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USGS Western Pond Turtle (*Emys marmorata*) Trapping Survey Protocol for the Southcoast Ecoregion

Survey Protocol, version 1



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

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U.S. DEPARTMENT OF THE INTERIOR
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1.0 INTRODUCTION

This protocol documents standard trapping survey techniques for southern populations of the western pond turtle (*Emys marmorata*), hereafter referred to as pond turtle, in the southcoast ecoregion of the United States (within the U. S. this extends from Santa Barbara, California to the Mexican boarder). The purpose of this protocol is to provide standard guidelines for determining pond turtle presence, relative abundance, population demographics and provide baseline information applicable to declines in pond turtle populations. The protocol, in combination with the USGS Western Pond Turtle (*Emys marmorata*) Visual Survey Protocol for the Southcoast Ecoregion, contributes information on general habitat components and disturbances found at each location so that hypotheses can be formulated and tested as to why a species occurs or does not occur in a particular area (U. S. Geological Survey, 2006a). In addition, the techniques are effective at documenting other aquatic species such as fish, amphibians, and other aquatic freshwater taxa. This protocol is based on methods found in the USGS Aquatic Species and Habitat Assessment Protocol for Southcoast Ecoregion Rivers, Streams, and Creeks (U. S. Geological Survey, 2006b).

This protocol describes trapping surveys that are to be conducted in streams, rivers, ponds, reservoirs and lakes. Surveys conducted on linear sites, for example streams or rivers, will be broken down into 250 m segments. Segmenting the linear survey areas will provide a reasonable means of recording data that are representative of the entire site and will allow for detection probability analyses to be calculated. Surveys should be conducted during the time of greatest pond turtle activity, typically during the breeding season (May - July), and when pond turtles have not left the water to aestivate or overwinter in the uplands. Southern populations of pond turtles may remain active and in the water year-round, if the conditions are suitable (enough water, warm temperatures); however, this is not well studied.

In this protocol we assume that prior to conducting a survey, surveyors have familiarized themselves with background information and the biology of the pond turtle in order to form a good search image and know where to look for this species. For information on the key characteristics, natural history, and biology of the pond turtle we suggest referring to Stebbins (2003) and “A Field Guide to the Reptiles and Amphibians of Coastal Southern California” (<http://www.werc.usgs.gov/fieldguide/>). A brief summary of pond turtle natural history is included in this protocol.

2.0 POND TURTLE NATURAL HISTORY

The pond turtle, a member of the Emydidae family, is the only turtle native to coastal California. Pond turtles are cryptically colored and vary from a brown to olive-brown to dark brown (Figure 1). The scutes on their carapace have a radiating marbled pattern that are sometimes only visible in sunlight and their head and body have a mottled appearance (Figures 1 & 2). Males and females have slight morphological differences. Males tend to have thicker tails and their cloacal opening falls posterior to the posterior edge of their carapace (Figure 3). Females have thinner tails and their cloacal opening falls at or anterior to the posterior edge of their carapace (Figure 3). Males tend to have concave plastrons (to aid in mating), while females tend to have flat or slightly convex plastrons. The carapaces of females are also taller to allow room for eggs.

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Figure 1. Western pond turtle.



Figure 2. Western pond turtle carapace.

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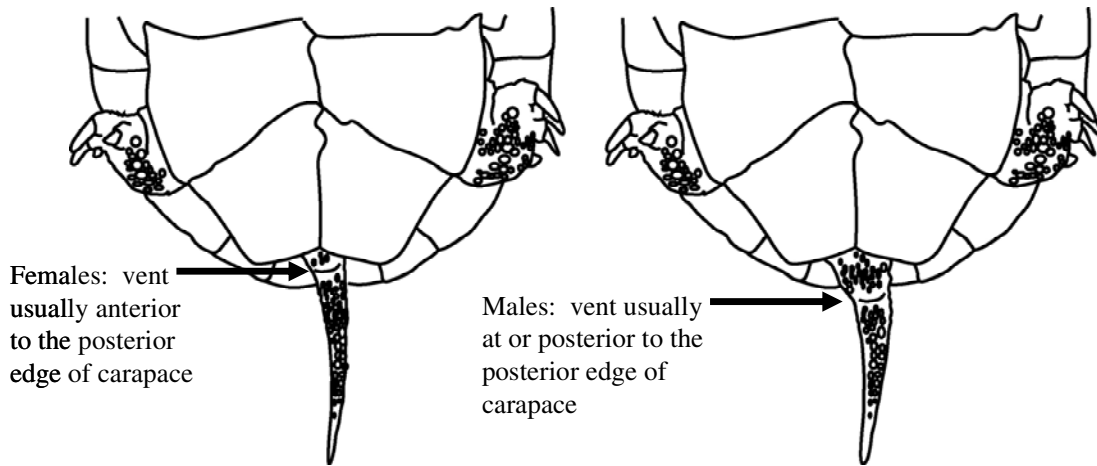


Figure 3. Sexing and measuring guidelines for western pond turtles.

In southern California, pond turtles reach sexual maturity at about 100 - 105 mm in carapace length and 4 - 6 years of age (Holland, 1992; Bury et al., 2001). In southern populations, females typically produce eggs yearly and sometimes double clutch (Goodman, 1997a, 1997b; Lovich & Meyer, 2002; Bury, in press). Clutch size ranges from about 1 to 13 eggs and is positively correlated with body size (Holland, 1991, 1994; Hays et al., 1999; Pires, 2001; Lovich & Meyer, 2002). Eggs are laid in excavated nests in upland habitat. Females will travel 100 m to just over 400 m perpendicular from wetland habitats to nest (Storer, 1930; Rathbun et al., 1992; Holland, 1994; Goodman, 1997a; Reese & Welsh, 1997; Lovich & Meyer, 2002; Rathbun et al., 2002). Hatchling survivorship is low; under undisturbed conditions only 10 - 15% survive the first year (Hays et al., 1999).

Pond turtles can often be found thermoregulating on aquatic basking areas such as rocks, downed logs, or emergent vegetation. They have acute hearing and eyesight and are easily disturbed. You will often hear them as they splash into the water to take cover before you see them. Basking behavior may be witnessed year round in southern populations due to warmer year round temperatures.

Pond turtles are dietary generalists and locate food by either sight or smell. Aquatic invertebrates are the mainstay of the adult diet, but carrion, small fish, frogs and some plants are also consumed. The diet of young pond turtles is poorly understood, but they are thought to eat zooplankton (Jennings & Hayes, 1994; McAllister et al., 1996).

The pond turtle is considered a habitat generalist because it inhabits many types of water bodies ranging from permanent to intermittent and from freshwater to brackish environments (Holland, 1991, 1994; Buskirk, 2002). Pond turtles are known to inhabit creeks, slow moving rivers, marshes, ponds, lakes, reservoirs, vernal pools, canals and even sewage treatment plants (Stebbins, 2003; Holland, 1991; Ernst et al., 1994; Reese, 1996) and prefer habitats with slow flowing water with the presence of woody or rocky debris that provide emergent and underwater refugia sites (Reese, 1996; Reese & Welsh, 1998a; Buskirk, 2002).

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Pond turtles are mostly aquatic, but will leave water to travel to surrounding upland habitats to nest, over-winter, bask and aestivate (Holland, 1991; Reese, 1996; Reese & Welsh, 1998b; Lovich & Meyer, 2002; Rathbun et al., 2002). Although it is clear that pond turtles rely on these terrestrial environments to meet their life history requirements, the amount of time that they spend in these areas and the distance they travel from water is poorly known in the arid southern portion of its range (except see Goodman, 1997a).

Historically, this species was common in most major coast-facing drainages and had a relatively continuous distribution from Washington to northern Baja California, with a few scattered isolated populations elsewhere (Storer, 1930; Stebbins, 2003; Ernst et al., 1994; Jennings & Hayes, 1994). The pond turtle is in a general state of decline throughout much of its range (Brattstrom & Messer, 1988; Holland, 1991; Jennings & Hayes, 1994). In southern California, pond turtles were once widespread and common (Brattstrom, 1988; Brattstrom & Messer, 1988). The pond turtle is a Federal and California Department of Fish and Game Species of Concern. The principal cause of decline in the pond turtle is riparian and terrestrial habitat loss and degradation.

3.0 PURPOSE

Currently, pond turtle inventory and monitoring surveys are conducted regularly across the ecoregion by a large number of biologists from federal and state agencies, educational institutions, and non-governmental organizations throughout Los Angeles, San Bernardino, Riverside, Orange and San Diego Counties. Survey methods and data collection differ greatly among biologists and across sites. Therefore, we are often unable to establish detection probabilities which require standard survey techniques, to analyze what factors influence probabilities of detection for pond turtles, or to build predictive or explanatory models in an area or region. The purpose of this protocol is to provide a standard means of taking measurements and recording data so that changes reflected in these data are the result of natural phenomena and not because of changes in the way different individuals collect and record these data (Oakley et al., 2003). Standardizing data collection methods will also allow for data comparisons to be made across all parties and agencies using these methods (Oakley et al., 2003). The specific data collection methods described herein are intended for the purpose of quantifying information on the location and biology of pond turtles throughout the southcoast ecoregion and on the habitat components at these survey locations. We attempted to include a full suite of standard measures that may be used to adequately describe and predict suitable habitat for pond turtles and other native and non-native aquatic species. Our goal is to then use these measures as covariates in statistical analyses to determine probability of detection and predict species (MacKenzie et al., 2002, 2003).

4.0 PROTOCOL ORGANIZATIONAL OVERVIEW

This protocol is arranged in chronological order using a step-by-step procedure of what to do before, during and after a survey. We begin with pre-survey preparation, including trap preparation, making a survey map, preparing temperature loggers, preparing a field kit, and navigating to a site. We then describe how to set up and remove traps, which data are to be collected and the techniques used to collect them. We follow with post-survey procedures such as disinfecting and storing equipment, and correcting and storing data. Appendices have been added at the end of this document to provide more detailed information on data definitions (Appendix 1), an example of a paper data form (Appendix 2), and additional references and

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resources (Appendix 3). When performing certain procedures and measurements within this protocol special equipment may be needed. For care, use and methods for implementing these special procedures and using required instruments we refer the reader to additional protocols found in the USGS Vertebrate Sampling Protocols for Basic Procedures and Equipment Use (U. S. Geological Survey, 2006c). This manual of basic procedures will be provided as supplementary material to this protocol for those requesting the information.

As procedures, equipment, and survey techniques improve, this protocol may be revised periodically to ensure that the most effective means of surveying and data collection are utilized.

5.0 PRE-SURVEY PROCEDURES

5.1 Trap Preparation

If a site is considered potentially suitable for pond turtles during a visual survey (for visual survey protocol refer to USGS Western Pond Turtle (*Emys marmorata*) Visual Survey Protocol for the Southcoast Ecoregion), surveys using baited traps may be conducted to determine pond turtle presence, relative abundance, and population demographics (U. S. Geological Survey, 2006a). We suggest the following methods based on Holland (1994), Reese (1996), Ashton et al. (2001), Lovich & Meyer (2002), Rathbun et al. (2002), Bury et al. (2001), and Madden-Smith et al. (in press).

We recommend using commercial turtle traps (hoop traps) or a similar type of funnel trap. Hoop traps work well in deeper water, consist of one or more funnels, and come in a range of diameters and mesh size (Figure 4). Smaller box type funnel traps work well in shallow water (Figure 5). Trap netting should be treated with a coating (usually tar) to increase the longevity of the traps. Minnow traps (Figure 6), small funnel traps, can be set along with turtle traps to aid in detecting small turtles as well as small fish, amphibians, and amphibian larvae.

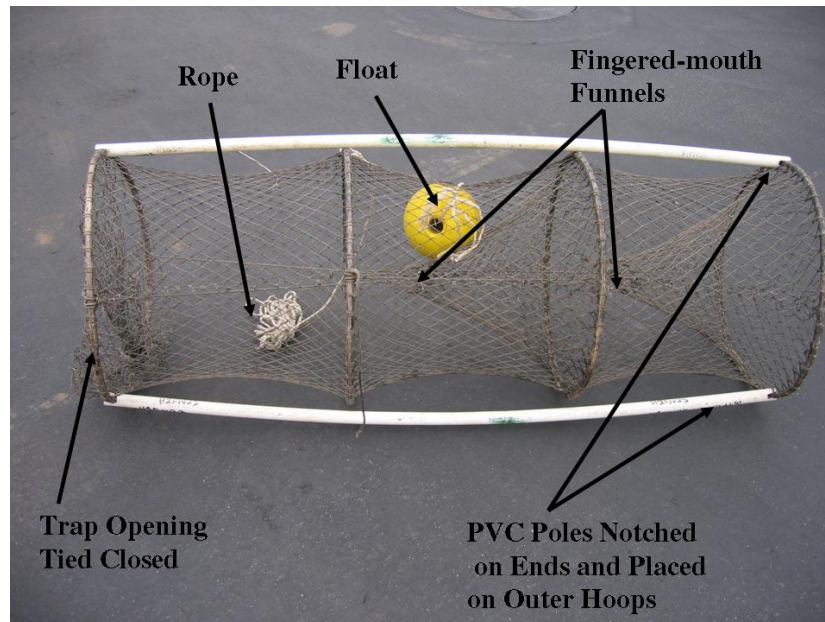


Figure 4. Example of a turtle trap. This trap is a 1.5 ft diameter double fingered-mouth funnel trap.

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Figure 5. Box type funnel trap.



Figure 6. Types of minnow traps.

We recommend baiting the traps with canned sardines (or any other type of fish) in oil, but any type of canned, fresh or frozen fish will work. Using a punctured can of sardines in each trap works well, preventing the consumption of the fish by the turtles, so traps remain baited. Sardines canned in oil seem to attract turtles better because they have a stronger odor than those canned in water. To save money, traps can be re-baited every other day and/or sardines can be divided into smaller containers or mesh bags. Traps should be set near habitat features likely to be used by pond turtles (possible basking areas, areas with underwater refugia). In stream habitats, traps should be set with the opening of the trap facing downstream. This will allow easier access to turtles as they swim upstream following the scent of sardines. The traps should also be anchored securely to shore with a rope (tied to the center top of the trap) so that the traps do not drift or sink. In addition, the top of the traps should be raised above the water's surface with floats to allow captured turtles (and other animals) to surface for air. Poles made out of PVC pipe or wood can be used to keep the hoop traps open (Figure 4). PVC poles should be filled with a spray foam (a non-toxic latex based insulating foam sealant) to help keep the traps afloat and to prevent the loss of poles in deep water if they happen to fall off of the trap. The floats and poles should be painted a dark color to help camouflage the traps to prevent them from

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being noticed and tampered with by humans or noticed and avoided by turtles. Two labels should be placed on each trap; 1) a unique identification number and 2) a please do not disturb equipment sign. The unique identification number should provide information about the type of trap and a unique number (i.e., H1-FN-13 this means the trap is a 1.5 ft. diameter (H1) funnel trap (FN) and it is trap number 13 or BX-04 is box trap number 4. It is best if traps are set for a minimum of 4 days. At a minimum, traps should be checked daily. In high traffic areas, traps should be monitored during the day and removed every evening to prevent traps from being tampered with or vandalized and deter the taking of animals.

The number of traps to be used will be based on the amount of time available to check all traps and process animals, the amount of available suitable turtle habitat, the accessibility of the habitat, and the number of traps available. Larger areas can be broken down and trapped over several survey sessions. Reviewing the visual survey data may help you determine the number of traps.

5.2 Preparing a Survey Map

Since sites must be visually surveyed prior to trapping, the sites are already pre-defined. Print a map of the survey site that shows the entire survey area. Depending on your survey site; a linear site, stream or creek broken up into 250 m segments, or a non-linear site, such as a pond, (hereafter referred to as segment and polygon respectively); make sure your map shows your 250 m segments or central point of each polygon. Also include any possible trap locations downloaded to the GPS unit or any pond turtle visual encounter locations from the visual survey.

5.3 Preparing Temperature Loggers

Temperature loggers need to be initialized prior to entering the field. Refer to USGS Vertebrate Sampling Protocols for Basic Procedures and Equipment Use, Module 14 (U. S. Geological Survey, 2006c).

5.4 Preparing a Field Kit

Prepare or inspect the field kit. Make sure batteries are fresh and there are sufficient extras. Familiarize yourself with the GPS unit. Make sure coordinate system and datum are set appropriately. USGS recommends using the datum WGS84 (NAD83 is also acceptable). The coordinates should be recorded in decimal degrees or hddd.ddddd°. See Figure 7 for the basic contents of a pond turtle field kit.

Survey Kit:

1. Appropriate permits (if required)
2. Copy of protocol
3. Maps
4. GPS unit with accompanying list of coordinates
5. PDA (Personal Digital Assistant) with field forms (or paper data forms). *Note: bring backup paper data forms in case of PDA technical difficulties.*
6. Field guides: USGS field key for aquatic species and/or Stebbins (2003) (western reptile and amphibian species), Conant and Collins (1998) (central and eastern North American turtle species), and McGinnis (1984) (fish).
7. Digital camera

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8. Binoculars
9. Thermometer (for air & water temp)
10. 50 ml vials of 95% ethanol (for collecting any dead non-turtle specimens and cleaning small instruments). Bring enough to accommodate more than the anticipated number of specimens you intend to collect.
11. Re-sealable bags (1-gallon and 1-quart size). Bring enough to accommodate more than the anticipated number of animals you intend to examine.
12. Alcohol-proof indelible pens (we generally use VWR markers)
13. Extra batteries (AA, AAA, D) depending on equipment
14. Bleach and extra water (for disinfecting equipment that has come in contact with animals or water)
15. Hiking boots or waders/water shoes (depending on the terrain and/or water levels)
16. Safety and first-aid kit
17. Large plastic container (for removing non-native turtles)
18. Extra rope (approximately 10 m per trap)
19. Flagging (for marking trails to traps in dense vegetation)
20. Bait (USGS suggests using canned sardines in oil)
21. Bags, carabineers, hooks, zip ties (1 per trap to attach bait to the trap)
22. Turtle traps (1.5 and 2.5 foot diameter commercial turtle or similar type of funnel trap with 1-1.5 inch-squared mesh)
23. Minnow traps (for catching small turtles, amphibians, and amphibian larvae)
24. Temperature data loggers- Hobo® (air) and TidbiT® (water)

Additional equipment needed for processing turtles:

25. Pesola® spring scales
26. Passive Integrated Transponder (PIT) tags (optional)
27. PIT-tag reader (optional)
28. 1.5 ml tissue vials (optional)
29. Surgical scissors for taking tissue sample from turtle tails (optional)
30. Small dial calipers (small turtles) and large slide calipers (large turtles) for measuring carapace
31. Triangular file (for notching shell)



Figure 7. Basic equipment needed for pond turtle surveys.

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5.5 Navigating to a Site

Use your GPS unit to navigate the vehicle(s) closest to the beginning of the site by selecting the “GO TO” button. On foot, navigate to the start point or edge of the site. Since the coordinates are typically figured using a topographical mapping program (TOPO!®) you can expect there to be some positioning error and you may need to adjust your position accordingly to place yourself in or adjacent the stream channel or pond. Now you are ready to start your forms and deploy traps.

6.0 TRAPPING SURVEY PROTOCOL

6.1 Opening Day of Trapping Surveys

6.1.1 Initial Survey Data

Once at your site, 250 m segment or polygon, data need to be collected before setting traps. Initial survey data include; block name (study site name), site name, weather, and site photo. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

At the start of each sampling period (250 m segment or polygon) start a new “StreamSurvey” form. The data fields at the top of the form relate to when, who, why, and how.

1. Survey ID: Self generating with the unique identifier for the survey.
2. Date: Self generating.
3. Survey Type: Select from the drop down menu the option “Turtle: Trapping”
4. Name: Self generating with the date and survey type (i.e., 5/8/06Turtle: Trapping).
5. Project: Record the project code for which the data are being collected. Obtain the correct project code from the project lead.
 - a) Field Project Notes: Record any pertinent information related to the project code.
6. Observer: Hit “Add” to open to a new form to begin entering observers. Record the name of each person on the survey.
 - a) Observer ID#: Select the observer from the drop down menu; if the name does not appear in the list, write the name in.
 - b) Observer Order: Self generating field.
 - c) Task: Select from the drop down menu the task each observer will do in the field. The options are; Both Observer/Recorder, Observer, Recorder, and Processor.
 - d) Note: Enter any additional relevant information about the observer.
7. Site Visit: Hit “Add” to open to a new form to begin entering site survey data.
8. Notes: Enter any additional relevant information about the site.

5/18/06Turtle: Trapping	
SurveyID	CC6-98
Name	5/18/06Turtle: Tr
Project	[Dropdown]
Observer	[Dropdown]
SiteVisit	[Dropdown]
Species Data	[Dropdown]
Weather	[Dropdown]
Notes

6.1.2 Site Visit Form

The next section of the “StreamSurvey” form includes site location information, along with several additional site descriptors. If using the PDA, some of these variables will be predefined for the survey site and will automatically populate when you choose your site name and segment. If multiple 250 meter sites or polygons are being trapped, create a new site visit record for each.

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Open the “SiteVisit” form and hit “Add”. The data fields at the top are related to the survey location.

1. Block: Chose the block name (= the name of your site) from the drop down menu.
2. Site: If your survey site is a stream, select the name of the 250 m segment from the pre-defined list (scroll to the name in your PDA or write down the name that was assigned to the site when it was pre-defined). If your site is a polygon the site name might be the same as the block.

Note: At this point the “Block” and “Site” you entered become the “Survey Name” and the predefined latitude/longitude, elevation, datum, drainage, and site length are populated for that record. If using the paper form these fields must be entered by hand.

SurveyName	Santiago Reservoir
Lats & Longs	
Weather	
Site Photo	Y N
# of Photos	4
Animals	
P&A records	A=4
PondTurtleTraps	
TemperatureLog	
Notes	test of pond turtle
Show All	(Show All)

3. Latitudes/Longitudes/Elevations: If you have correctly pre-defined the site, the start and end coordinates and elevations for each 250 m segment or central point coordinates and elevations for each polygon will be displayed by the PDA. If you do not have a PDA, enter data by hand in the fields for latitude, longitude, elevation, and datum on your paper data sheet.

6.1.2.1 Weather Data

Weather data only need to be recorded once per day. Record the date, weather condition, air and water temperature, wind speed, and any weather notes using the drop down menus. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

At the start of each survey day, start a new “Weather” form and hit “Add”. The data fields at the top of the form relate to where and when.

1. Site: Self generating with the Site, Block information.
2. Survey Date: Self generating with the current date and time.
3. Weather Conditions: Select the general sky conditions. The options are: clear or few clouds, partly cloudy or variable, cloudy or overcast, fog, mist or drizzle, showers or light rain, heavy rain, sleet or hail, snow.
4. Air Temperature: Measure air temperature (in degrees Celsius). Record temperature 1 m off the ground in the shade.
5. Water Temperature: Measure water temperature (in degrees Celsius). Place your thermometer 10 cm below the surface of the water (if possible) in an area that is representative of the creek or pond, (i.e., not in a backwater pool or side channel where temperatures would be expected to be warmer). Leave the thermometer under water for a minute or so and record the temperature once the thermometer reading has stabilized.
6. Wind Speed: Report the general wind speed based on the Beauford scale. The options are: <1 mph - calm, smoke rises vertically; 2~3 mph - light air movement, smoke drifts;

Site	Santiago Reservoir
Survey Date	5/19/06
WthrCond	1
Air Temp. C	
Water Temp. c	
Wind	
Weather Notes	
Show All	(Show All)

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4~7 mph - light breeze; 8~12 mph - gentle breeze leaves/small twigs in constant motion, raises dust; 13~18 mph - moderate breeze, small branches move; 19~24 mph - fresh breeze, small trees begin to sway; 25~31 mph - strong breeze, large branches move; 32~38 mph - near gale, large trees begin to sway, noticeably difficult to walk; >39 mph - gale and above; and no data.

7. Weather Notes: Enter any additional relevant weather information here (i.e., if there were any changes in the weather patterns such as rain during the middle of the survey).
8. Show All: The show all button brings up additional fields that are not required for this protocol. Ask your project lead if you need to record any additional data for your specific project.

Hit “End” and “Done” to close out the “Weather” form and continue the “SiteVisit” form.

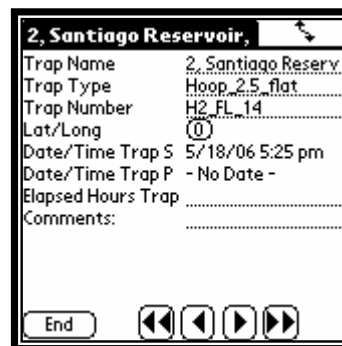
4. Site Photo: Yes/No. Indicate whether or not a photo was taken of the study site. Photo should be taken facing upstream at the beginning of each 250 m segment of stream or facing the pond.
 - a) Number of Photos: If photos were taken of the site, enter in the number of photos taken. You can also enter the names displayed on the LCD monitor by the digital photos generated by the digital camera. This will later help identify the correct photos for the respective survey sites.

6.1.2.2 Setting Pond Turtle Traps

Traps should be placed in areas known or thought to be used by pond turtles; areas of slow moving water with basking areas such as rocks, downed logs, and emergent vegetation or areas with underwater refugia. Once you have determined a trap location and the type of trap that will work the best, the trap can be deployed. If the surrounding habitat prevents the traps from being set from the shore a water craft may be required. Attach the PVC pipes perpendicular to the floats. Puncture the can of bait and hang it in the trap using a carabineer (the carabineer can be hooked through the netting of the trap and the tab on the bait can). If using a hoop trap, place the bait near the trap opening (Figure 4) on the side to which the float is attached. If using box traps, attach the bait with a zip tie or carabineer to the top, center of the trap. You may have to adjust the position of the bait to make sure it is submersed in the water. Now that the trap is set, the following data need to be recorded; trap type, trap number, and coordinates. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

The following fields appear when you select the “PondTurtleTraps” form and hit “Add”. Record all of the site information (described above).

1. Trap Name: Self generating with the unique identifier for the trap.
2. Trap Type: Select the type of trap that was set. The options are: Box, Hoop_1.5_fingered, Hoop_2.5_fingered, Hoop_2.5_flat, and Minnow. Selecting a trap type will affect the drop down list which appears under Trap Number.
3. Trap Number: Select from the drop down the trap number. The trap number is attached to the trap.



2, Santiago Reservoir	
Trap Name	2, Santiago Reservoir
Trap Type	Hoop_2.5_flat
Trap Number	H2_FL_14
Lat/Long	(0)
Date/Time Trap S	5/18/06 5:25 pm
Date/Time Trap P	- No Date -
Elapsed Hours: Trap
Comments:

End ⏪ ⏩ ⏴ ⏵

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4. Latitude/Longitude/Elevation: Select Lat/Long field and hit “GPS Grab” in the form that pops up. This will generate your GPS location, elevation, estimated positioning error (EPE) and datum for where you are setting the trap. Make sure your GPS is connected to your PDA. If you do not have a GPS cable to connect to your PDA you may enter data by hand in the fields for lat, long, elevation, EPE, and datum.
5. Date/Time Trap Set: Self generating.
6. Date/Time Trap Pulled: Ignore until the traps are closed.
7. Elapsed Hours Trap Effort: Self generating once the Date/Time Trap Pulled is filled out.
8. Comments: Enter any additional information pertaining to the trap.

Continue to “Add” traps into the “PondTurtleTrap” form until all turtle traps are deployed.

6.1.2.3 Setting Minnow Traps

Minnow traps need to be set to aid in detecting small turtles as well as small fish, amphibians, and amphibian larvae. Set one minnow trap per every ten turtle traps in the same body of water. If turtle traps are set in different bodies of water within a site, set a minnow trap in each body of water at the same 1:10 ratio. Minnow trap information needs to be recorded the same way you record the pond turtle traps (refer to section 6.1.2.2). Once all traps have been set, hit “Done” to return to the “SiteVisit” form.

6.1.2.4 Setting Temperature Loggers

A minimum of two temperature loggers should be deployed at each site, one to record the air temperature and one to record the water temperature. Depending on the size of the site you may want to deploy additional loggers. Data loggers are usually deployed at the center of the site or at the start and end of the survey site. Once a logger has been set, data about the logger need to be recorded including; logger type, logger number, coordinates, and a start time.

Data fields are presented in the digital PDA forms format. The following fields appear when you select the “TemperatureLogger” form and hit “Add”. Fill out the form with all of the site information (described above).

1. Logger Type: Select the type of logger that was set. The options are: Hobo, Tidbit, or iButton.
2. Logger Number: Each logger has a unique identification number on the logger. Record that number.
3. Latitude/Longitude/Elevation: Select Lat/Long field and hit “GPS Grab” in the form that pops up. This will generate your GPS location, elevation, estimated positioning error (EPE) and datum for where you are recording water temperature data. Make sure your GPS is connected to your PDA. If you do not have a GPS cable to connect to your PDA you may enter data by hand in the fields for lat, long, elevation, EPE, and datum.
4. Start Time: Record the start date and time the logger was set.
5. End Time: Ignore this field until the temperature logger is removed from the site.

19	
Logger Type	↓Hobo
Logger #	19
Lat/Long	0
Start Time	5/18/06 5:25 pm
End Time	5/18/06 6:23 pm

End ⏪ ⏩ ⏴ ⏵

Continue to “Add” loggers until all temperature loggers are accounted for.

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The opening day turtle trapping survey is complete. Make sure you have recorded all visual species encounters, traps, temperature loggers and weather record then back-up your PDA.

6.2 Checking the Traps

For the next two to three days you will be checking the traps. Navigate to the start site (refer to sections 5.5). Once you are at the first trap site, initial data need to be recorded including weather. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

Open the “StreamSurvey” form that was created on the opening day and fill out the following fields.

6.2.1 Initial Survey Data

1. Survey ID: Self generating with a unique survey identification number.
2. Name: Self generating, with the date and survey type.
3. Project: Ignore this field; it was completed on opening day of turtle trapping.
4. Observer: Record the names of each person on the survey if different then the prior day.
 - a) Observer ID#: Select the observer from the drop down menu; if the name does not appear in the list write the name in.
 - b) Observer Order: Self generating field.
 - c) Task: Select from the drop down menu the task each observer will do in the field. The options are; Both Observer/Recorder, Observer, Recorder, and Processor.
 - d) Note: Enter any additional relevant information about the observer.
5. Site Visit: Ignore this field.
6. Notes: Enter any additional relevant information about the site.

6.2.2 Weather Data

Weather data only need to be recorded once per day. Record the date, weather condition, air and water temperature, wind speed, and any weather notes using the drop down menus. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

At the start of each survey day, start a new “Weather” form and hit “Add”. The data fields at the top of the form relate to where and when.

1. Site: The user must select which site to associate the weather data. A dropdown list of the sites entered on opening day will appear.
2. Survey Date: Self generating with the current date and time.
3. Weather Conditions: Select the general sky conditions. The options are: clear or few clouds, partly cloudy or variable, cloudy or overcast, fog, mist or drizzle, showers or light rain, heavy rain, sleet or hail, snow.
4. Air Temperature: Measure air temperature (in degrees Celsius). Record the temperature 1 m off the ground in the shade.
5. Water Temperature: Measure water temperature (in degrees Celsius). Place your thermometer 10 cm below the surface of the water (if possible) in an area that is representative of the creek or pond, (i.e., not in a backwater pool or side channel where

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temperatures would be expected to be warmer). Leave the thermometer under water for a minute or so and record the temperature once the thermometer reading has stabilized.

6. Wind Speed: Report the general wind speed based on the Beauford scale. The options are: <1 mph - calm, smoke rises vertically; 2~3 mph - light air movement, smoke drifts; 4~7 mph - light breeze; 8~12 mph - gentle breeze leaves/small twigs in constant motion, raises dust; 13~18 mph - moderate breeze, small branches move; 19~24 mph - fresh breeze, small trees begin to sway; 25~31 mph - strong breeze, large branches move; 32~38 mph - near gale, large trees begin to sway, noticeably difficult to walk; >39 mph - gale and above; and no data.
7. Weather Notes: Enter any additional relevant weather information here (i.e., if there were any changes in the weather patterns such as rain during the middle of the survey).
8. Show All: The show all button brings up additional fields that are not required for this protocol. Ask your project lead if you need to record any additional data for your specific project.

Hit “End” then “Done” to return to the main page.

Now you can start checking traps. An animal record needs to be recorded for each trap, even if no animals were captured in the trap. If no animals are in the trap a “none” record needs to be recorded to account for negative data (directions below).

6.2.3 Species Data

6.2.3.1 Non-turtle Animal Records

Every animal captured in a trap needs to be recorded. Take a photo and record the trap in which the animal was captured, species, age class, and disposition in the “Species Data” form. If several animals of the same species are captured (excluding turtles), in the same trap, you do not need to make a separate record for each individual. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

The following fields appear when you select “Species Data” and hit “Add” in the form with all of the site information (described above).

1. Animal Record ID: Self generating with the unique identifier for the animal.
2. Observation Method: Select the method of observation. The options are: Audio, Hand Capture, Trap, or Visual.
3. Site: This field appears after you have selected “Audio”, “Hand Capture”, or “Visual” as your observation method. Click on the blank line next to this field and chose your site from the drop down list.
4. Trap Name: This field appears if you selected “Trap” as your observation method. Select from the drop down menu the number on the trap. If the number of the trap is not being displayed, select “Trap Number” as the data field to be displayed in the right hand column of the drop down list.
5. Type: Select from the drop down menu whether the animal is a fish, frog, turtle, bird, invertebrate, etc.

The screenshot shows a PDA form titled "GRAF". The fields and their values are: Animal Record ID: CC6-98-1; Observation Meth: Visual; Site: Santiago Reservoir; Species: GRAF; Lat/Long: (0); Age: (empty); Disposition: R D E C; Photo: Y N; Location within hab: (checked); Animal Behavior: (checked); Notes: test of pond turtle. At the bottom, there is an "End" button and several navigation arrows.

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6. Species: Record all species captured and record each visually encountered species the first time it is seen during each trapping day within each 250 m segment or polygon.
7. Lat/Long: This field appears if you have selected “Audio”, “Hand Capture”, or “Visual” for your observation method. Perform a GPS grab.
8. Age: Select from the drop down menu the appropriate age class. The options are: Adult, Juvenile, Metamorph, Tadpole, 2nd Year Tadpole, and Hatchling.
9. Swab: This field shows up if you chose “Frog” from the species list. Ask your project lead if you need to use this field.
10. Disposition: Select the checkbox according to if the animal was Released (R), Dead (D), Escaped (E), or Collected (C).
11. Photo: Select Yes (Y) if you took a photo of the animal or No (N) if you did not.
 - a. Number of Photos: If photos were taken of the animal, enter in the number of photos taken.
12. Location Within Habitat: Select from the drop down menu the location within the habitat in which the animal was found. The options are pool, run, riffle, bank, upland, splashzone, and other. If you choose “Other” please indicate what that is.
13. Animal Behavior: Select from the drop down menu any behaviors you observed the individual doing. The options are calling, basking, foraging, mating, hiding, and other. If you choose “Other” please indicate what that is.
14. Notes: Record any pertinent information that does not fit into one of the other data fields.
15. Show All: The show all button brings up additional fields that are not required for the visual survey protocol. Ask your project lead if you need to record any additional data for your specific project.

If no animals were captured at a trap enter the “Type” as None and the “Species” as None. When multiple animals of the same species and age class are captured in the same trap (excluding turtles), create one “Species Data” record, hit “Show all”, then record the “Total Count”.

6.2.3.2 Non-native Turtle Animal Records

In addition to the information recorded for non-turtle species, you need to record the carapace length, weight, notch the shell and recaptured status. A “Species Data” record needs to be created for each turtle captured. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

Non-native turtles should be removed from the field. Local turtle clubs often accept donated animals and educate the public regarding the issues with releasing exotics into natural environments. Check with project lead for instructions on turtle removal.

The following fields are the fields that will appear in the “Species Data” form when a turtle is selected as the “Type”.

1. Animal Record ID: Self generating with the unique identifier for the animal.
2. Observation Method: Select the method of observation. The options are: Audio, Hand Capture, Trap, or Visual.
3. Site: This field appears after you have selected “Audio”, “Hand Capture”, or “Visual” as your observation method. Click on the blank line next to this field and chose your site from the drop down list.

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4. Trap Name: This field appears if you selected “Trap” as your observation method. Select from the drop down menu the number on the trap.
5. Type: Select turtle from the drop down menu.
6. Species: Record all turtle species captured and record each visually encountered species the first time it is seen during each trapping day.
7. Lat/Long: This field appears if you have selected “Audio”, “Hand Capture”, or “Visual” for your observation method. Perform a GPS grab.
8. Age: Select from the drop down menu the appropriate age class. The options are: Adult, Juvenile, Metamorph, Tadpole, 2nd Year Tadpole, and Hatchling.
9. Sex: Select Male (M), Female (F), Unknown (U), or Not Checked (X) as appropriate.
10. Length (mm): This is the carapace length for turtles or the snout-to-vent length for other herpetofauna in mm. This is the only measurement required by this protocol and is used to estimate age in turtles. For turtles, this measurement is taken with calipers along the midline of the carapace (Figure 8). Small dial calipers work well for small turtles (most pond turtles). Large slide calipers are best for large turtles. For other herpetofauna this measurement is taken from the tip of the nose to the cloaca using a measuring tape or ruler.



Figure 8. Using large calipers to measure the carapace length of a red-eared slider (*Trachemys scripta elegans*).

11. Notched: Select Yes (Y) or No (N). Indicate whether the plastron is already notched or if you notched the plastron by filing a single triangular notch on the right femoral scute (Figure 9). This notch will indicate that the turtle has been captured by someone using this protocol in the past. Since we are removing non-native turtles from the site, we want to know if turtles put up for adoption are being re-released.



Figure 9. Notch in right femoral scute of a pond turtle.

12. Disposition: Select the checkbox according to whether your animal was Released (R), Dead (D), Escaped (E), or Collected (C).
13. Tissue: Choose Yes (Y), No (N), or Unknown (U) by checking the appropriate box.
14. Photo: Select Yes (Y) if you took a photo of the animal or No (N) if you did not.

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- b. Number of Photos: If photos were taken of the animal, enter in the number of photos taken. All turtles captured should have three photos taken; the top of the carapace, the plastron, and the head.
15. Location Within Habitat: Select from the drop down menu the location within the habitat in which the animal was found. The options are pool, run, riffle, bank, upland, splashzone, and other. If you choose “Other” please indicate what that is.
16. Animal Behavior: Select from the drop down menu any behaviors you observed the individual doing. The options are calling, basking, foraging, mating, hiding, and other. If you choose “Other” please indicate what that is.
17. Notes: Record any pertinent information that does not fit into one of the other data fields.
18. Show All: The show all button brings up additional fields that are not required for the visual survey protocol. Ask your project lead if you need to record any additional data for your specific project.

6.2.3.3 Pond Turtle Animal Records

In addition to the information recorded for non-native turtle species you need to record the carapace width and height, plastron length, weight, PIT tag, and take tissue. Carapace width and height, plastron length, pit-tagging and tissue collection are optional. Check with the individual project lead for instruction on the processing techniques you will be using.

The following fields will appear in the “Species Data” form when a pond turtle is selected.

1. Animal Record ID: Self generating with the unique identifier for the animal.
2. Observation Method: Select the method of observation. The options are: Audio, Hand Capture, Trap, or Visual.
3. Site: This field appears after you have selected “Audio”, “Hand Capture”, or “Visual” as your observation method. Click on the blank line next to this field and chose your site from the drop down list.
4. Trap Name: This field appears if you selected “Trap” as your observation method. Select from the drop down menu the number on the trap.
5. Type: Select turtle from the drop down menu.
6. Species: Record all pond turtles captured and record each visually encountered species the first time it is seen during each trapping day.
7. Lat/Long: This field appears if you have selected “Audio”, “Hand Capture”, or “Visual” for your observation method. Perform a GPS grab.
8. Age: Select from the drop down menu the appropriate age class. The options are: Adult, Juvenile, Metamorph, Tadpole, 2nd Year Tadpole, and Hatchling.
9. Sex: Select Male (M), Female (F), Unknown (U), or Not Checked (X) as appropriate.
10. Length (mm): This is the carapace length for turtles in mm. This is the only measurement required by this protocol and is used to estimate age in turtles. For turtles, this measurement is taken with calipers along the midline of the carapace (Figure 8). Small dial calipers work well for small turtles (most pond turtles). Large slide calipers are best for large turtles.
11. Carapace Width: This measurement is taken on the widest part of the carapace, usually between the eighth and ninth marginal scutes. This measurement is taken with calipers and recorded in mm (Figure 10). Small dial calipers work well for small turtles (most pond turtles). Large slide calipers are best for large turtles.

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Figure 10. Using large calipers to measure the carapace width of a red-eared slider (*Trachemys scripta elegans*).

12. Carapace Height: This measurement is taken between the lowest and the highest points of the turtle with calipers and recorded in mm (Figure 11). Small dial calipers work well for small turtles (most pond turtles). Large slide calipers are best for large turtles.



Figure 11. Using large calipers to measure the carapace height of a red-eared slider (*Trachemys scripta elegans*).

13. Plastron Length (mm): This measurement is taken with calipers along the midline of the plastron (Figure 12). Small dial calipers work well for small turtles (most pond turtles). Large slide calipers are best for large turtles.

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Figure 12. Using large calipers to measure the plastron length of a red-eared slider (*Trachemys scripta elegans*).

14. Weight (g): Weight can be taken by placing the animal into a plastic resalable bag or for large animals, a snake bag or pillow-case, and clipping the bag to a Pesola® spring scale (Figure 13). First tare the bag to the scale. This means that you will be adjusting the scale to account for the weight of the bag so only the weight of the animal is measured. Be sure the animal is motionless before trying to read the scale.



Figure 13. Weighing a red-eared slider using a Pesola® spring scale.

15. Recap: Select Yes (Y), No (N), Unknown (U) or Not Checked (X). All captured turtles should be scanned with a PIT-tag reader and checked for notches on the carapace or plastron. The reader should be used to scan all around the body cavity, focusing on the areas anterior to the rear legs and scanning both sides of the shell. It may take multiple scans from the reader to detect and read a PIT-tag. If turtles are captured in an area previously surveyed by USGS, check for a notch on the right femoral scute (Figure 9). This scute is notched by USGS to indicate the turtle is a recap in the case that a PIT-tag

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has failed or been expelled. See below for more information on PIT-tags and plastron notching.

16. ID Number: All pond turtles should be tagged with a PIT tag, encoded with a unique identification number. The PIT tag is inserted inside the body cavity anterior to the rear right leg following methods of Rathbun et al. (1993) and Buhlmann & Tuberville (1998). If this is a recapture, enter the number in this field as well.
17. Notched: Select Yes (Y) or No (N). Indicate whether the turtle's plastron has been marked or will be marked with a single triangular notch on the right femoral scute (Figure 9) indicating that the turtle has been PIT tagged. This combined with PIT tagging will assist in future recognition of individual turtles.
18. Shell Damage: Select Yes (Y) or No (N). If yes is selected enter the following information:
 - a. Type of Shell Damage: Describe the severity and location of any shell damage, see Figures 14 & 15.

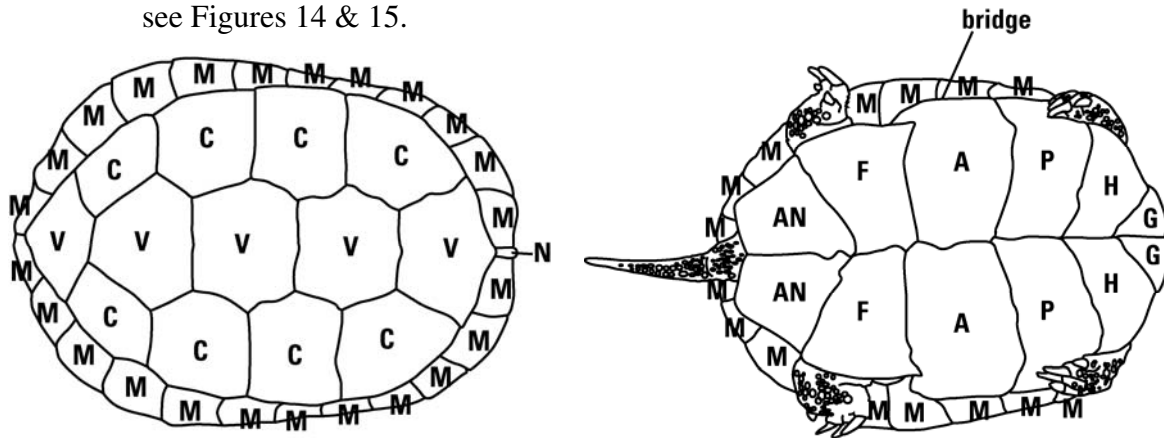


Figure 14. Pond turtle shield names; Abdominal (A), Anal (AN), Costal (C), Femoral (F), Gular (G), Humeral (H), Marginal (M), Nuchal (N), Pectoral (P), Vertebral (V), and the bridge is the connection point of the carapace with the plastron.

19. Other ID Markings: This is the unique identification number given to turtles by notching the marginal scutes of the carapace (Figures 15 & 16). This method is not used by USGS. Check with landowners/regulatory agencies before initiating a trapping survey to determine if pond turtles have been previously captured and marked in the area.

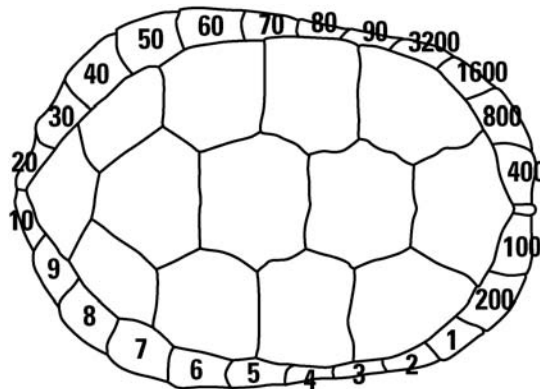


Figure 15. Pond turtle with notched marginal scutes. Example of marginal scute numbering scheme.

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paper data forms, you will be recording these data fields manually.

The following fields need to be completed by entering the “SiteVisit” form. Select the appropriate site name. Within this site, select the “PondTurtleTraps” form and select the trap you are removing.

1. Trap Name: Self generating with the unique identifier for the trap.
2. Trap Type: Field already completed.
3. Trap Number: Make sure the record selected corresponds to the trap being removed.
4. Latitude/Longitude/Elevation: Field already completed.
5. Date/Time Trap Set: Field already completed.
6. Date/Time Trap Pulled: Record the date and time the trap was pulled. If you select “Today” on the calendar page, the date and time will fill in automatically.
7. Elapsed Hours Trap Effort: Self generating once the Date/Time Trap Pulled is filled out.
8. Comments: Enter any additional information pertaining to the trap.

Repeat section 6.3.1 for every trap removed.

6.3.2 Closing Minnow Traps

The minnow traps also need to be closed and the Date/Time Trap Pulled needs to be recorded the same as in section 6.3.1.

Repeat section 6.3.1 for every trap removed. Once all traps have been closed, hit “End” then “Done” to close out the “PondTurtleTraps” form to return to the “SiteVisit” form.

6.3.3 Closing Temperature Loggers

After all the traps have been checked and removed the data loggers need to be removed. When a logger is removed the End Date/Time needs to be recorded. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be recording these data fields manually.

The following fields need to be completed with all of the site information (described above) when you select “TemperatureLoggers” form. Select the “Logger #” that is being removed.

1. Logger Type: Field already complete.
2. Logger Number: Make sure the temperature logger record selected corresponds to the logger being removed.
3. Latitude/Longitude/Elevation: Field already complete.
4. Start Time: Field already complete.
5. End Time: Record the end date and time the logger was removed. If you select “Today” on the calendar page, the date and time will fill in automatically.

Repeat section 6.3.3 for every logger removed. Once all loggers have been removed, hit “End” then “Done” to close out the “TemperatureLoggers” form to return to the “SiteVisit” form. Once all traps and loggers have been removed, make sure to back up the PDA.

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7.0 POST-SURVEY PROCEDURES

When you are finished with your field survey there are several post survey procedures that must be completed to 1) prevent the spread of biological pathogens and 2) to ensure that your data are correct and can be read by anyone requesting it.

1. Immediately after returning from the field, all equipment coming in contact with water or mud (i.e., boots, dip nets, seine nets, plastic specimen containers) must be thoroughly disinfected in a 16:1 water/bleach solution to prevent moving pathogens between study sites. Turtle traps can be soaked in the solution in a plastic child's pool or large garbage can. Traps can also be sprayed down with a higher concentration of bleach (using a spray bottle) and rinsed with a hose after a few minutes. The traps should then be placed in the sun to dry; see U. S. Geological Survey (2006c) Module 1.
2. Review and check the quality assurance/quality control (QA/QC) of the data from your surveys. Correct any mistakes.
3. Enter data into the USGS database. (This entails hotsyncing your PDA or hand entering data from your paper form).
4. Label photographs and send to project lead.
5. Get positive species identifications from experts if needed.
6. Make sure pH, conductivity and DO meters are calibrated and properly stored; see U. S. Geological Survey (2006c) Modules 10 - 13.

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Appendix 1: Data definitions.

Basking Area: Area above the surface of the water where sunny space is available for animals to rest and sun themselves (i.e., rocks, sunny banks).

Carapace: The dorsal, convex part of the shell structure of a turtle, consisting of an external layer of horny material, divided into large plates known as scutes, which overlie a layer of interlocking bones.

Plastron: The ventral, nearly flat part of the shell structure of a turtle, similar in composition to the carapace; with an external layer of horny material divided into plates called scutes and an underlying layer of interlocking bones.

Project Code: A unique alpha-numeric code assigned by USGS BRD, San Diego to each of our projects for the purpose of organizing projects, billing project accounts and retrieving data.

Scute: A horny, chitinous, or bony external plate or scale, as on the shell of a turtle.

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Appendix 2. Paper data form.

Turtle: Trapping Survey Form

Date _____	Survey Name _____	Survey Completed	Y N
Project Code _____	Observer1 _____	Obsv1 Task <u>observer/recorder/processor</u>	Block _____
Survey Type <u>visual/trapping</u>	Observer2 _____	Obsv2 Task <u>observer/recorder/processor</u>	Site _____
Start Time _____	Observer3 _____	Obsv3 Task <u>observer/recorder/processor</u>	Site Photo
End Time _____	Observer4 _____	Obsv4 Task <u>observer/recorder/processor</u>	Y N
		# photos _____	

Start Lat _____	End Lat _____
Start Long _____	End Long _____
Start Elev _____	End Elev _____
Datum _____	Drainage _____
	Site _____
	Length _____

Weather:

Air Temp (°C) _____
Water Temp (°C) _____
Condition <u>clear or few clouds, partly cloudy or variable, cloudy or overcast, fog, mist or drizzle, showers or light rain, heavy rain, sleet or hail, snow, no data</u>
Wind Speed <u><1 calm, 2-3 light air movement, 4-7 light breeze, 8-12 gentle breeze, 13-18 moderate breeze, 19-24 fresh breeze, 25-31 strong breeze, 32-38 near gale, >39 gale and above, no data</u>

All Animals:

Observ Method	Trap Name (if applicable)	Trap Type (if applicable)	Trap Number (if applicable)	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours
1	audio/hand/trap/vis						
2	audio/hand/trap/vis						
3	audio/hand/trap/vis						
4	audio/hand/trap/vis						
5	audio/hand/trap/vis						
6	audio/hand/trap/vis						
7	audio/hand/trap/vis						
8	audio/hand/trap/vis						
9	audio/hand/trap/vis						
10	audio/hand/trap/vis						
11	audio/hand/trap/vis						
12	audio/hand/trap/vis						

All Animals (continued):

Type	Species	Age Category	Disposition				Sex				Length (mm)	Notched		Tissue			Photo	# Photo
1		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
2		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
3		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
4		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
5		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
6		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
7		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
8		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
9		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
10		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
11		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
12		A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	

Additional Fields for Pond Turtles:

Carapace Width (mm)	Carapace Height (mm)	Plastron Length (mm)	Weight (g)	Shell Damag		Type of Shell Damage	Other ID Markings	
1				Y	N		Y	N
2				Y	N		Y	N
3				Y	N		Y	N
4				Y	N		Y	N
5				Y	N		Y	N
6				Y	N		Y	N
7				Y	N		Y	N
8				Y	N		Y	N
9				Y	N		Y	N
10				Y	N		Y	N
11				Y	N		Y	N
12				Y	N		Y	N

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Appendix 3. Additional References and Resources.

Contact Information:

For questions and comments on this protocol (including additional information, modular protocols, and supplementary materials): scompton@usgs.gov, chitchcock@usgs.gov, abacklin@usgs.gov

Additional Reference Material:

Conant, R. and J. T. Collins. 1998. A Field Guide to Reptiles & Amphibians of Eastern & Central North America. Boston, Massachusetts, Houghton Mifflin Company.

Ernst, C. H., J. E. Lovich, and R. W. Barbour. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington and London. 578 pp.

Stebbins, R. C., 2003. A Field Guide to Western Reptiles and Amphibians. Boston, Massachusetts, Houghton Mifflin Company.

Internet Resources:

USGS herp. field guide: <http://www.werc.usgs.gov/fieldguide>

California's Plants and Animals: <http://www.dfg.ca.gov/hcpb/species/species.shtml>

eNature Wildlife Field Guide: <http://www.enature.com/home/>

Western Pond (*Clemmys marmorata*) Turtle Library:

<http://www.atlantismagazine.com/bettelheim/marmorata.html>