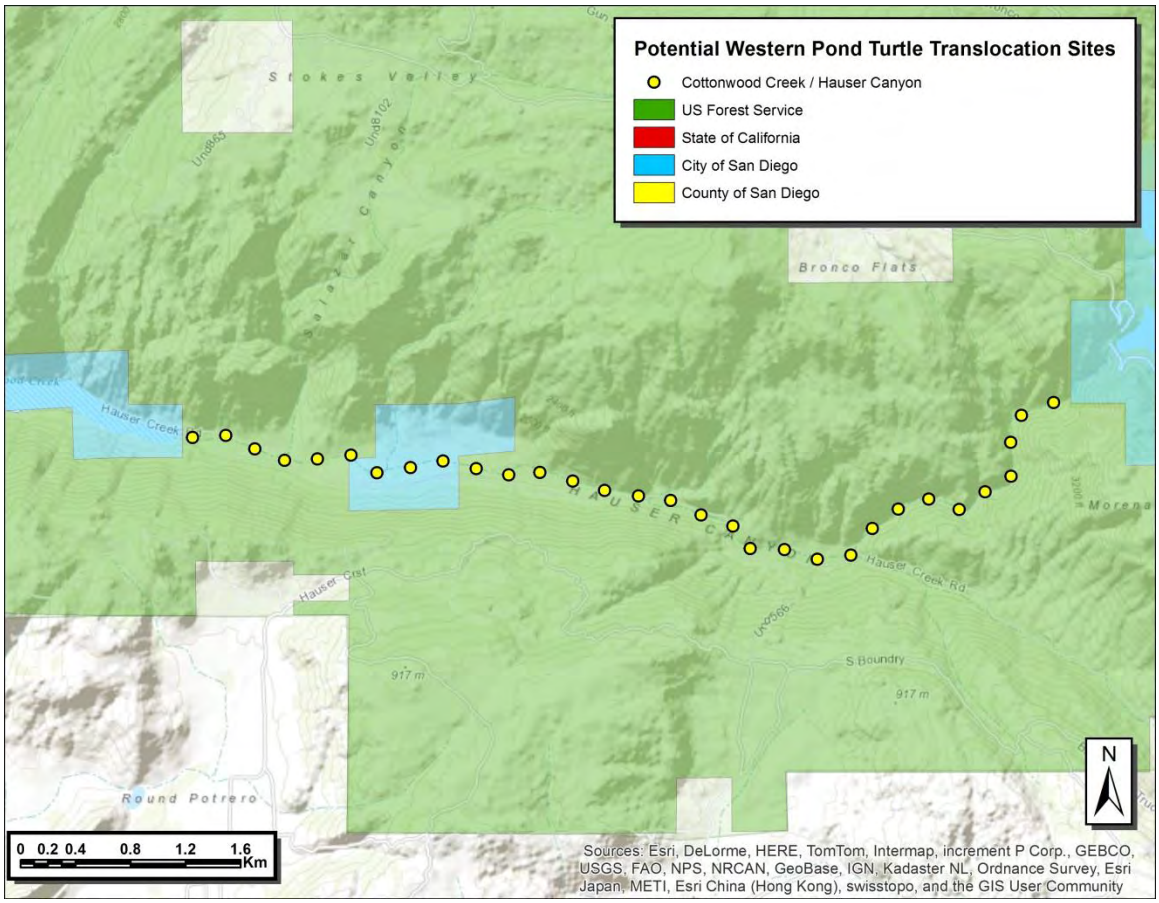

Figure 3.23. Potential pond turtle donor sites in Hauser Canyon. The yellow dots represent the boundaries of the 250 meter sections surveyed within the site.

Barrett Reservoir

Barrett Reservoir is a City of San Diego water storage reservoir that supports a recreational fishery (Figure 3.22). Created in 1922, this reservoir has a storage capacity of over 4,200 hectare meters of water. USGS captured pond turtles at this site in 2002, but also captured largemouth bass and detected bullfrogs. This is a potential donor site.

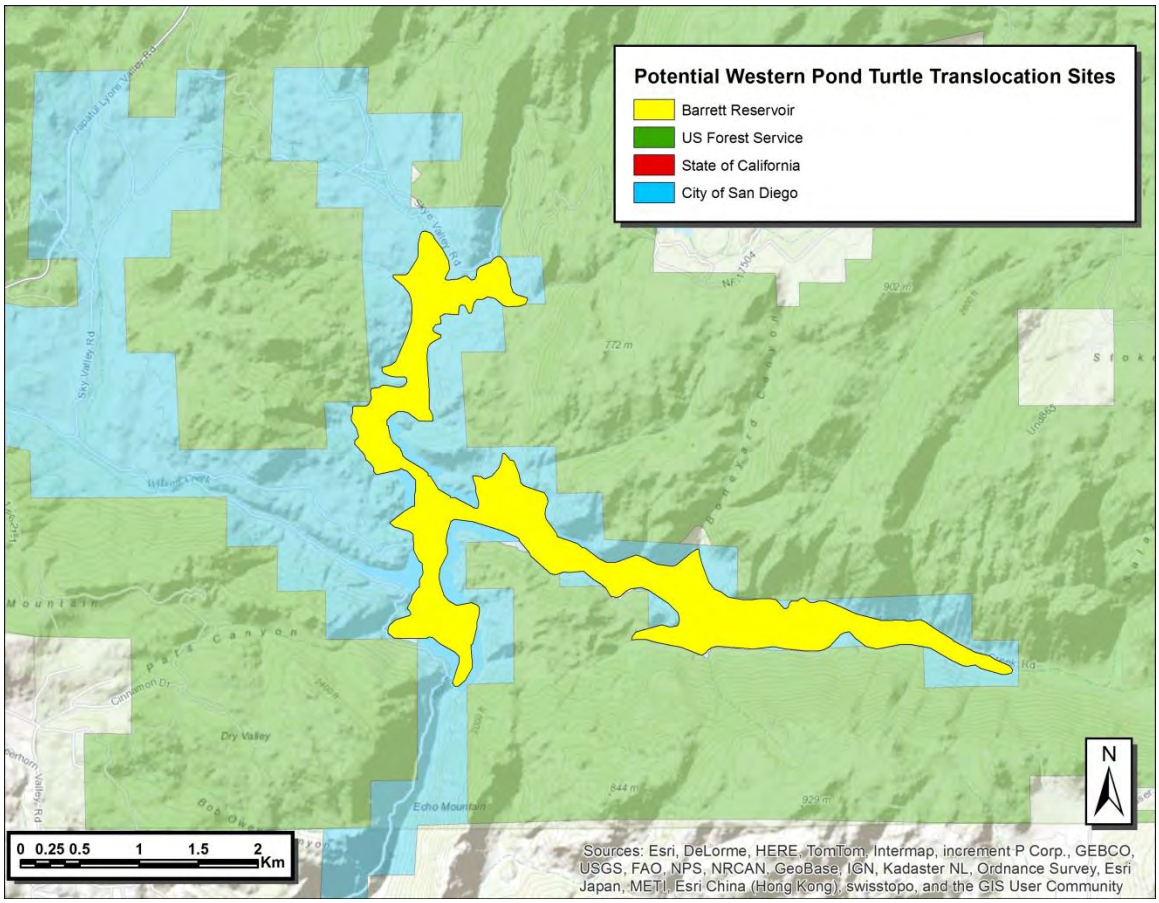

Figure 3.24. Potential pond turtle donor site at Barrett Reservoir.

Methods

Site identification

Potential sites were identified by stakeholders (SDMMP, CDFW, SANDAG, USFWS, and USGS) based on historic records, current observations, current land ownership and management, and known on site water features and resources. Landowners were contacted to determine feasibility of access and permitting needs. Through the course of permitting and access, sites became more defined and feasibility of surveying the potential habitat was assessed.

Survey Methods

Potentially suitable sites were first assessed for habitat quality for pond turtles following the USGS daytime stream survey protocols (USGS 2006a, USGS 2006b). Sites were first examined for ponding water with basking features present. If suitable, visual encounter surveys for aquatic species were conducted.

Following visual encounter surveys, if the site appeared to be suitable and contain deep pooling water (greater than 0.5 meters in depth), the site was trapped utilizing the USGS pond turtle trapping protocol (USGS 2006c) in order to capture and identify aquatic species.

Results

Site Identification

Upper San Dieguito River Watershed

The upper San Dieguito River watershed including San Dieguito River and Santa Maria, Temescal, and Santa Ysabel Creeks, has been known to have pond turtles but the size and health of the populations has been relatively unknown. But observations by D. Holland, USFS, and USGS (Holland 1991, Wells and Turnbull 1997, Madden-Smith et al. 2005) have indicated these populations may be large and stable enough that they could potentially serve as donor populations for translocations with the goal of restoring pond turtles to the lower portions of the San Dieguito River watershed.

Santa Ysabel Creek at Witch Creek

This site was identified as a potentially suitable donor site based on the presence of large bedrock and boulder pools within an area known to contain pond turtles. The property is owned and managed by San Dieguito River Park JPA as conserved. The stream was surveyed for arroyo toads in 2010 and several pools were identified at that time even though no pond turtles were observed.

Santa Ysabel Creek at Pamo Valley

This site was identified as a potentially suitable donor site based on the presence of pooling water observed during daytime arroyo toad surveys and its conservation status being owned and managed by the City of San Diego. During arroyo toad surveys in 2012, a juvenile pond turtle was observed at this site indicating that successful recruitment is occurring at this site.

Santa Ysabel Creek at Clevenger Canyon

This site was identified as a potentially suitable donor site based on the presence of pooling water observed during daytime arroyo toad surveys and its conservation status being owned and managed by the City of San Diego. During arroyo toad surveys in 2008, an adult pond turtle was observed at this site.

San Dieguito River Park below Lake Hodges (Santa Fe Valley)

This site was identified as a potentially suitable receiver site based on the presence of large bedrock and boulder pools within an area known historically to have had pond turtles where none have been observed in recent surveys (J. Lopez personal communication 2014). The property is owned and managed by San Dieguito River Park JPA as conserved and is undergoing riparian restoration and active management for the removal of nonnative aquatic species.

Scholder Creek

This was identified as a potentially suitable donor site based on the presence of large bedrock and boulder pools within an area known to contain pond turtles. The property is owned and managed by US Forest Service as conserved. Pond turtles were observed here historically and are known from nearby (Fisher et al. 2014, B. Hubbs personal communication 2015). Access is pending.

Black Canyon

This site was identified as a potentially suitable donor site based on the presence of large bedrock and boulder pools within an area known to contain pond turtles. The property is owned and managed by US Forest Service as conserved. Pond turtles were observed here historically and have been captured at this location during CDFW visual encounter surveys in support of the USGS and UCLA pond turtle genetics program (Fisher et al. 2014, Spinks et al. 2014). Access is pending.

Boden Canyon Ecological Reserve

This site was identified as a potentially suitable receiver site based on the presence of large pools near an area known to have pond turtles. The property is owned and managed by CDFW as conserved and has the potential to undergo riparian restoration and active management for the removal of nonnative aquatic species and to provide for more surface water through the removal of sediment from the largest artificial pool in the stream system.

Upper San Diego River Watershed

Much of the upper San Diego River watershed was surveyed for arroyo toads by USGS from 2008 to 2012. During these surveys, pond turtles were observed throughout the study area above El Capitan Reservoir, detecting both juveniles and adults.

San Diego River at Penin Canyon

This section of the San Diego River contains numerous large pools with several pond turtles having been detected throughout the reaches. The land is owned and managed by

US Forest Service and is accessible from Eagle Peak Road via a trail leading to and down Penin Canyon. Access is pending.

San Diego River Above Ritchie Creek

This section of the San Diego River contains numerous large pools with several pond turtles having been detected throughout the reaches and is potentially suitable as a donor site. The land is owned and managed by US Forest Service and is accessible from Eagle Peak Road via the Saddleback Trailhead. Access is pending.

San Diego River at Eagle Peak Road

This section of the San Diego River contains numerous large pools with several pond turtles having been detected throughout the reaches and is potentially suitable as a donor site. The land is owned and managed by City of San Diego and is accessible from the Barona Indian Reservation.

San Diego River Hanson Pond

This pond is a former quarry that is now under management as conserved lands by the Endangered Habitat Conservancy. This site is below El Capitan Reservoir and is potentially suitable as a receiver site as no pond turtles are currently known to inhabit the site.

Cedar Creek

This section of the San Diego River contains numerous large pools with several pond turtles having been detected throughout the reaches and is potentially suitable as a donor site. The land is owned and managed by US Forest Service and is accessible from Cedar Creek Road. Access is pending.

Cañada de San Vicente (Rancho Cañada)

This site has been surveyed by CDFW for the USGS/CDFW genetic study in 2010 and found not to contain pond turtles (Fisher et al. 2014). With some large, trappable pools, this site has potential habitat for the pond turtle. It is currently owned and managed by CDFW and is potentially suitable as a receiver site.

Boulder Oaks Preserve

This site has been surveyed by USGS and found not to contain pond turtles but have potential habitat with management for removal of nonnative aquatic species (Brown and Fisher 2008). It is currently owned and managed by the County of San Diego and is potentially suitable as a receiver site.

Upper Otay River Watershed

Pond turtles have been found in the upper Otay River Watershed historically but not in recent years (Madden-Smith et al. 2005) though potential habitat exists. Much of the land ownership is now public/quasi-public being managed for either recreation or conservation. Many locations have large permanent pools and may be suitable for reintroduction of pond turtles with continued management for restoration and conservation.

Rancho Jamul Ecological Reserve

Rancho Jamul Ecological Reserve owned and managed by CDFW has been examined for habitat suitability and as a potential receiver site for pond turtles since 2002 (Hathaway et al. 2002). USGS has surveyed the reserve for pond turtles with none detected but potential habitat identified (Madden-Smith et al. 2005). With current riparian restoration efforts and management for nonnative species, this site is potentially suitable as a pond turtle receiver site.

Lawrence and Barbara Daley Reserve

Dulzura and Pringle creeks within the Lawrence and Barbara Daley Preserve have been surveyed by USGS for pond turtles and suitable habitat with no turtles being detected (Madden-Smith et al. 2005). This preserve is currently owned and managed by the County of San Diego for conservation and active management for riparian restoration is ongoing near sites sample for pond turtles by USGS. With this management, this area may have become suitable for pond turtles and is potentially suitable as a pond turtle receiver site.

Upper Tijuana River Watershed

The upper Tijuana River watershed including Pine Valley Creek and Hauser Canyon has been known to have pond turtles but the size and health of the populations has been relatively unknown. But observations by D. Holland, USFS, and USGS (Holland 1991, Wells and Turnbull 1997, Madden-Smith et al. 2005) have indicated these populations may be large and stable enough that they could potentially serve as donor populations for translocations with the goal of restoring pond turtles to the Otay River watershed and preserving the genetic makeup of the upper Tijuana River watershed pond turtles.

Pine Valley Creek

Pine Valley Creek above Barrett Reservoir is predominately in USFS lands traversing through chaparral and oak and sycamore woodlands. Based on Wells and Turnbull 1997 and D. Holland 1991, a preliminary survey was conducted by USGS in 2010 which observed several pond turtles in a short amount of time. Following the 2010 survey we began to examine the potential use of the site as a translocation donor population.

Oak Valley Creek Ponds

The Oak Valley Creek Ponds are owned and managed by the Corte Madera Ranch and are in the upper portion of the Pine Valley Creek watershed. Based on proximity to large populations of pond turtles in the main channel of Pine Valley Creek, we examined this as a potential donor population site.

Hauser Canyon

The section of Cottonwood Creek in Hauser Canyon is predominately in USFS and San Diego City lands. Wells and Turnbull 1997 detected pond turtles along this section of Cottonwood Creek indicating it may be suitable as a potential donor population site.

Barrett Reservoir

Barrett Reservoir is owned and operated by City of San Diego. USGS trapped the reservoir in 2004 and found pond turtles. This site was surveyed as a potential donor population site.

Surveys

Not all sites identified and described have been surveyed as of this writing. During the identification process, some sites were determined to be impractical translocation receiver or donor sites based on limited access to the site or other management concerns. Also, this is a program in progress and not all potentially suitable sites have been visited at this time, mainly because access had not been granted by the landowner or current drought conditions made the site unsuitable for surveying for pond turtles and their habitat due to lack of water. All potentially suitable sites will be surveyed as access is granted and/or water conditions improve. Below are the survey results for the sites that could be accessed and/or had conditions suitable for pond turtle surveys. Trapping surveys were conducted at sites with suitable habitat and adequate water, otherwise only a visual survey was conducted.

Upper San Dieguito River Watershed

Santa Ysabel Creek at Pamo Valley

This site was identified as a potential donor site as a juvenile pond turtle was observed here in 2012 and was surveyed by visual encounter survey on 2 April 2015. With the prolonged drought, only one survey reach had surface water and the depth was less than 0.25 meters and no pond turtles were observed during the 2015 survey.

Upper San Diego River Watershed

No sites within this watershed have been surveyed, mainly because access is still pending.

Upper Otay River Watershed

Rancho Jamul Ecological Reserve

Jamul Creek was surveyed from Dulzura Creek to Highway 94 on June 25th, 2014 (Figure 3.23 and Figure 3.24). Even with record low rainfall, nearly two kilometers of surface water were observed with pools sufficiently deep enough for pond turtle foraging (Figure 3.23 and Figure 3.24). The Pump Pond and Bedrock Pond (previously unnamed pond) contained a large amount of water and suitable structure for both foraging and basking.

Nonnative aquatic species were observed throughout the wetted regions of the creek. crayfish (*Procambarus* spp.) were detected at 11 locations and bullfrogs were detected at 6 locations (Figure 3.23 and Figure 3.24).

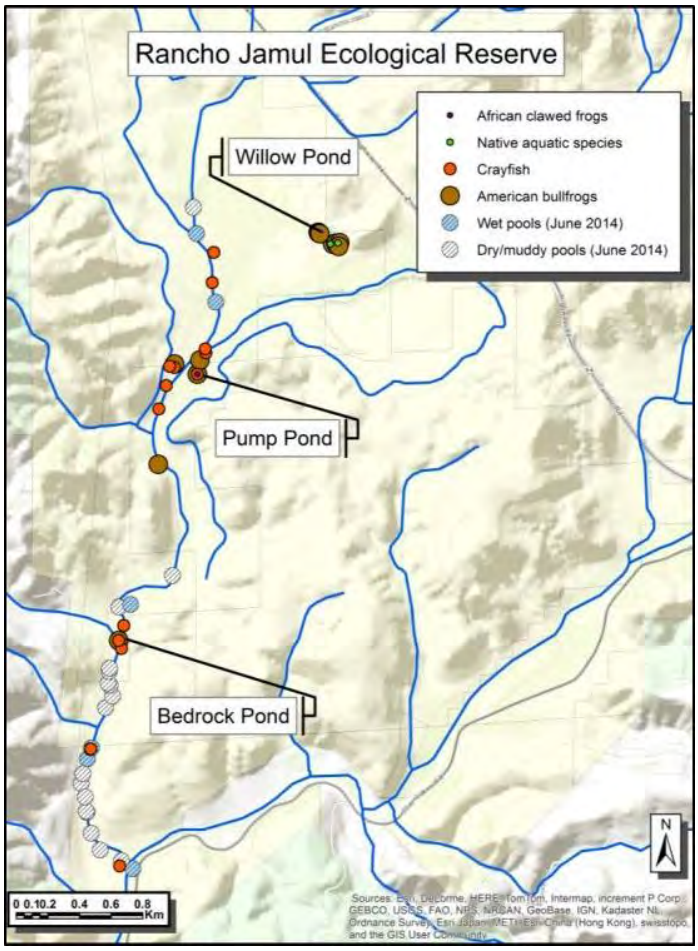

Figure 3.25. Survey results for the Rancho Jamul Ecological Reserve.

a)  b) 

c)  d) 

Figure 3.26. Photographs of potential pond turtle habitat at Rancho Jamul Ecological Reserve: a) Jamul Creek, b) Willow Pond, c) Pump Pond, and d) Bedrock Pond.

Pine Valley Creek

The presence of pond turtles at Pine Valley Creek made this site suitable for trapping; however, the remoteness of the site would have made hauling in traps difficult and time consuming. Instead, the site was divided into two easily surveyable reaches (upper and lower) and surveyed by visual encounter surveys with the purpose of detecting and hand capturing pond turtles. In seven daytime visual encounter surveys (3 at the lower site and 4 at the upper site), we made a total of 134 pond turtle observations (53 in lower site and 81 in upper site; Tables 3.1 and 3.2). Ninety-three of the 134 total observations were captures (either by hand or by net). Of the 93 pond turtle captures, 81 were newly captured and marked individuals (36 in lower site and 45 in upper site), 4 were recaptures (1 in lower site and 3 in upper site), and 12 were released unmarked (6 in lower site and 6 in upper site) because they were either too small to PIT-tag (10) or the PIT-tags failed (2). An additional 37 pond turtles were observed visually but escaped capture (10 in lower site and 27 in upper site). Unmarked pond turtles and those with unknown recapture status (escapees, etc.) were not included in the population estimates. During the surveys, three pond turtles were found dead and were not included in the number of observations. The overall pond turtle capture rate per day averaged 13.5 ± 1.0 at the upper site and 14.3 ± 3.8 at the lower site. Approximately 53% (29/55) of known-sex adult captures were male and approximately 47% (26/55) were female for both sites combined (Table 3.3). Juveniles (less than 105 millimeters) comprised 25% (20/81) of the known-age population (Table 3.3).

Table 3.1. Western pond turtle captures by date for mark recapture surveys, Pine Valley Creek, upper site, 2013. Pond turtles were captured by hand or by net or detected visually.

	Survey Date				
	18 April 2013	09 May 2013	21 May 2013	06 June 2013	Total
New Captures, Marked	12	10	9	14	45
New Captures, Unmarked[a]	2	1	3	0	6
Recapture	0	1	2	0	3
Unknown Status[b]	8	9	3	7	27
Total/Day	**22**	**21**	**17**	**21**	**81**

[a]Individuals that were captured but not PIT-tagged as they were too small or the PIT-tags failed.
[b]Individuals that escaped or avoided capture.

Table 3.2. Western pond turtle captures by date for mark recapture surveys, Pine Valley Creek, lower site, 2013. Pond turtles were captured by hand or by net or detected visually.

	Survey Date			
	14 April 2013	16 May 2013	05 June 2013	Total
New Captures, Marked	11	9	16	36
New Captures, Unmarked[a]	0	2	4	6
Recapture	0	0	1	1
Unknown Status[b]	3	6	1	10
Total/Day	**14**	**17**	**22**	**53**

[a]Individuals that were captured but not PIT-tagged as they were too small or the PIT-tags failed.
[b]Individuals that escaped or avoided capture.

Table 3.3. Sex and age of individual western pond turtles (marked new captures only) captured during visual encounter surveys: Pine Valley Creek, 2013.

	Adults				Juveniles				
	Male	Female	Unknown	Adult Total	Male	Female	Unknown	Juvenile Total	Site Total
Upper Site	13	20	2	35	0	1	9	10	45
Lower Site	16	6	4	26	2	0	8	10	36
Total	**29**	**26**	**6**	**61**	**2**	**1**	**17**	**20**	**81**

We estimated the lower Pine Valley Creek lower site to contain 220 pond turtles (95% limit: lower 82, upper 8607) and the upper Pine Valley Creek site to contain 215 pond turtles (95% limit: lower 106, upper 1052). Thus, for the 20% of the Pine Valley Creek habitat surveyed, we estimated a pond turtle population of approximately 435 individuals. These estimates do not include 12 juvenile individuals that were captured but not PIT-tagged as they were too small or the PIT-tags failed.

The Pine Valley Creek pond turtle population is discussed in detail in Study 2: Population Assessment of Western Pond Turtles at Pine Valley Creek.

Oak Valley Creek Ponds

The Oak Valley Creek Ponds were surveyed visually for pond turtles on 28 August 2014. With the observation of suitable habitat and active pond turtles, traps were placed in both ponds on 28 August 2014 and subsequently trapped for 2 days (Table 3.4). Only one pond turtle was captured at Pond 2 during the first trapping session and trapping was discontinued for this pond. Five pond turtles were captured at Pond 1 during the first trapping session and trapping surveys were repeated on 2 September 2014 and 1 October 2014 for a total of 14 adult pond turtle captures, one of which was a recapture (2 October 2014)

Table 3.4. Western pond turtle captures by date and sex for trapping surveys, Oak Valley Creek Ponds, 28-30 August 2014, 2-4 September 2014, and 1-3 October 2014. Ten baited hoop traps were used. All captured turtles were adults.

	Pond 1							**Pond 2**			
	29 August 2014	**30 August 2014**	**03 September 2014**	**04 September 2014**	**02 October 2014**	**03 October 2014**	**Pond 1 Total**	**29 August 2014**	**30 August 2014**	**Pond 2 Total**	**Total**
Male	2	0	4	0	1	0	7	1	0	1	8
Female	3	0	4	0	0	0	7	0	0	0	7
Total Captures	5	0	8	0	1	0	14	1	0	1	15

Hauser Canyon

Hauser Canyon was visually surveyed on 28 August 2014 to examine pooling areas for pond turtles as a donor site for translocation. With the prolonged drought, the survey area we had access to on City of San Diego property (Figure 3.21) had no pooling habitat suitable for pond turtles.

Barrett Reservoir

Barrett Reservoir was trapped for pond turtles from 25 August 2014 to 29 August 2014 with. Twenty traps were placed throughout available surface water near structures suitable for basking including tree limbs and rock outcrops (figures 3.25 and 3.26). No turtles of any species were detected and the only capture was largemouth bass (*Micropterus salmoides*).

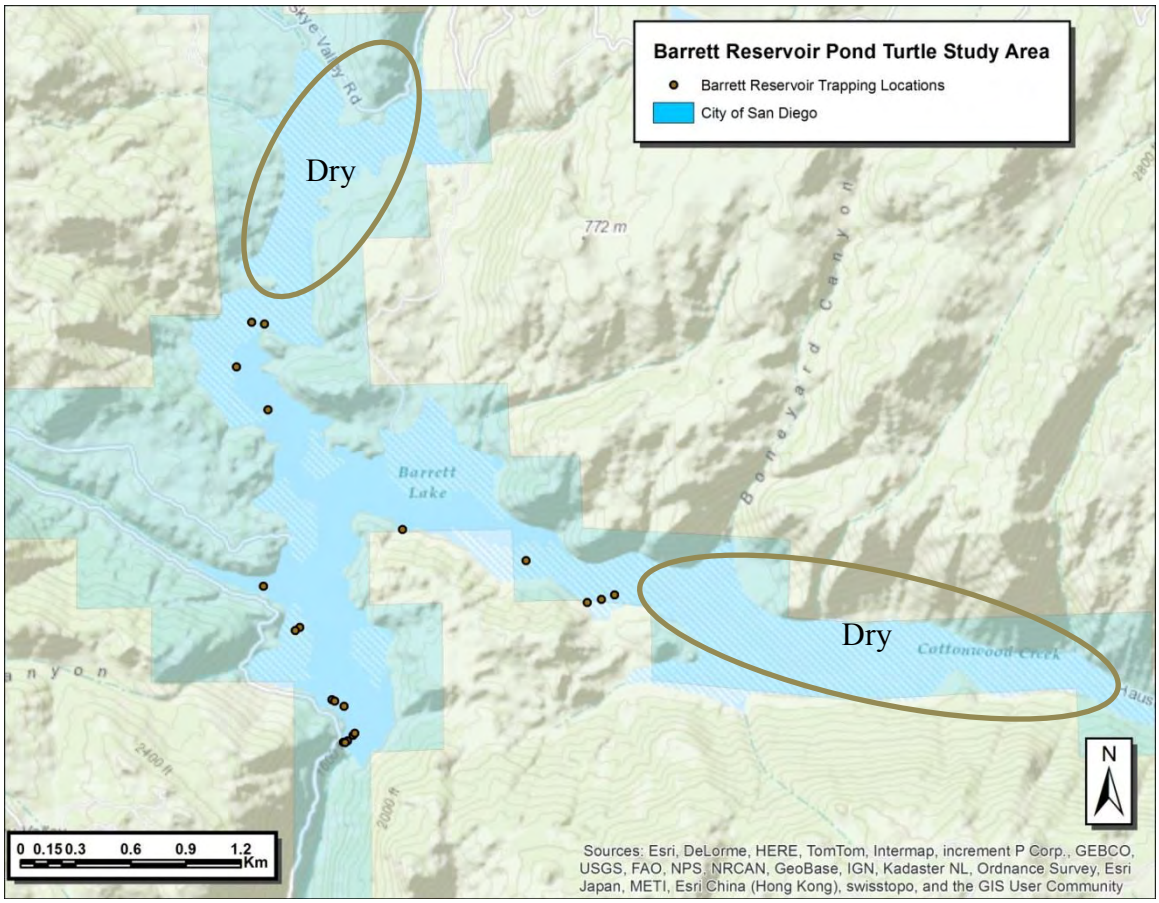

Figure 3.27. Pond turtle trap locations at Barrett Reservoir, 25-29 August 2014. With prolonged drought conditions, the reservoir level had dropped such that some of the most suitable habitat in the Cottonwood Creek and Pine Valley Creek sections had dried and were no longer trappable.

Figure 3. 28. Pond turtle habitat at Barrett Reservoir, 25-29 August 2014.

Discussion

Out of 11 potential translocation donor and 7 potential receiver sites within the study area, we found 2 suitable donor sites and 1 suitable receiver site. No suitable donor sites and no suitable receiver sites have been fully determined within the upper San Dieguito River and upper San Diego River watersheds. One suitable receiver site has been determined within the Otay River watershed. Two suitable donor sites have been determined within the upper Tijuana River watershed. This study is ongoing so additional translocation donor and receiver sites may be identified.

There were several locations we expected to have suitable habitat based on historical observations, aerial imagery, and current management, but instead the prolonged drought has lowered water levels at potential translocation donor and receiver sites throughout the study area, making them unsuitable due to lack of water. For example, during our surveys for arroyo toads in 2008-2010, Santa Ysabel Creek from Pamo Valley to San Pasqual Valley had several pools with observations of both an adult and a juvenile pond turtle. Being conserved with multiple agency ownerships, this section of Santa Ysabel Creek had great potential as a donor site; however, with prolonged drought, most of the stream in this area is dry with only a few scattered pools and none deep enough to place traps. In the San Diego River Watershed, the Boulder Oaks Ponds were also examined as a high priority receiver site; however, we saw these ponds dry completely during this study. In addition, areas with controlled, but easy access in the Tijuana River Watershed, including Pine Valley Creek and Cottonwood Creek at and above Barrett Reservoir were too dry to support pond turtles.

The cascading effect of lack of water also has made presumed stable populations of pond turtles unstable. Potential donor populations in Hauser Canyon, Barrett Reservoir, and Santa Ysabel Creek are either gone or not detectable (e.g. aestivating in the uplands, population too small to detect). Even though there was still water in Barrett Reservoir, the level had dropped sufficiently enough that it may have become unsuitable for pond turtles by becoming too warm or because of fish die offs. These areas should be revisited and reassessed during years of normal rainfall and after the reservoir returns to normal levels.

However, we also found that some populations are more robust than predicted (upper Pine Valley Creek, Oak Valley Creek). Finding very young pond turtles (hatchlings and yearlings) at Pine Valley Creek during low rainfall years was very encouraging. The number of turtles we encountered and amount of available habitat was far beyond our expectations.

We are concerned about prolonged drought and what can happen with reduced habitat in combination with stochastic disturbance events including large scale wildfires. Historical large contiguous populations could buffer large events like wildfire by providing recolonizing pond turtles from nearby. Without these lower watershed populations, even the protected populations in the upper watershed become more at risk form drought and wildfire.

We also have sites that need to be fully assessed that were not vetted due to lack of access or low priority. For example, Hanson Pond along San Diego River was initially considered a low priority receiver site because it is less remote than the Boulder Oaks Ponds and potentially has a greater risk of human disturbance. However, it is retaining sufficient water and habitat for pond turtles despite current drought conditions, while the Boulder Oaks Ponds have dried completely. For these reasons, Hanson pond will be fully examined as this study continues.

Based on this assessment, repeat surveys and continued monitoring is necessary to get a better understanding of the pond turtle populations within the upper watersheds of the Otay, Tijuana, San Dieguito, and San Diego Rivers. Sites expected to be suitable during years of normal rainfall, but were found unsuitable due to the current drought conditions, should be revisited and reassessed during years of normal rainfall. We also recommend continued monitoring of the Pine Valley Creek population and continuing the restoration effort and monitoring at RJER. In addition, Rancho Guejito, in the San Dieguito River watershed, was not included in this study, and should be assessed as a potential donor population.

Study 4: Rancho Jamul Ecological Reserve Western Pond Turtle Translocation

Introduction

In 2001-2003 surveys by USGS, western pond turtles (hereafter referred to as pond turtle) were absent from Rancho Jamul Ecological Reserve (RJER; Hathaway et al. 2002, Madden-Smith 2005). However, the Rancho Jamul Ecological Reserve's Land Management Plan identified ponds on RJER as suitable for translocation and management of pond turtles (CDFG 2008). This site was later chosen by USGS, CDFW, and SANDAG as a location for pond turtle translocation. In June2014, RJER was surveyed to locate all potentially suitable pond turtle habitat and to identify sources of nonnative aquatic species. Nonnative aquatic species were then removed from areas determined suitable for pond turtle translocation. In September of 2014, a total of 12 western pond turtles were translocated from private ponds in the Pine Valley Creek watershed to ponds at RJER. The pond turtles were fitted with radio transmitters before release and were radio tracked and monitored to determine movement and health status. Monitoring of pond turtles at this site is ongoing.

Methods

Study Area

Rancho Jamul Ecological Reserve is a 2,266 hectare CDFW reserve along Jamul and Dulzura Creeks (Figure 4.2) with a diverse range of habitats from grassland to coastal sage to willow-sycamore dominated riparian. The reserve has several natural and augmented ponding areas and Jamul Creek has reaches with permanent ponding water. Since 2001, USGS has been investigating removal of nonnative aquatic species to benefit the native riparian obligate reptiles and amphibians (Hathaway et al. 2002). Several ponding locations within the reserve may be suitable receiver sites for pond turtle translocation. USGS has surveyed the reserve for pond turtles with none detected but potential habitat identified (Madden-Smith et al. 2005). With current riparian restoration efforts and management for nonnative species, this site is potentially suitable as a pond turtle receiver site.

Oak Valley Creek is a tributary to Pine Valley Creek south of Highway 8 (Figure 4.2). The creek has several natural pooling locations along oak and sycamore riparian with a series of large ponds with earthen dams, two of which are permanent. The Oak Valley Creek Ponds are owned and managed by the Corte Madera Ranch and are in the upper portion of the Pine Valley Creek watershed. Based on proximity to large populations of

pond turtles in the main channel of Pine Valley Creek this site potentially contains large numbers of pond turtles.

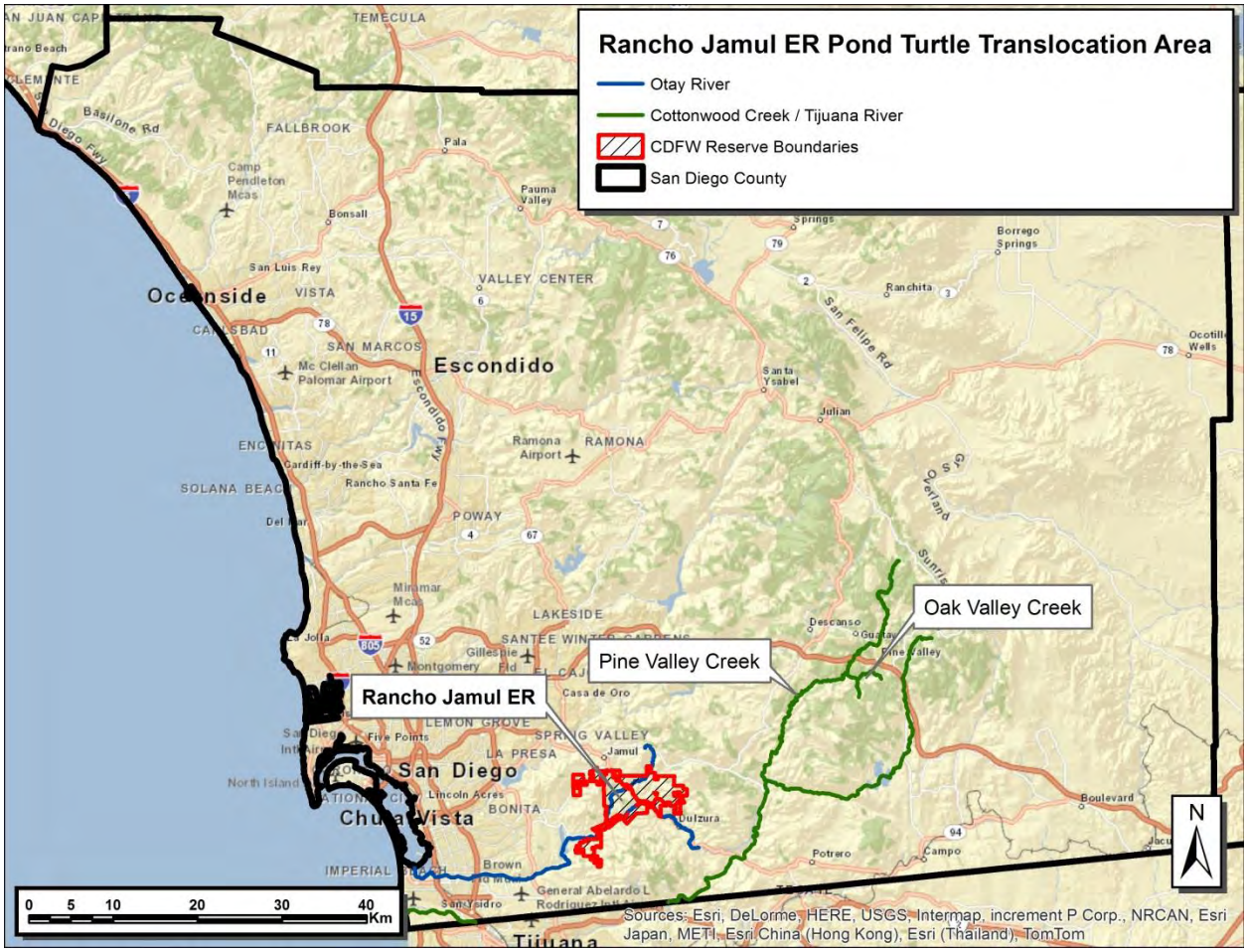

Figure 4.1. Locations of Rancho Jamul ER and Oak Valley Creek in southern San Diego, CA.

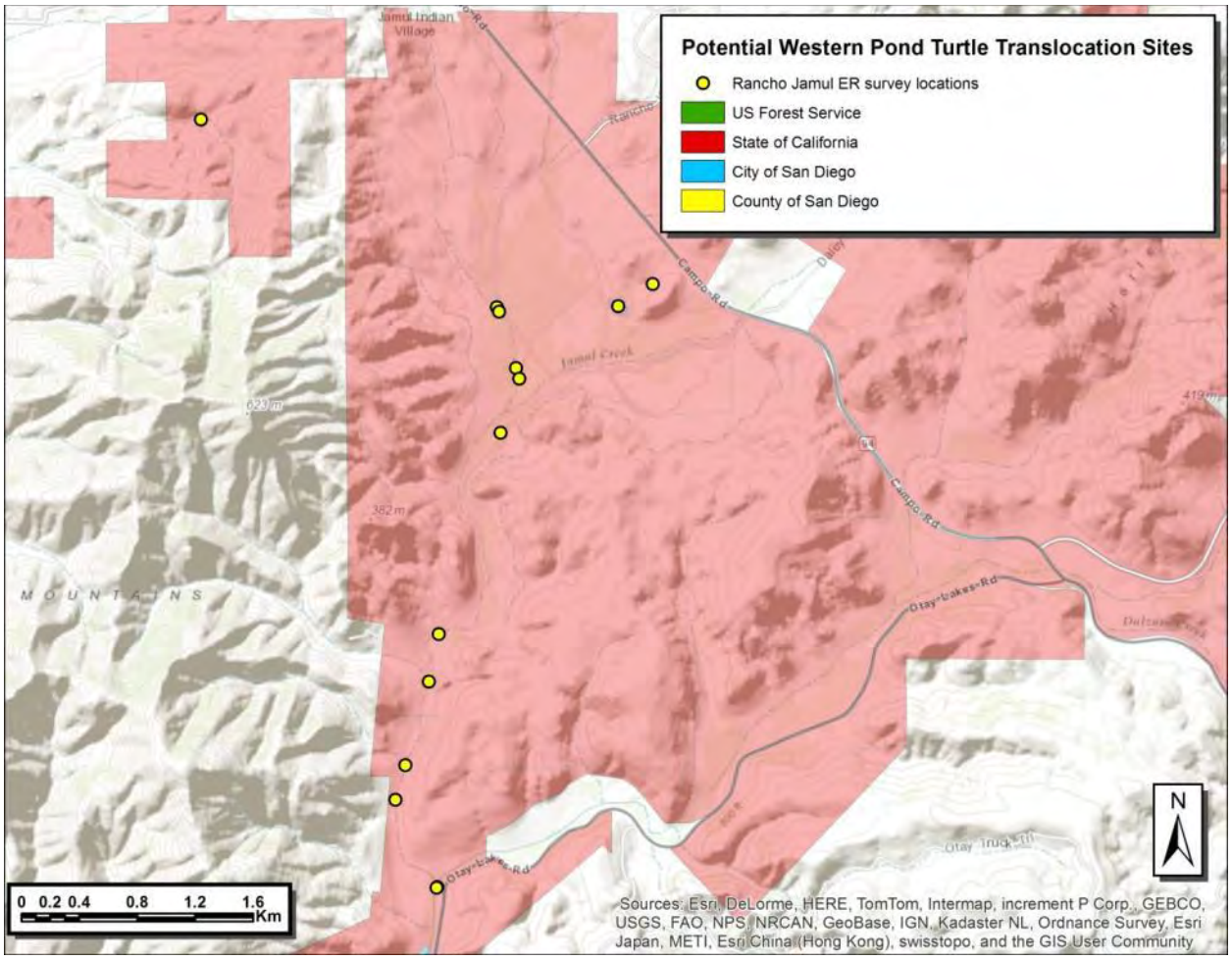

Figure 4.2. Ponding sites at RJER examined for suitability for pond turtles.

A. 

B. 

C. 

Figure 4.3. Potential pond turtle habitat at RJER: A. Two areas of pooling in Jamul Creek (June 2014), B. Bedrock Pond (June 2014 (left) and after dry down in September 2014 (right)), and C. aerial (Google Earth image October 2012) and ground views of Pump Pond (September 2014)

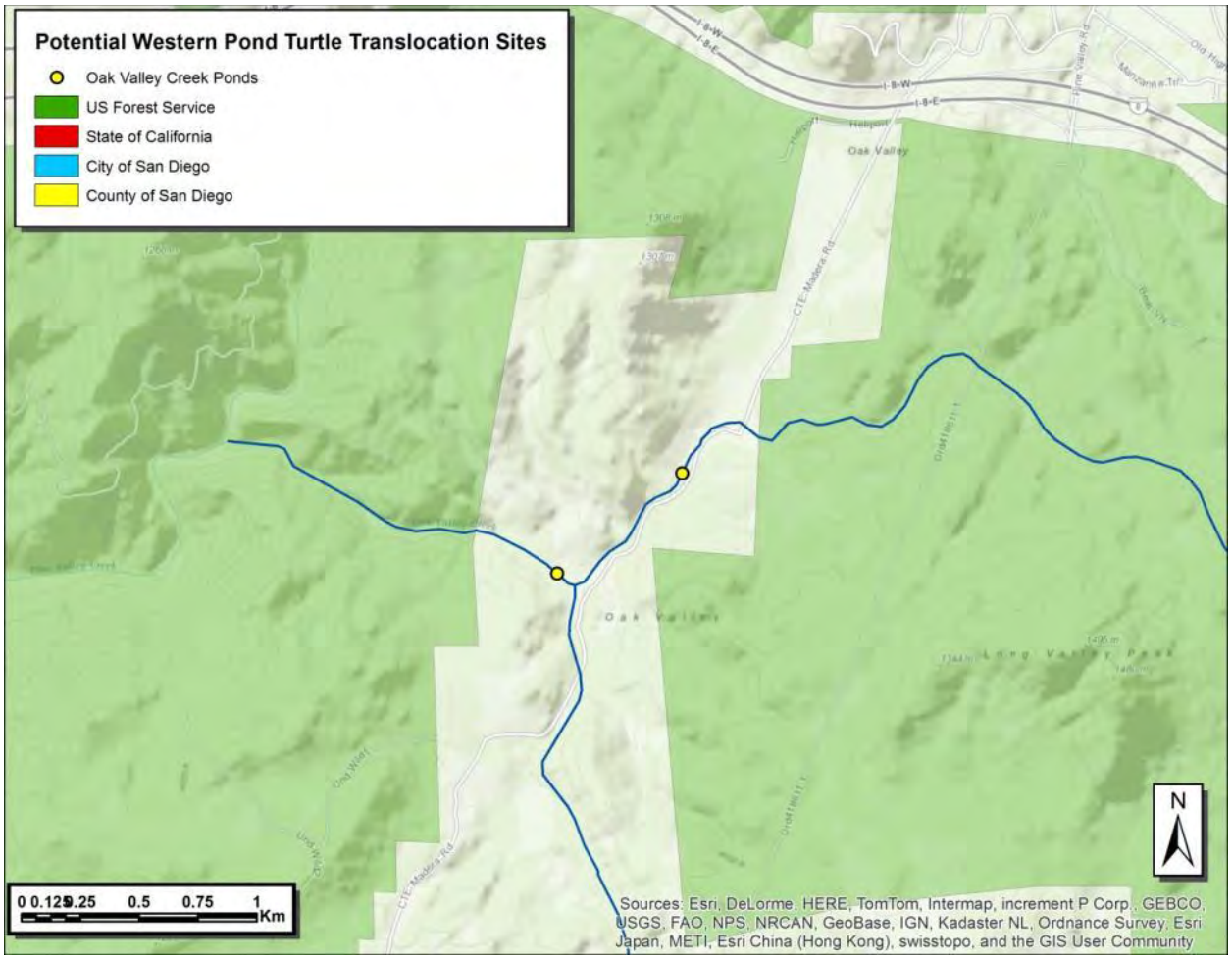

Figure 4.4. Oak Valley Creek Ponds in the Pine Valley Creek watershed.

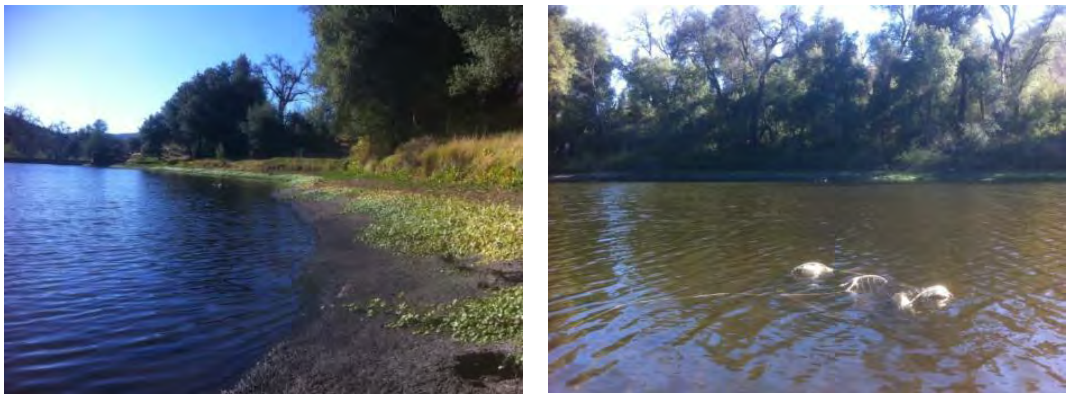

Figure 4.5. Pond turtle habitat in the Oak Valley Creek Ponds**:** Largest turtle pond in Oak Valley Creek (August and September 2014). This pond forms at the confluence of the two tributaries.

Surveys

Insert brief summary of survey types pre- and post-translocation (habitat, nonnative removal, etc. please add anything I may have missed)

Table 4.1. Post-translocation survey types and visits at RJER, September 2014 – May 2015. Surveys listed by type, date, and location with attending staff.

Survey Type	Methods/Data Recorded	Number of Visits (Sept 2014-May 2015)	Staff[b]
Visual	Record of basking or swimming behavior	39	CB,AA,BI, LG,OG
Telemetry	Location of individuals in pond, transmitter pulse interval for temperature determination	49	CB,AA,BI, LG,OG
Nonnative Aquatic Species Control[a]	minnow traps, hand capture, seine nets, slings, and airguns	19	CB, CR, RF, SF
Temp logger	Logging of transmitter pulse interval at 5 minute intervals to determine temperatures	2	CB, AA,OG

[b]Nonnative aquatic species control included crayfish (*Procambarus* spp.), bullfrog (*Lithobates catesbeianus*), and African clawed frog (*Xenopus laevis*).
[a]USGS staff conducting surveys: AA = Angelica Aguilar Duran, BI = Brittany Idrizaj, CB = Chris Brown, CR = Carlton Rochester, LG = Lizzie Grolle, OG = Omar Salcido, RF = Robert Fisher, SF = Sam Fisher.

Habitat Surveys

Jamul Creek was surveyed from Dulzura Creek to Highway 94 on June 25th, 2014 (see Appendix) utilizing the USGS Stream Survey protocols (USGS 2006c) in order to locate all potentially suitable pond turtle habitat and to identify additional sources of nonnative aquatic species. The USGS daytime visual encounter survey was conducted along the stream for each 250 meter reach between Dulzura Creek and Highway 94. Potential pooling areas were identified and recorded as either dry or wet and all aquatic species were recorded for a given 250 meter reach.

Nonnative Aquatic Species Removal

Non-native aquatic species management has focused on removal of crayfish (*Procambarus* spp.), bullfrogs (*Lithobates catesbeianus*), and African clawed frogs (*Xenopus laevis*). Methods included using minnow traps, hand capture, seine nets, slings, and airguns.

Minnow traps and seines have been used at Willow and Bedrock Ponds for removal of crayfish and/or African clawed frogs (Fig. #). Two types of minnow traps have been used: Gee Wire Minnow Trap (9 by 17.5 inch model) and Memphis Net and Twine's collapsible Shrimp and Minnow Trap (10 by 10 by 17 inch model). Minnow traps for African clawed frogs were set in the water tethered to the shoreline. Minnow traps for crayfish were set similarly but were baited with meat. Seine nets were also used to

capture African clawed frogs and crayfish. Captures were recorded and individuals disposed of offsite.

Bullfrog removal surveys have been conducted at Willow, Pump, and Bedrock Ponds and Jamul Creek. Bullfrog removal used hand capture, slings, and airguns. Most frequently Bullfrogs were captured by airgun and sling but were also captured by hand opportunistically. Captured bullfrogs were returned to USGS where stomachs were removed to examine content and bodies were sent to the Aquatic Parasite Observatory at the University of Colorado for examination.

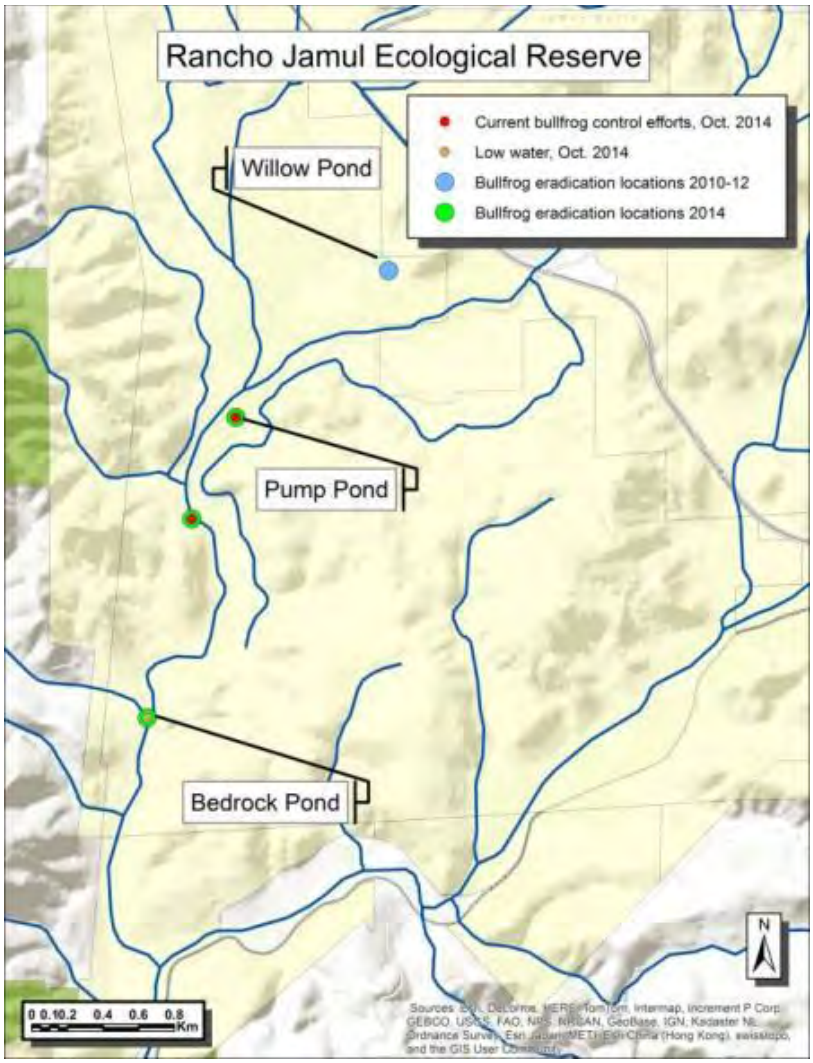

Figure 4.6. Map of RJER ponds and drainages, including locations and years of nonnative aquatic species removal.

Translocation

Pond turtles were captured at the Oak Valley Ponds using trapping methods from Madden-Smith et al. (2005) and then transported in separate clean containers. Water was changed as needed to keep conditions clean. The rear of the carapace of each pond turtle was gently cleaned with water and cotton cloth to determine the most suitable scute for transmitter placement. Scute selection was made based on cleanliness, size, and shape such that when the transmitter was placed, the antenna would lay naturally along the rear of the carapace with no large gaps.

We used 10 gram RI-2BT temperature sensing transmitters from Holohil with frequencies approved for use on this project by USFWS. Transmitters were configured for glue attachment to the turtles. Each transmitter was first attached with kitchen and aquarium approved silicone adhesive and allowed to dry. Then a bead of clear five-minute epoxy was placed around the transmitter to adhere it to the scute. Care was taken to not cover any sutures with epoxy. If the scute was too small to avoid covering sutures, a bead of silicone was placed over the suture in order to not impact the carapace growth.

The first group of six turtles was translocated from Oak Valley Creek to RJER on 2 September 2014 and was released to Bedrock Pond. The second group of six turtles was translocated from Oak Valley Creek to RJER on 8 September 2014 and was released to Bedrock Pond. Shortly after their release, Bedrock Pond began to dry down and all pond turtles were moved to Pump Pond between 26 September 2015 and 1 October 2015.

Telemetry and Monitoring

The translocated pond turtles were radio tracked and located to a quadrant. Data on habitat use (whether they were in the water, on the shore, under the cattail mat, or in the upland) were recorded (Figure 4.7). Similar data were recorded for other aquatic species observed. Pond turtles were tracked daily for the first two weeks, and then tracked approximately every three days through November, weekly through May of 2015 for a total of 54 daytime radio tracking surveys.

Figure 4.7. Pond turtle radio telemetry data collection at Pump Pond. The translocated pond turtles were located to a quadrant and data on habitat use (whether they were in the water, on the shore, under the cattail mat, or in the upland) were recorded. Similar data were recorded for other aquatic species observed.

Results

Habitat Surveys

Even with record low rainfall, nearly two kilometers of surface water were observed with pools sufficiently deep for pond turtle foraging. Additionally, the Pump Pond and Bedrock Pond contained a large amount of water and suitable structure for both foraging and basking.

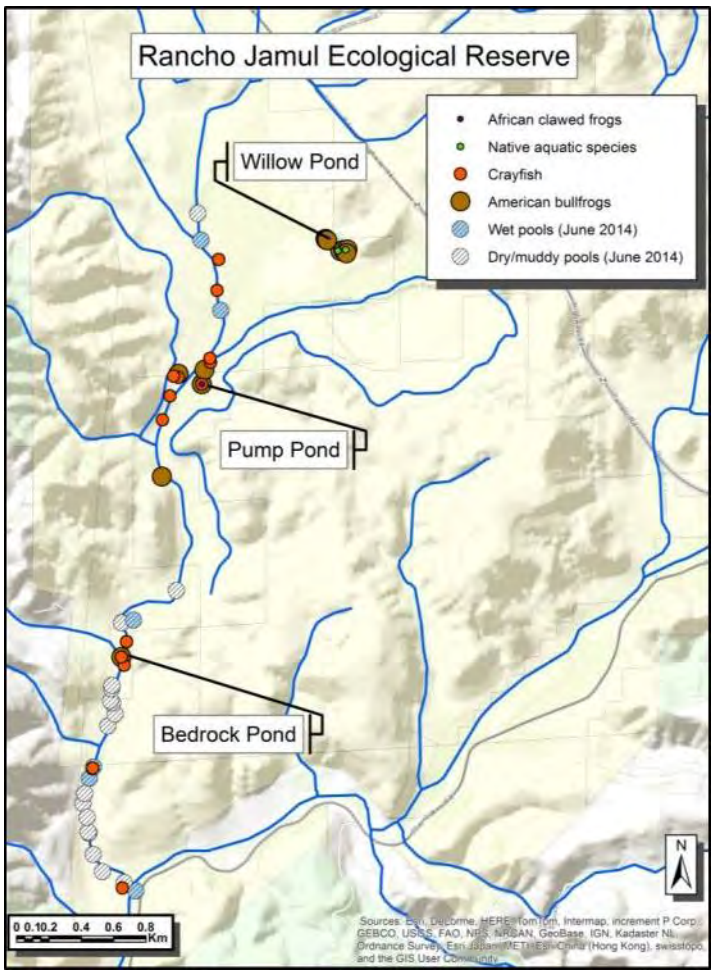

Figure 4.8. Location of wetted areas and nonnative species observed during pond turtle habitat surveys at RJER, 2014.

Nonnative Aquatic Species Removal

In preparation for pond turtle translocation, over 400 African clawed frogs, 60 bullfrogs, and 800 crayfish were removed from RJER. Our nonnative removal efforts have remained ongoing, focusing on remaining wetted locations where bullfrogs are still being detected (likely moving in from adjacent creeks), which has been at or near Pump Pond (Figure 4.8). Bullfrogs are no longer being detected at Willow and Bedrock Ponds. Bedrock Pond is at historically low levels, presenting a great opportunity to remove silt deposits at the site.

Telemetry and Monitoring

During September through November 2014, telemetry surveys focused on locating the pond turtles relative to the pond to assess site fidelity. We also examined ways to effectively record temperature data. In December of 2014, we settled on using a Telonics TR5 radio receiver mounted to the California walnut (*Juglans californica*) tree at the south end of the pond, attached to a 12 volt RV/Marine deep cycle battery, recording transmitter pulse rates every 20 minutes. This allowed us to leave the receiver in place recording data for up to two weeks without maintenance.

During December 2014 through May 2015, 11 pond turtles with temperature dependent transmitters were being regularly monitored at the Pump Pond at RJER (Table 4.2), including 20 minute temperature logging (one transmitter failed and one male pond turtle had been taken to the San Diego Zoo for treatment of a shell injury). In February, another transmitter on one pond turtle stopped broadcasting but the pond turtle is presumed still on site as it was showing site fidelity up to that point.

The male pond turtle which had been receiving medical treatment at the San Diego Zoo was given a clean bill of health and released with a new transmitter to the Pump Pond on February 23rd. Data recorded continued to include location of the individuals in the pond and pulse interval of the transmitter (to determine temperature). Visual observations and behaviors were also recorded when possible (Figure 4.9) and increased as air and water temperatures increased.

The transmitter pulse rate (temperature data) data logger files from the Telonics TR5 receiver contain several thousands of points per individual that require processing to develop temperature profiles which then need to be calibrated. However, we have examined small amounts of data throughout the duration of sampling to help determine activity patterns of individuals. An example of these data is presented in Figure 4.10.

Table 4.2. Radio telemetry results for the 11 pond turtles with functional transmitters by location at the Pump Pond December 2014 through May 2015 (Fig 4.7).

	Number of Observations per Radio Tracked Pond Turtle											
Location at Pond	**RJER 1**	**RJER 2**	**RJER 3**	**RJER 4**	**RJER 5**	**RJER 6**	**RJER 7**	**RJER 9**	**RJER 10**	**RJER 11**	**RJER 12**	**All Combined**
Water- Quad A	14	20	11	5	7	7	11		8	8	8	99
Water- Quad B	4	6	5	3	8	7	2	5	9	1	7	57
Water- Quad C	8	12	10	2	6	11	18	2	6	4	9	88
Water- Quad D	15	6	14	6	8	8	6	4	14	6	14	101
Bank- Quad A					2				1	1	2	6
Bank- Quad B		1	1		2	3	2	3	2		3	17
Bank- Quad C						1	1				2	4
Bank- Quad D		1									1	2
Pond-no fix	6	3	3	23	11	8	7	25	7	22	2	117
Total	47	49	44	39	44	45	47	39	47	42	48	491

Figure 4.9. Pond turtle basking at Pump Pond. Pond turtles can now be frequently observed basking on branches along the shoreline at the Pump Pond.

In addition to pond turtle observations, other aquatic species were recorded. The nonnative bullfrog was the most observed species with a total of 92 individuals detected during 76 survey days (Table 4.3). The most observed native species was the Two-stripped Garter Snake (*Thamnophis hammondii*) with a total of 17 individuals detected on 11 surveys days.

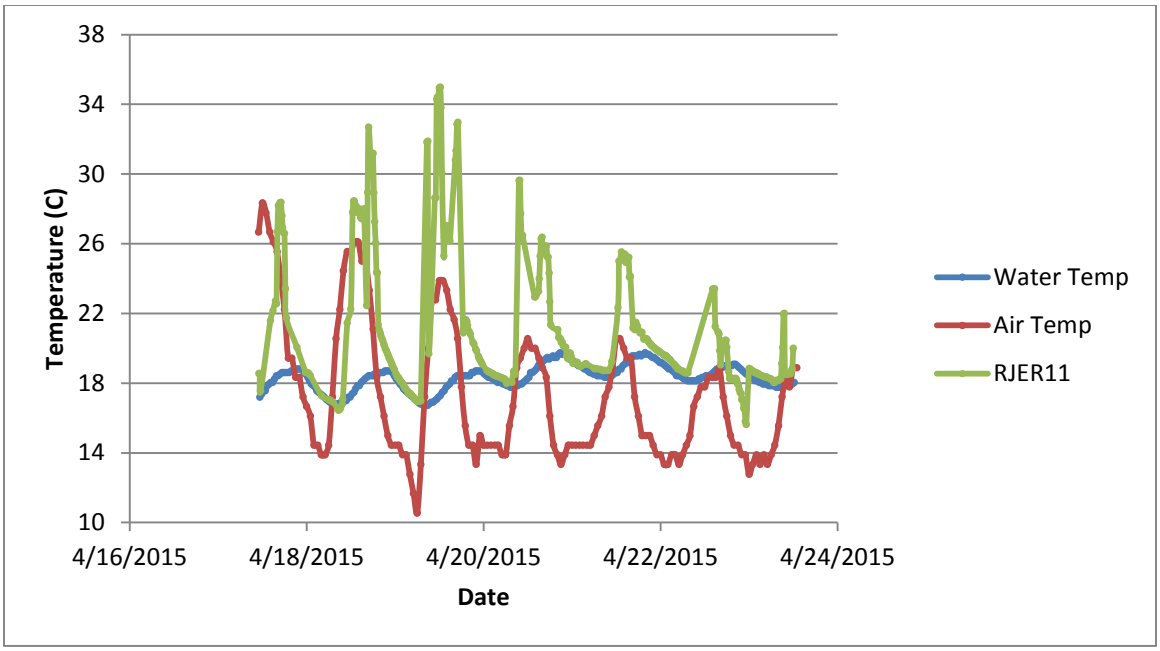

Figure 4.10. Temperature profile for pond turtle RJER 11 for six days in April 2015. This chart was used to determine basking timing and duration for this pond turtle in relation to surface water temperature and air temperature.

Table 4.3. RJER species observations. Other reptiles and amphibians observed at RJER's pump pond. These are numbers of observations and not captures or recaptures and are not representative of the total numbers of individuals at the site.

Species	Number of Days Observed	Number of Individuals Observed
California Kingsnake (*Lampropeltis getulae*)	1	1
Southern Pacific Rattlesnake (*Crotalus helleri*)	1	1
Two-stripped Garter Snake (*Thamnophis hammondii*)	11	17
Pacific Treefrog (*Pseudacris regilla*)	3	3
Western Toad (*Anaxyrus boreas*)	4	4
Bullfrog (*Lithobates catesbeianus*)	76	92

Discussion

The translocated pond turtles appear to be active and staying at the Pump Pond. Basking is frequently observed on many features of the pond, including fallen logs, cattail mats, and the shoreline. Pond turtle monitoring should continue in order to determine the long term success of the translocation. No juvenile pond turtles were detected during this study. Successful recruitment is an indicator of population health and is necessary for the long term survival of this population. Additionally, bullfrogs continue to be problematic at RJER as they appear to be moving into the Pump Pond from nearby areas and will

need continued management for successful pond turtle recruitment to occur within this population (See Study 1). Long term monitoring and management of this population can follow the same guidelines suggested for the pond turtles at SPER (Appendix B).

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Appendix A: Draft Western Pond Turtle Translocation Plan and Study Design

PROJECT TITLE:

Enhancement of Western Pond Turtle in San Diego County

IMPLEMENTATION PLAN DATE:

April 15, 2014

ORGANIZATIONS INVOLVED:

US Geological Survey (USGS)
San Diego Management & Monitoring Program (SDMMP)
California Department of Fish and Wildlife (CDFW)
City of San Diego (SD City)
County of San Diego (SD Co.)
San Diego Association of Governments (SANDAG)
San Diego Natural History Museum (SDNHM)
San Dieguito River Park (SDRP)
US Fish and Wildlife Service (USFWS)

PRINCIPAL INVESTIGATOR(s):

Robert Fisher[1]
CDFW[2]

TECHNICAL AND LOGISTICAL SUPPORT:

US Geological Survey
Western Ecological Research Center
San Diego Field Station

and

San Diego Management & Monitoring Program

AFFILIATION:

[1]US Geological Survey
Western Ecological Research Center
San Diego Field Station

[2]California Department of Fish and Wildlife

PROJECT DURATION:

Translocation to take place over two years, plus continued monitoring

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ABSTRACT

The western pond turtle (*Emys marmorata*, WPT) was once widespread and common in southern California but has experienced sharp declines. This species is heavily impacted by fragmentation, recreation, and the introduction of nonnative aquatic species which compete with and directly prey upon it (Brattstrom and Messer 1988; Holland 1991). This species has only moderate legal protection statewide. In San Diego County, the southwestern pond turtle (*E. m. pallida*) is a covered (protected) species under the Multiple Species Conservation Program (MSCP) and the Multiple Habitat Conservation Program (MHCP) both of which require monitoring and management. The southwestern pond turtle has also been included in the region's Management Strategic Plan for Conserved Lands in Western San Diego County (MSP; SDMMP 2013) and was identified as a species at high risk of loss from the MSP area (MSPA).

In support of the MSCP, MHCP, and MSP, the US Geological Survey (USGS) has been studying the status of WPT in San Diego County to determine region wide and site specific stressors and has conducted surveys throughout San Diego County to determine presence of WPT. South of Marine Corps Base Camp Pendleton (MCBCP), USGS has examined 17 occupied sites across seven watersheds to determine the status of those populations. USGS has also investigated headstarting juvenile WPT in conjunction with nonnative aquatic species removal as a management strategy to enhance WPT in San Diego with successful results.

Recent findings show WPT remain absent from many historic locations in the MSPA which may contain suitable habitat. The recent conservation of riparian habitat under the MSCP and MHCP combined with adaptive management can provide suitable locations for restoration of WPT in San Diego. USGS, in collaboration with the San Diego Management & Monitoring Program (SDMMP), proposes to investigate sites within four watersheds as potential restoration sites and identify suitable donor populations for translocations to those sites. Once potential donor and receiver sites have been identified, USGS and SDMMP will work in collaboration with landowners to implement translocation and subsequent management and monitoring.

INTRODUCTION

Background

The western pond turtle (*Emys marmorata*, WPT) has been identified as a species of concern and in decline as early as the 1980's in southern California. In 1988, Brattstrom and Messer identified only eight populations in San Diego County and indicated that as few as five of the populations south of the Santa Clara River were reproductively viable over the long term (Brattstrom and Messer 1988). In the 1980's and 1990's, studies began to examine the status and health of the populations in southern California and San Diego County (Holland 1991; Lovich 1998), but little was known about the viability of populations south of Marine Corps Base Camp Pendleton (MCBCP; Madden-Smith, et al. 2005; Brown, et al. 2012). US Geological Survey (USGS) has since developed and implemented a monitoring and research program for WPT in the south coast ecoregion with partners from Federal, state and local governments as well as

universities and non-governmental organizations (NGO's) to determine the status and needs of WPT in San Diego County (Figure 1 and Tables 1 and 2).

In collaboration with US Forest Service (USFS), USGS began to survey for sensitive aquatic species, including WPT, on USFS lands in Orange, Riverside, Los Angeles, San Bernardino, and San Diego counties beginning in 1998. These surveys verified populations of WPT in the upper San Diego River watershed (San Diego River and Cedar and Boulder Creeks), upper San Luis Rey River Watershed (west fork) and upper Santa Margarita River watershed (Long Canyon). These populations and the known populations from Pine Valley Creek and upper San Dieguito River Watershed (Scholder Creek) indicate that some populations above water diversions and reservoirs were able to persist and successfully recruit new juveniles into the populations (Wells and Turnbull 1997; Fisher 2014). However, populations downstream from reservoirs and water diversions remained poorly understood.

USGS in collaboration with USFS, MCBCP, and CDFW has examined over 200 locations in San Diego County to assess habitat suitability for WPT and to establish WPT presence or absence (Madden-Smith et al. 2005; Brown and Fisher 2008; Schuster and Fisher 2010; Fisher et al. 2014). In support of the MSCP, USGS began surveying the MSCP region of San Diego in 2002 to assess WPT populations (Figure 1). All previously known sites and other potentially suitable sites were surveyed from 2002 through 2005 and potential threats to WPT population persistence were recorded (Tables 1 and 2). Pond turtles were observed at five locations within the MSCP region, only three of which had females (Escondido Creek, Lusardi Creek, and Sycuan Peak Ecological Reserve (SPER)) with breeding documented at only one site (SPER). However, no juveniles had been observed at SPER, indicating that the population was unable to successfully recruit individuals (produce young turtles) even though gravid females were detected.

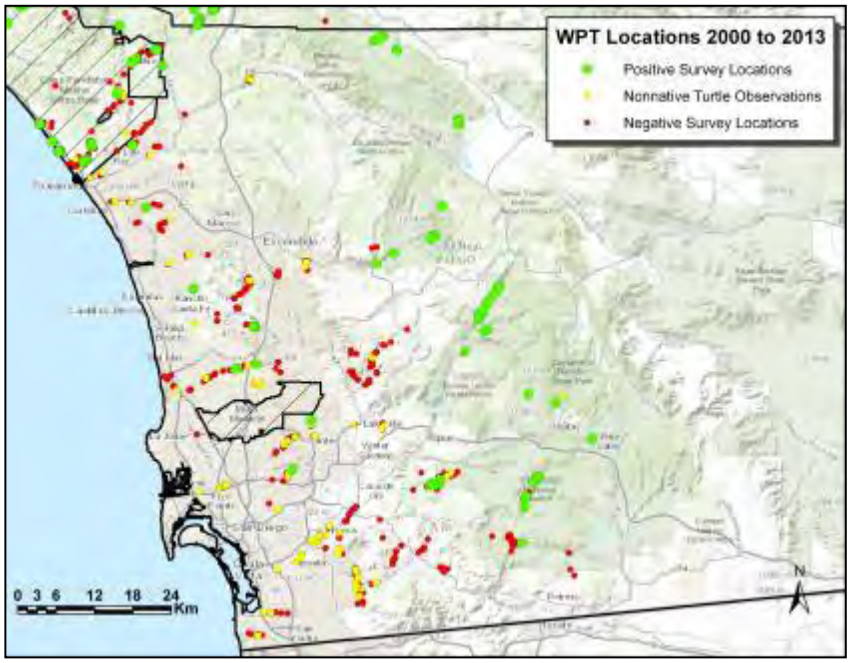

Figure 1. WPT survey locations from 2000 to 2013 including positive WPT observations (green), observations of nonnative turtles (yellow), and locations where no turtles were detected (red).

USGS began to examine possible management strategies for WPT in 2008, examining potential restoration sites that had been recently acquired and looking at ways to enhance the population at SPER. In 2010, USGS, California Department of Fish and Wildlife (CDFW), and San Diego Zoological Society (SD Zoo) initiated a program to restore and enhance the population at SPER.

Eggs were harvested from gravid WPT for headstarting at the SD Zoo and nonnative aquatic species were removed from SPER. Natural recruitment was observed subsequent to the reduction of the nonnative aquatic species, producing the first wild juvenile WPT observed in the MSCP in over 12 years. Juvenile WPT have also been successfully headstarted and released at SPER to add to this natural recruitment. This indicates that active management of a site (controlled access, removal of nonnative aquatic species, and headstarting/translocation of WPT) can help WPT to persist in the MSPA.

Table 1. Recently surveyed/verified populations of the western pond turtle (2000-2013) in San Diego County south of MCBCP by watershed including land managers and threats.

Site	Land Manager	Years Surveyed	Observations/ Pop. Estimate	American Bullfrogs	Nonnative Turtles	Nonnative Pred Fish	Roads or Residential	Recreation
San Luis Rey Watershed								
West Fork San Luis Rey	Vista Irrigation District and US Forest Service	2010, 2014	2 males, 6 females	Yes	No	No	No	No
Foss Lake	Center for Natural Lands Management	2013	2 males, 1 female	Unk	Yes	No	Both	No
Carlsbad Watershed								
Escondido Creek	Escondido Creek Conservancy	2005	2 males, 2 females	Unk	Yes	Unk	Roads	Hiking
Lake Calavera	City of Carlsbad	2014	1 male, 1 female	Yes	Yes	Yes	Both	Heavy use
San Dieguito River Watershed								
Lusardi Creek	County of San Diego	2005, 2007-8	Est. 15 (9-29) 9:1 male to female	Yes	Yes	Yes	Both	Heavy use
Lower Santa Ysabel Creek	US Forest Service and City of San Diego	2008-12	1 adult male, 1 juvenile	Yes	No	No	No	Hiking
Scholder Creek	US Forest Service	2010	4 adults	Unk	No	Unk	No	Hiking and Bathing
Los Penasquitos River Watershed								
Los Penasquitos Creek	County of San Diego and City of San Diego	2005, 2007-2008	2 males	Unk	Yes	Yes	Roads	Heavy use
Los Penasquitos ponds	City of San Diego	2005	2 males	Unk	Yes	Yes	Roads	Heavy use
San Diego River Watershed								
Upper San Diego River	US Forest Service and City of San Diego	2000, 2008-12	14 adults, 6 juveniles 7:3 males to females	Yes	No	Yes	No	No
Cedar Creek	US Forest Service	2000, 2008-12	10 adults 1:1 male to female	Yes	No	Yes	No	Hiking and Bathing
Boulder Creek	US Forest Service	2000	1 adult	Yes	No	Yes	No	No
King Creek	US Forest Service	2009	1 incidental observation	Unk	No	Unk	Both	Hiking
Sweetwater River Watershed								
Upper Sweetwater River	US Forest Service and California State Parks	2008-14	1 male	Yes	Yes	Yes	No	Hiking and Bathing
Sycuan Peak ER	California Dept. of Fish and Wildlife	2002-3, 2008-14	Est. 38 (30-81) 10:9 male to female	No*	No*	No*	No	No
Sweetwater Reservoir	Sweetwater Authority	2002	1 male	Yes	Yes*	Yes	Yes	Hiking, Biking, and Fishing
Tijuana River Watershed								
Middle Pine Valley Creek 1	US Forest Service	2010, 2013	Est. 220 (82-8607)	No	No	No	No	Hiking and bathing
Middle Pine Valley Creek 2	US Forest Service	2013	Est. 215 (106-1052)	No	No	No	No	Hiking and bathing
Barrett Reservoir	City of San Diego	2005	1 female	Yes	Yes	Yes	No	Fishing, hiking, and boating

*Current active management for nonnative species

In addition to local monitoring and management of WPT, USGS has partnered with CDFW and the Shaffer Lab (UC Davis/ UC Los Angeles) to determine the regional and watershed genetic structure of WPT in the south coast ecoregion (Fisher et al. 2014). The results of this study indicate that WPT populations can be effectively sorted by watershed. This sorting can assist with determining management priorities and suitable management actions including enhancement through headstarting or translocation from a healthy population with a similar genetic makeup. To these ends, Fisher et al. 2014 proposed genetic management units in the south coast ecoregion, with four separate management units in San Diego County south of MCBCP (Figure 2).

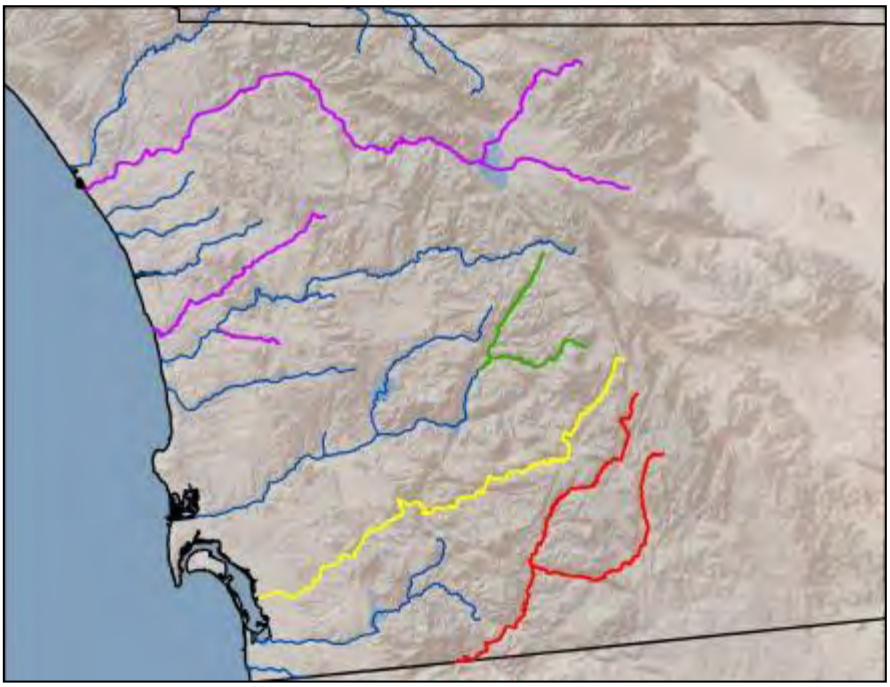

Figure 2. Proposed WPT genetic units based on Fisher, et al. 2014. San Luis Rey, Carlsbad and Lusardi watersheds in purple, upper San Diego watershed in green, Sweetwater in yellow and upper Tijuana watershed in red.

Problem Statement

The WPT has been extirpated from much of San Diego County with very few populations still remaining in the MSPA. Stephenson and Calcarone 1999 identify Pine Valley Creek as one of only two large WPT populations on the Cleveland National Forest and list the upper San Diego and San Luis Rey populations as smaller. The rarity of WPT even on USFS lands combined with the impacts of water diversions and stream alterations creates the need for management considerations on a site by site basis, particularly when threatened by prolonged drought (Stephenson and Calcarone 1999) or newly introduced species including feral pigs (Wilcox 2010).

Translocation of WPT has been identified as a means to restore this species to drainages within this region from which they have been extirpated. It can also be used to preserve genetics of distinct populations through geographic replication, for example, securing the fate of the Pine Valley genetic makeup by having reserve populations in other locations. The Management Strategic Plan for Conserved Lands in Western San Diego County (MSP) includes objectives for translocation of WPT as a strategy for restoration and conservation of WPT in San Diego County (SDMMP 2013). The Rancho Jamul Ecological Reserve's (RJER) Land Management Plan identifies ponds on RJER as suitable for translocation and management of WPT (California Department of Fish and Wildlife, 2008).

Translocation of headstarted WPT has recently been tested in San Diego County at SPER and has shown success in recruiting WPT (Brown and Fisher 2012). Such management actions may need to be done in conjunction with riparian habitat restoration consisting of the removal of nonnative aquatic species (Brattstrom and Messer 1988; Spinks et al. 2003; Madden-Smith, et al. 2005). The few other successful WPT restoration programs have detected a shift in demographics over time from a population that was entirely adults or heavily adult biased to a more even or juvenile biased population indicating successful recruitment (Spinks et al. 2003; Harmsworth Associates and B. Goodman 2006). In Orange County, translocations of WPT produced recruiting populations when the translocation site consisted of isolated ponds devoid of nonnative aquatic predators but containing suitable aquatic and upland habitat features (Harmsworth Associates and B. Goodman 2006). The recent conservation of riparian habitat under the MSCP and MHCP combined with adaptive management can provide suitable locations for restoration of WPT in San Diego County by controlling access and removing nonnative aquatic species.

Project Objectives

WPT Restoration: Rationale for translocation

WPT appear to be successfully recruiting new juveniles in only three of the locations recently surveyed for WPT habitat suitability in San Diego County outside of MCBCP, including Santa Ysabel Creek, San Diego River above El Capitan Reservoir, and Pine Valley Creek. To enhance and/or establish reserve populations of the WPT in three genetically distinct management units in San Diego County, sites will be assessed as suitable for being a donor population site or a potential translocation site. These assessments can be made following a WPT translocation plan that is based on identifying presence of WPT including all age classes and the potential to manage for threats and stressors to WPT including persistence of water in a managed system (Figure 3).

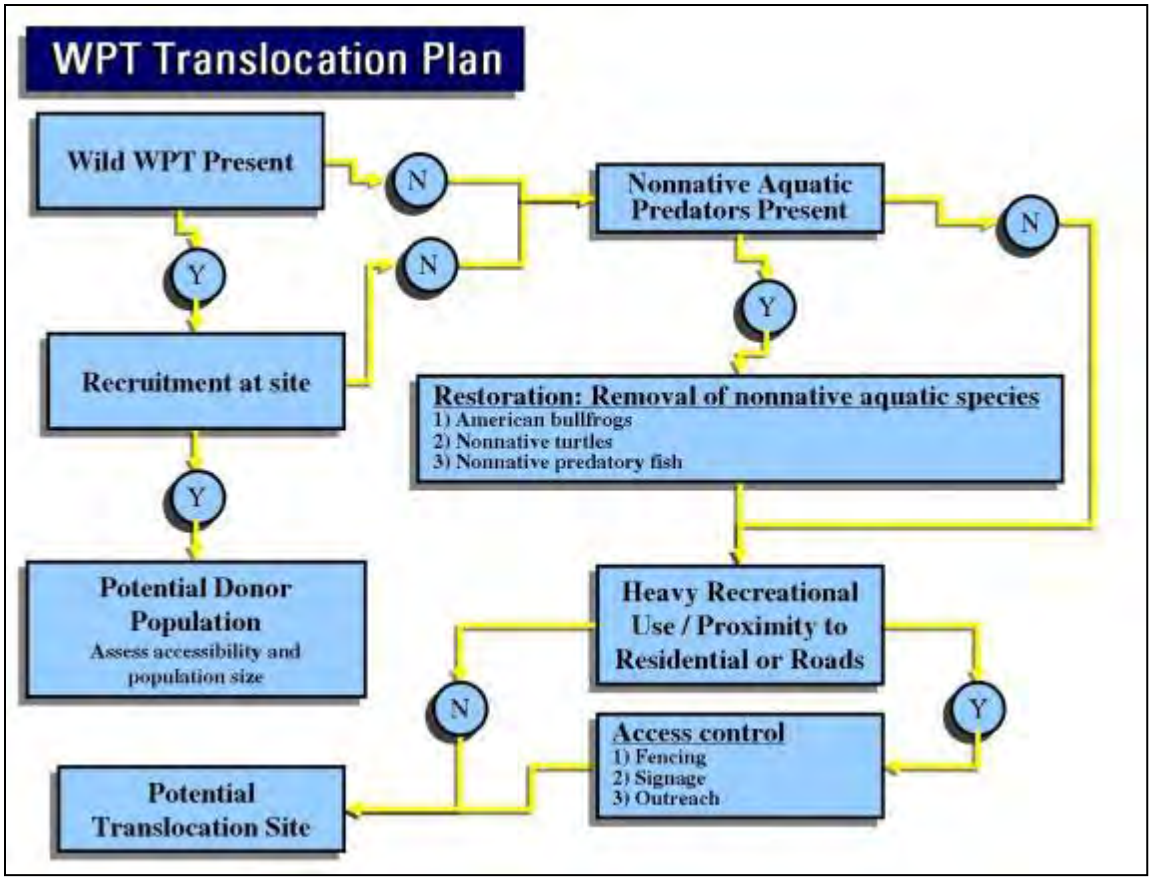

Figure 3. WPT Translocation Plan. Steps to determine suitable translocation and donor sites for the translocation of WPT.

WPT Restoration: Strategy for translocation

Following the WPT translocation plan, USGS, in collaboration with the SDMMP, will work with partners and land managers to examine potentially suitable donor populations and sites for translocation. Sites with successful wild WPT recruitment can be assessed for accessibility and population size. Sites with adequate access and populations large enough to safely harvest WPT can be considered for potential donor sites. Sites without WPT present, or with WPT that are failing to recruit, should be considered as a potential translocation site if management of the site is conducive to WPT habitation.

Once potential donor/receiver sites are identified, USGS and SDMMP will work with stakeholders and landowners/land managers to develop MOUs and obtain appropriate permits. Each set of sites will have specific threats and considerations that would require watershed specific strategies to facilitate adaptive management.

The following section presents information on the status of potential receiver sites in the Otay, San Diego, San Dieguito and Sweetwater Rivers. Three of these watersheds are examined in further detail with identification of potential donor sites.

Table 2. Recently surveyed sites without western pond turtles in San Diego County south of MCBCP by watershed that are potentially suitable and should be assessed for translocation. Known water source management and threats are indicated for each site.

Site	Land Manager	Water source and mgmt.***	Years Surveyed	Nearest WPT Population	American Bullfrogs	Nonnative Turtles	Nonnative Pred Fish	Roads or Residential	Recreation
San Dieguito River Watershed									
Boden Canyon	California Dept. of Fish and Wildlife	R, E/C, S	2008-2011	Scholder and Santa Ysabel Creeks	Yes	No	No	No	Hiking and hunting
San Dieguito River below Lake Hodges	San Dieguito River Park	R, U, S, C	2013**	Scholder and Santa Ysabel Creeks	Yes*	Yes*	Yes	Roads	Hiking
San Diego River Watershed									
Boulder Oaks Ponds	County of San Diego	R, E	2007-2008	Upper San Diego River	Yes	No	No	No	None
Sweetwater River Watershed									
Sweetwater River Refuge Ponds	US Fish and Wildlife Service	R, I	2003	Sycuan Peak ER	Unk	Yes	Yes	No	None
Rickey Ponds	Otay Water District	I, E	2009	Sycuan Peak ER	Yes	Yes	Yes	Limited access road	Limited recreation off site
Otay River Watershed									
Proctor Valley Pond	California Dept. of Fish and Wildlife	R, E	2012	Pine Valley Creek	No	No	No	Residential nearby	Hiking and bathing
Willow (Wildlife) Pond	California Dept. of Fish and Wildlife	I, E	2000-2, 2011-2	Pine Valley Creek	Few*	No	No*	Road off site	None
Jamul Creek (between Kiln and Dulzura Creek)	California Dept. of Fish and Wildlife	R, I, S /	2000-2, 2014	Pine Valley Creek	Few	No	No	No	None
Pringle Creek	County of San Diego	R, S	2003	Pine Valley Creek	Unk	No	No	Road off site	Unk

*Current active management for nonnative species

**San Dieguito River surveys conducted by SDRVP and SDNHM

***Water source and management categories: R (natural runoff or spring fed), I (imported/pumped in), U (urban runoff), S (natural streambed), C (concrete/rock dam), E (earthen berm)

1. Otay and Tijuana River Watershed

WPT populations have been extirpated from the Otay River watershed. For restoring WPT to the Otay River watershed, a potential donor population with the same genetic makeup has been identified at Pine Valley Creek upstream from Barrett Reservoir.

Two reaches of Pine Valley Creek upstream from Horsethief Canyon have relatively easy access and WPT are present. These reaches had large numbers of WPT in 1997 (Brattstrom and Messer 1998; Wells and Turnbull 1997). These reaches were surveyed by USGS in 2013 and found to have approximately 215-220 WPT per reach yielding approximately 100 WPT per kilometer (Attachment 1). Based on our estimates, 20 WPT can be harvested from these reaches while staying well within the 5% harvest rate for the population which has been used elsewhere as a model for sustainable harvest (Heppell et al. 1995). WPT have also been observed in Barrett Reservoir downstream from these reaches, making it a suitable donor site as well (Madden-Smith et al. 2005).

Potential translocation sites have been identified within the Otay River watershed, but not all potential receiver sites have been fully evaluated. RJER potential WPT habitat has been impacted historically but is now being managed for native species including restoration of riparian habitat, much of which has been previously identified as suitable for WPT translocations (Figures 4 and 5; Brattstrom and Messer 1998; CDFW). Pringle Creek along the Lawrence and Barbara Daley Preserve (LBDP) is another location now managed for native species conservation that was identified as suitable for WPT (Figure 6; Madden-Smith et al. 2005) but needs to be surveyed for native and nonnative aquatic species.

A. Rancho Jamul Ecological Reserve. RJER contains a large amount of potential WPT habitat where current management favors conservation and restoration. Jamul Creek was surveyed from Dulzura Creek to Highway 94 on June 25th, 2014 (Figure 4) utilizing the USGS Stream Survey protocols (USGS 2006c) in order to locate all potentially suitable WPT habitat and to identify additional sources of nonnative aquatic species. Even with record low rainfall, nearly two kilometers of surface water were observed with pools sufficiently deep for WPT foraging (Figure 5). Additionally, the Sump/Pump Pond and Bedrock Pond (newly named pond surveyed and trapped for nonnative aquatic species; Figure 4 and Table 3) contained a large amount of water and suitable structure for both foraging and basking.

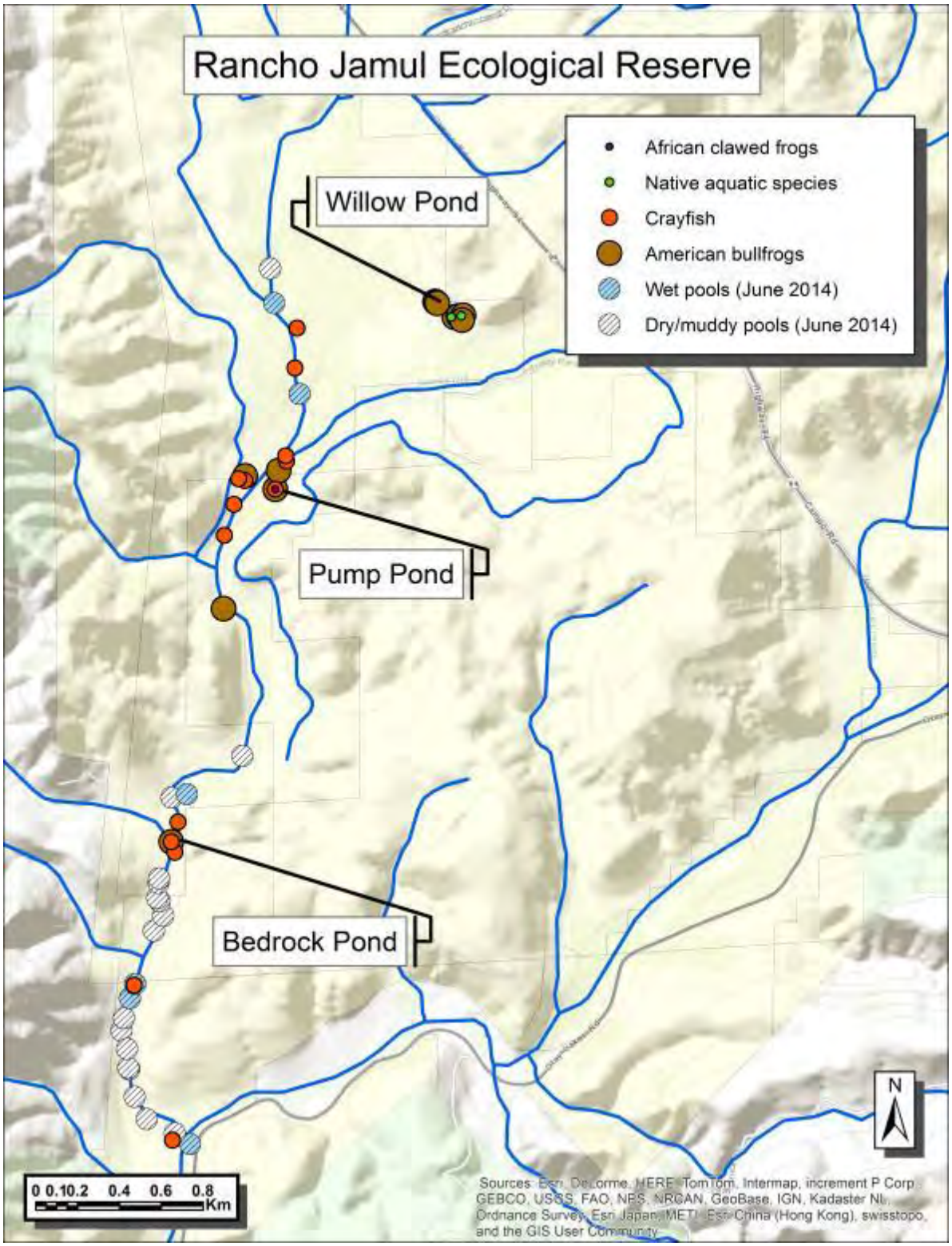

Figure 4. Aquatic surveys at RJER. Presence of native and nonnative aquatic species 2010 to present, as well as pool conditions along Jamul Creek (wet vs dry) for June 2014 where aquatic species were not detected. These pools would be potential WPT habitat during wetter years.

A.  B.  C. 

Figure 5. Photographs of potential WPT habitat at RJER. A. Jamul Creek, B. Bedrock Pond, and C. Pump Pond (from Google Earth).

Site assessment/preparation. In addition to habitat suitability surveys, nonnative aquatic species management has focused on removal of crayfish, American bullfrogs, and African clawed frogs (Table 3). A total of 479 African clawed frogs, 48 American bullfrogs, and 680 crayfish have been removed in recent efforts utilizing seine nets, hand capture, traps, and airguns. USGS will continue to control nonnative aquatic species at RJER through the dry season in preparation for and in support of WPT translocation. As many as 10 adult WPT would be moved initially to each of two locations; the Pump and Bedrock ponds. Significant progress has been made for nonnative aquatic species control at these sites and they are ready to receive WPT now. As the translocated WPT would be adults or large juveniles, predation by any remaining American bullfrogs would not be a concern. Efforts to remove remaining American bullfrogs would continue through the winter to eliminate potential effects to WPT recruitment.

Table 3. Nonnative species removed at RJER 2011 through July, 2014.

	Bedrock Pond 2014*	Pump Pond 2014*	Willow Pond 2011-2012
African clawed frog			479
American bullfrog	3	26	19
Crayfish	666	14	

*Nonnative species management is continuing, actual numbers will be higher than at the time of this reporting.

Monitoring and management needs. Telemetry of WPT can be used initially to track the success of the translocation by monitoring site fidelity, movement, and basking behaviors. Periodic trapping of turtles in connection with transmitter replacement can be used to assess health and reproductive status as well as detection of ongoing recruitment at the site. The amount of effort for telemetry is dependent on WPT activity at the site. Recent telemetry of WPT in San Diego County indicates movements of translocated WPT to be much less than the 250m stream reaches, requiring less effort for monitoring than other species. Harmsworth Associates and B. Goodman 2006 also indicate that translocated WPT in Orange County have good site fidelity in general, requiring minimal monitoring.

Management for nonnative aquatic species can focus on detecting and removing large, breeding adults early in the season prior to egg laying using manual capture, gigs, and airguns. Periodic trapping of crayfish and African clawed frogs using low cost crayfish traps could be conducted in connection with WPT monitoring telemetry visits. Specific and concentrated efforts for control of nonnatives in this manner has shown effective at Sycuan Peak ER for recruitment of WPT and at Willow Pond and West Fork of the San Luis Rey River for increasing activity of native aquatic species including western toads, two-striped garter snakes, and pacific treefrogs.

A sample monitoring and management schedule may include:

a. Monitoring: approximately 168-180 hours/year
b. Trapping (transmitter replacement, health check, reproductive status): approximately 80 hours/year
c. Nonnatives control: approximately 160 hours per year (much of this can be done at the same time as the monitoring)

Success criteria. Success criteria would include translocated WPT establishing site fidelity within the first year, attempting to breed within three years, and natural recruitment occurring within five years. 1. Establishment of site fidelity within the first season of translocation, allowing translocated WPT to move up and down the stream and into the upland and back as they take some time to settle. 2. Attempted breeding within three years (detection of gravid females). 3. Natural recruitment detected within five years (juveniles are much more detectable at 1-2 years old, requiring less survey effort and less disturbance at the site).

B. Lawrence and Barbara Daley Preserve.

LBDP contains a reach of Pringle Creek that had been identified by Madden-Smith et al 2005 as a potential WPT translocation site.

Site assessment/preparation. Habitat suitability surveys would be conducted following established USGS stream survey protocols.

Monitoring and management needs. Telemetry of WPT can be used initially to track the success of the translocation by monitoring site fidelity, movement, and basking behaviors. Periodic trapping of turtles in connection with transmitter replacement can be used to assess health and reproductive status as well as detection of ongoing recruitment at the site. The amount of effort for telemetry is dependent on WPT activity at the site. Recent telemetry of WPT in San Diego County indicates movements of translocated WPT to be much less than the 250m stream reaches, requiring less effort for monitoring than other species. Harmsworth Associates and B. Goodman 2006 also indicate that translocated WPT in Orange County have good site fidelity in general, requiring minimal monitoring.

Figure 6. Potential WPT translocation site at Lawrence and Barbara Daley Preserve, San Diego County DPR.

A sample monitoring and management schedule may include:
a. Monitoring: approximately 168-180 hours/year
b. Trapping (transmitter replacement, health check, reproductive status): approximately 80 hours/year

Success criteria. Success criteria would include translocated WPT establishing site fidelity within the first year, attempting to breed within three years, and natural recruitment occurring within five years. 1. Establishment of site fidelity within the first season of translocation, allowing translocated WPT to move up and down the stream and into the upland and back as they take some time to settle. 2. Attempted breeding within three years (detection of gravid females). 3. Natural recruitment detected within five years (juveniles are much more detectable at 1-2 years old, requiring less survey effort and less disturbance at the site).

2. San Diego River Watershed

For restoring WPT to the San Diego River watershed below El Capitan Reservoir, potential donor populations have been identified along San Diego River upstream of El Capitan Reservoir. Potential donor locations exist on USFS, City of San Diego and private properties.

WPT have been observed during USGS visual encounter surveys in San Diego River above El Capitan Reservoir and Cedar and Boulder Creeks. Potential access points exist along Eagle Peak Road and Cedar Creek Road. While WPT have been observed, population estimate surveys following the methods used in Pine Valley Creek will be conducted to determine a suitable harvest rate from these locations.

A suitable translocation location site has been identified in the San Vicente Creek watershed at the Boulder Oaks Preserve (Figure 6; Brown and Fisher 2008).
Telemetry surveys of released/translocated WPT will be used to monitor settlement (site fidelity) and health of translocated individuals.

A. Boulder Oaks Preserve. Boulder Oaks Preserve is now managed by San Diego County Department of Parks and Recreation (DPR) and contains two large ponds that have potential for WPT translocation. In 2007, USGS surveyed one of the ponds and found large numbers of American bullfrogs with a nearby pond which could act as a source population for the pond that was surveyed (Brown and Fisher 2008). DPR has recently acquired the second pond which makes management for the nonnative American bullfrog much more feasible.

Figure 7. Potential WPT translocation sites at Boulder Oaks Preserve, San Diego County DPR.

3. San Dieguito River Watershed

For restoring WPT to the San Dieguito River below Pamo Valley, potential donor populations have been identified at Scholder and upper Santa Ysabel Creeks. Current conservation and management of the San Dieguito River Watershed provides opportunities for

reintroduction of WPT to Boden Canyon and the San Dieguito River Park. Below Lake Hodges, reaches of the San Dieguito River were recently cleared of nonnative turtles which had inhabited the drainage for several years. Partners include California Department of Fish and Wildlife, San Diego Museum of Natural History, San Dieguito River Park, and City of San Diego.

Telemetry surveys of released/translocated WPT will be used to monitor settlement (site fidelity) and health of translocated individuals.

Past Studies

Brattstrom and Messer 1998 identified Jamul Creek and several ponds within the current footprints of RJER and Hollenbeck Canyon Wildlife Area (HCWA) as sites suitable for restoration and translocation of WPT (Brattstrom and Messer 1988). This study also indicated the Pine Valley population to be one of the three largest WPT populations in San Diego County. Madden-Smith et al. 2005 examined 79 sites within the MSCP identifying only 6 sites with WPT, and only 4 of those had more than one WPT. Madden-Smith et al. 2005 also indicated locations that contain suitable habitat that are now within conserved lands footprints that have no WPT but are potential translocation sites.

Successful WPT restoration programs have detected a shift in the demographics over time from a population that was entirely adults or heavily adult biased to a more even or juvenile biased population indicating successful recruitment (Spinks et al. 2003; Harmsworth Associates and B. Goodman 2006). These studies have used site restoration in combination with translocations to enhance or create recruiting populations of WPT. In Orange County, Harmsworth Associates and B. Goodman translocated adult and juvenile WPT to created and restored ponds. The translocated WPT increased in size and weight and were recruiting new juveniles into the population within the first two years (Harmsworth Associates and B. Goodman 2006).

The WPT restoration program at SPER illustrates how combining active management with translocation (in this case, headstarting) can greatly enhance a population that has been historically impacted by human activities and nonnative aquatic species (Brown et al. 2012; Brown and Fisher 2014).

Environmental Planning (permits)
Translocation of WPT in San Diego County would require a collection permit from the wildlife agency (CDFW) as well as special use and access permits from the landowners of both receiver and donor sites. These permits insure that appropriate steps are being followed throughout the translocation.

- USFS Special Use Permit: USFS special use permits are required to survey for and collect WPT on USFS properties. In this study, the potential donor locations of upper San Diego River and Pine Valley Creek are on USFS property and would be included in the SUP.

- Site Access permits: Site access permits would be required by the landowners of non-USFS receiver and donor sites. Potential receiver sites that would require site access permits include Boden Canyon and RJER (CDFW), Boulder Oaks and Pringle Creek (County of San Diego) and San Dieguito River Park (SDRP). San Diego River immediately upstream from El Capitan Reservoir is a potential donor location on City of San Diego property.

- Scientific Collecting Permit. For any actions involving the handling or capture of the WPT, a state Scientific Collecting Permit is required from California Department of Fish and Wildlife.

STUDY PLAN

For restoring WPT to the three watersheds, potential translocation sites and donor populations with suitable genetic makeup will be identified and assessed. Each potential donor population will be surveyed to determine distribution, total number, age class structure, and sex ratio.

Following the population assessment at the potential donor site, a harvest rate can be determined for translocation to not exceed 5% of the donor population should the donor site show even sex ratios and evidence of successful recruitment (Tuberville 2008).

Telemetry surveys of released/translocated WPT will be used to monitor settlement (site fidelity) and health of translocated individuals. Translocated WPT will be monitored for weight gain/loss and evidence of breeding which have been identified as indicators of successful population establishment and enhancement (Harmsworth Associates and B. Goodman 2006; Vander Haegen et al. 2009).

Methods

1. Translocation Site Assessment

Visual encounter surveys will be conducted following established USGS protocols (USGS 2006a, 2006b, 2006c). Presence of native and nonnative aquatic reptiles, amphibians, and fish will recorded in conjunction with habitat covariates indicative of suitability for pond turtles. Assessments and prioritization will be based on amount and quality of suitable habitat and potential for restoration and management.

2. Donor Site Assessment

Potential donor sites will first be assessed for access and the ability to transport WPT safely from the site prior to conducting population assessment surveys. Population assessment surveys will be conducted to determine if the population is not only large enough but contains sufficient numbers of juveniles and both sexes to support harvest. Mark-recapture surveys will be conducted in predefined reaches of the site to develop minimum estimates for the population. Only sites which are successfully recruiting will be considered as donor sites.

WPT will be captured utilizing hand capture, dip nets, and seines following established USGS protocols (USGS 2006a, 2006b, 2006c). Each WPT captured will be measured, weighed, and sex determined based on morphological traits (Holland 1991). Measurements will include carapace length, carapace width, carapace height, and plastron length and will be used to assess health. General health condition and number of annuli will also be recorded; any indications of illness or injury will be recorded. WPT will be checked for tags or tagged with an Avid® radio-frequency identification (RFID) microchip (encoded with a unique identification number). The microchips will be inserted inside the body cavity anterior to the right rear leg following methods of Buhlmann and Tuberville (1998) and a triangular notch will be made with a small triangular file

on the femoral scute to indicate that the individual was tagged to assist in future recognition of the individual.

3. Western Pond Turtle Translocation

Multiple translocation trips for as many WPT per trip as feasible will be conducted for each site. Handling and transport time will be kept sufficiently short to minimize stress to the WPT. Captured WPT will be assessed for health prior to removal; examining weight, skin, eyes, nares and cloaca for any indications of poor health and will be coordinated with SD Zoo herpetological staff. Only healthy turtles from naturally recruiting locations will be translocated in order to minimize the potential for disease transmission. Turtles will be aged and sexed in order to select an even sex ratio and a ratio of adults to subadults of approximately 7:3 to facilitate territory establishment at the receiver site (T. Owens, pers com.).

WPT will be transported in sterile, insulated, dry containers to the release site. Temperature sensitive radio transmitters will be attached to the rear scutes of the carapace using silicone and epoxy. Radios will use approved frequencies and will not exceed 5% of the body weight (including glue, antennae, and batteries). Prior to release, a small (approximately 3-5mm) tail-tip tissue sample of each WPT will be collected and stored in 95% ethanol for genetic assessment. WPT will be hand released at the receiver site at nearby but separate locations to allow them to acclimate to the site.

Monitoring will occur daily until activity patterns and territories are established and on site radio checks will be phased to bi-weekly monitoring. Water, air, and radio temperatures will be logged to determine habitat use and basking preferences. Translocated WPT will be monitored semiannually to assess general health, growth, and reproductive status and activity.
Nonnatives removal maintenance will involve periodic surveys to capture/remove adult bullfrogs (*Lithobates catesbeianus*) and crayfish (*Procambarus* sp.) following the visual encounter survey protocols (USGS 2006a, 2006b, 2006c).

Staffing
Robert Fisher, USGS
Chris Brown, USGS
Denise Clark, USGS
Tommy Owens, SD Zoo

TASKS, ORGANIZATION, AND SCHEDULE

TASKS	RESPONSIBLE PARTY	DATE
Population assessment of potential donor sites	USGS	April 2014
Identification of potential translocation sites	USGS	April 2014
Nonnatives assessment/removal at translocation site	USGS	April 2014
Harvest of WPT from donor site	USGS	April 2014
Health checks	SD Zoo	April 2014
Attachment of Transmitters	USGS/SD Zoo	April 2014
Release of WPT to Translocation site	USGS	April 2014
Monitoring of WPT at Translocation site	USGS	April 2014-April 2016

DELIVERABLES

Turtle translocations would be coordinated closely with CDFW, USFS, SD Zoo, and USGS taking into consideration regional genetics and health of nearby populations in adjacent watersheds. Translocations would include monitoring of pond turtles utilizing telemetry to determine activity and health of individual turtles. Semiannual reports on status of translocations will be provided to the partners and management agencies.

BUDGET

Task	Description	Cost
1	Task 1 description	$x,xxx
2	Task 2 description	$x,xxx
3	Task 3 description	$x,xxx
4	Task 4 description	$x,xxx
5	Task 5 description	$x,xxx
	Total	**$xx,xxx**

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ATTACHMENT 1: Draft Population Estimates for WPT in Pine Valley, 2013

Carlton Rochester, Stacie Hathaway, Chris Brown, and Robert Fisher

DRAFT FOR REVIEW

Population Estimates for Western Pond Turtles in Pine Valley, 2013

The USGS is working to estimate the numbers of Western pond turtles (WPT) in Pine Valley Creek (PVC) within the Pine Valley Wilderness Area (USFS) to assess the potential for the translocation of WPT from this site to the restored Wildlife Pond (WP) at Rancho Jamul Ecological Reserve owned by California Department of Fish and Wildlife. The Pine Valley population of WPT has been considered one of the three largest populations in San Diego County since the 1980's and was discussed specifically in the 1988 Report back to, then, California Department of Fish and Wildlife of the study done by Brattstrom and Messer (Contract C-2044). Wells and Turnbull in 1997 surveyed Pine Valley for sensitive birds, reptiles and amphibians finding large numbers of WPT detecting adults, subadults and juveniles. No estimate of the size of this population has been conducted and this study is the first to develop minimum estimates for this population.

Background: WPT are restricted in the Tijuana Watershed in the United States to tributaries of Cottonwood Creek above and including Barrett Reservoir. The USGS has done extensive surveys downstream of Barrett Reservoir over a decade without recording any pond turtles. The USGS has also conducted extensive surveys throughout the Otay Watershed without detecting any WPT. This proposal is to move 20 turtles (10 males and 10 females) that would be harvested from PVC (Tijuana Watershed) during 2014 to WP (Otay Watershed) to begin to restore populations of pond turtles in the MSCP. The USGS has conducted genetic assessments of pond turtles throughout southern California, and the PVC turtles are unique and genetically differentiated from the pond turtles in the next watershed to the north, Sweetwater River, at Sycuan Peak Ecological Reserve (SPER). Independent of the PVC project, population enhancement took place at SPER in 2013 through the release of head-started WPT that were previously harvested as eggs from SPER.

Scope and Assessment: Initiated in April 2013, we conducted at total of 7 WPT surveys within PVC to determine population estimates. We have divided the site into two reaches, PVC Lower and PVC Upper (Figure 1) and these two combined sites represent approximately 20% of the available habitat in PVC. For PVC Lower we have conducted three field surveys where we have captured and PIT-tagged pond turtles this year. Four field surveys were done this year in the upper portion. We have conducted Schnabel estimates for population size of each of these sites separately and included multiple visits into the estimates.

Results: These surveys resulted in 158 observations of WPT, which include minimally 98 individuals, 82 of which were individually marked. We estimate that the PVC Lower site contains 220 pond turtles (95% limit: lower 82, upper 8607) and that the PVC Upper site contains 215 WPT (95% limit: lower 106, upper 1052). Thus our estimate for the 20% of the PVC habitat that has been surveyed for WPT is 435 individuals. These estimates do not include 10 individuals that were captured but not PIT-tagged as they were too small, but are a good proportion of the population at PVC (Figure 2). We are proposing a harvest rate of <5% of the

estimated population for 2013 to move to WP, which is 10 individuals from the PVC Upper and 10 individuals from the PVC Lower sites.

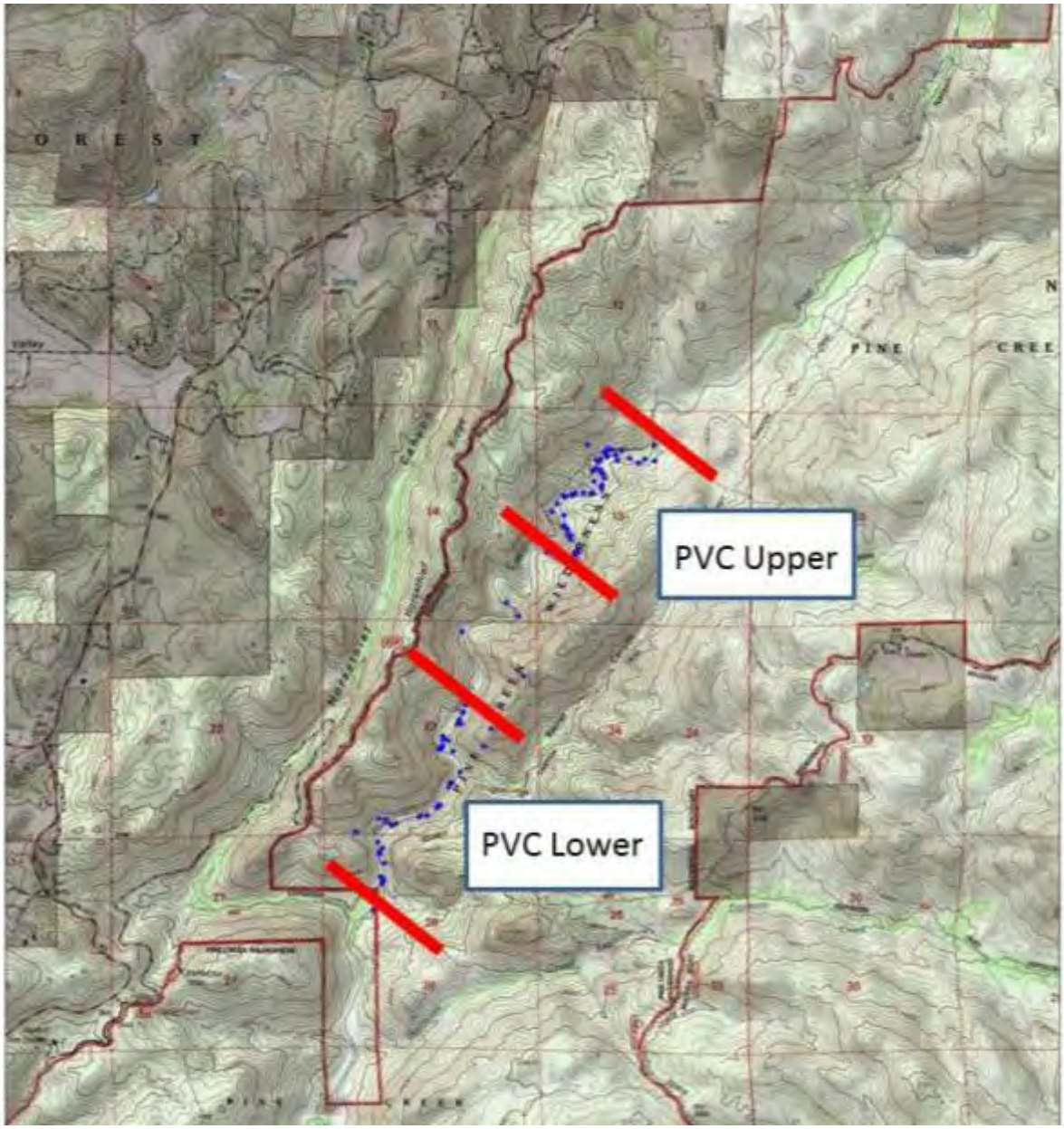

Figure 1. Map of study sites at Pine Valley Creek for 2013 population estimates and proposed harvesting.

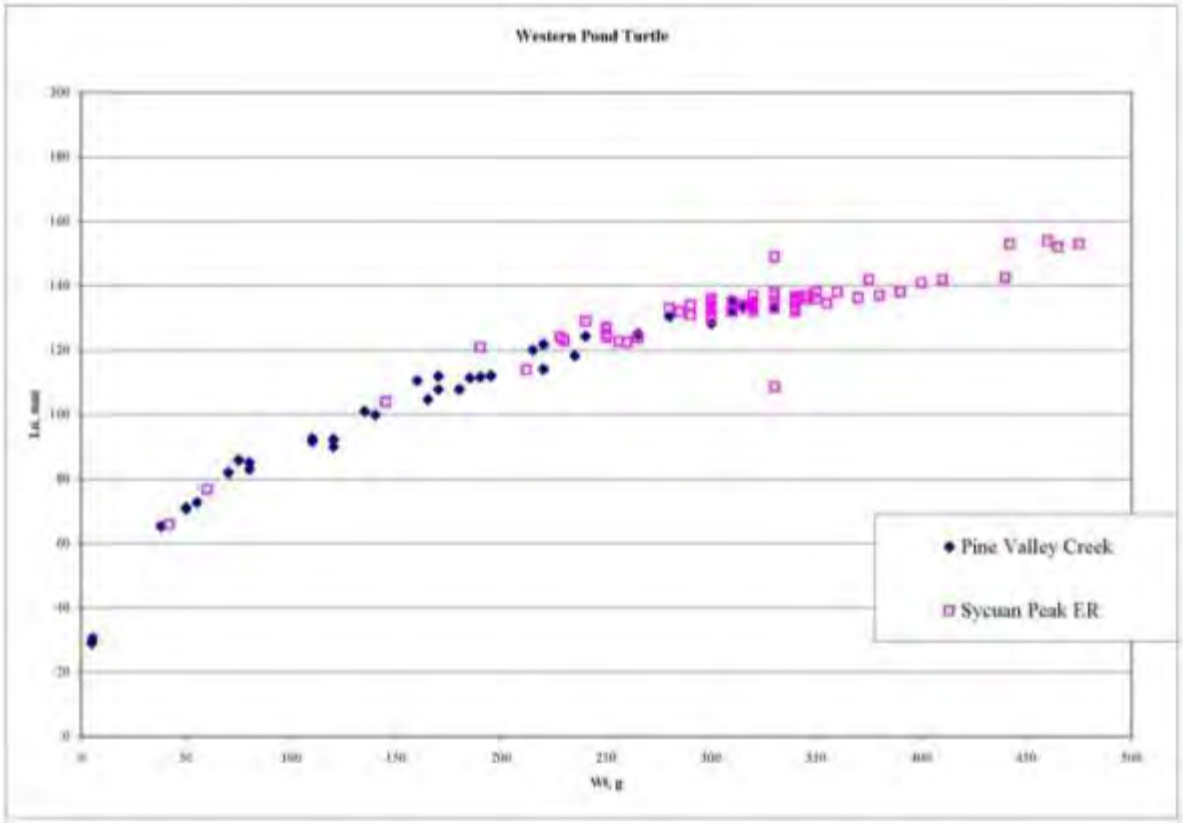

Figure 2. Body size and weight relationships for Pine Valley Creek turtles compared to SPER turtles. Small turtles at PVC are not part of the population estimates, only adults were PIT-tagged and considered in the estimations. The three smallest turtles (under 150 grams) at SPER were all observed post-restoration.

Appendix B: Long Term Western Pond Turtle Monitoring and Management Plan for Sycuan Peak Ecological Reserve

Long Term Western Pond Turtle Monitoring and Management Plan for Sycuan Peak Ecological Reserve

Introduction

In 2009 the U.S. Geological Survey (USGS) began removing nonnative species from Sycuan Peak Ecological Reserve (SPER) with the goal of restoring the aquatic habitat for western pond turtles (*Emys marmorata*; hereafter referred to as pond turtle) and stimulating recruitment. Nonnative aquatic species removed include American bullfrogs (*Lithobates catesbeianus*), African clawed frogs (*Xenopus laevis*), sunfish (*Lepomis* spp.), largemouth bass (*Micropterus salmoides*), and crayfish (*Procambarus* spp.). In connection with the nonnatives removal, eggs were harvested from gravid female pond turtles to establish a captive rearing program at the San Diego Zoo to head-start pond turtles for reintroduction to the Sweetwater River (Brown et al. 2012).

Following the nonnatives removal, the pond turtle population was monitored to determine if there were any initial beneficial effects of the removal of nonnative aquatic species. Five wild hatched juvenile pond turtles were detected at SPER, one juvenile first detected on 25 June 2010, a second juvenile detected on 15 July 2011, a third juvenile detected on 24 September 2013 and two juveniles detected on 29 April 2014. These were the first detections of successful recruitment of this species in the MSCP in over a decade. Recolonization by nonnatives was also monitored and compared with the different seasonal water discharge events that can occur at SPER. The type, timing, and amount of effort required for maintenance of nonnatives reduction depends on the type of water discharge (intentional water release or natural overtopping of Loveland Reservoir) for that year.

This document outlines a course of action for continued monitoring and management of pond turtles at SPER with the goal of maintaining or increasing population size and recruitment.

Pond Turtle Monitoring

Based on recent monitoring (2002-2008) resulting in no detections of natural recruitment, success of the recent (2009-2011) nonnatives maintenance was determined by the detection of natural recruitment (defined as the presence of younger age classes) in the population of pond turtles at SPER. Turtle surveys utilizing visual encounter surveys, baited hoop traps, and camera stations can all detect juvenile pond turtles.

During the warm summer and early fall months, visual encounter surveys can be used to quickly determine if younger turtles are present at the site and if nonnatives have re-invaded. These surveys are also used to gather information on habitat, weather, water conditions, and disturbance in addition to the presence of aquatic species. In addition, visual encounter surveys can be used to determine whether the seasonal conditions provide adequate basking habitat for camera stations or if baited trapping is required or if a combination of the two methods is most suitable (i.e., one pool may have large, sunny areas for basking and another pool may not). Prior

to setting baited hoop traps or camera stations, visual encounter surveys should be conducted to determine optimal placement of traps or cameras.

Baited hoop traps at SPER have yielded capture rates of 0.001 to 0.006 pond turtles per trap hour with the highest capture rates in August and September. Because of the variable capture rates of baited hoop traps, this method should be applied at minimum in two one week sample periods at least one week apart in the late summer or early fall. Resulting in direct capture of individuals, this method allows for positive identification and accurate assessment of age, sex, and growth of individual turtles. Figure 1 and Table 1 include data on the pools and trapping locations at SPER.

Camera stations positioned on potential basking areas increases detectability of pond turtles by photographing individuals that may not be entering traps or may be able to easily escape from traps (i.e., very young juveniles and hatchlings). In August of 2011, camera stations successfully detected a basking juvenile pond turtle three weeks before being captured in a baited hoop trap. Camera stations can run continuously for five weeks (being checked regularly) for the same cost in labor as one week of trapping. However, with no individual being captured, this method does not allow for accurate individual identification or precise age assessment. Figure 2 and Table 2 provide a conceptual model and overview of pond turtle monitoring, respectively.

Nonnative Aquatic Species

Initial results illustrate that nonnatives control at SPER has direct benefits for the pond turtle and can be a successful strategy to restore the species in the reserve. The five juvenile pond turtles observed during the post nonnatives removal surveys were the first signs of successful recruitment of the species in the MSCP region in over a decade.

The different water management strategies along the Sweetwater River affect the success of the nonnatives removal over time. Water that is intentionally released or allowed to overtop from Loveland Reservoir provides connectivity between SPER and off site pools and allows nonnatives to spread throughout the system. In years where water flows from Loveland Reservoir, periodic maintenance of nonnatives at the main pools at SPER will be necessary to allow the wild recruitment to persist.

Nonnatives removal following overtopping events associated with high rainfall years should begin after discharge from Loveland Reservoir terminates. Two one week surveys consisting of trapping, visual encounter, seine, and dipnet methods in the spring and early summer will capture adults potentially before breeding. Two one week surveys consisting of trapping and visual encounter methods in the fall when water levels are lowest will capture residual adults and juveniles.

Nonnatives removal following wintertime water releases should focus on American bullfrogs with visual encounter surveys as early as March or April before any dispersing bullfrogs have an opportunity to breed. In addition, two one week surveys consisting of trapping and visual encounter methods in the late summer and fall appear to be effective at removing any maturing aquatic nonnatives that dispersed into the site during the water release. Figure 3 and Table 3 provide a conceptual model for nonnative aquatic species and disturbances and an overview of

management actions at SPER, respectively.

Nonnative Vegetation

Nonnative vegetation such as giant reed (*Arundo donax*) can alter the streambed of the site by filling in pools and reducing water availability which impacts turtle habitat. While not present in much of SPER, some small stands of giant reed exist downstream of the main turtle pools. These stands of giant reed should be monitored as removal of these stands may expand the available habitat for the pond turtles.

Pond Turtle Headstarting

During the 2009 and 2010 trapping surveys at SPER, San Diego Zoo staff assisted with pond turtle monitoring and capture of gravid female pond turtles. Gravid females were taken to the San Diego Zoo and kept until eggs were laid, then returned to the site. The San Diego Zoo staff then incubated and hatched the eggs; juveniles were raised in isolated enclosures. Two females laid eggs in 2009; only one clutch was fertile producing five hatchlings. In 2010, three females produced three fertile clutches producing five additional hatchlings. The hatchlings were raised off exhibit at the San Diego Zoo until large enough for release. This component of the program was paid for by the San Diego Zoo and its employee contributions program.

One set of head-started pond turtles was ready to be released in 2013 and the other in 2014. The head-started turtles were monitored by telemetry, motion cameras, and visual surveys after release. All ten headstarted pond turtles remained on site for the duration of the monitoring effort, increasing the population size by nearly 30%.

Head-starting of pond turtles can be productive when needed, however it is slow and costly. The 10 pond turtles head-started at the San Diego Zoo for SPER came from four females during two years. The ability to produce large numbers of headstarted juveniles is limited by the current population size and the relatively low clutch sizes. If nonnative species management is not working, head-starting is an acceptable management action.

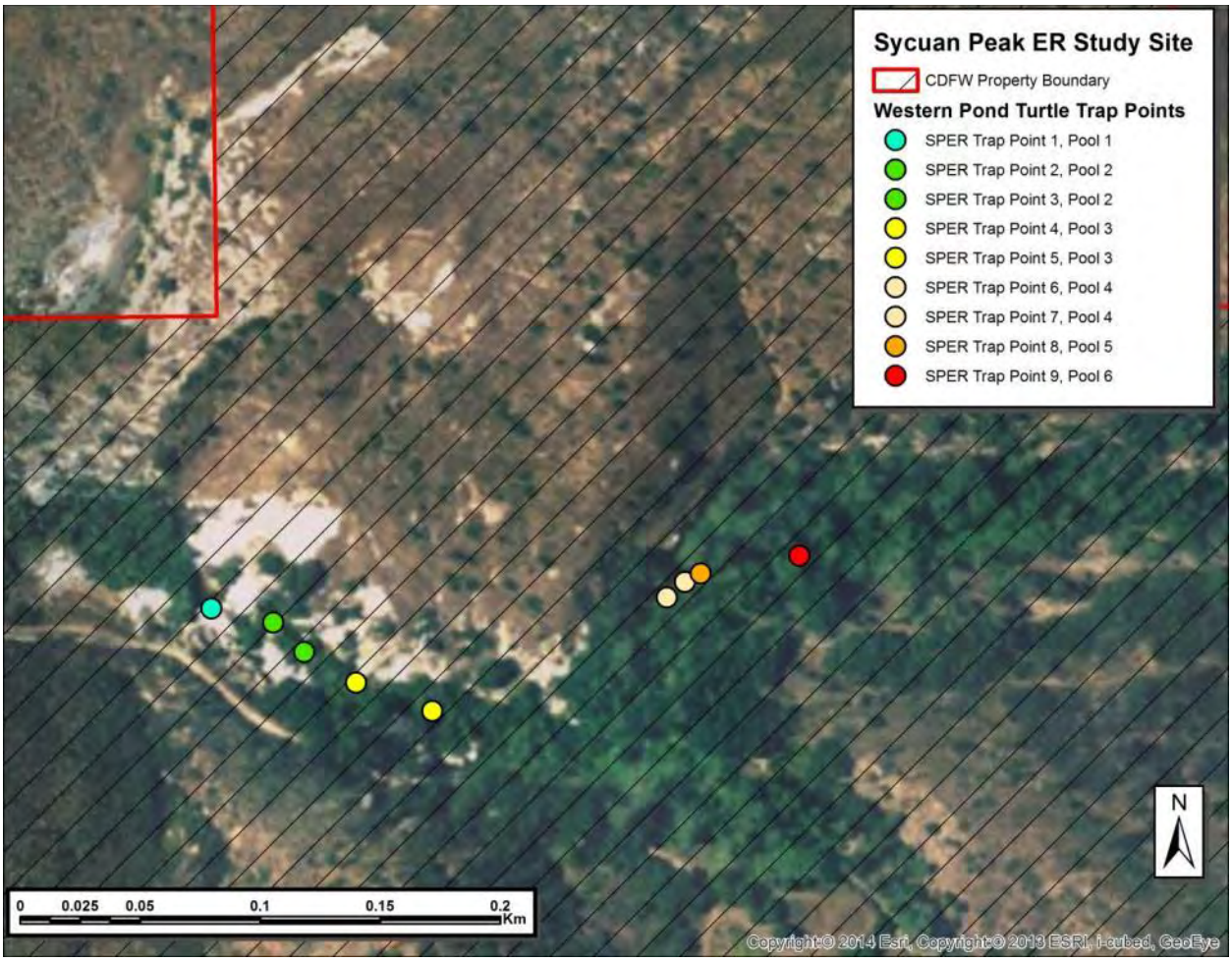

Figure 1. Map of specific pools and trapping points at SPER for pond turtle monitoring and management actions.

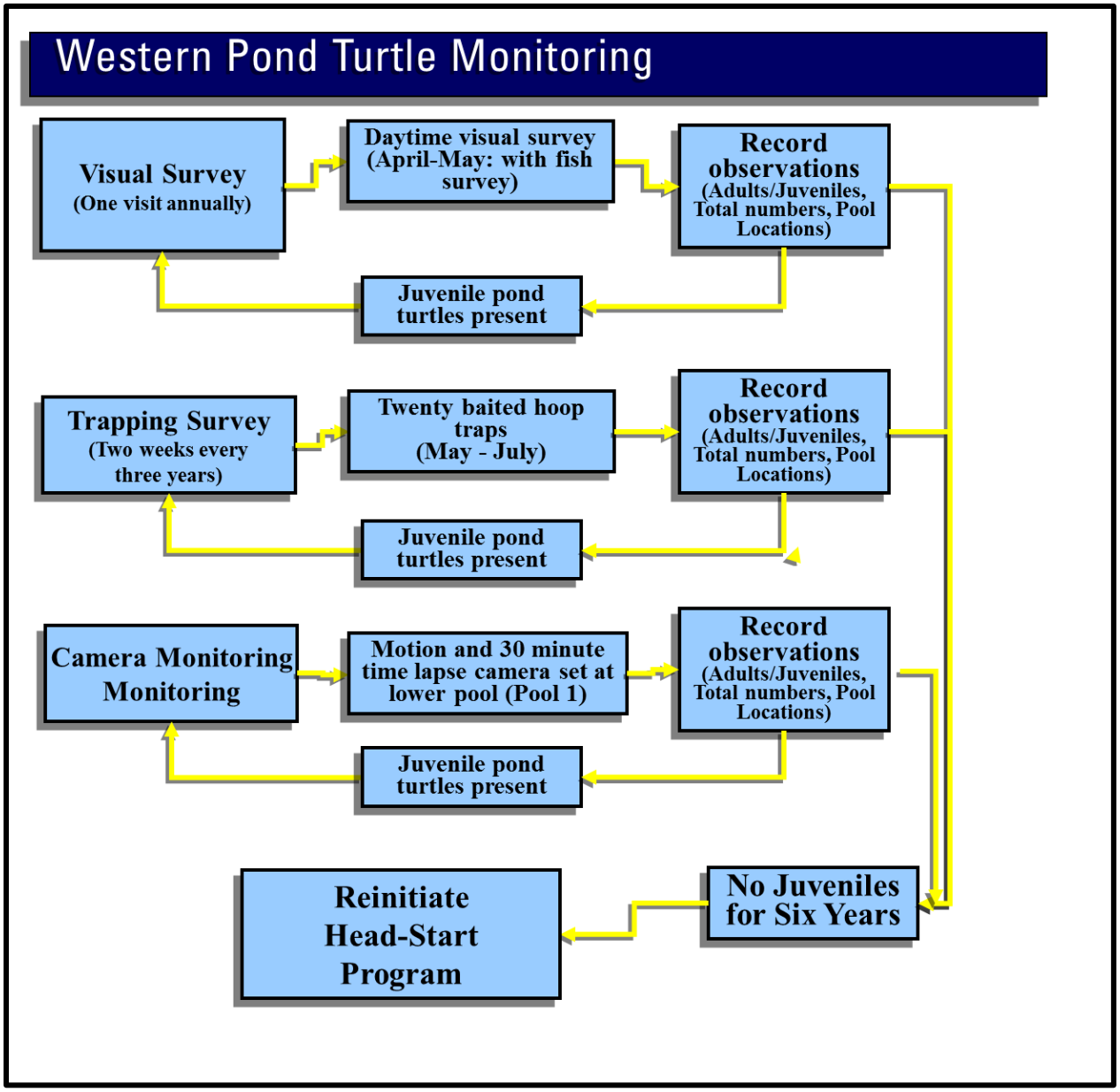

Figure 2. Conceptual model for monitoring of pond turtles at SPER utilizing daytime visual encounter surveys, trapping surveys, and motion/time lapse cameras.

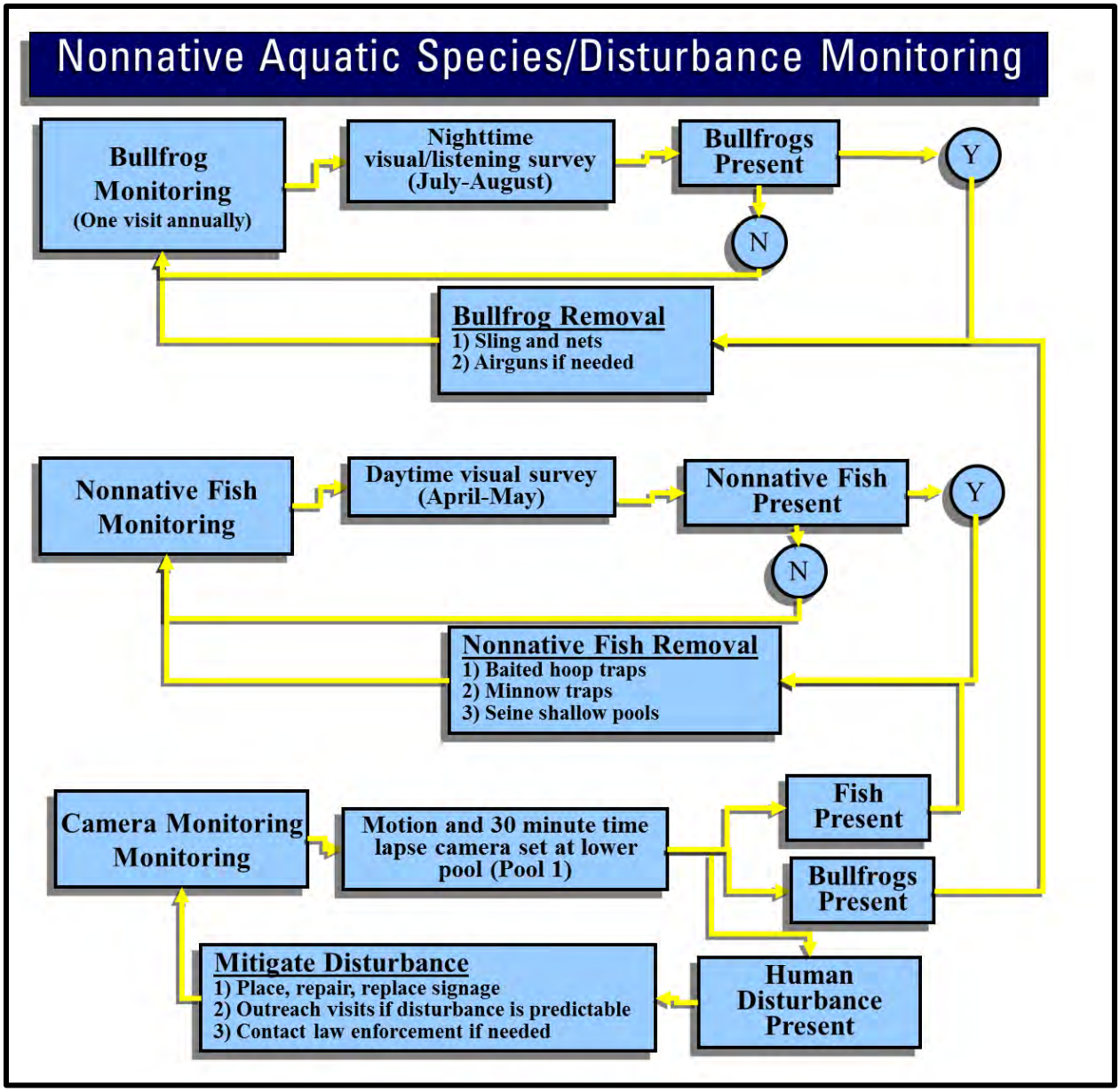

Figure 3. Conceptual model for monitoring of nonnative aquatic species and disturbances at SPER utilizing nighttime visual encounter surveys, trapping surveys, and motion/time lapse cameras.

Table 1. List of pools and trapping locations for pond turtles and nonnative aquatic species during surveys from 2009 to 2014.

Name	Trap Point	Latitude	Longitude	General Description
Pool 1	1	32.772248	-116.800807	Most downstream pool with a bedrock and sand bottom and open canopy. This pool has retained water during the duration of this study
Pool 2	2 3	32.772195 32.772084	-116.800532 -116.800395	Second most downstream pool with shallow bedrock and sandy bottom and partial canopy cover. This pool has retained water during the duration of this study.
Pool 3	4 5	32.771969 32.771861	-116.800163 -116.799825	Third most downstream pool with predominately sandy bottom and shoreline and thick canopy cover. This pool dried during 2010 but has retained water through all of 2014.
Pool 4	6 7	32.772286 32.772344	-116.798780 -116.798701	Fourth most downstream pool with predominately sandy bottom and shoreline. Shoreline vegetation is thick but the canopy is open. This pool dries completely seasonally.
Pool 5	8	32.772375	-116.79863	Fifth most downstream pool with predominately sandy bottoms and shorelines with thick vegetation and closed canopy. This pool has retained water longer than pools 4 and 5, but is prone to seasonal drying.
Pool 6	9	32.772441	-116.798191	Most upstream pool with predominately sandy bottoms and shorelines with a mostly closed canopy. This pool dries down seasonally and has been the first pool to dry completely each year.

Table 2. Overview of monitoring actions for SPER. The following methods found in the referenced protocols can be used to monitor for nonnative aquatic species, human disturbances, and pond turtle activity and recruitment.

Monitoring			
Activity	**Recommended Timing**	**Methods**	**Management Objectives**
Pond Turtle Trapping (all pools)	Two one week trapping sessions during May to July every three years.	20 baited hoop traps placed in wetted trapping locations (see map). Follow USGS protocol for pond turtle trapping survey (USGS 2006b)	Detection of young pond turtles to establish if recruitment is occurring
Pond Turtle Visual Survey (all pools)	Once every spring, can be conducted with nonnative fish visual surveys	Follow USGS protocol for daytime pond turtle survey (USGS 2006a and USGS 2006c)	Detection of young pond turtles to establish if recruitment is occurring
Pond Turtle Camera Survey (Pool 1)	Change digital film and batteries opportunistically or every three months.		Detection of young pond turtles to establish if recruitment is occurring
Bullfrog Visual Survey (all pools)	Once every summer	Follow USGS protocol for nighttime stream survey (USGS 2006a)	Determine presence of bullfrogs
Nonnative Fish Visual Survey (Pools 1 and 2)	Once every spring, can be conducted with pond turtle visual surveys	Follow USGS protocol for daytime stream survey (USGS 2006a)	Determine presence of nonnative fish
Disturbance Camera Survey (Pool 1)—SAME AS POND TURTLE CAMERA SURVEY	Change digital film and batteries opportunistically or every three months.	Monitor head-started individuals for first water release or overtopping event	Detection of human disturbance at site

Table 3. Overview of management actions for SPER. The following methods found in the referenced protocols can be used to manage for nonnative aquatic species, human disturbances, and pond turtle activity and recruitment.

Management Actions			
Activity	**Recommended Timing**	**Methods**	**Management Objectives**
Bullfrog Removal	Within 5 days of a new moon after bullfrogs are detected	Nighttime visual surveys using slings, nets, and airguns as needed. Follow USGS protocol for stream surveys (USGS 2006a)	Removal of bullfrogs
Nonnative Fish Removal	Once every three years August-September	Two weeks of baited hoop and minnow trapping. Seine netting of shallow pools. Baited hook can be useful for catching larger individuals. Follow USGS protocol for pond turtle trapping survey (USGS 2006b)	Removal of nonnative fish
Pond Turtle Head Starting *Coordinate with San Diego Zoo*	Trapping for gravid females in May-June.	20 baited hoop traps placed in wetted trapping locations (see map). Follow USGS protocol for pond turtle trapping survey (USGS 2006b) USGS or Zoo staff must be present on site to check females and transfer gravid individuals to Zoo facility	Captive rearing of juvenile pond turtles to a size sufficiently large to avoid predation. See Brown et al. 2012 for need for nonnative aquatic species removal in connection with head-starting.

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