



Data Summary for the 2007 and 2008 Pacific Pond Turtle (*Actinemys marmorata*) Surveys Conducted in the County of San Diego; Boulder Oaks, Lusardi Creek and Los Penasquitos Canyon

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Prepared for:

County of San Diego

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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Introduction and Goals

The Pacific pond turtle (*Actinemys marmorata*) is the only native aquatic turtle species in southwestern California. While historically abundant in most major San Diego County drainages: habitat loss, human disturbance, hydrologic alterations, and invasive species have resulted in a significant decrease in Pacific pond turtle populations in San Diego and throughout California (Madden-Smith et al. 2005). Evaluating and addressing these threats is critical for the long-term persistence of Pacific pond turtle populations in San Diego County, and is a focus of the Multiple Species Conservation Program (MSCP), an approved Natural Community Conservation Plan (NCCP) in southern San Diego County. The Pacific pond turtle is a MSCP covered species with an impact avoidance condition. The condition is as follows: “Maintain and manage areas within 1500 feet around known locations within preserve lands for the species. Within this impact avoidance area, human impacts will be minimized, non-native species detrimental to pond turtles will be controlled, and habitat restoration/enhancement measures will be implemented.”

During a 2002-2003 study conducted by the United States Geological Survey (USGS), 72 sites within the MSCP area were surveyed for Pacific pond turtle presence. Pacific pond turtles were detected at only 5 of these 72 sites (Lake Murray, Los Penasquitos Canyon Preserve, Lusardi Creek Preserve Lands, Santee Lakes, and Sycuan Peak Ecological Reserve), only 3 of which had more than one individual (Los Penasquitos Canyon Preserve, Lusardi Creek Preserve Lands, and Sycuan Peak Ecological Reserve along the Sweetwater River; Madden-Smith et al. 2005). The surveys conducted by the USGS in 2002-2003, provided valuable information regarding the distribution of Pacific pond turtles, and raised management concerns about their viability. Following the 2002-2003 survey efforts, MSCP managers have sought to assess additional unsurveyed sites, and to prioritize and implement restoration actions to ensure the persistence of western pond turtles within the MSCP Preserve System.

The Boulder Oaks Preserve became a part of the MSCP preserve system in 2003 after completion of the 2002-2003 USGS survey and has not been surveyed for Pacific pond turtles. Boulder Oaks Preserve includes three ponds which are potential habitat for Pacific pond turtles. Unlike other sites where restoration actions may be affected by human impacts (e.g., invasive species introduction, collection of the Pacific pond turtle, etc), the relatively remote location of the Boulder Oaks Preserve ponds provides greater assurance that restoration activities will result in long term benefits to Pacific pond turtles.

The primary objective of this project was to survey the three ponds in the Boulder Oaks Preserve to determine whether Pacific pond turtles were present and to assess the habitat suitability for the Pacific pond turtle. If the Boulder Oaks Preserve ponds were not found to support Pacific pond turtles, our second objective was to survey other priority San Diego County owned and/or managed sites (Lusardi Creek [4S Ranch] and Los Penasquitos Canyon) for the presence of pond turtles and assess these sites for future enhancement or restoration.

Methods

Surveys for Pacific pond turtles used baited commercial traps (Holland 1994; Reese 1996; Ashton et al. 2001; Lovich & Meyer 2002; Rathbun et al. 2002) and followed the established USGS protocol (U.S. Geological Survey, 2006). Traps were set parallel to shore in most cases and anchored to shore with a rope (tied to the center top of the trap) so that the traps do not drift

or sink. The top of the traps were raised above the water's surface with floats to allow captured turtles (and other species) to surface for air (see Figure 1). The traps were baited with punctured cans of sardines to prevent consumption by the turtles; the bait simply serves as an attractant to the trap. Surveys were conducted at Boulder Oaks Preserve for a total of five days in August 2007 and at Lusardi Creek (4S Ranch) and Los Penasquitos Canyon for a total of eight days, four in August 2007 and four in April 2008 (see Tables 1 and 2). Trap sizes and locations were selected based on available habitat (see Table 2 and Figures 2 through 8). Los Penasquitos Canyon had much less habitat with shallower pools than either Boulder Oaks Preserve or Lusardi Creek (4S Ranch) requiring only small turtle traps. Boulder Oaks had both shallow and deep near shore habitat requiring the use of small and large turtle traps. The entire near shore habitat at Lusardi Creek (4S Ranch) was deep enough to use only the large turtle traps. All traps regardless of size used the same amount of bait.

Each Pacific pond turtle captured was measured, tissue sampled (for genetics), marked, and sex was determined based on morphological traits (Holland 1991). 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 Pacific pond turtle was collected and stored in 95% ethanol. Pacific pond 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 Pacific pond turtle had been PIT tagged. The PIT tags were inserted inside the body cavity anterior to the rear right leg and the notches were 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. Pacific pond turtles were released near the point of capture immediately following processing. All captured non-native turtles were processed similarly to the Pacific pond turtles except they were not be implanted with a PIT tag nor were they released. All non-native turtles removed from the wild went to the San Diego Turtle and Tortoise Society to be adopted by members of the society. All non-native turtles given to the San Diego Turtle and Tortoise Society were marked with a notch on the right femoral scute, so that if future trapping yielded captures of marked individuals, we would know that they had been re-released.

Results and Discussion

Capture results are tabulated in Tables 3 and 4. The surveys at Boulder Oaks Preserve yielded no Pacific pond turtles. Only one of the mapped ponds on the property contained water and with an intensive trapping effort, the only vertebrates captured were American bullfrogs (*Rana catesbeiana*). No turtles of any species were observed by any methods during the surveys.

One Pacific pond turtle was captured at Los Penasquitos Canyon (see Figure 9). This capture occurred during the August sample period at the largest pool which was at the most upstream section of the property (see Figure 5). A common slider was also captured at this location. Other species captured at Los Penasquitos Canyon include black bullhead (*Ictalurus melas*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and red swamp crawfish (*Procambarus clarkii*).

Pacific pond turtles were observed at Lusardi Creek (4S Ranch) during both surveys (see Tables 3 and 4). During the April 2008 survey, a female Pacific pond turtle was found dead on a small makeshift fishing platform. An x-radiograph was taken of this turtle (Figure 10) to try to determine cause of death. Two radiopaque objects (too dense to allow x-rays to pass through)

were detected. The turtle was then dissected and these objects were found to be common BBs measuring 4.34mm (.1710 inches) in diameter and of steel construction (Figure 10). One BB was in the body cavity and the other was lodged against the spine at the back of the neck. The BBs had not been ingested orally as they were not in the digestive track. These surveys also documented common sliders and adult largemouth bass for the first time at this site (see Table 3 and Figure 11). Other species observed at Lusardi Creek (4S Ranch) include American bullfrogs, black bullhead, green sunfish, bluegill sunfish, and mosquitofish (*Gambusia affinis*).

Based on the data collected, our recommendations remain consistent with Madden-Smith et al. 2005 (see Appendix A.) with additional comments in regards to Lusardi Creek (4S Ranch), Los Penasquitos Canyon, and Boulder Oaks Preserve:

- The 2007 and 2008 survey efforts at Lusardi Creek (4S Ranch) detected fewer Pacific pond turtles than the 2002 surveys, but did detect three adult common sliders (*Trachemys spp.*) and largemouth bass which had not been detected in 2002 (Madden-Smith et al. 2005). These exotics (along with the American bullfrog, which was detected in both survey efforts) have been shown to negatively impact the Pacific pond turtle (Moyle 1973; Brattstrom & Messer 1988; Holland 1991, 1994). Methods to control the exotic species should be examined; potential methods should include reduction of water levels to facilitate easy capture and removal of exotic species (Harmsworth Associates, 2003; Spinks et al, 2003).
- Fishing was observed at Lusardi Creek (4S Ranch) during the 2007 and 2008 survey efforts. Fishing has been found to impact Pacific pond turtles (Appendix A, section 5.2.1.1). Methods to control fishing include posting signs to alert users that fishing is restricted.
- Currently, there are no observable signs for education or outreach posted at the Lusardi Creek (4S Ranch) population (see Appendix A, section 5.2.2. which contains specific recommendations for installing such signs at Lusardi Creek [4S Ranch]).
- No Pacific pond turtles were observed at the Boulder Oaks Preserve. Two of the three potential survey sites (ponds) were dry during the 2007 surveys; therefore, unsuitable for Pacific pond turtles. The third pond had a robust population of American bullfrogs and no turtles were observed during an intensive five day trapping effort in 2007. Consideration of Boulder Oaks Preserve as a location for Pacific pond turtle relocation should include an examination of the genetics of the Pacific pond turtle populations in San Diego and efforts to reduce the American bullfrog population in the third pond.
- The County property in the Los Penasquitos Canyon Preserve makes up only a small proportion of the Preserve. Habitat enhancement efforts for the Pacific pond turtle on this property should take into consideration management activities up and downstream from the property, coordinating with adjacent landowners.

REFERENCES

- Ashton, D. T., K. E. Schlick, N. E. Karraker, D. A. Reese, A. J. Lind, and H. H. Welsh. 2001. Ecology and sampling methods for the western pond turtle. USDA Forest Service, Redwood Sciences Laboratory, Arcata, California. 60 pp.
- Brattstrom, B. H. and D. F. Messer. 1988. Current status of the southwestern pond turtle, *Clemmys marmorata pallida*, in southern California. Final report to California Department of Fish and Game. Contract C-2044. Sacramento, CA. 62 pp.
- Bash, J. S. 1999. The role of wood in the life cycle of western pond turtles (*Clemmys marmorata*). Unpublished final report to ELWd Systems, a division of Forest Concepts LLC. 14 pp.
- Buhlmann, K. A. and T. D. Tuberville. 1998. Use of passive integrated transponder (PIT) tags for marking small freshwater turtles. *Chelonian Conservation and Biology* 3:102-104.
- Christiansen, J. L. and B. J. Gallaway. 1984. Raccoon removal, nesting success, and hatchling emergence in Iowa turtles with special reference to *Kinosternon flavescens* (Kinosternidae). *The Southwestern Naturalist* 29:343-348.
- Collier, M., R.H. Webb, and J.C. Schmidt. 2000. Dams and rivers, a primer on the downstream effects of dams. U. S. Geological Survey Circular 1126.
- Dodd, C. K. 1990. Effects of habitat fragmentation on a stream-dwelling species, the flattened musk turtle *Sternotherus depressus*. *Biological Conservation* 54:33-45.
- Garber, S. D. and J. Burger. 1995. A 20 yr study documenting the relationship between turtle decline and human recreation. *Ecological Applications* 5:1151-1162.
- Goodman, R. H., Jr. 1997. The biology of the southwestern pond turtle (*Clemmys marmorata pallida*) in the Chino Hills State Park and the West Fork of the San Gabriel River. Master's Thesis, California State Polytechnic University, Pomona, CA. 81pp.
- Harmsworth Associates and B. Goodman, 2003. Shady Canyon turtle pond mitigation monitoring annual report for 2002. Annual Report. 39pp.
- Hays, D. W., K. R. McAllister, S. A. Richardson, and D. W. Stinson. 1999. Washington State recovery plan for the western pond turtle. Washington Department of Fish and Wildlife, Olympia. 66 pp.
- Holland, D. 1991. A synopsis of the ecology and status of the western pond turtle (*Clemmys marmorata*) in 1991. Report to National Ecological Research Center. United States Fish and Wildlife Service, San Simeon, California. 38 pp.
- Holland, D. C. 1994. The western pond turtle: Habitat and history. Final report to U. S. Department of Energy, Bonneville Power Administration, Portland, Oregon. 303 pp.

- Holzhauser, N. and A. Work. 1999. Western pond turtles need your help – a landowner’s guide for creating pond turtle habitat in the McKenzie Valley. The McKenzie Watershed Council, brochure. 2 pp.
- Jennings, M. R. and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. Report prepared for California Department of Fish and Game, Rancho Cordova, California. 255 pp.
- Joslin, G. and H. Youmans, coordinators. 1999. Effects of recreation on Rocky Mountain wildlife: a review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society, G. Joslin and H. Youmans, coordinators. 307 pp.
- Ligon, F. K., W. E. Dietrich, and W. J. Trush. 1995. Downstream ecological effects of dams, a geomorphic perspective. *BioScience* 45:183-192.
- Lovich, J. and K. Meyer. 2002. The western pond turtle (*Clemmys marmorata*) in the Mojave River, California, USA: Highly adapted survivor or tenuous relict? *Journal of Zoology* London 256:537-545.
- Madden-Smith, M. C., E. L. Ervin, K. P. Meyer, S. A. Hathaway, and R. N. Fisher. 2005. Distribution and status of the arroyo toad (*Bufo californicus*) and western pond turtle (*Emys marmorata*) in the San Diego MSCP and surrounding areas. Report to County of San Diego and California Department of Fish and Game, San Diego, California. 190 pp.
- Moyle, P. B. 1973. Effects of introduced bullfrogs, *Rana catesbeiana*, on the native frogs of the San Joaquin Valley, California. *Copeia* 1973:18-22.
- Oregon Department of Fish and Wildlife (ODFW). 1999. Oregon's western pond turtle: Private landowners can help their survival. Wild Flyer brochure. 2 pp.
- Oregon Department of Fish and Wildlife (ODFW). 2000. Living with wildlife - *Clemmys marmorata*: western pond turtle. 4 pp.
- Rathbun, G. B., N. J. Scott Jr., and, T. G. Murphy. 2002. Terrestrial habitat use by pacific pond turtles in a Mediterranean climate. *The Southwestern Naturalist* 47:225-235.
- Rathbun, G. B., M. R. Jennings, T. G. Murphey, and N. R. Seipel. 1993. Status and ecology of sensitive aquatic vertebrates in Lower San Simeon and Pico Creeks, San Luis Obispo County, California. Unpublished report to National Ecology Research Center, Piedras Blancas Research Station, San Simeon, California, 93452-0070. Cooperative Agreement 14-16-0009-91-1909. 103 pp.
- Reese, D. A. 1996. Comparative demography and habitat use of western pond turtles in northern California: The effects of damming and related habitat alterations. PhD dissertation, University of California Berkeley, Berkeley, California. 253 pp.

- Reese, D. A. and H. H. Welsh, Jr. 1998a. Comparative demography of *Clemmys marmorata* populations in the Trinity River of California in the context of dam-induced alterations. *Journal of Herpetology* 32:505-515.
- Reese, D. A. and H. H. Welsh, Jr. 1998b. Habitat use by western pond turtles in the Trinity River, California. *Journal of Wildlife Management* 62:842-853.
- Spinks, P. Q., G. B. Pauly, J. J. Crayon, and H. B. Shaffer. 2003. Survival of the western pond turtle (*Emys marmorata*) in an urban California environment. *Biological Conservation* 113:257-267
- U.S. Geological Survey. 2006. USGS western pond turtle (*Emys marmorata*) trapping survey protocol for the southcoast ecoregion. U.S. Geological Survey protocol. San Diego, CA. 30 pp.
- Williams, G. P. and M. G. Wolman. 1984. Downstream effects of dams on alluvial rivers. U. S. Geological Survey Professional Paper 1286. 83 pp.

Table 1. Summary of 2007 and 2008 Pacific pond turtle surveys.

Site	General Location Longitude (W) ¹	General Location Latitude (N) ¹	Date	Pacific Pond Turtle Detected
Boulder Oaks Preserve	116.93140	32.96096	1-Aug-2007 to 6-Aug-2007	No
Los Penasquitos	117.1354	32.93842	27-Aug-2007 to 31-Aug 2007	Yes
			21-Apr-2008 to 25-Apr-2008	No
Lusardi Creek (4S Ranch)	117.10233	32.99971	27-Aug-2007 to 31-Aug 2007	Yes
			21-Apr-2008 to 25-Apr-2008	Yes

¹Coordinates are in decimal degrees, WGS84**Table 2.** Summary of turtle trap locations for 2007 and 2008 Pacific pond turtle surveys.

Site	Trap Type	Longitude (W) ¹	Latitude (N) ¹
Boulder Oaks Preserve	2.5' Fingered Hoop	116.93120	32.96030
		116.93088	32.96070
		116.93081	32.96100
		116.93078	32.96117
		116.93081	32.96095
		116.93228	32.96088
	1.5' Fingered Hoop	116.93140	32.96145
		116.93140	32.96140
		116.93158	32.96133
		116.93177	32.96073
		116.93161	32.96051
		116.93173	32.96110
Los Penasquitos	1.5' Fingered Hoop	117.14248	32.93770
		117.14050	32.93713
		117.13637	32.93757
		117.13142	32.93887
		117.13043	32.93977
		117.13095	32.93948
Lusardi Creek (4S Ranch)	2.5' Fingered Hoop	117.10335	33.00035
		117.10353	33.00048
		117.10360	33.00033
		117.10298	33.00005
		117.10342	32.99984
		117.10272	32.99934
		117.10221	32.99901
		117.10145	32.99906
		117.10087	32.99911
		117.10075	32.99945
		117.10114	32.99975
		117.10182	32.99981
117.10248	32.99966		

¹Coordinates are in decimal degrees, WGS84

Table 3. Summary of aquatic species observed during surveys, 2007-2008.

Site	Survey	Species	Number Captured ¹	Native
Boulder Oaks Preserve	1	American bullfrog (<i>Rana catesbeiana</i>)	5	
Los Penasquitos	1	Pacific pond turtle (<i>Actinemys marmorata</i>)	1	X
	1	Common slider (<i>Trachemys scripta</i>)	1	
	1 & 2	Black bullhead (<i>Ameiurus melas</i>)	34	
	1	Green sunfish (<i>Lepomis cyanellus</i>)	4	
	1	Largemouth bass (<i>Micropterus salmoides</i>)	1	
	1 & 2	Red swamp crawfish (<i>Procambarus clarkii</i>)	10	
Lusardi Creek (4S Ranch)	1 & 2	American bullfrog (<i>Rana catesbeiana</i>)	Obs.	
	1 & 2	Pacific pond turtle (<i>Actinemys marmorata</i>)	1 ²	X
	1	Common slider (<i>Trachemys scripta</i>)	3	
	1	Black bullhead (<i>Ameiurus melas</i>)	1	
	1	Green sunfish (<i>Lepomis cyanellus</i>)	1	
	1	Bluegill sunfish (<i>Lepomis macrochirus</i>)	5	
	2	Largemouth bass (<i>Micropterus salmoides</i>)	2	
1 & 2	Mosquitofish (<i>Gambusia affinis</i>)	Obs.		

¹"Obs." Indicates species that were observed but not captured in traps.

²Two individuals were observed but not captured in traps.

Table 4. Summary of Pacific pond turtles observed during surveys, 2007-2008.

Site	Date	Sex	Age	Location ¹	Observation Method
Los Penasquitos	28-Aug-2007	Male	Adult	117.13095W, 32.93948N	Found in trap
Lusardi Creek (4S Ranch)	9-Aug-2007	Male	Adult	117.10289W, 33.00061N	Found on trail before traps were set
	28-Aug-2007	Male	Adult	117.10221W, 32.99901N	Found in trap
	24-Apr-2008	Female	Adult	117.10178W, 33.00009N	Found dead at fishing platform

¹Coordinates are in decimal degrees, WGS84

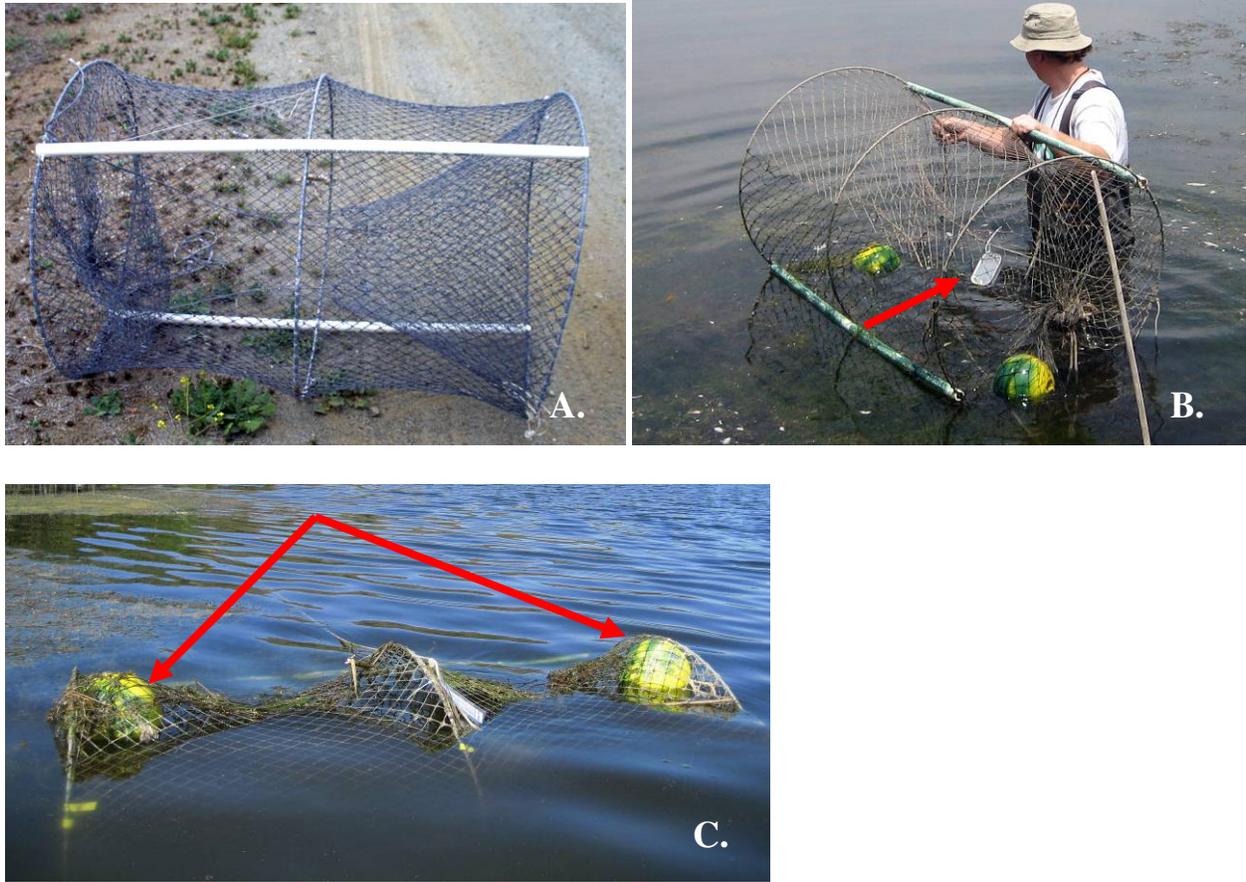


Figure 1. Representative photos of turtle traps. A. Photo of assembled 2.5' fingered hoop turtle trap. B. Photo of baited 2.5' fingered hoop turtle trap being set at Boulder Oaks Preserve (arrow points to the bait which is a punctured can of sardines in oil). C. Photo of baited and set 2.5' fingered hoop turtle trap at Lusardi Creek (4S Ranch) (arrows point to floats which provide airspace for captured turtle and frogs).

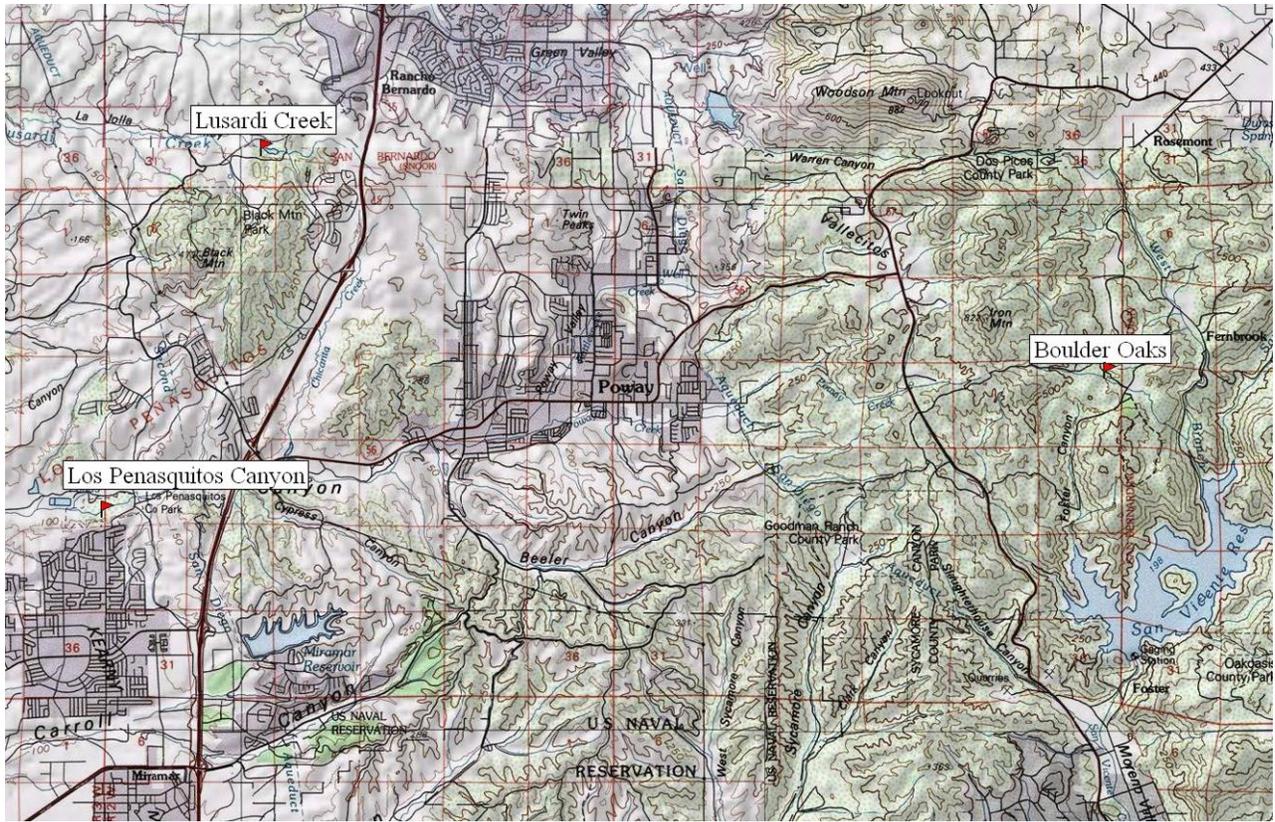


Figure 2. Map of study sites 2007-2008. General locations of trapping surveys are indicated by the red flags.

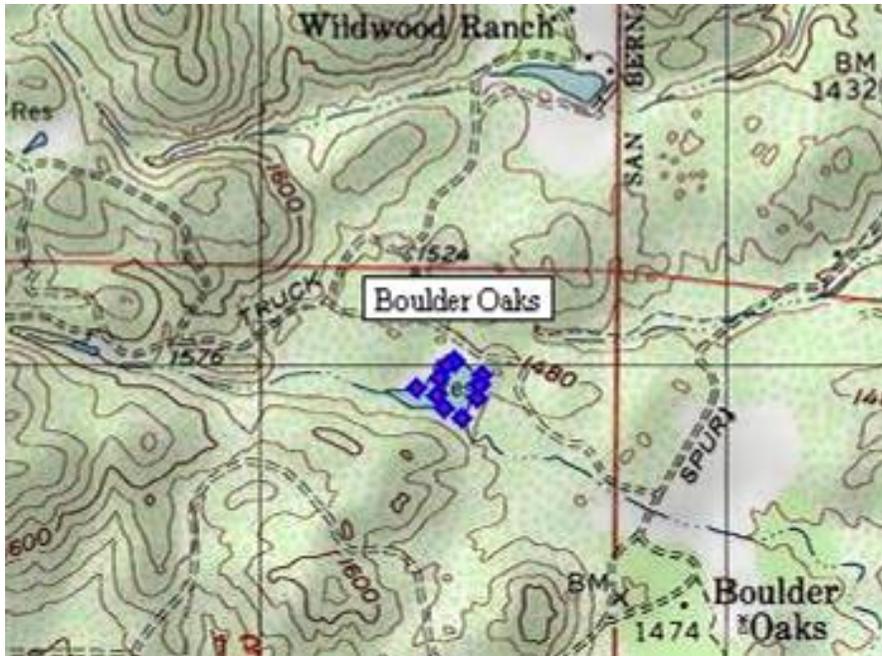


Figure 3. Turtle trap locations at Boulder Oaks Preserve.



Figure 4. Representative photos of habitat at Boulder Oaks Preserve.

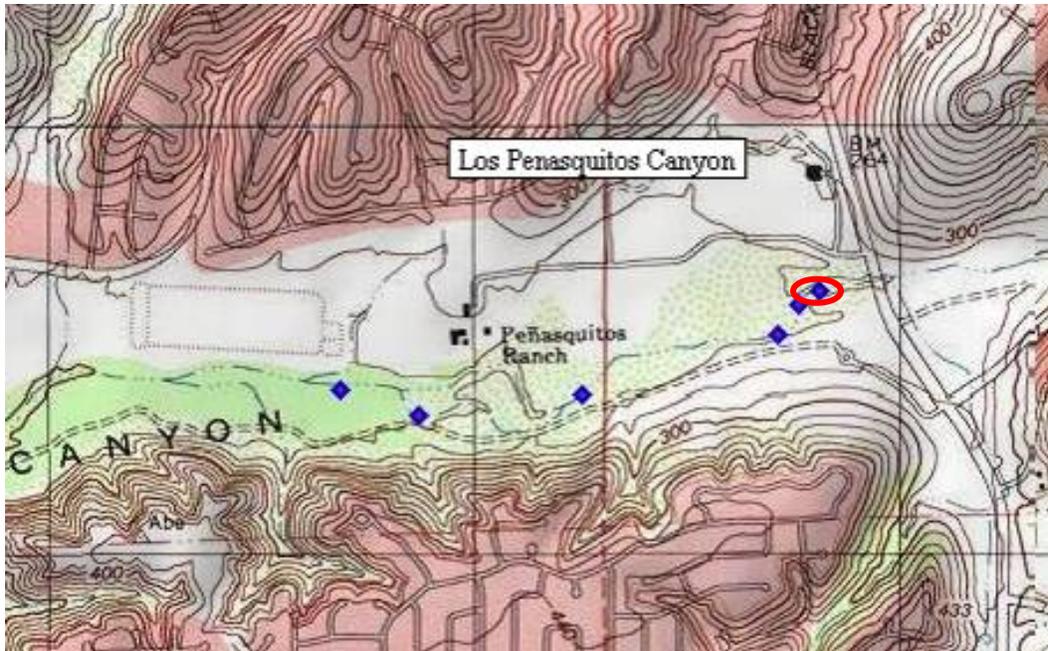


Figure 5. Turtle trap locations at Los Peñasquitos Canyon (location of all turtle observations circled in red).



Figure 6. Representative photos of habitat at Los Peñasquitos Canyon.

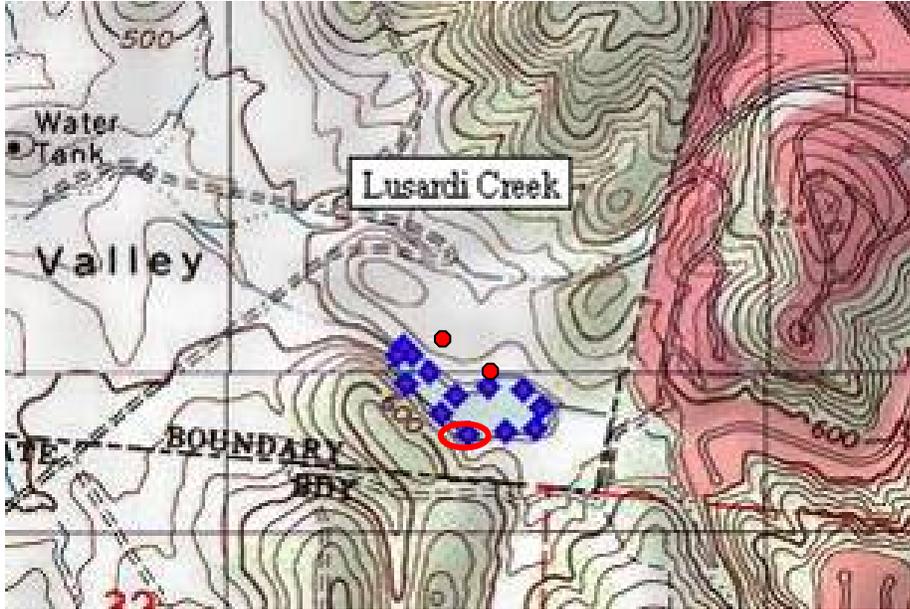


Figure 7. Turtle trap locations at Lusardi Creek (4S Ranch). Location of Pacific pond turtle trapped in turtle traps is indicated by the red oval, red dots represent approximate locations of Pacific pond turtles observed outside of traps.



Figure 8. Representative photos of habitat at Lusardi Creek (4S Ranch).



Figure 9. Representative photos of Pacific pond turtles (*Actinemys marmorata*) observed, 2007-2008. Photos A and B are the turtle from Los Penasquitos Canyon and photos C and D are from Lusardi Creek (4S Ranch).

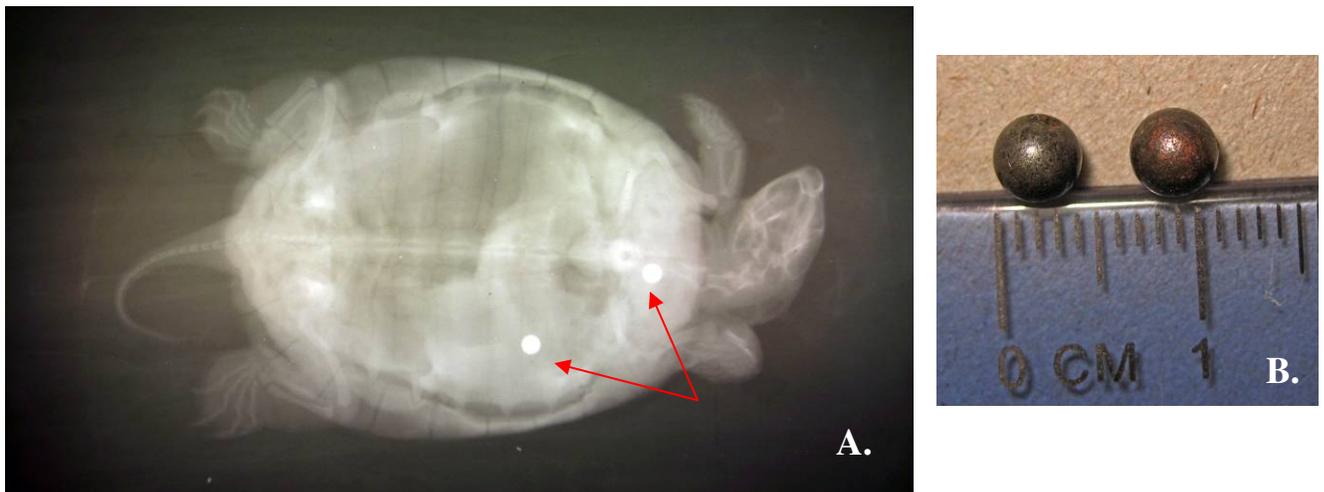


Figure 10. A. X-Radiograph of female Pacific pond turtle (*Actinemys marmorata*) found dead at Lusardi Creek (4S Ranch) fishing platform. Arrows point to radiopaque objects (BBs) inside the body of the turtle (note that there are not hardened eggs visible). B. The two BBs that were removed from the turtle.



Figure 11. Pictures of other species observed, 2007-2008. A. American bullfrog from Boulder Oaks Preserve. B. Largemouth bass from Lusardi Creek (4S Ranch). C. Largemouth bass from Los Penasquitos Canyon. D. Bluegill sunfish from Lusardi Creek (4S Ranch). E. Green sunfish from Lusardi Creek (4S Ranch). F. Mosquitofish from Lusardi Creek (4S Ranch). G. Black bullhead from Los Penasquitos Canyon. H. Black bullhead from Lusardi Creek (4S Ranch). I, J, and K. Common sliders from Lusardi Creek (4S Ranch).

Appendix A

Excerpts from Madden-Smith et al. 2005 discussing restoration for Pacific pond turtles (*Actinemys marmorata*)

5.2.1.1 Human Recreation

Human access, especially recreation, should be limited in wetland and upland habitats used by pond turtles in order to minimize disturbance and take. Non-consumptive recreation, such as hiking, dog walking, and fishing, can potentially trigger problems for native turtles if the recreational activities interfere with any aspect of the turtle's life history requirements. For instance, Garber & Burger (1995) found a 100% decrease in two wood turtle (*Glyptemys insculpta*) populations within 10 years of a wildlife reserve being opened up to recreation (fishing, hiking and dog walking). Recreation can lead to removal of turtles, road kills, handling by recreationists, increased predation as a function of increased food waste resulting in an increase in predators (raccoons, coyotes) (see also Joslin & Youmans 1999), and disturbance by dogs (Garber & Burger 1995). The effects of human recreation on the pond turtle are of concern because all pond turtle locations within the study area, except for Sycuan Peak Ecological Reserve, Sweetwater River, are heavily recreated.

Fishing is of concern for pond turtles because they can be attracted to bait and subsequently hooked and released, possibly with the hook still embedded in the mouth or esophagus, or the turtles may be taken for consumption or as a pet. In this study, non-native turtles removed from a heavily fished area of the San Diego River (FSDRIP) excreted fish hooks after capture and an x-ray radiograph of a red-eared slider specimen from this site revealed a fish-hook was deeply embedded in its esophagus and a red-eared slider from Lake Miramar had a perforated esophagus most likely due to a fish-hook (USGS NWHC, unpublished data). In a similar USGS pond turtle study in Orange County, an x-ray of a red-eared slider found dead at a heavily fished site also revealed that a fish-hook was embedded in its esophagus and another red-eared slider at the same site was found dead with fishing line entangling its front legs (USGS NWHC, unpublished data). It is uncertain if the embedded fish-hooks caused impaired feeding, starvation or metal poisoning and it was also uncertain if the fishing line entangled turtle had drowned because of the fishing line or if the fishing line had become entangled postmortem. Pond turtles occurring in heavily fished areas are likely to be similarly affected by fishing and it is also possible that fishing may be one of the many factors in the overall decline of this species (Holland 1991). Holland (1991) noted that pond turtles captured from a fishing site in the Sierra Nevada had either obvious trauma due to hook removal, had hooks in place or were found dead with hooks embedded in their esophagus and that similar records of injury or death from fish-hooks suggest that this situation was widespread and frequent. Pond turtles have also been fished and taken for consumption from San Dieguito River near Lake Hodges (K. Thomas, personal communication). Jennings and Hayes (1994) suggested that fishing with barbed hooks be regulated in areas containing pond turtles.

Other forms of recreation, such as hiking and dog walking, also need to be considered as potential causes of pond turtle population decline due to the possible disturbance and take that may result from these activities. Hikers or joggers may disrupt pond turtle behavior such as basking, foraging or mating and may encounter nesting females and disrupt nesting or collect them as pets. With the slightest disturbance, females may abandon a nesting attempt and head back to the water (Holland 1994; Goodman 1997). Turtles may also be encountered while they are heading to or returning from upland aestivation or overwintering sites, and young may be encountered as they disperse from nests to wetland habitats. Dogs, especially those that are off leash and allowed to go off-trail, can also disturb or harm nesting females, turtles heading to or returning from upland aestivation or overwintering sites, and dispersing young. Dogs may also

dig up nests with eggs or overwintering young or may dig up overwintering or aestivating adult turtles.

As public usage of the MSCP reserve areas increases, there will likely be an increase in the number of people recreating (hiking, biking, dog walking and fishing), both legally and illegally, in areas where pond turtle populations exist. In the Garber and Burger (1995) study on wood turtles (*Clemmys insculpta*), they found a negative correlation between wood turtle population size and human population size in the surrounding area- as human populations increased wood turtle populations declined. Pond turtles may be similarly impacted by the growing population of San Diego. Possible solutions to help prevent future pond turtle decline due to human population growth and increased recreation include gaining a better understanding of pond turtle population dynamics and habitat requirements, better fencing of reserves, limiting off-trail travel, requiring dogs to be leashed, improved signage, improved outreach and public education, and increased patrols. Protecting females and juveniles will be especially important, because few or no females and no juveniles were detected in the pond turtle populations during this study.

5.2.2 Education and Outreach

Educational kiosks or signs should be installed at trailheads to educate and inform the public of any restrictions and the importance of not releasing unwanted pets, especially turtles. This is particularly important at all locations where pond turtles occur, especially those sites heavily recreated or easily accessed by humans such as Los Peñasquitos Canyon Preserve and 4S Ranch. People frequent Los Peñasquitos Canyon Preserve for use as a recreational outlet and 4S ranch is currently undergoing development for housing. Hence, the likelihood of unwanted pet turtles being released into these sites is higher than at a more remote site, such as Sycuan Peak Ecological Reserve. At a minimum, these informative displays should provide information such as the following: 1) any restrictions for the site (e.g., no fishing), 2) the importance of not disturbing or molesting any wildlife they may encounter, 3) the potential danger(s) of handling and collecting wild animals, 4) the ramifications of releasing pet turtles and other non-native pets and emphasizing that it is also illegal (California Fish and Game Code Section 2121 and California Penal Code 597s), and 5) contact information for organizations that will accept unwanted pet turtles, such as the San Diego Turtle and Tortoise Society.

Similar to that discussed for the arroyo toad in section 5.1.2, educational pamphlets, outreach, and educational programs can be used to promote the value of pond turtles and native ecosystems as well as the negative effects of non-native species. Partnerships should be established with organizations such as the San Diego Turtle and Tortoise Society and the San Diego Herpetological Society to educate the public on the negative impacts of releasing pets and offer alternative ways of getting rid of unwanted pets. The San Diego Turtle and Tortoise Society has expressed interest in helping this cause (K. Thomas, personal communication). In addition, an outreach program should be initiated with local pet stores to educate consumers and possibly establish an unwanted turtle return policy. Educational programs may also be initiated or incorporated with currently existing school programs (elementary through high school) throughout San Diego County. Again, education and outreach may be coordinated by the already established MSCP Outreach Committee in conjunction with landowners.

5.2.5 Habitat Restoration and Creation

Another management goal should be to expand the abundance and range of known populations of pond turtles through restoration or creation of wetland habitats for both adult and juvenile life stages. Habitat degradation or loss can lead to abnormal population structure in pond turtles (Dodd 1990; Reese & Welsh 1998a) and eventually result in population decline or

extirpation. All known populations of pond turtles within the MSCP would benefit from habitat restoration. Hollenbeck Canyon Wildlife Area and Rancho Jamul Ecological Reserve are locations that should be considered for restoration of historic pond turtle habitat or creation of new habitat with the purpose of reestablishing pond turtle populations.

The Washington Department of Fish and Wildlife and the Oregon Department of Fish and Wildlife have set guidelines, either through pond turtle recovery plans or public outreach, for restoring or creating pond turtle habitat (Hays et al. 1999; ODFW 1999, 2000). Below are detailed descriptions of the required habitat characteristics to consider for restoration or creation of pond turtle habitats based on Bash (1999), Hays et al. (1999), ODFW (1999, 2000), Holzhauser and Work (1999), and others. Although these requirements are based on northern populations of pond turtles, they can still act as guidelines for southern populations.

Water Bodies: Water bodies should contain still or slow-moving water with some areas at least one meter, but preferably up to two meters deep for adults. In addition, at least 25% of the water's edge should be less than 30.5 centimeters deep with a gentle gradient for young juveniles. Water body should also be permanent.

Vegetation: There should be emergent and submergent aquatic vegetation present, but the water body should get good sun exposure. Reese and Welsh (1998b) suggest that some cover, especially along the water's edge, may help pond turtles avoid predation and that pools receiving patchy sunshine may allow for better thermo-regulation. If the water bodies become too choked with vegetation, some vegetation should be removed.

The reduction in scouring flows due to water diversion or damming of a watercourse can lead to an increase in downstream vegetation (i.e., the vegetation does not get scoured away on a regular basis as with the historic natural hydrologic regime) (Williams & Wolman 1984; Ligon et al. 1995; Collier et al. 2000), thus allowing vegetation to encroach on pond turtle habitat and eventually completely shade or fill in the deep open pools adults require. This was observed in Sweetwater River below Loveland Dam and in the Otay River below Savage Dam (Lower Otay Reservoir). As a result, monitoring the presence of native or non-native plant species and their effects on pond turtle habitat (e.g., *Typha* spp. or *Arundo donax* encroaching on deep pools), should be a part of the pond turtle management plan. It may be necessary to remove native and non-native species in areas that are too shaded or have become choked with vegetation. These sites should then be monitored to determine the effectiveness of removal and to measure benefits to pond turtles. Early removal of known problem species, especially non-natives, can be more cost effective than delaying removal until an impact on the turtles is clearly detectable.

Aquatic Refugia: If not present, aquatic refugia such as plants, rock, pieces of wood, or roots wads should be added for turtles to retreat or hide.

5.2.7 Native and Non-Native Predatory Species

Introduced predators, especially bullfrogs and largemouth bass, pose potential threats to pond turtles (Holland 1991, 1994). Bullfrogs and/or largemouth bass were detected at most of the locations that were surveyed within the MSCP, including locations where pond turtles occur. In general, pond turtles are most vulnerable to predation during the younger life history stages (when they are neonates and small juveniles). When pond turtles enter aquatic systems, they are about the size of a silver dollar. Bass and bullfrogs are “gape limited” predators that have been

reported to eat young pond turtles (neonates to yearlings) (Moyle 1973; Brattstrom & Messer 1988; Holland 1991, 1994). Due the threats non-native predators pose to population recruitment and because recruitment rates appear low or absent within the MSCP pond turtle populations, non-native predatory species should be removed from locations to be managed for pond turtles, the effectiveness of eradication techniques should be monitored, and the benefits to pond turtles should be measured.

In addition to non-native aquatic species, native and non-native terrestrial predators must also be monitored and controlled, if necessary. Native predators, such as raccoons (*Procyon lotor*) and coyotes (*Canis latrans*), and introduced predators, such as opossums (*Didelphis virginiana*) are more likely to injure or take females, eggs and young. Terrestrial predator removal has been shown to reduce the number of destroyed turtle nests and enhance hatchling yield (Christiansen & Gallaway 1984). The reproductive success of pond turtles is low and recruitment rates are very low or absent within the known MSCP populations, thus it is important to monitor predator populations in areas that contain pond turtles.

5.2.8 Other Non-native Threats

Other non-native species that may be detrimental to pond turtle populations, such as sunfish, carp, mosquitofish, and crayfish, were found at many locations throughout the MSCP (see Section 4.2.7). These species may indirectly affect pond turtles by changing the aquatic community, competing for prey, or spreading disease. The presence of these species may also be beneficial, as they may serve as a prey source for pond turtles. However, controlling these species and restoring the aquatic community, especially in or near locations that support pond turtles, will likely benefit pond turtles. It will also be important to monitor the effectiveness of eradication techniques and measure benefits to pond turtles.

Non-native plant species were also detected at many locations throughout the MSCP. Non-native plants should be controlled and monitored in areas that support pond turtles.