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USGS Western Pond Turtle (*Emys marmorata*) Visual 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
DIRK KEMPTHORNE, SECRETARY

U.S. GEOLOGICAL SURVEY
P. Patrick Leahy, Acting Director

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For additional information, contact:

Center Director
Western Ecological Research Center
U.S. Geological Survey
3020 State University Drive, East Modoc Hall
Sacramento, CA 95819

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1.0 INTRODUCTION

This protocol documents standard visual 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 and relative abundance. The protocol also 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. In addition, the techniques are effective at documenting other aquatic species such as fish, amphibians, snakes, 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, 2006a).

This protocol describes visual 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 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.

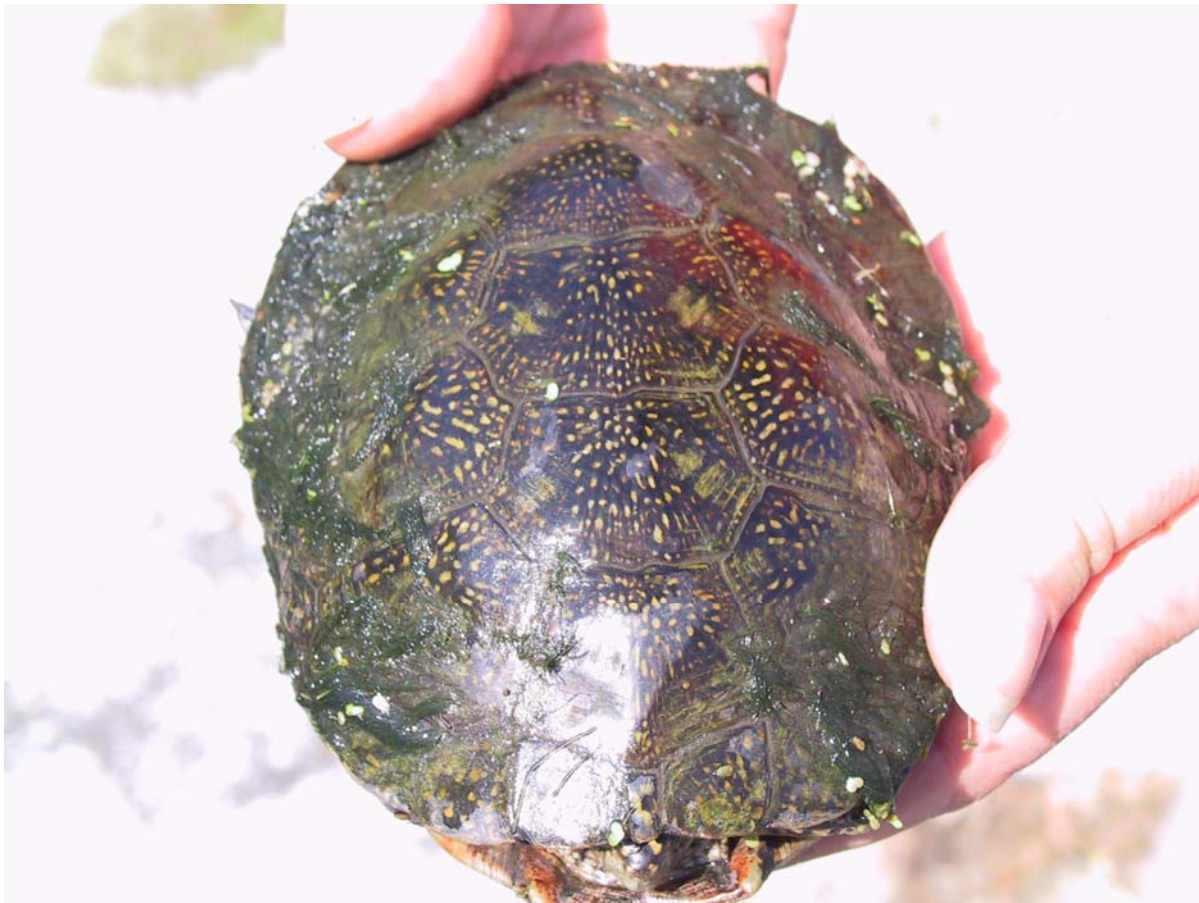


Figure 2. Western pond turtle carapace.

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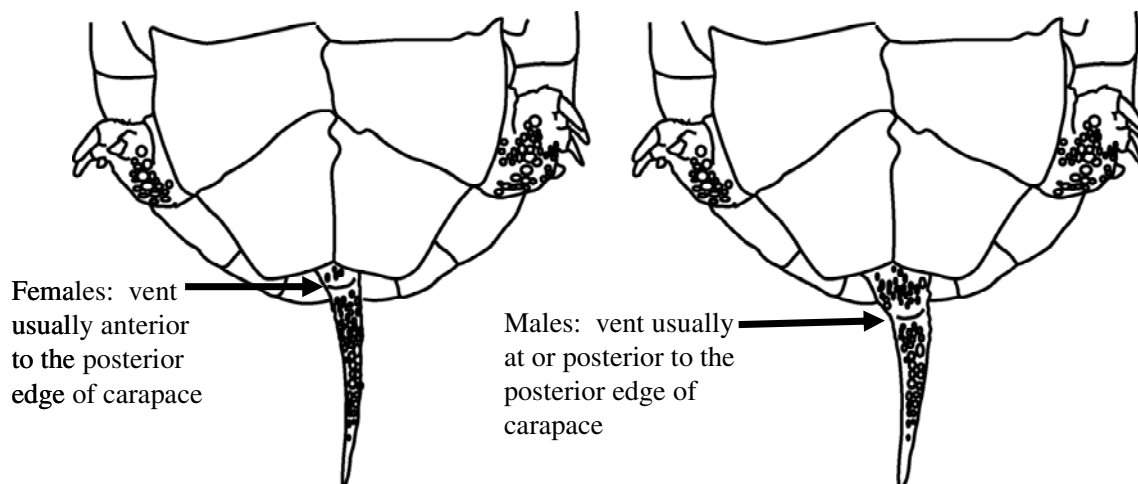


Figure 3. Sexing and measuring guidelines for western pond turtles.

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).

Pond turtles are mostly aquatic, but will leave water to travel to surrounding upland habitats to nest, overwinter, bask and aestivate (Holland, 1991; Reese, 1996; Reese & Welsh, 1998b;

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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 making a survey map, preparing a field kit, and navigating to a site. We then describe which data are to be collected, the techniques used to collect them, and recording data. 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 (Appendices 1 & 2), southcoast ecoregion vegetative communities (Appendix 3), an example of a paper data form (Appendix 4), and additional references and resources (Appendix 5). When performing certain procedures and measurements within this protocol special equipment may be needed. For care, use and methods for implementing these special

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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, 2006b). 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 Preparing a Survey Map

Prior to each initial survey, the survey site must be “pre-defined” in the USGS database before you can collect data in a standardized manner. The term “pre-defined” in this protocol, when surveying a stream, means that the survey start and end points have been determined, that the linear stream area between the start and end points has been divided up into 250 m segments and all associated information (i.e., drainage, location name, datum, GPS, and elevation of each segment) has been linked to each segment and location name (hereafter referred to as segments). When surveying a pond, the term “pre-defined” in this protocol means that a central point is determined and all associated location information has been linked to each location name (hereafter referred to as polygons). Many sites within the southcoast ecoregion have already been pre-defined. Check with the individual project lead for the status of your site and request that it be pre-defined if it has not already been done. If you are a project lead and need to pre-define a 250 m segment or polygon, please refer to the U. S. Geological Survey (2006b) Module 4. Once a site is pre-defined, you should print a map of your survey site that shows the entire survey area. Depending on your survey site segment or polygon make sure your map shows your 250 m segments or central point. For repeated surveys, you will use the same 250 m segments or central point within each polygon for data collection, thus making it possible to standardize how our data are being collected and analyzed.

5.2 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 4 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. Calibrated dissolved oxygen (DO) meter
11. Calibrated conductivity (EC) meter
12. Calibrated pH meter
13. Metric ruler
14. Measuring tape and / or range finder (for stream and channel width measurements)
15. 50 ml vials of 95% ethanol (for collecting any dead specimens and cleaning small instruments). Bring enough to accommodate more than the anticipated number of specimens you intend to collect.
16. Re-sealable bags (1-gallon and 1-quart size). Bring enough to accommodate more than the anticipated number of animals you intend to examine.
17. Alcohol-proof indelible pens (we generally use VWR markers)
18. Extra batteries (AA, AAA, D) depending on equipment
19. Bleach and extra water (for disinfecting equipment that has come in contact with animals or water)
20. Dip net, waterscope, seine, etc., (as needed to detect turtles and non-target species)
21. Hiking boots, rubber boots, waders, or water shoes (depending on the terrain and/or water levels)
22. Safety and first-aid kit
23. Cell phone (optional)

Additional equipment needed to process turtles

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



Figure 4. Basic equipment needed for pond turtle surveys.

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5.3 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. When surveying a stream by walking, whenever possible, start downstream and work your way upstream. This prevents stirred up debris from traveling ahead of you, which may alert the animals to your presence before you approach and also decrease your visibility within the creek making it difficult to detect animals. At the beginning of each 250 m segment press the “GO TO” button and select the end point of that 250 m segment (also the start point of the next 250 m segment) and keep track of your distance walked as you survey so you do not overshoot that end point. When a polygon is surveyed walk the perimeter of the water. If unable to walk the entire perimeter of the water walk as much as possible to survey the entire site. You may be unable to walk a stream or pond due to thick vegetation or deep water, if this is the case a water craft may be used to survey. Different habitat and site data will be recorded at the beginning and the end of each 250 m segment or perimeter walk of the polygon while animals encountered will be recorded throughout the survey.

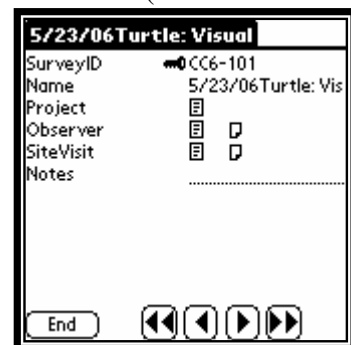
6.0 VISUAL SURVEY PROTOCOL

6.1 Initial Survey Data for Visual Surveys

At the start of each site, 250 m segment or polygon, during a visual survey, data need to be collected before surveying for animals and habitat characteristics. Initial survey data include; block name (study site name), site name, weather, site photo, and water measurements. Data fields are presented in the digital PDA forms format. If using paper data forms, you will be manually recording these data fields.

At the start of each survey (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: Visual”
4. Name: Self generating with the date and survey type (i.e., 5/8/06Turtle: Visual).
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 names 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 visit data.



5/23/06 Turtle: Visual	
SurveyID	CC6-101
Name	5/23/06Turtle: Vis
Project	
Observer	
SiteVisit	
Notes	

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8. Notes: Enter any additional relevant information about the site.

6.1.1 Site Visit Form

The next section of the “StreamSurvey” Form includes site location information, along with several additional site descriptors. Project leads will relay this information to the survey team once the site has been predefined. 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.

Open the “SiteVisit” form. 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 predefined 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 may be the same as the “Block” name.

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.

3. Stream Survey Completed: Y/N. If a stream survey was completed during the current season select Yes (Y), if not select No (N). This will hide fields where data have already been collected.
4. Latitudes/Longitudes/Elevations: If you have correctly predefined 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 generated 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.
5. ActualStartLL: Select ActualStartLL and add a new record. 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 quality 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.

The screenshot shows a PDA screen with the following fields and controls:

- Block: [Dropdown menu]
- Site: [Dropdown menu]
- StreamSurvey Co: [Y/N]
- SurveyName: [Text field]
- Lats & Longs: [Dropdown menu]
- ActualStartLL: [0]
- Weather: [Dropdown menu]
- Site Photo: [Y/N]
- Water: [Dropdown menu]
- SpeciesList: [Dropdown menu]
- StartTime: [- No Time -]

At the bottom, there is an "End" button and four navigation arrows (up, left, right, down).

6.1.1.1 Weather Data

Weather data need to be recorded at the start of the survey. Record the current weather condition, air temp, and wind speed. 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 “Weather” in the form, record all of the weather information (described above).

1. 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.
2. Air Temperature: Measure air temperature (in degrees Celsius). Record temperature 1 m off the ground in the shade.

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3. Wind: 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; 25~31mph - 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.
4. 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).
5. 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.

5/23/06	
WthrCond	2
Air Temp. C	19
Wind	3
Weather Notes	
Show All	(Show All)
End	◀◀ ▶▶

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

6. Site Photo: Y/N. Indicate whether or not a photo was taken of the study site, Yes (Y) or No (N). Photos 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. This will later help identify the correct photos for the respective survey sites.

6.1.1.2 Water Quality Measurements

The first time water is encountered, usually (but not always) at the start of the survey site, you will measure and record a number of water quality variables. Before taking measurements, look for any aquatic species within or next to the water. Document the species before recording water quality and stream/pond measurements. If animal species are recorded and the water is affected by the search (i.e., increased turbulence, substrate is disturbed in water, etc.), take water quality in an unaffected area upstream (if surveying a 250 m segment) or away from the disturbance, if possible.

The following fields appear when you select “Water” in the form, record all of the water information (described above).

1. Water Present: Y/N, is water present along the study site? Yes (Y) or No (N). If yes, then report the rest of the water quality measurements. If you select no, the below fields 2-6 will remain hidden fields.
2. 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.
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 quality data. (Make sure your GPS

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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. pH: Immerse the electrode of the pH meter below the surface of the water in an area that is representative of the creek, (i.e., not in a backwater pool or side channel). Leave the meter under water for a minute or so and record the pH once the reading has stabilized. See USGS, (2006b) Module 12 for more information.
5. Conductivity (μS): Immerse the electrode of the conductivity meter below the surface of the water in an area that is representative of the creek, (i.e., not in a backwater pool or side channel). Leave the meter under water for a minute or so and record the conductivity once the reading has stabilized. Specific conductance should be recorded in microsiemens (μS). See USGS, (2006b) Modules 10 and 11 for more information.
6. Dissolved Oxygen mg/L and % Saturation: Be sure to set the D.O. meter to the appropriate elevation prior to taking each reading. Remove the probe from the body and put it in the water in an area that is representative of the creek, (i.e., not in a backwater pool or side channel). If the water is still or stagnant you will need to slowly and steadily move the probe back and forth through the water while taking the reading. Wait until the reading has stabilized before recording it. D.O. should be recorded in percent saturation and also in milligrams per liter. See USGS, (2006b) Module 13 for more information.
7. Transparency: Do a visual estimate of water transparency of the water at mid-channel (if possible), and chose a category from the lookup table in the PDA. An easy method is to set a penny in the bottom of the pool. Choose one of the following options: “Clear” = can see the year on penny clearly in bottom of pool, “Moderate / Translucent” = cannot see year, but can see outline of penny, or “Opaque” = cannot see year or outline of penny.
8. Remarks: Enter any additional relevant water information here.
9. Show All: The show all button brings up additional fields that are not required for the general pond turtle survey protocol.

The screenshot shows a PDA form titled '1' with the following fields and values:

Water Present?	<input checked="" type="checkbox"/> Y <input type="checkbox"/> N
Water Temp. C	17
Lat/Long	(32.1N116.45)
pH	7.8
Conduct(μS)	
D.O. mgL	
D.O. % Sat.	
Transparency	Clear
Remarks	
Show all	<input type="button" value="showall"/>

At the bottom, there is an 'End' button and four navigation arrows (left, right, up, down).

When you have completed the water measurements click “End” to return to the main “SiteVisit” form and continue to fill in the following fields.

6.1.1.3 Species List

This list documents negative data and insures common species are accounted for during a survey. A list of the most common species will appear when you select the “Species List” form. Check the appropriate box for each species. If you are going to survey for that specific species, select surveyed and not detected (N). If you are not surveying for that species select not surveyed and not detected (X). Once an animal record is created for a species encounter, the checked boxes will automatically change to detected (D).

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

The screenshot shows a PDA form titled '3231226186' with a table of species and their status:

Pacific Chorus Frog	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
Western Toad	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
California Newt	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
Southwestern Toa	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
Mosquitofish	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
Crayfish	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
California TreeFro	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
Bullfrog	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
African clawed frog	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X
Western pond turtl	<input checked="" type="checkbox"/> D	<input type="checkbox"/> N	<input checked="" type="checkbox"/> X

Below the table is a 'Notes' field and an 'End' button with navigation arrows.

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7. Start Time: Record your start time. Click on the “-No Time-” next to start time and the PDA will generate the current time for you, click “OK”. You are able to manually adjust this time if this was not the actual start time of the survey.

Once a start time is recorded, begin visually searching the survey reach.

6.2 Visual Survey Techniques

Visual surveys are conducted to determine pond turtle presence, to make an assessment of habitat quality, to determine whether a site is trappable for pond turtles, and to select future trapping locations. Pond turtles are habitat generalists and can occupy a wide range of aquatic habitats, thus the most limiting factor of habitat suitability is the presence of water. Based on literature (Bury, 1972; Holland, 1991; Jennings & Hayes, 1994; Reese, 1996; Reese & Welsh, 1998b; Hays et al., 1999), in addition to the presence of deep pools and slow moving water, the following general characteristics are associated with pond turtle habitat: 1) basking sites, 2) aquatic refugia, 3) streamside refugia, and 4) upland nesting habitat. These characteristics should be kept in mind while conducting a visual survey. Once a site has been determined as potentially suitable pond turtle habitat and conditions are right for trapping, refer to the USGS Western Pond Turtle (*Emys marmorata*) Trapping Survey Protocol for the Southcoast Ecoregion, to conduct trapping (U. S. Geological Survey, 2006c).

As you search for animals, pay attention to the substrate and riparian vegetative and upland communities. Also note any non-native vegetation in the water or along the watercourse. Some common non-native plants include arundo (*Arundo donax*), tamarisk (*Tamarix sp.*), watercress (*Rorripa nasturtium aquaticum*), and mustard (*Brassica nigra*). Please bring and refer to a plant field guide if you are unfamiliar with the common native and non-native plants in southern California. As you conduct the visual survey, point out non-native plants and abrupt habitat changes to other members of the survey, this will help with documenting the vegetation at the end of the survey. Also look around every so often (USGS suggests every 50 m) and make a mental note about the dominant substrate on the banks and in the water, riparian vegetation types, vegetative cover in the channel and on the banks, and amount of potential basking areas and aquatic refugia (see Appendices 1 & 2 for definitions). This information will be recorded at the end of the segment so you want to obtain a representative mental picture of the proportions of these habitat components as you walk through them. It may take some practice to make a good estimate of all of the habitat components and their proportions within each 250 m segment or polygon so you may want to conduct a few mock-surveys to get accustomed to these methods. It is best if each member of the survey team makes their own individual mental notes and estimations, and compares these to the estimates of other team members at the end of each 250 m segment or polygon.

Start slowly walking up the stream channel, either in the water or immediately adjacent to the water. If you are unable to walk the site due to habitat features the visual survey can be conducted by water craft. If you come across an area that looks like it is suitable for trapping or a good location to place a trap, mark the point in your GPS unit. Saving points will help save time searching for trap locations during a trapping survey. In addition to looking for pond turtles and pond turtle habitat you need to document any other native and non-native aquatic species observed. For example, include all life stages of other amphibians, turtles, snakes, fish, crayfish, Asian clams, beavers, and beaver sign (see expected species list in PDA or paper data form for

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common species and field guides for proper identification). Use the following techniques to search for aquatic species.

1. Visual encounter: Search aquatic habitat with and without binoculars for the presence of basking or underwater pond turtles. Open pools or possible basking areas should first be observed from a distance and then approached slowly and quietly to help prevent disturbing basking turtles. Listen for the splash of water, possible unseen turtles entering the water. If you should hear a splash, spend additional time observing the area for a turtle to resurface. The length of time open pools or basking areas should be observed and searched depends on your research goals. If trapping surveys will not be conducted, due to difficult terrain, inadequate water depths, insufficient funding, etc., visual surveys may provide estimates of abundance and size classes.
2. Dip netting and seining: Pond turtles can be found at the edge or in the bottom of pooled water, in aquatic vegetation and under ledges along the perimeter of stream refugia and pools. When encountering deep pools and aquatic refugia, first visually search for turtles and any other aquatic animals and egg masses. If no eggs are seen, you may take long sweeps with the dip net or seine through the area. Gently sweep the net along the bottom and sides of the pool or refugia, then check the net for aquatic species by carefully sifting through any mud and debris brought up from the bottom. We recommend using two sizes of nets, a large fish net with a long handle for turtles and deep pools; and a small aquarium size net for small pond turtle hatchlings, fish and tadpoles. Do not disturb any egg masses with dip nets. Capturing turtles, tadpoles and fish with a net is useful method to observe animals more carefully, take voucher photos, and make positive identification. Special state and federal permits may be required for capturing and handling listed species.

6.3 Visual Survey Animal Records

6.3.1 Non-turtle Animal Records

The first time you encounter any species or different species age class within a site, the encounter must be recorded in the animal record. With the exception of turtles, once a species and each age class has been documented one time in the animal record additional encounters do not need to be recorded. Every single turtle encountered must be entered in the animal record. If you have specific questions pertaining to a non-turtle species you may want to record it more than once per site depending on your research goals. The first time you encounter a species within the site take a photo and record the species, age class, coordinates, and disposition in the animal form. If a turtle is actually captured on a visual survey refer to the USGS Western Pond Turtle (*Emys marmorata*) Trapping Survey Protocol for the Southcoast Ecoregion, to process and record the animal data (U. S. Geological Survey, 2006c).

The following fields appear when you select “Animals” and “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. Although Trap appears in the lookup list, it does not apply while conducting a visual survey.
3. Type: Select from the drop down menu whether the animal is a fish, frog, turtle, bird, invertebrate, etc.

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4. Species: During a visual survey, record each species the first time it is encountered within the 250 m segment or polygon by selecting that species from the drop down list. During a trapping survey, record all species captured and record each visually encountered species the first time it is seen during each trapping day.
5. 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 animal 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.
6. Age: Select the age. The options are: Adult, Juvenile, Metamorph, Tadpole, 2nd Year Tadpole, and Hatchling.
7. Swab: Y/N. This field will only show up if you are documenting an amphibian record. Refer to Geological Survey (2006b) Module 7 for the swab protocol.
8. Disposition: Select the appropriate checkbox according to if the animal was Released (R), Dead (D), Escaped (E), or Collected (C).
9. 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.
10. Notes: Record any pertinent information that does not fit into one of the other data fields.
11. 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.

The image shows a screenshot of a PDA application window titled "BUBO". The window contains the following fields and controls:

- Animal Record ID: CC6-101-1
- Observation Meth: Visual
- Species: BUBO
- Lat/Long: 0
- Age: Tadpole
- Swab: Y N
- Disposition: R D E C
- Photo: Y N
- Location within hab:
- Animal Behavior:
- Notes: (empty text area)

At the bottom of the screen, there are several navigation buttons: "End", a home button, and left/right arrow buttons.

6.3.2 Non-native Turtle Animal Records

If you choose non-native turtle from the species drop down menu the fields for Sex, Length, and Notched appear and must be filled in. Refer to the USGS Western Pond Turtle (*Emys marmorata*) Trapping Survey Protocol for the Southcoast Ecoregion for instructions on the additional turtle data collection (U. S. Geological Survey, 2006a).

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. Type: Select turtle from the drop down menu.
4. Species: During a visual survey, record each species the first time it is encountered within the 250 m segment or polygon by selecting that species from the drop down list. During a trapping survey, record all species captured and record each visually encountered species the first time it is seen during each trapping day.
5. 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 quality 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.
6. Age: Select the age. The options are: Adult, Juvenile, Metamorph, Tadpole, 2nd Year Tadpole, and Hatchling.

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- Sex: Record the sex of the turtle; Male (M), Female (F), Unknown (U), Not Checked (X).
- Length: Record the carapace length in mm.
- Notched: Chose Yes (Y) or No (N) depending on if the turtle has had the plastron notched or you will be notching it.
- Disposition: Select the appropriate checkbox, Released (R), Dead (D), Escaped (E), or Collected (C).
- Tissue: Check Yes (Y), No (N), or Unknown (U) depending on if turtle tissue was taken.
- Photo: Select Yes (Y) if you took a photo of the animal or No (N) if you did not.
 - 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.
- Notes: Record any pertinent information that does not fit into one of the other data fields.
- 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.

The screenshot shows a handheld device screen with a form titled "TRSC". The fields are as follows: Animal Record ID: CC6-101-2; Observation Meth: Visual; Species: TRSC; Lat/Long: 32.4N32.116; Age: Adult; Sex: M; Ln, mm: 48; Notched: Y; Disposition: R; Tissue: Y; Photo: Y. At the bottom, there is an "End" button and four navigation arrows.

6.3.3 Pond Turtle Animal Records

If you chose pond turtle from the species drop down menu the fields for Sex, Length, Carapace Width, Carapace Height, Plastron Length, Weight, Recap, ID Number, Notched, Shell Damage, and Other ID Markings appear and must be filled in. Refer to the USGS Western pond turtle (*Emys marmorata*) Trapping Survey Protocol for the Southcoast Ecoregion for instructions on the additional pond turtle data (U. S. Geological Survey, 2006a).

- Animal Record ID: Self generating with the unique identifier for the animal.
- Observation Method: Select the method of observation. The options are: Audio, Hand Capture, Trap, or Visual.
- Type: Select turtle from the drop down menu.
- Species: During a visual survey, record each species the first time it is encountered within the 250 m segment or polygon by selecting that species from the drop down list.
- 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 quality 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.
- Age: Select the age. The options are: Adult, Juvenile, Metamorph, Tadpole, 2nd Year Tadpole, and Hatchling.
- Sex: Record the sex of the turtle; Male (M), Female (F), Unknown (U), Not Checked (X).
- Length: Record the carapace length in mm.
- Carapace Width: Record the carapace width in mm.
- Carapace Height: Record the carapace height in mm.
- Plastron Length: Record the plastron length in mm.
- Weight: Record the weight in grams.
- Recap: Record if the animal is a recap Yes (Y) if it has a previous plastron notch or is PIT tagged. If the animal is

The screenshot shows a handheld device screen with a form titled "CLMA". The fields are as follows: Animal Record ID: CC6-101-3; Observation Meth: Hand Capture; Species: CLMA; Lat/Long: 32.3N117.45; Age: Adult; Sex: M; Ln, mm: 48; Carapace Width (m): 23; Carapace Height (m): 15; Plastron Length (m): 35; Weight, g: 17. At the bottom, there is an "End" button and four navigation arrows.

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not a recap record No (N). If you are unsure, record Unknown (U). Or if you forgot to check record Not Checked (X).

14. ID Number: All pond turtles should be tagged with a passive integrated transponder (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.
15. Notched: Plastron 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 indicating that the turtle has been PIT tagged. This combined with PIT-tagging will assist in future recognition of individual turtles.
15. 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.
16. Other ID Markings: Select Yes (Y) or No (N). This is the unique identification number given to turtles by notching the marginal scutes of the carapace. 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.
 - a. Record the ID Markings on the scutes of the carapace.
17. Disposition: Select the appropriate checkbox according to if the animal was Released (R), Dead (D), Escaped (E), or Collected (C).
18. Tissue: Check Yes (Y), No (N), or Unknown (U) depending on if turtle tissue was taken.
19. 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. All turtles captured should have three photos taken; the top of the carapace, the plastron, and the head.
20. Notes: Record any pertinent information that does not fit into one of the other data fields.
21. 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.

Hit "End" then "Done" to close out the "Animals" form and continue the "SiteVisit" form.

6.4 Ending a Site

6.4.1 Documenting Non-native Vegetation

Once a visual survey is complete, the non-native vegetation in the water or along the watercourse needs to be recorded.

The following fields appear when you select "Plants" and "add" in the form with all of the site information (described above).

1. Plant Species: Document the species of non-native vegetation detected. Select from the drop down menu.
2. Size Class: For each species report the abundance class of that species across the site by selecting a category from the drop down menu. The options are: few plants, scattered small patches, or large contiguous stands.
3. Notes: Record any other information that is pertinent to non-native vegetation in the field.

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- b. Upland Community: Record the dominant vegetative community along the 250 m segment outside of the main channel by selecting a community from the dropdown menu. This may be the vegetative community in the terrace or upland. See Appendix 2 for definition and Appendix 3 for a list of southern California vegetative communities. The selection in “Upland Community Type” will determine the options in the drop down list in “Upland Community”.
 - c. Riparian Community Type: Record the dominant riparian vegetative community type from the drop down menu. This is typically the habitat adjacent to the channel on the bank and in the floodplain. The options for riparian community types are: Chaparral, Desert, Forest, Grassland, Meadow/Marshes, Riparian, Scrub, Urban/Invasive, and Woodland. See Appendix 2 for definition and Appendix 3 for a list of southern California vegetative communities.
 - d. Riparian Community: Record the dominant riparian community along the 250 m segment or polygon by selecting one from the dropdown menu. This is typically the habitat adjacent to the channel on the bank and in the floodplain. See Appendix 2 for definition and Appendix 3 for a list of southern California vegetative communities. The selection in “Riparian Community Type” will determine the options in the drop down list in “Riparian Community”.
 - e. Dominant Riparian Plant: Record the top three dominant riparian plant species seen along the 250 m segment or polygon. Each plant should represent at least 10% of the riparian community or it should not be included. For example, if the segment is largely a monotypic stand of willow, with no other co-dominants \geq 10%, record willow only.
 - f. Dominant Riparian Plant 1 (2, 3): Choose from the drop down menu the riparian plant(s) that is most abundant. To be dominant it must comprise at least 10% of the overall vegetation in the area.
 - g. % Submergent Veg: Choose a category from the drop down menu that best corresponds with the percentage of submergent vegetation along the waterway.
 - h. % Emergent Veg: Choose a category from the drop down menu that best corresponds with the percentage of emergent vegetation along the waterway.
3. Dominate Bank Substrate
 - a. Substrate 1 (2, 3): Estimate and record the top 3 dominant substrate types on the bank and the relative percentage of each along the site by selecting a type and percentage range from the drop down menu. The choices for substrate are clay, silt, sand, pebbles, cobble, boulders/bedrock, leaf-litter, and fallen logs/trees. See Appendix 2 for definitions.
 - i. % Substrate 1 (2,3): The options for dominate bank substrate percentage are 0%, 1-10%, 11-25%, 26-50%, 51-75%, 76-100%.

6.4.2.1 Documenting Water and Habitat Characteristics

In the section labeled “PTAquaticRefuge/Disturbance” estimate and record characteristics of the wetted portion of the site. 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 “PTAquaticRefuge/Disturbance” form.

1. End Time: Enter the time that you finished surveying the segment.
2. End Water:

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- a. Percent Wet Length of Survey: Record the percentage of the length of the 250 m segment or polygon that was wetted by selecting a range from the drop down menu.
 - b. Percent Reach With Shallow Pooling Water: Estimate the percentage of the 250 m segment or polygon containing shallow pooling water (water less than 10 cm deep with little or no water movement). Include side pools, pooling water along side of the channel, within main channel, and isolated pools when making this estimate. Select the percentage range from the drop down menu.
 - c. Percent Reach With Medium Pooling Water: Estimate the percentage of the 250 m segment or polygon containing medium pooling water, (water depth greater than 10 cm and less than 1 m). Include side pools, pooling water along side of channel, within main channel, and isolated pools when making this estimate. Select the percentage range from the drop down menu.
 - d. Percent Reach With Deep Pooling Water: Estimate the percentage of the 250 m segment or polygon containing deep pooling water, (water depth greater than 1 m deep). Include side pools, pooling water along side of channel, within main channel, and isolated pools when making this estimate. Select the percentage range from the drop down menu.
 - e. Plunge Pools Present: Record whether or not plunge pools were present. See Appendix 2 for definition. Record Yes (Y), No (N), Unknown (U), or Not recorded (X). If “Yes,” record the estimated number of plunge pools.
 - i. Number of Plunge Pools: If “Yes” to above, estimate the number of plunge pools that occurred along the site. The options are 1 - 5, 6 - 10, 11 - 20, 21 - 30, 31 - 50, and 51 - 100.
 - f. Aquatic Refugia Present: Record whether or not aquatic refugia were present along the site. See Appendix 2 for definition. Record “Yes” or “No”. If “Yes,” identify the type(s) of refugia observed within the segment. The options for types of refugia are undercuts, tree roots, woody debris, rock crevices, aquatic submerged vegetation, emergent vegetation, and floating material (dead and live plant matter and / or algae). Select all that apply.
3. Dominate Aquatic Substrate:
- a. Substrate 1 (2, 3): Estimate and record the top 3 dominant aquatic substrate types and the relative percentage of each along the site by selecting a type and percentage range from the drop down menu. The choices for substrate are clay, silt, sand, pebbles, cobble, boulders/bedrock, leaf-litter, and fallen logs/trees. See Appendix 2 for definitions.
 - i. % Substrate 1 (2,3): The options for dominate aquatic substrate percentage are 0%, 1-10%, 11-25%, 26-50%, 51-75%, 76-100%.
4. Recent Disturbance:
- a. Disturbance Type: Document any disturbance seen and record the nature of the disturbance that was at the study site. Check all that apply (e.g., heavy foot traffic, trash, road / vehicle crossings, fire, etc.)
 - b. Intensity of Disturbance: Estimate the level of the disturbance across the 250 m segment or polygon. The options are light, moderate, and heavy.

SSEWID3231226428

End time 10:53 am

End Water

% Wet Length of S 26-50%

% reach with shallo 11-25%

% reach with medi 0%

% reach with deep 0%

Plunge pools prese Y N U X

Aquatic refugia pre Y N U X

Type of Aquatic re

Dom Aquatic Sub

Substrate 1 Gravel (2-32 mm)

End

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- c. Notes: Add any relevant information on the stream properties that have not yet been recorded.

6.5 End of Survey

Now that the site has been visually surveyed and animals, habitat, vegetation, substrate and disturbances are recorded in the “StreamSurvey” form, the end site location information needs to be recorded.

Close out the “PT Aquatic Refuge/Disturbance” form by clicking “End” and close out the “Landscape & Vegetation” form by clicking “End.” You will now be looking at the “SiteVisit” form. Scroll down to the bottom of this form and be sure to click on “Actual End LL.”

8. ActualEndLL: Select “ActualEndLL” and add a new record. 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 have finished your survey. 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.
9. End Time: Record your end time. Click on the “-No Time-” next to end time and the PDA will generate the current time for you, click “OK”. You are able to manually adjust this time if this was not the actual end time of the survey.
10. Notes: Record any pertinent information that does not fit into one of the other data fields.
11. 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.

The visual survey is complete. Using the data collected during this survey and communication with the survey team, the project lead can determine if the site is suitable for trapping. Any pictures and possible trap location points taken by the survey team should be downloaded, saved, and transferred to the project lead. If the site is suitable for trapping refer to the USGS Western Pond Turtle (*Emys marmorata*) Trapping Survey Protocol for the Southcoast Ecoregion (U. S. Geological Survey, 2006c).

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 (2006b) 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.

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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 (2006b) Modules 10 - 13.

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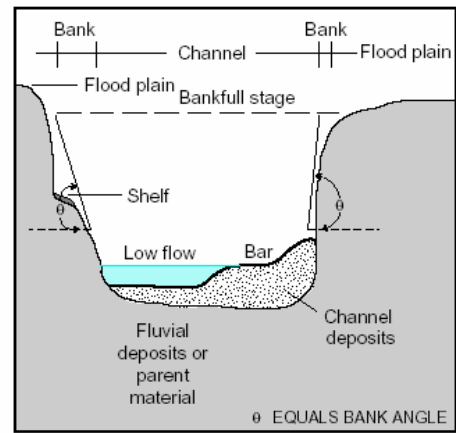
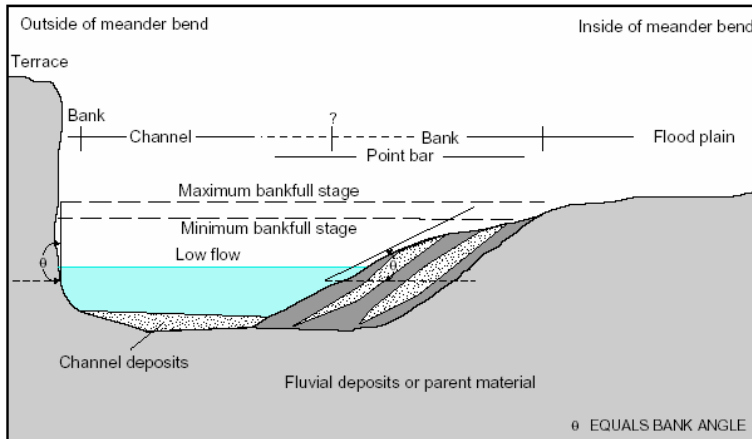
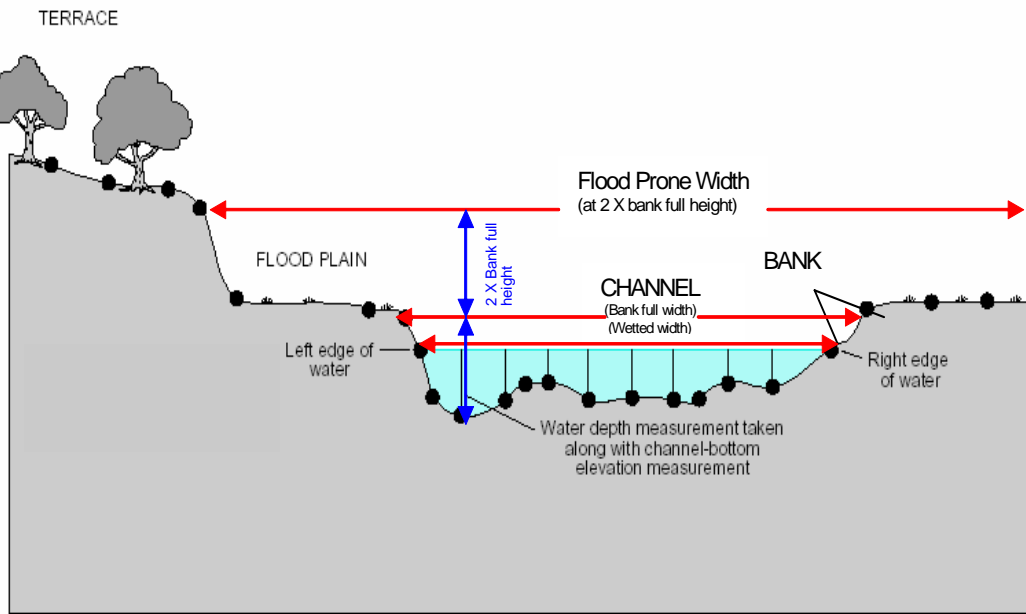
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Appendix 1: Landscape figures. (Most material in this section is directly taken or adapted from Fitzpatrick et al., 1998).



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Appendix 2: Data definitions (many landscape definitions in this section are taken directly taken or adapted from Fitzpatrick et al., 1998).

Aquatic Refugia: Any material within the water or on the surface that provides shelter, cover, or hiding place, (i.e., rocks, downfall in the form of logs, branches, woody debris, and artificial materials, undercuts of banks, tree roots, rock crevices, aquatic submerged vegetation, emergent vegetation, and other floating material).

Bank: The sloping ground that borders a stream and confines the water in the natural channel when the water level, or flow, is normal. It is bordered by the flood plain and channel.

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.

Channel: The channel includes the thalweg and streambed. Bars formed by the movement of streambed are included as part of the channel.

Conductance: A measure of the dissolved solids content of water supply by means of determining the capacity of a water sample to carry an electrical current. Conductivity is a measure of the ability of a solution to carry electrical current. (www.environmentalencyclopedia.com)

Disconnected Pools: Any pool that is completely disconnected from the main channel.

Dissolved Oxygen: The concentration of oxygen dissolved in water, expressed in mg / l or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature. (www.biology-online.org)

Disturbance: Any natural or artificial destruction and / or alteration of the habitat (e.g., flood, fire, beaver dams, vehicle, trail, trash, etc.).

Downfall: Any forest material that has fallen (downfall in the form of logs, branches).

Drainage: The area of land that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel (www.environmentalencyclopedia.com).

Emergent Vegetation Cover: This is cover from plants that emerge from the water (i.e., cattails, sedges, bulrush).

Flood Plain: The relatively level area of land bordering a stream channel and inundated during moderate to severe floods. The level of the flood plain is generally about the stage of the 1 to 3 year flood.

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Overhead Canopy: The area of the stream covered by the topmost vegetative cover. Can be calculated by estimating the average percent of the sky visible between 45 degree upward angles of the bank.

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.

Permanency: For this protocol, an estimate of how permanent or transitory the water source is (based on prior knowledge or maps). Choices include permanent, semi-permanent, or ephemeral.

pH: An expression of the intensity of the basic or acid condition of a liquid; may range from 0 to 14, where 0 is the most acid and 7 is neutral. Natural waters usually have a pH between 6.5 and 8.5.

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.

Riparian: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands (www.environmentalencyclopedia.com).

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

Side Pool: Any still water area that adjoins or is part of the main area channel.

Slope: A measure of the angle of the ground with respect to the plane of the horizon. Also called “inclination”. Measured by dividing the “rise” (difference in elevation between point A and point B) by the “run” (the length of the distance between point A and point B).

Streamside Refugia: Any material outside of the water that provides shelter, cover, hiding place, (i.e., tree roots, woody debris, rock crevices, streamside vegetation).

Submergent Vegetation Cover: This is cover from plants growing mostly under water (i.e., algae, waterweed).

Substrate: The surface composition of the ground. (Aquatic substrate = the ground composition under the water, usually cobble, gravel, silt, etc.; Terrestrial substrate = the ground composition on the banks and upland, usually boulder, cobble, leaf litter, etc.)

Terrace: An abandoned flood-plain surface. A terrace is a long, narrow, level or slightly inclined surface that is contained in a valley and bounded by steeper ascending or descending slopes, and it is always higher than the flood plain. A terrace may be inundated by floods larger than the 1 to 3 year flood.

Upland: The area or habitat outside of the riparian corridor.

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Appendix 3. Vegetation communities commonly found in southern California (Holland, 1986; Sawyer and Keeler-Wolfe, 2003; SANDAG, 2006).

Vegetative Community	Abbreviated List	Description	Name that Populates Database	Element Code
Chaparral				
	Mixed Chaparral	general chap	chaparral	37000
	Chamise Chaparral	chamise dominate	chamise chaparral	37200
	Scrub Oak Chaparral	scrub oak dominate	scrub oak chaparral	37900
	Manzanita Chaparral	manzanita dominate	upper sonoran manzanita chaparral	37B00
Desert				
	Creosote Bush Scrub	creosote dominate	mojave creosote bush scrub	34100
	Wash Scrub	sandy canyon bottom with shrubs	mojave wash scrub	34250
	Blackbush Scrub	blackbush dominate	blackbush scrub	34300
	Tamarisk Scrub	tamarisk dominate	tamarisk scrub	63810
	Sonoran Cottonwood-Willow Riparian	desert	sonoran cottonwood-willow riparian forest	61810
	Fan Palm Oasis	fan palm dominate	desert fan palm oasis woodland	62300
	Mojave Riparian Forest	cottonwood and willow	mojave riparian forest	61700
	Joshua Tree Woodland	Joshua tree dominate	Joshua tree woodland	73000
	Desert Mountain White Fir	desert - white fir dominate	desert mountain white fir	85330
Forest				
	Knobcone Pine	1000-5000 ft	knobcone pine forest	83210
	Coulter Pine	4000-5000 ft	coulter pine forest	84140
	Bigcone Spruce-Canon Oak	douglas fir and live oak dominate	bigcone spruce-canon oak forest	84150
	Westside Ponderosa Pine	2000-5000 ft	westside ponderosa pine forest	84210
	Jeffrey Pine	5500-8000 ft	Jeffrey pine forest	85100
	Jeffrey Pine-Fir	6000-8000 ft	Jeffrey pine-fir forest	85210
	White Fir	7500-9500 ft	southern California white fir forest	85320
	Lodgepole Pine	9000-11000 ft	lodgepole pine forest	86100
	Subalpine	9500-11200 ft	southern California subalpine forest	86500
	Cypress	cypress dominated	southern interior cypress forest	83230
Grassland				
	Non-Native	non-native grasses	non-native grassland	42200
	Native	bunchgrass dominate	native grassland	42100
Meadows/Marshes				
	Coastal Salt Marsh	salt tolerant plants	southern coastal salt marsh	52120
	Brackish Marsh	salt marshes with freshwater input	coastal brackish marsh	
	Montane Freshwater Marsh	permanently flooded by fresh water	montane freshwater marsh	52430
	Montane Meadow		montane meadow	45100
	Pavement Plain	herb grass dominated opening in Jeffrey pine forest	pavement plain	47000
Riparian				
	Cottonwood Willow	non-desert	southern cottonwood willow riparian forest	61330
	Coast Live Oak	live oak dominate	southern coast live oak riparian forest	61310
	Alder	alder dominate	white alder riparian forest	61510
	Sycamore-Alder	sycamore, alder dominate	southern sycamore-alder riparian woodland	62400
	Mule Fat Scrub	mule fat dominate	mule fat scrub	63310
	Willow Scrub	willow dominate	southern willow scrub	63320
	Tamarisk Scrub	tamarisk dominate	tamarisk scrub	63810
	Arundo	arundo dominate	arundo	RNF01
Scrub				
	Sage Scrub	low soft-woody subshrubs (to 1 m high)	coastal scrub	32000
Urban/Invasive				
	Arundo Scrub/Forest	arundo dominate	arundo scrub / forest	RNF01
	Tamarisk Scrub	tamarisk dominate	tamarisk scrub	63810
	Eucalyptus Woodland	eucalyptus dominate	eucalyptus woodland	11100
	Other Non-Native Community		other non-native community	11000
	Urban/Developed		urban / developed	12000
	Agriculture		general agriculture	18000
	Field/Pasture		field / pasture	18310
	Unvegetated	no vegetation present	unvegetated habitat	13000
Woodland				
	Oak	oak dominate	oak woodland	71100
	CA Walnut	CA walnut dominate	California walnut woodland	71210
	Pinon/Juniper	pinon / juniper dominate	pinon and juniper woodland	72000

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Appendix 3a. Vegetation communities commonly found in southern California (Holland, 1986; Sawyer and Keeler-Wolfe, 2003; SANDAG, 2006).

SCRUB

SAGE SCRUB

Element Code: 32000

Combined several sage scrub vegetation communities – description from the Diegan Coastal Sage Scrub community, element code – 32500.

Description: Low, soft-woody subshrubs (1 m tall) that is most active in winter and early spring. Many taxa are facultatively drought-deciduous. Dominated by CA sagescrub (*Artemisia californica*) and CA buckwheat (*Eriogonum fasciculatum*) together with laurel sumac (*Malosma laurina*) and white sage (*Salvia apiana*). Stem and leaf succulents, while present, are not nearly as conspicuous as in Maritime Succulent scrub (32400).

Site Factors: Typically on low moisture-availability sites: steep, xeric slopes or clay-rich soils that are slow to release stored water. Intergrades at higher elevations with several chaparrals (37000) or, in drier more inland areas with Riversidean Sage Scrub (32700).

Characteristic Species: CA sagebrush (*Artemisia californica*), CA buckwheat (*Eriogonum fasciculatum*), bush-snapdragon (*Galvesia speciosa*), isocoma (*Haplopappus venetus*), CA tree mallow (*Lavatera assurgentiflora*), CA broom (*Lotus scoparius*), chaparral mallow (*Malacothamnus fasciculatus*), laurel sumac (*Malosma laurina*), lemonadeberry (*Rhus integrifolia*), white sage (*Salvia apiana*), foothill stipa (*Stipa lepida*).

Distribution: This is a wide-spread coastal sage scrub in coastal southern CA from LA into Baja CA.

DESERT

CREOSOTE BUSH SCRUB

Element Code: (34100)

Description: Shrubs, 0.5 - 3 m tall, widely spaced, usually with bare ground between. Growth occurs during spring (or rarely in summer or fall) if rainfall is sufficient. Growth is prevented by cold in winter and limited by drought at other seasons. Many species of ephemeral herbs may flower in late March and April if the winter rains are sufficient. Other, less numerous species of annuals appear following summer thundershowers. This is the basic creosote scrub of the Mojave Desert, dominated by creosote bush (*Larrea tridentate*) and white bur-sage (*Ambrosia dumosa*).

Site Factors:

Well-drained secondary soils with very low available water holding capacity on slopes, fans, and valleys rather than upland sites with thin residual soils or sites with high soil salinity. Winter

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temperatures often below freezing. Intergrades at higher elevations with Shadscale Scrub (36140), or Joshua Tree Woodland (73000), at lower elevations or more osmotic sites with Desert Chenopod Scrub (36100).

Characteristic Species: white bur-sage (*Ambrosia dumosa*), desert senna (*Cassia armata*), Mormon tea (*Ephedra nevadensis*), burrobrush (*Hymenoclea salsola*), creosote bush (*Larrea tridentata*), box thorn (*Lycium* spp.).

Distribution: Extensive from the Death Valley region southward across the Mojave Desert to the little San Bernardino Mountains, eastward to northwestern Arizona and southern Nevada. The dominate plant community below 3,000 or 4,000 feet (910 - 1210 m) in this region.

WASH SCRUB

Element Code: (34250)

Description: A low, open community with a scattered to locally dense overstory of microphyllous trees.

Site Factors: Sandy bottoms of wide canyons, incised arroyos of upper bajadas, and sandy, braided, shallow washes of the lower bajadas, usually below about 5,000 feet.

Characteristic Species: catclaw (*Acacia greggii*), alkali saltbush (*Atriplex polycarpa*), desert willow (*Chilopsis linearis*), rabbitbrush (*Chrysothamnus paniculatus*), smoke tree (*Dalea spinosa*), cheesebush (*Hymenoclea salsola*), desert fir (*Peucephyllum schottii*), honey mesquite (*Prosopis glandulosa torreyana*), screwbean mesquite (*P. pubescens*), Desert Almond (*Prunus fasciculata*), Skunk bush (*Rhus trilobata anisophylla*).

Distribution: Washes, arroyos, and canyons of intermittent streams throughout the Mojave Desert region.

BLACKBUSH SCRUB

Element Code: (34300)

Description: Low, often intricately branched shrubs, 0.5 - 1 m tall, with crowns usually not touching and with bare ground between plants. Most growth and flowering occurs in late spring. Dormant in winter (from cold) and probably in summer and fall (from drought).

Site Factors: On dry, well-drained slopes and flats with shallow often calcareous soils of very low water holding capacity, often intergrading with Great Basin Sagebrush Scrub (35210), Joshua Tree Woodland (73000), or Pinyon Juniper Woodlands (72000), but typically at somewhat lower elevations, warmer, and drier.

Characteristic Species: Utah agave (*Agave utahensis*), shadescale (*Artemisia spinescens*), rabbitbrush (*Atriplex confertifolia*), rubberbush (*Chrysothamnus teretifolius*), blackbush (*Coleogyne ramosissima*), Mormon tea (*Ephedra nevadensis*), CA buckwheat (*Eriogonum fasciculatum polifolium*), winterfat (*Eurotia lanata*), big galleta (*Hilaria rigida*), hop-sage

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(*Grayia spinosa*), spiny desert olive (*Menodora spinescens*), Mexican bladder sage (*Salazaria mexicana*), Dorr's sage (*Salvia dorrii*), squirreltail (*Sitanion longifolium*), desert globmallow (*Spherulcea ambigua*), turpentine-broom (*Thamnosma Montana*), Joshua tree (*Yucca baccata*).

Distribution: From the Owens Valley region (Inyo and southern Mono Counties to the Mojave Desert (Kern and San Bernardino Counties). Typically between 4000 and 7000 feet.

TAMARISK SCRUB

Element Code: (63810)

Description: A weedy, virtual monoculture of any of several tamarisk (*Tamarix*) species, usually supplanting native vegetation following major disturbance.

Site Factors: Sandy or gravelly braided washes or intermittent streams, often in areas where high evaporation increases the streams saltiness. Tamarisk is a strong phreatophyte and a prolific seeder, attributes which predispose the species to be aggressive competitors in disturbed riparian corridors.

Characteristic Species: big saltbush (*Atriplex lentiformis*), Palmer's coldenia (*Coldenia palmeri*), salt grass (*Distichlis spicata*), arrow-weed (*Pleuchea sericea*), sandbar willow (*Salix exigua*), tamarix (*Tamarix chinensis*), (*T. ramosissima*).

Distribution: Widely scattered and increasing its range, throughout the drier parts of CA from the rain shadow east of the Inner North Coast Ranges south through the Great Valley to southern CA and across the deserts to Nevada, Arizona and beyond.

SONORAN COTTONWOOD-WILLOW RIPARIAN

Element Code: (61810)

Description: Winter-deciduous, broad-leafed streamside forests to about 60 feet tall, dominated by cottonwood (*Populus fremontii macdougallii*) with dense understories of several *Salix* species. There appear to be virtually no compositional data available for this type.

Site Factors: Deep well-watered, loamy alluvial soils along the near-channel floodplains of perennial desert rivers. This forest intergraded on sites slightly higher above and farther away from the river channels with Mesquite Bosques (61820) before these were cut down for fence posts and fuel.

Characteristic Species: arundo (*Arundo donax*), devil-weed (*Aster spinosus*), big saltbush (*Atriplex lentiformis*), sticky baccharis (*Baccharis glutinosa*), (*B. glutinosa*), (*B. sarothroides*), common reed (*Phragmites australis*), arrow-weed (*Pleuchea sericea*), cottonwood (*Populus fremontii macdougallii*), willow species (*Salix exigua*), (*Salix gooddingii gooddingii*), (*Sesbania macrocarpa*), tamarix (*Tamarix* spp).

Distribution: Formerly extensive along the lower Colorado River but now virtually eliminated by flood control projects, agriculture, or by tamarisk invasion.

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FAN PALM OASIS

Element Code: (62300)

Description: Open to dense groves dominated by fan palms (*Washingtonia filifera*) to 75 - 100 feet tall. The understory is sparse in dense groves (where the ground is mulched by fallen fronds) or in more alkaline areas. More open or favorable sites may have a dense understory reminiscent of Mojave or Colorado Riparian Forests (61700, 61800) or Riparian Scrubs (62700, 62800).

Site Factors: Restricted to sites with high water tables in regions with high summer temperatures, mild winters, and little rain. The largest groves are in steep-sided canyons with permanent streams, or adjacent to large springs. Smaller groves occur in canyon bottoms with intermittent surface water, moist canyon sides, or seeps. Oases often have alkaline soils due to high evaporation. Intergrades (often abruptly) with Mojave Riparian Forest (61700), Mojave Mixed Scrub (32400), Desert Dry Wash Woodland (62200), or Sonoran Creosote Bush Scrub (33100).

Characteristic Species: southern maidenhair fern (*Adiantum capillus-veneris*), desert columbine (*Aquilegia shockleyi*), squaw waterweed (*Baccharis sergiloides*), netleaf hackberry (*Celtis reticulata*), thistle sp. (*Cirsium nidulum*), stream orchid (*Epipactis gigantea*), smooth horsetail (*Equisetum laevigatum*), velvet ash (*Fraxinus velutina*), alkali goldenbush (*Haplopappus acradenius*), common reed (*Phragmites australis*), CA sycamore (*Platanus racemosa*), arrowweed (*Pleuchea sericea*), western cottonwood (*Populus fremontii*), mesquite (*Prosopis glandulosa*), canyon live oak (*Quercus chrysolepis*), willow Sp. (*Salix exigua*), (*S. gooddingii*), (*S. lasiolepis*), blue elderberry (*Sambucus mexicana*), alkali dropseed (*Sporobolus airoides*), tamarisk (*Tamarix* spp.), cat-tail (*Typha domingensis*), and nettle (*Urtica dioica*).

Distribution: Scattered in the canyons of the western edge of the Colorado Desert from near Twenty-nine Palms south into Baja CA, usually below 3000 feet.

MOJAVE RIPARIAN FOREST

Element Code: (61700)

Description: A relatively open, broad-leafed, winter-deciduous streamside forest dominated by western cottonwood (*Populus fremontii*), willow (*Salix gooddingii*), and (*S. laevigata*). The open canopy allows a dense shrubby understory of Torrey's saltbush (*Atriplex torreyi*), rabbitbrush (*Chrysothamnus nauseosus*), Woods' rose (*Rosa woodsii*), and sandbar willow (*Salix exigua*) to prosper. Similar to and intergrading in the lower elevations of Inyo County with Modoc-Great Basin Cottonwood-Willow Riparian Forest (61610).

Site Factors: Flat, fine-grained, subirrigated alluvium along perennial desert rivers.

Characteristic Species: shadescale (*Atriplex confertifolia*), (*A. parryi*), (*A. torreyi*), rabbitbrush (*Chrysothamnus nauseosus*), Russian olive (*Eleagnus angustifolia*), desert olive (*Forestiera neomexicana*), western cottonwood (*Populus fremontii*) (and var. *macdougallii*), Woods' rose

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(*Rosa woodsii*) willow (*Salix exigua*), (*S. gooddingii*), (*S. Laevigata*), greasewood (*Sarcobatus vermiculatus*), and tamarix (*Tamarix* spp.).

Distribution: Along the larger desert rivers (Owens, Mojave, Colorado) where the vegetation has not been cleared for irrigated agriculture or been dewatered by upstream diversions. Generally below about 4000 feet.

JOSHUA TREE WOODLAND

Element Code: (73000)

Description: An open woodland with Joshua trees (*Yucca brevifolia*) usually as the only arborescent species (to 12 m high) and numerous shrub species between 1 and 4 m tall. Little or no herbaceous understory during most of the year. The dominate species display a diversity of life forms: sclerophyllous evergreen trees and shrubs *Yucca* (*Yucca* spp.), microphyllous evergreen shrubs juniper (*Juniperus* spp.), semideciduous shrubs buckwheat, horsebrush (*Eriogonum*, *Tetradymia*), semi-succulents box thorn (*Lycium* spp.), and succulents prickly pear (*Opuntia* spp.). The main growing season is spring, with most growth limited by cold in winter and brought in summer and fall. Many species of ephemeral herbs may germinate following sufficient late fall or winter rains and flower in mid-spring.

Site Factors: Typically on sandy, loamy, or gravelly, well-drained gentle alluvial slopes. Transitional climatologically and biologically between low and high elevation desert regions. Intergrades at lower elevations with Mojave Creosote Bush Scrub (34100) (poorer soil drainage, colder winters from cold air drainage). At higher elevations, intergrades with Mojavean Pinyon-Juniper Woodland (72200) (cooler and moister, but better drained).

Characteristic Species: buckwheat (*Eriogonum fasciculatum*), (spp. *polifolium*), juniper sp. (*Juniperus californica*), (*J. osteosperma*), box thorn (*Lycium* spp.), prickly pear (*Opuntia* spp.), longspine horsebrush (*Tetradymia axillaris*), Joshua tree (*Yucca brevifolia*), Mojave yucca (*Y. schidigera*), banana yucca (*Y. baccata*), Great Basin sagebrush (*Artemisia tridentata*), (*Coreogyne ramosissima*), spiny hopsage (*Grayia spinosa*), juniper (*Juniperus californica*), creosote bush (*Larrea divaricata*), Anderson box thorn (*Lycium andersonii*), stipa (*Stipa speciosa*), Mormon tea (*Ephedra nevadensis*), big galleta (*Hilaria ridida*), spiny menodora (*Menodora spinescens*), branched pencil cholla (*Opuntia ramosissima*), and bladder sage (*Salazaria mexicana*).

Distribution: Desert slopes of the Southern Sierra Nevada, Tehachapi, and Transverse Ranges of Inyo, Kern, LA, San Bernardino, and northern Riverside Counties. Eastward across the Mojave Desert to southwestern Utah, mostly on the slopes of mountains and mesas. Extensive stands in the vicinity of Halloran Summit and Mountain Pass in northeastern San Bernardino County. One extensive stand west of the Sierran Crest on the watershed of the South fork of Kern River. Elevation from 2500 – 5000 feet (760 – 1520 m). Many of the characteristics species (but not Joshua trees (*Yucca brevifolia*) occur southward into San Diego County and northern Baja CA, on the Desert slopes of the Peninsular Ranges.

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DESERT MOUNTAIN WHITE FIR

Element Code: (85330)

Description: Fairly low (to 50 feet) open forests dominated by the Rocky Mountain race of white fir (*Abies concolor*) and single leaf pinyon pine (*Pinus monophylla*). Understories are fairly open, shorter than 8 - 10 feet, characterized by several shrubs with affinities to the southern Rocky Mountains.

Site Factors: Steep, mesic, north-facing canons and slopes near mountain ridges and summits, mostly between 6200 and 7500 feet. Occurs on both granite and limestone parent materials.

Characteristic Species: Rocky Mountain maple (*Acer glabrum diffusum*), Coville's service-berry (*Amelanchier utahensis covillei*), sedge (*Carex brevipes*), rabbitbrush (*Chrysothamnus viscodiflorus*), Mormon tea (*Ephedra utridis*), Utah fendlerbush (*Fendlerella utahensis*), Utah fendlerella (*Franxinus anomala*), goldenbush (*Haplopappus cuneatus*), Mojave halimolobos (*Halimolobos diffusa jaegeri*), pink alumroot (*Heuchera rubescens pachypoda*), (*Holodiscus microphyllous*), juniper (*Juniperus osteosperma*), matted prickly-phlox (*Leptodactylon pungens hallii*), canyonlands biscuitroot (*Lomatium parryi*), (*Oryzopsis micrantha*), (*Philadelphus microphyllous stramineus*), singleleaf pinyon (*Pinus monophylla*), current (*Ribes cereum*), (*R. velutinum*), and desert snowberry (*Symphoricarpos longiflorus*).

Distribution: Limited to the higher ranges of the eastern Mojave Desert: Kingston, Clark, and New York Mountains.

CHAPARRAL

MIXED CHAPARRAL

Element Code: (37000)

Combined several chaparral vegetation communities – description from the Southern Mixed Chaparral community (37120)

Description: Similar to Northern Mixed Chaparral (37110) but typically not quite so tall (1.5 – 3 m) or dense. Occasionally with patches of bare soil or forming a mosaic with Venturan Coastal Sage Scrub (32300) or Riversidean Sage Scrub (32700). Divisible into Granitic (37121) and Mafic (37122) subtypes based on substrate, but floristic distinctions between these two subtypes remain unknown.

Site Factors: Similar to Northern Mixed Chaparral (37110) but somewhat lower precipitation and more moderate temperatures. Often adjacent to and on moister sites than Chamise Chaparral (37200). Transitional from the chaparral habitats of California to the coastal semi-desert of Baja CA Norte.

Characteristic Species: chamise (*Adenostoma fasciculatum*), manzanita sp. (*Arctostaphylos glandulosa*), (*A. pennisularis*), Mariposa lily (*Calochortus albus*), ceanothus (*Ceanothus tomentosus olivaceus*), (*C. verrucosus*), mountain mahogany (*Cercocarpus minutiflorus*),

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bushrue (*Cneoridium dumosum*), chocolate lily (*Fritillaria biflora*), toyon (*Heteromeles arbutifolia*), honeysuckle (*Lonicera subspicata*), scrub oak (*Quercus dumosa*), laurel sumac (*Malosma laurina*), spiny redberry (*Rhamnus crocea*), lemonadeberry (*Rhus ovata*), gooseberry (*Ribes indecorum*), mission manzanita (*Xylcoccus bicolor*), Mojave yucca (*Yucca schidigera*), and our lord's candle (*Y. whipplei*).

Distribution: Coastal foothills of San Diego County and Northern Baja CA, usually below 3000 feet (910 m).

CHAMISE CHAPARRAL

Element Code: (37200)

Description: A 1 - 3 m tall chaparral overwhelmingly dominated by chamise. Associated species contribute little to cover. Adapted to repeated fires by stump sprouting. Mature stands are densely interwoven with very little herbaceous understory or litter.

Site Factors: Similar to Upper Sonoran Mixed Chaparrals (37100), but on shallower, drier soils or at somewhat lower elevations. Often on xeric slopes and ridges, with adjacent more mesic sites mantled by Upper Sonoran Mixed Chaparrals.

Characteristic Species: chamise (*Adenostoma fasciculatum*), manzanita sp. (*Arctostaphylos glauca*), (*A. tomentosa*), (*A. viscida*), mariposa lily (*Ceanothus cuneatus*), (*C. papillosus*), birch-leaf mountain mahogany (*Cercocarpus betuloides*), hairgrass (*Dendromecon rigida*), CA buckwheat (*Eriogonum fasciculatum*), yerba santa (*Eriodictyon californicum*), deerweed (*Lotus scoparius*), holly-leaf cherry (*Prunus ilicifolia*), scrub oak (*Quercus dumosa*), sugar bush (*Rhus ovata*), lemonadeberry (*R. laurina*), white sage (*Salvia apiana*), black sage (*S. mellifera*), ashy spike-moss (*Selaginella cinerascens*), Mojave yucca (*Yucca schidigera*), and our lord's candle (*Y. Whipplei*).

Distribution: General distribution similar to Northern Mixed Chaparral (37110) but relatively infrequent in the north compared to its abundance in the south. The predominate chaparral type in Ventura, LA, San Bernardino, Riverside, and San Diego Counties.

SCRUB OAK CHAPARRAL

Element Code: (37900)

Description: A dense, evergreen chaparral to 20 feet tall, dominated by scrub oak (*Quercus dumosa*) with considerable birch-leaf mountain mahogany (*Cercocarpus betuloides*).

Site Factors: Somewhat more mesic than many chaparrals, and often occurring at slightly higher elevations (to 5000 feet). These more favorable sites recover from fire more quickly than other chaparrals. Substantial leaf litter accumulates.

Characteristic Species: Del Mar manzanita (*Arctostaphylos glandulosa*), deerbrush (*Ceanothus integerrimus*), CA whitethorn (*C. leucodermis*), blueblossom (*C. thrysiflorus*), birch-leaf mountain mahogany (*Cercocarpus betuloides*), CA ash (*Fraxinus dipetala*), narrow-leaved

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bedstraw (*Galium angustifolium*), canyon silktassel (*Garrya veatchii*), toyon (*Heteromeles arbutifolia*), honeysuckle (*Lonicera* spp.), chaparral pea (*Pickeringia montana*), holly-leaved cherry (*Prunus ilicifolia*), scrub oak (*Quercus dumosa*), live oak (*Q. wislizenii frutescens*), spiny redberry (*Rhamnus californica*), holly-leaved redberry (*R. ilicifolia*), poison oak (*Toxicodendron diversilobum*).

Distribution: Western Sierran foothills and North Coast ranges from Tehama County south through the southern California mountains to Baja California.

MANZANITA CHAPARRAL

Element Code: (37B00)

Description: A dense chaparral to 15 feet in which dominance is shared by chamise and various species of Manzanita.

Site Factors: Most stands appear to be disturbance followers, establishing after fire, logging, hydraulic mining, or other disruptions. Young conifers (especially white fir (*Abies concolor*) or ponderosa pine (*Pinus ponderosa*) often can be found beneath the shrub canopy in these seral stands.

Characteristic Species: chamise (*Adenostoma fasciculatum*), Del Mar manzanita (*Arctostaphylos glandulosa*), manzanita (*A. glauca*), big berry manzanita (*A. mariposa*), Indian manzanita (*A. mewukka*), pinemat manzanita (*A. nevadensis*), greenleaf manzanita (*A. patula*), sticky white-leaf manzanita (*A. viscida*), and whitethorn chaparral (*Ceanothus leucodermis*).

Distribution: Widespread in the Sierran foothills and Coast Ranges, usually at elevations higher than Chamise Chaparral (37200), but lower than Montane Chaparral (37500). Somewhat more patchily distributed along the coastal side of the Transverse and Peninsular Ranges, typically between 2500 and 5000 feet.

GRASSLAND

NON-NATIVE

Element Code: (42200)

Description: A dense to sparse cover of annual grasses with flowering culms 0.2 - 0.5 (1.0) m high. Often associated with numerous species of showy-flowered, native annual forbs ("wildflowers"), especially in years of favorable rainfall. Germination occurs with the onset of the late fall rains; growth, flowering, and seed-set occur from winter through spring. With a few exceptions, the plants are dead through the summer-fall dry season, persisting as seeds.

Site Factors: On fine-textured, usually clay soils, moist or even waterlogged during the winter rainy season and very dry during the summer and fall. Oak Woodland (71100) is often adjacent on moister, better drained.

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Characteristic Species: slender wild oats (*Avena barbata*), wild oats (*A. fatua*), Brome sp. (*Bromus mollis*), (*B. rigidus*), red brome (*B. rubens*), Fillaree (*Erodium botrys*) red stem fillaree (*E. cicutarium*), CA poppy (*Eschscholtzia californica*), gilia sp. (*Gilia* spp.), tarweed (*Hemizonia* spp.), goldfields (*Lasthenia* spp.), tidytips (*Layia* spp.), Italian ryegrass (*Lolium multiflorum*), lupine sp. (*Lupinus* spp.), pepperweed (*Lepidium dictyotum*), CA burclover (*medicago hispida*), (*Namophila manziesii*), owl's clover (*Orthocarpus* spp.), Phacelia (*Phacelia* spp.), Mediterranean schismus grass (*Schismus arabicua*), fescue sp. (*Vulpia megalura*), and (*V. microstachys*).

Distribution: Valleys and foothills of most of California except for the north coastal and desert regions. Usually below 3000 feet, but reaching 4000 feet in the Tehachapi Mountains and interior San Diego County. Intergrades with Coastal Prairie (41000) along the central coast. Formerly occupied large portions of the Sacramento, San Joaquin, and Salinas Valleys as well as the LA basin, areas that are now agricultural or urban.

NATIVE

Element Code: (42100)

Combined several native vegetation communities – description is a combination of the Valley Needlegrass Grassland (42110) and the Serpentine Bunchgrass (42130) vegetation communities.

Description: Open grassland dominated by perennial bunchgrasses or a mid-height (to 2 feet) grassland dominated by perennial, tussock-forming Needlegrass (*Stipa pulchra*). Cover typically is low, but is markedly dominated by native species (usually much more so than Non-native Grasslands (42200) or Native and introduced annuals occur between the perennials, often actually exceeding the bunchgrasses in cover.

Site Factors: Serpentine Bunchgrass is restricted to serpentine sites. While Valley Needlegrass Grasslands usually on a fine-textured (often clay) soils, moist or even waterlogged during winter, but very dry in summer. Often interdigitates with Oak Woodlands (71100) on moister, better drained sites.

Characteristic Species: blow wives (*Achyrachaena mollis*), bentgrass (*Agoseris heterophylla*), wild oats (*Avena fatua*), goldenstar (*Bloomeria crocea*), brodiaea (*Brodiaea lutea*), ripgut brome (*Bromis diandrus*) brome sp. (*Bromis mollis*), red brome (*Bromis rubens*), serpentine reedgrass (*Calamagrostis ophitidis*), soap plant (*Chlorogalum pommeridianum*), farwell-to-spring (*Clarkia purpurea*), shooting star (*Dodecatheon jefferyi*), CA poppy (*Eschscholtzia californica*), fescue sp. (*Festuca grayii*), tarweed (*Hemizonia luzulaefolia*), trefoil (*Lotus subpinnatus*), oniongrass (*Melica californica*), (*M. imperfecta*), owl's clover (*Orthocarpus attenuatus*), plantain (*Plantago hookeriana californica*), bluegrass (*Poa scabrella*), stipa sp. (*Stipa cernua*), (*S. lepida*), (*S. pulchra*), fescue (*Vulpia microstachys*).

Distribution: Scattered widely through the Coast Ranges, less common in the Sierra Nevada and southern CA mountains.

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RIPARIAN

COTTONWOOD WILLOW

Element Code: (61330)

Description: Tall, open, broad-leaved winter-deciduous riparian forests dominated by cottonwood sp. (*Populus fremontii*), (*P. trichocarpa*), and several tree willows. Similar to Central Coast Cottonwood-Sycamore Riparian Forest (61210), although apparently with less coast live oak (*Quercus agrifolia*) or white alder (*Alnus rhombifolia*) (this merits further study). Understories usually are shrubby willows.

Site Factors: Sub-irrigated and frequently overflowed lands along rivers and streams. The dominate species requires moist, bare mineral soil for germination and establishment. This is provided after flood waters recede, leading to uniform-aged stands in this seral type.

Characteristic Species: mugwort (*Artemisia douglasiana*), mule fat (*Baccharis viminea*), wild cucumber (*Marah macrocarpus*), western sycamore (*Platanus racemosa*), western cottonwood (*Populus fremontii*), cottonwood sp. (*P. trichocarpa*), willow sp. (*Salix gooddingii*), (*S. hindsiana*), (*S. lasiandra*), (*S. lasiolepis*), stinging nettle (*Urtica holosericea*).

Distribution: Along perennially wet stream reaches of the Transverse and Peninsular Ranges, from Santa Barbara County south to Baja California north and east to the edge of the deserts.

COAST LIVE OAK

Element Code: (61310)

Description: Open to locally dense evergreen sclerophyllous riparian woodlands dominated by coast live oak (*Quercus agrifolia*). This type appears to be richer in herbs and poorer in understory shrubs than other riparian communities. Similar to and questionably distinct from Central Coast Live Oak Riparian Forest (61220).

Site Factors: Bottomlands and outer floodplains along larger streams, on fine-grained, rich alluvium.

Characteristic Species: bigleaf maple (*Acer macrophyllum*), mugwort (*Artemisia douglasiana*), milkmaids (*Cardamine californica*), spotted hideseed (*Eucrypta chrysanthemifolia*), toyon (*Heteromeles arbutifolia*), keckiella (*Keckiella cordifolia*), honeysuckle (*Lonicera hispidula*), wild cucumber (*Marah macrocarpus*), fiesta flower (*Pholistoma auritum*), coast live oak (*Quercus agrifolia*), skunkbrush (*Rhus trilobata*), CA wild rose (*Rosa californica*), CA blackberry (*Rubus ursinus*), elderberry (*Sambucus Mexicana*), trip vine (*Symphoricarpos mollis*), poison oak (*Toxicodendron diversilobum*), CA laurel (*Umbellularia californica*).

Distribution: Canyons and valleys of coastal southern California, mostly south of Point Conception.

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ALDER

Element Code: (61510)

Description: Medium-tall broad-leafed deciduous streamside forests dominated by (*Alnus rhombifolia*), with a shrubby, deciduous understory. Stands in the Coast Ranges have abundant (*Salix* spp.), (*Baccharis viminea*), (*Symphoricarpos* spp.), CA wild rose (*Rosa californica*), and poison oak (*Toxicodendron diversilobum*), while Sierran stands have understories rich in (*Cornus stolonifera*), (*Fraxinus latifolia*), and (*Rhododendron occidentale*). These two types probably should be separated. Riparian alder forests in southern CA need study – these too may be separable.

Site Factors: Best developed along rapidly flowing, well aerated perennial streams with coarse bedloads that reflect high stream power during spring runoff. These streams typically flow in bedrock-constrained, steep sided canyons, so the riparian corridor typically is rather narrow.

Characteristic Species: bigleaf maple (*Acer macrophyllum*), white alder (*Alnus rhombifolia*), mule fat (*Baccharis viminea*), blackfruit dogwood (*Cornus sessilis*), dogwood sp. (*C. stolonifera*), Oregon ash (*Fraxinus latifolia*), western azalea (*Rhododendron occidentale*), willow sp. (*Salix* spp.), and poison oak (*Toxicodendron diversilobum*).

Distribution: Perennial streams in incised canyons of the lower Sierra Nevada, Coast, Transverse, and Peninsular ranges, usually below about 6000 feet.

SYCAMORE-ALDER

Element Code: (62400)

Description: A tall, open, broad-leafed, winter-deciduous streamside woodland dominated by western sycamore (*Platanus racemosa*), (and often also white alder (*Alnus rhombifolia*)). These stands seldom form closed canopy forests, and even may appear as trees scattered in a shrubby thicket of sclerophyllous and deciduous species. Lianas include CA blackberry (*Rubus ursinus*) and poison oak (*Toxicodendron diversilobum*). Distinctions between this type and Sycamore Alluvial Woodland (62100) merit additional study.

Site Factors: Very rocky streambeds subject to seasonally high-intensity flooding. (*Alnus*) increases in abundance on more perennial streams, while (*Platanus*) favors more intermittent hydrographs.

Characteristic Species: bigleaf maple (*Acer macrophyllum*), white alder (*Alnus rhombifolia*), mugwort (*Artemisia douglasiana*), CA spikenard (*Aralia californica*), scouring rush (*Equisetum hyemale*), smilo grass (*Oryzopsis miliacea*), coast live oak (*Quercus agrifolia*), CA blackberry (*Rubus ursinus*), elderberry (*Sambucus Mexicana*), poison oak (*Toxicodendron diversilobum*), CA laurel (*Umbellularia californica*), and stinging nettle (*Urtica holsoericea*).

Distribution: Transverse and Peninsular ranges from Point Conception south into Baja California Norte

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MULE FAT SCRUB

Element Code: (63310)

Description: A depauperate, tall herbaceous riparian scrub strongly dominated by mule fat (*Baccharis viminea*). This early seral community is maintained by frequent flooding. Absent this, most stands would succeed to cottonwood- or sycamore-dominated riparian forests or woodlands.

Site Factors: Intermittent stream channels with fairly coarse substrate and moderate depth to the water table. Frequently occurs as a patchy understory in light gaps in Sycamore Alluvial Woodlands (62100), especially under heavy grazing.

Characteristic Species: mule fat (*Baccharis viminea*), sedge sp. (*Carex barbarae*), willow sp. (*Salix exigua*), (*S. hindsiana*), (*S. lasiolepis*), stinging nettle (*Urtica holosericea*).

Distribution: Widely scattered along intermittent streams and near larger rivers from about Tehama County south through the Coast Ranges and Sierra Nevada to San Diego and northwestern Baja California Norte, usually below about 2000 feet.

WILLOW SCRUB

Element Code: (63320)

Description: Dense, broad-leafed, winter-deciduous riparian thickets dominated by several willow sp. (*Salix*), with scattered emergent western cottonwood (*Populus fremontii*) and (*Plantanus racemosa*). Most stands are too dense to allow much understory development.

Site Factors: Loose, sandy or fine gravelly alluvium deposited near stream channels during flood flows. This early seral type requires repeated flooding to prevent succession to Southern Cottonwood-Sycamore Riparian Forest (61330).

Characteristic Species: arrowweed (*Pluchea sericea*), western cottonwood (*Populus fremontii*), willow sp. (*Salix gooddingii*), (*S. hindsiana*), (*S. laevigata arauipa*), (*S. lasiandra*), (*S. lasiolepis*), (*S. hindsiana*), (*S. leucodendroides*), others?

Distribution: Formerly extensive along the major rivers of coastal southern CA, but now much reduced by urban expansion, flood control, and channel “improvements”.

TAMARISK SCRUB

Element Code: (63810)

Description: A weedy, virtual monoculture of any of several *Tamarix* species, usually supplanting native vegetation following major disturbance.

Site Factors: Sandy or gravelly braided washes or intermittent streams, often in areas where high evaporation increases the streams saltiness. Tamarisk is a strong phreatophyte and a prolific

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seeder, attributes which predispose the species to be aggressive competitors in disturbed riparian corridors.

Characteristic Species: big saltbush (*Atriplex lentiformis*), Palmer's coldenia (*Coldenia palmeri*), salt grass (*Distichlis spicata*), arrow-weed (*Pleuchea sericea*), sandbar willow (*Salix exigua*), tamarix (*Tamarix chinensis*), (*T. ramosissima*).

Distribution: Widely scattered and increasing its range, throughout the drier parts of CA from the rain shadow east of the Inner North Coast Ranges south through the Great Valley to southern CA and across the deserts to Nevada, Arizona and beyond.

ARUNDO SCRUB/FOREST

Element Code: (RNF01)

Description: A dense monoculture dominated by arundo also known as the giant reed (*Arundo donax*). This is a very invasive grass that was introduced to CA in the 1880's. This species persist in riparian areas, and reduces or replaces native species

WOODLAND

OAK

Element Code: (71100)

Combined several oak woodland vegetation communities – description from the Coast Live Oak Woodland community, element code – 71160

Description: Very similar to Oregon Oak Woodland (71110) within only one dominate tree, coast live oak (*Quercus agrifolia*), which is evergreen and reaches 10 - 25 m in height. The shrub layer is poorly developed, but may include toyon (*Heteromeles arbutifolia*), gooseberry (*Ribes* spp.), laurel sumac (*Rhus laurina*), or elderberry (*Sambucus mexicana*). The herb component is continuous and dominated by ripgut brome (*Bromis diandrus*) and several other introduced taxa.

Site Factors: Typically on north-facing slopes and shaded ravines in the south and more exposed sites in the north. Intergrades with Coastal Scrub (32000) and Upper Sonoran Mixed Chaparral (37100) on drier sites and with Coast Live Oak Forest (81310) or Mixed Evergreen Forest (81100) on moister sites.

Characteristic Species: CA buckeye (*Aesculus californica*), saniclle (*Sanicula laciniata*), toyon (*Heteromeles arbutifolia*), coast live oak (*Quercus agrifolia*), coffee berry (*Rhamnus californica*), elderberry (*Sambucus mexicana*), poison oak (*Toxicodendron diversilobum*), orange monkey flower (*Diplacus aurantiacus*), pacific pea (*Lathyrus vestitus*), CA sagebrush (*Artemisia californica*), pacific madrone (*Arbutus menziesii*), CA laurel (*Umbellularia californica*), gooseberry (*Ribes* spp.), ripgut brome (*Bromus diandrus*), chickweed (*Stellaria media*), bedstraw (*Galium aparine*), thistle (*Cirsium vulgare*), knotted hedgeparsley (*Torilis nodosa*).

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Distribution: Outer south Coast Ranges, and coastal slopes of Transverse and Peninsular Ranges, usually below 4000 feet (1220 m). Intergrades with Blue Oak Woodland (71120) in inner South Coast Ranges and with Engelmann Oak Woodland (71180) in interior southern CA.

CA WALNUT

Element Code: (71210)

Description: Similar to and intergrading with Interior Live Oak Woodland (71150) or Coast Live Oak Woodland (71160), but with a more open tree canopy locally dominated by CA walnut (*Juglans californica*). The open tree canopy allows development of a grassy understory. In most sites, this understory is comprised of introduced winter-active annuals that complete most of their growth cycle before the deciduous walnut (*Juglans*) leafs out in spring.

Site Factors: On relatively moist, fine-textured soils of valley slopes and bottoms, as well as encircling rocky outcrops. These drier, rocky sites often support Venturan (32300) or Riversidean Sage Scrub (32700). Intergrades with Coast Live Oak Woodland (71160) or Coast Live Oak Forest (81310) on more mesic sites, especially in canyons.

Characteristic Species: CA walnut (*Juglans californica*), coast live oak (*Quercus agrifolia*), Engelmann oak (*Quercus engelmannii*), sugar bush (*Rhus ovata*), skunkbrush (*R. trilobata*), red brome (*Bromus rubens*), horehound (*Marrubium vulgare*).

Distribution: South side of San Gabriel Mountains to the Santa Ana Mountains, mostly between 500 and 3000 feet.

PINON/JUNIPER

Element Code: (72000)

Combined several Pinon and/or Juniper vegetation communities – description from the Great Basin Pinon-Juniper Woodland community, element code – 72121

Description: Very similar to Northern Juniper woodland (72110), but lacking the occasional taller trees and having Utah juniper (*Juniperus occidentalis*) and singleleaf pinyon pine (*Pinus monophylla*) as conspicuous canopy components. Shrub and herb species typically are those seen in adjacent non-forested stands of Great basin Scrub (35000 series).

Site Factors: Very similar to Northern Juniper Woodlands (72110) but receiving slightly more moisture. Intergrades at higher elevations with Jeffrey Pine Forest (85100) or Montane Chaparral (37500) in the Sierra Nevada; and with Bristlecone Pine Forest (86400) or Subalpine Sagebrush Scrub (35200) in the White, Inyo, and Panamint Ranges.

Characteristic Species: wheat grass (*Agropyron spicatum*), big sagebrush (*Artemisia tridentata*), curled-leafed mountain-mahogany (*Cercocarpus ledifolius*), Utah juniper (*Juniperus osteosperma*), singleleaf pinyon pine (*Pinus monophylla*), desert bitterbrush (*Purshia glandulosa*), and antelope bush (*P. tridentate*).

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Distribution: Desert mountains from the first range east of the Sierra Nevada from Alpine County to Kern County, east through the Basin Ranges of Nevada. Abundant in the White Mountains, Inyo Mountain, and Panamint Range, from 6000 - 9000 feet (1830 - 2745 m). Intergrades in Kern County (on both sides of the Sierran crest) with Mojavean Pinon-Juniper Woodland (72210).

FOREST

KNOBCONE PINE

Element Code: (83210)

Description: A fire-maintained, variable forest dominated by knobcone pine (*Pinus attenuate*) that may reach 25 - 30 m, though usually closer to 15 m tall. Stands usually are even-aged except on relatively “fire-proof”, rocky sites. Understories usually are sparse scatters of chaparral shrubs whose composition varies greatly over the type’s range.

Site Factors: Shallow, dry, stoney sites, often on serpentine or other magnesium-rich ultramafics that limit effective conifer competition. Adapted to frequent fires by means of very early and abundant production of seeds, which are retained in the closed cones until released by the heat of a fire. Similar to Bishop Pine Forest (83121), but in more interior, hotter and drier localities, where growth is probably more limited by drought in summer. Often associated with Serpentine Chaparral (37600), Chamise Chaparral (37200) or Californian Mixed Chaparral (37110). On better-developed or non-serpentine soils, may intergrade with Broadleaved Evergreen Montane Coniferous forest (84000).

Characteristic Species: chamise (*Adenostoma fasciculatum*), Saskatoon serviceberry (*Amelanchier alnifolia*), Del Mar manzanita (*Arctostaphylos glandulosa*), whitethorn ceanothus (*Ceanothus cordulatus*), wart-stemmed ceanothus (*C. velutinus*), cypress sp. (*Cupressus abramsiana*), bush poppy (*Dendromecon rigida*), tarweed (*Holodiscus discolor*), knobcone pine (*Pinus attenuate*), Coulter pine (*P. coulteri*), Monterey pine (*P. radiata*), deer oak (*Quercus sadleriana*), huckleberry oak (*Q. vaccinifolia*), interior live oak (*Q. wislizenii*).

Distribution: Abundant in the Siskiyou, Klamath and North Coast Ranges away from the immediate coast, from southwestern Oregon to southern Sonoma and Napa Counties. On Mt. Diablo, Contra Costa County. Abundant in the Santa Cruz Mts. in Santa Cruz and Santa Clara Counties. In the Santa Lucia Mountains of Monterey County near San Luis Obispo. Eastward from the Klamath Mountains across the southern Cascade Range to Modoc County on the west slope of the Sierra Nevada. From Sierra to El Dorado Counties and Mariposa County. Also in the San Bernardino and Santa Ana Mountains in southern CA, and near Ensenada, Baja CA. Elevation usually between 1000 to 5000 feet (300 and 1500 m), occasionally to 6000 feet (1800 m).

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COULTER PINE

Element Code: (84140)

Description: An open forest (or more accurately, woodland) of scattered Coulter pine (*Pinus coulteri*) and CA black oak (*Quercus kelloggii*) over shrubs typically associated with Upper Sonoran Mixed Chaparral (37100). Some stands are dense enough to suppress the shrubby layer. Most growth occurs in spring and early summer

Site Factors: Typical on dry, rocky soils of slopes and ridges. Most frequent on south-facing slopes, frequently intermixing there with Californian Mixed Chaparral (37110) or Lower Montane Chaparral (37510). Subject to fairly frequent fires on these sites. In the Coast Ranges intergrades with Coast Range Mixed Conifer Forest (84110), Coast Range Ponderosa Pine Forest (84130), or Mixed Evergreen Forest (81100) on moist sites; Blue Oak Woodland on low-elevation, dry sites; Knobcone Pine Forest (83210) on dry, sterile soils. In southern CA, frequently merges into Sierran Mixed Conifer Forest (84230) at its upper limits. Fire exclusion may be facilitating conversion of some oak woodlands to Coulter pine stands as in the Gabilan Range.

Characteristic Species: bristlecone fir (*Abies bracteata*), Zaca's manzanita (*Arctostaphylos glandulosa*), pringle manzanita (*A. pringlei drupacea*), pointleaf manzanita (*A. pungens*), deerbrush (*Ceanothus integerrimus*), mountain mahogany (*Cercocarpus betuloides*), Coulter pine (*Pinus coulteri*), ponderosa pine (*P. ponderosa*), CA foothill pine (*P. sabiniana*), bigcone Douglas-fir (*Pseudotsuga macrocarpa*), coast live oak (*Quercus agrifolia*), canyon live oak (*Q. chrysolepis*), and CA black oak (*Q. kelloggii*).

Distribution: Widely scattered, through fragmented, throughout the south Coast Ranges from Contra Costa County south into Baja CA. Elevations vary from 2500 - 5000 feet in the north, to 4000 - 6500 feet in the south. Best developed in San Gabriel, San Bernardino, and San Jacinto Mountains.

BIGCONE SPRUCE-CANON OAK

Element Code: (84150)

Description: An open (on steep slopes) to dense (on flats) forest dominated by (*Pseudotsuga macrocarpa*) 50 - 80 feet tall over a dense sub-canopy of (*Quercus chrysolepis*) and a very sparse herb layer. Most stands are fairly small within a chaparral matrix.

Site Factors: Largely on rocky sites with little soil development. Restricted to mesic exposures and canon sides at low elevations (1000 feet), but on mesic exposures and canyon sides at low elevations (1000 feet), but on warmer aspects at upper altitudinal limit (8000 feet). Fires appear to be frequent, though perhaps less intense than in surrounding chaparrals. Mature (*Pseudotsuga*) is capable of trunk-sprouting after fire. Intergrades in canyon bottoms Southern Riparian Forest (62130), with Upper Sonoran Mixed Chaparral (37000) on more xeric sites, and with Coulter Pine Forest (84140) or Sierran Mixed Conifer Forest (84200) at higher elevations.

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Characteristic Species: bigleaf maple (*Acer macrophyllum*), incense cedar (*Calocedrus decurrens*), mountain mahogany (*Cercocarpus betuloides*), big cone Douglas fir (*Pseudotsuga macrocarpa*), coast live oak (*Quercus agrifolia*), canyon live oak (*Q. chrysolepis*), gooseberry (*Ribes californicum*), poison oak (*Toxicodendron diversilobum*), CA laurel (*Umbellularia californica*), wild grape (*Vitis girdiana*).

Distribution: Transverse and Peninsular Ranges from the Mt. Pinos region south to near Banner in San Diego County, mostly on coastal (rather than desert-facing) slopes.

WESTSIDE PONDEROSA PINE

Element Code: (84210)

Description: An open, park-like forest of coniferous evergreens to 70 m tall, dominated by ponderosa pine (*Pinus ponderosa*). The understory typically is sparse, consisting of scattered chaparral shrubs and young trees. There is often considerable accumulation of needle litter and pine cones on the ground. Growth occurs mostly from late spring to midsummer and is probably limited by summer and fall drought. Cones mature in the early autumn. All plants are essentially dormant in the winter.

Site Factors: Well-developed in areas with warm, dry summers and cool, moist winters with considerable snow accumulation at the higher elevations. Often on south-facing slopes, except near lower elevational margins. Usually on coarse, well-drained soils; often granite or basaltic, very rarely serpentine. Probably maintained by occasional ground fires. Crown fires may result in temporary replacement of the forest by dense Montane Chaparral (37500). At its lower limits, intergrades with Coast Range Ponderosa Pine Forest (84130) in the North Coast Ranges, with Blue Oak Woodland (71210) on non-rocky soils in the interior North Coast Ranges and Cascade-Sierra foothills, with Coulter Pine Forest (84140) in southern CA, with Knobcone Pine Forest (83210) on rocky, often serpentine soils; with Lower Montane Chaparral (37510) on dry, rocky soils in the Cascades and northern Sierra Nevada; with Californian Mixed Chaparral (37110) in the southern Sierra and extensively in southern CA. Within its elevational range, intergrades with Montane Chaparral (37500) or Mixed Conifer Forest (84230) on moist sites. At its upper limits, intergrades with Sierran Mixed Conifer Forest (85100) on dry slopes.

Characteristic Species: white fir (*Abies concolor*), manzanita sp. (*Arctostaphylos patula*), incense cedar (*Calocedrus decurrens*), deerbrush (*Ceanothus integerrimus*), whitethorn ceanothus (*C. cordulatus*), mountain misery (*Chamaebatia foliosa*), tanoak (*Lithocarpus densiflorus*), knobcone pine (*Pinus attenuata*), Coulter pine (*P. coulteri*), sugar pine (*P. lambertiana*), ponderosa pine (*P. ponderosa*), canyon live oak (*Quercus chrysolepis*), CA black oak (*Q. kelloggii*), coffee berry (*Rhamnus californica*).

Distribution: Higher elevations of the interior North Coast ranges and Siskiyou Mountains. From Lake County to Siskiyou County and northward into Oregon. Abundant on the west side of the Cascade Range and Sierra Nevada from the Siskiyou Mountains to northern Kern County. Also on the coastal side of the eastern San Gabriel Mountains, LA-San Bernardino Counties; the San Bernardino Mountains, San Bernardino County; and the San Jacinto Mountains, Riverside County. Sparingly presenting the San Rafael-San Emigdio Mountains, Santa Barbara-Ventura Counties; Tehachapi Mountains, Kern County/ Palomar and Cuyamaca Ranges, San Diego

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County. Elevation from 2000 - 5000 feet (900 -1500 m) in the north and 4500 - 6500 feet (1300 – 2000 m) in the south. The lowest-occurring montane forest type over most of its range.

JEFFREY PINE

Element Code: (85100)

Description: A tall, open forest dominated by Jeffrey pines (*Pinus jeffreyi*), with sparse understories of species drawn from Montane Chaparral (37500) or Sagebrush Scrub (35200). Very similar in aspect to Ponderosa Pine Forest (84210, 84220). Pure stands are best developed on desert-facing slopes.

Site Factors: Dry, cold sites, especially on well-drained slopes, ridges, or cold air accumulation basins. West of the Sierran crest, it intergrades at its lower elevational limit (5000 - 65000 feet) with Montane Chaparral (37500), Coulter Pine Forest (84140) or Westside Ponderosa Pine Forest (84210). East of the Crest it passes to Pinon-Juniper Woodlands (72000), Great Basin Scrub (35000) or Eastside Ponderosa Pine Forest (84220). Passes in more mesic sites or higher elevations (7000 - 9000 feet), into Upper Montane Mixed Conifer Forest (85200) or Subalpine Forest (86000).

Characteristic Species: Great Basin sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysolepis sempervirens*), Jeffrey pine (*Pinus jeffreyi*), antelope bitterbrush (*Purshia tridentata*), huckleberry oak (*Quercus vaccinifolia*), snowberry (*Symphoricarpus parishii*), prostrates ceanothus (*Ceanothus prostrates*), snowbush ceanothus (*C. velutinus*), whitethorn ceanothus (*C. cordulatus*), greenleaf manzanita (*Arctostaphylos patula*), curled-leaf mountain mahogany (*Cercocarpus ledifolius*), manzanita sp. (*Arctostaphylos nevadensis*).

Distribution: Similar to Sierran Mixed Conifer Forest (84230) but typically at higher elevations and more extensive toward the south and east. Scattered through the higher North Coast Ranges and Klamath Mountains. Abundant from Shasta and Lassen Counties southward through the Sierra Nevada to Kern County. Best developed on the east side of the central Sierra Nevada, especially south of Mono Lake. Relatively abundantly in the higher portions of the Transverse and Peninsular Ranges of southern CA and Baja California, including the Mt. Pinos region, the eastern San Gabriel Mountains, and the Sierra San Pedro Martir. Elevation usually 5500 - 7500 feet (1650 -2700 m) in the north and 6500 - 9000 feet (2000 - 2700 m) in the south. Stands at lower elevations probably are on ultramafic substrates.

JEFFREY PINE-FIR

Element Code: (85210)

Description: Very similar to Sierran Mixed Conifer Forest (84230), but not quite so tall (to 60 m). The understory is open, primarily of scattered Montane Chaparral (37500) and small trees, lacking the mesophytic components of the Sierran Mixed Conifer Forest. Growth is most active in early and midsummer, about the same as in Jeffrey Pine Forest (85100) and a little later than in Sierran Mixed Conifer Forest (84230).

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Site Factors: Similar to and probably the high-elevation equivalent of Sierran Mixed Conifer Forest (84230). Similar to Jeffrey Pine Forest (85100) but moister. On well-drained slopes, usually avoiding the driest and moistest sites. Typically occurs above Sierran Mixed Conifer Forest and intergrades broadly with Jeffrey Pine Forest on dry slopes and ridges, with Upper Montane Fir Forest (85300) on moist, north-facing slopes and with Lodgepole Pine Forest (86100) in cold, wet sites and stream valleys. Replaced at its upper limit by Subalpine Coniferous Forest (86000), usually Lodgepole Pine Forest.

Characteristic Species: White fir (*Abies concolor*) mostly in southern CA, (*A. magnifica*) lacking in southern CA, whitethorn ceanothus (*Ceanothus cordulatus*), rabbitbrush (*Chrysolepis sempervirens*), Jeffrey pine (*Pinus jeffreyi*), (*P. monticola*) lacking in southern CA, (*P. murrayana*), huckleberry oak (*Quercus vaccinifolia*).

Distribution: Abundant from Mt. Lassen southward along the west side of the Sierra Nevada to Tulare County. More scattered on the east side of the Sierra Nevada from Lake Tahoe to the Mt. Whitney region and in the higher portions of the North Coast Ranges and Klamath Mountains. Occurs with fewer tree species in the southern Sierra Nevada in Kern County, and the higher portions of the Tehachapi Mountains, the Mt. Pinos region, the eastern San Gabriel Mountains, San Bernardino Mountains, and San Jacinto Mountains. Elevation usually 6000 - 8000 feet (1800 - 2420 m) in the north and 7000 - 9000 feet (2100 - 2700 m) in the south.

WHITE FIR

Element Code: (85320)

Description: Very similar to Sierran White Fir Forest (84240) and Red Fir Forest (85310) but not so tall or dense. Typically consists of nearly pure stands of white fir (*Abies concolor*) which grows to about 30 m tall. The southern CA stands of this species, especially the Mojave Desert disjuncts, show some affinity to the Rocky Mountain form. The understory is sparse, with moderate accumulation of needles litter and downed branches. Growth is most active from early to midsummer, probably limited by drought in late summer and by low temperature.

Site Factors: Similar to Sierran White Fir Forest (84240), but higher, colder and probably drier. Similar to Red Fir Forest (85310) and probably its southern equivalent, but drier. Usually confined to steep, north-facing slopes where snow lingers until late spring. The soil is usually rocky and well drained. Intergrades at its lower elevation limit or on drier sites with Jeffrey Pine-Fir Forest (85210). Replaced at its upper limit by Lodgepole Pine Forest (86100).

Characteristic Species: white fir (*Abies concolor*), rabbitbrush (*Chrysolepis sempervirens*), sugar pine (*Pinus lambertiana*), gooseberry (*Ribes* spp.), snowplant (*Sarcodes sanguinea*), snowberry (*Symphoricarpos* spp).

Distribution: Scattered in the southern Sierra Nevada and the highest parts of the Tehachapi Mountains, Kern County; on Mt. Pinos, Ventura-Kern County line; common in the higher portions of the eastern San Gabriel Mountains, LA and San Bernardino Counties; the San Bernardino Mountains, San Bernardino County and the San Jacinto -Santa Rosa Mountains, Riverside County. Elevation usually 7500 - 9500 feet (2300 -2880 m).

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LOGGEPOLE PINE

Element Code: (86100)

Description: Typically form dense forests of slender trees up to 40 m tall, often in nearly pure stands of (*Pinus murrayana*). More open stands up to 20 m tall occur on dry sites or near timberline. May form krummholz at timberline. The trees in the moister, denser stands are relatively short-lived, and if the stand has not burned for a long time, fallen trees, branches and needles cover the ground. The understory is normally sparse in these dense stands, but low shrubs and perennial herbs occur abundantly in forest openings.

There is much less litter in the drier, more open stands; other tree species occur occasionally and understory plants are scattered throughout the stand. Flowering of most plants is concentrated in the early summer; growth of at least the smaller plants may be limited by drought in late summer. Most plants are dormant from fall through spring.

Site Factors: Typically occurs at elevations with long, snowy winters and cool, dry summers; colder in winter and usually drier than Red Fir Forest (85310). Often best developed in the transitional elevations between the Upper Montane Coniferous Forest (85000) and the true Subalpine Coniferous Forest (86000). At its lower limit it occupies cold, moist sites within the Upper Montane Coniferous Forest; at its upper limits it occupies dry, exposed sites at timberline, especially in the southern Sierra Nevada and in southern CA. Apparently tolerates large variations in soil and moisture factors, but most commonly occurs on rocky, well drained soils. Where it forms dense forests, it is subject to devastation by fire or epidemic outbreaks of Lodgepole Pine Needle Miner (*Coleotechnites milleri*). Reseeding is relatively rapid following fires, and Lodgepole Pine Forest is often successional in areas that are eventually dominated by other species. However, this fire succession is more universal in the moister forests of the Cascades and northern Rockies.

Characteristic Species: purple mountainheath (*Phyllodoce breweri*), Sierra lodgepole pine (*Pinus contorta murrayana*), quaking aspen (*Populus tremuloides*), cinquefoil (*Potentilla breweri*), wintergreen (*Pyrola* spp.), mountain hemlock (*Tsuga martensiana* from Yosemite North), blueberry (*Vaccinium* spp).

Distribution: Scattered and poorly developed in the Klamath Mountains. More extensive stands occur east of Mt. Shasta on the Modoc Plateau of eastern Siskiyou and Shasta Counties. Scattered in the higher parts of the Warner Mountains in eastern Modoc County. Abundant in the vicinity of Mt. Lassen. Scattered in the northern most part of the Sierra Nevada, then very abundant from Sierra County to southern Tulare County. Scattered in the highest portions of the San Gabriel Mountains, LA-San Bernardino Counties; abundant on the upper slopes of the San Bernardino Mountains, San Bernardino County; locally abundant near the summit of Mt. San Jacinto, Riverside County; the southern limit is on the summit plateau of the Sierra San Pedro Martir, Baja CA. Extensively developed on the east side of the Cascade Range in Oregon and in the northern Rockies. Elevation 6000 - 8000 feet (1800 - 2420 m) in the north, 9000 - 11000 feet (2700 - 3330 m) in the south. Common as much as 2000 feet (610 m) lower in cold, moist sites such as stream valleys and meadow margins.

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SUBALPINE

Element Code: (86500)

Description: Very similar to Whitebark Pine-Lodgepole Forest (86220) and to Foxtail Pine Forest (86300), but dominated by (*Pinus flexilis*) and (*P. murrayana*). The former species is most important on exposed high slopes and ridges, where it may form small pure stands. The trees are rarely over 10 m high even in the lower portions of the forest and form very scattered, low krummholz at timberline. The understory is typically very sparse. Growth is concentrated in early summer, probably limited by drought in late summer and by low temperature the rest of the year.

Site Factors: Similar to Whitebark Pine-Lodgepole Pine Forest (86220), but drier and probably not quite so cold. Very similar to Foxtail Pine Forest (86300), but possibly with more variable precipitation and / or faster runoff. Usually occurs on dry, rocky slopes and ridges subject to very strong winds in winter. These winds, rather than other factors associated with high altitude, may determine the upper timberline of this forest. At its lower limit may intergrade with Jeffrey Pine Forest (85100) on south-facing slopes, Southern CA White Fire Forest (84320) on north-facing slopes, or Lodgepole Pine Forest (86100) in various situations. Lodgepole Pine Forest may also occur to timberline. Replaced above timberline by Southern California Alpine Fell-Fields (91130).

Characteristic Species: whitethorn ceanothus (*Ceanothus cordulatus*), rabbitbrush (*Chrysoeris sempervirens*), manzanita (*Arctostaphylos patula platyphylla*), limber pine (*Pinus flexilis*), Sierra lodgepole pine (*P. contorta murrayana*), western juniper (*Juniperus occidentalis australis*), curl-leaf mountain mahogany (*Cercocarpus ledifolius*), white fir (*Abies concolor*), Kern buckwheat (*eriogonum kennedyi alpigenum*).

Distribution: Confined to the highest peaks in southern CA: the upper slopes of Mt. Baden-Powell and San Antonio Mountain in the San Gabriel Mountains; Mt. San Jacinto in the San Jacinto Mountains; most abundant in the vicinity of Mt. San Geronimo in the San Bernardino Mountains. Outliers of (*Pinus flexilis*) occur on Mt. Pinos, southwestern Kern County and on Toro Peak, Riverside County. Elevation usually 9500 - 11200 feet (2880 - 3390 m) but occasionally as low as 8500 feet (2580 m).

CYPRESS

Element Code: (83230)

Description: A fairly dense, fire-maintained, low forest dominated by either (*Cupressus nevadensis*), (*C. forbesii*), or (*C. stephensonii*). This forest often occurs as isolated groves within a matrix of Chaparral or Pinon Juniper Woodland. Many stands are even-aged due to fire density, and spacing within the stands vary in relation to site factors and fire history.

Site Factors: Similar to but in a drier climate than Northern Interior Cypress Forests (83220), but not usually associated with ultramafic substrates. Most often found on northern exposures.

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Characteristic Species: (*Adenostoma fasciculatum*), (*Arctostaphylos glandulosa*), (*Cercocarpus betuloides*), (*Cupressus forbesii*), (*C. nevadensis*), (*C. stephensonii*), (*Eriogonum fasciculatum*), (*Heteromeles arbutifolia*), (*Juniperus californica*), (*Pinus coulteri*), (*P. monophylla*).

Distribution: Southern Sierra Nevada (Kern River watershed, *C. nevadensis*) and Peninsular Ranges south into Baja CA. Elevations vary with species: 1000 - 4500 feet for (*C. forbesii*), 5500 feet for (*C. stephensonii*), and 4000 - 6000 feet for (*C. nevadensis*).

MEADOWS/MARSHES

COASTAL SALT MARSH

Element Code: (52120)

Description: Similar to Northern Coastal Salt Marsh (52110) but with longer growing season and a greater abundance of suffrutescent species in the higher, drier sites. Southern “specialties” include (*Atriplex watsonii*), (*Batis maritima*), (*Lucium californicum*), (*Monanthochloe littoralis*), (*Sueda californica*), and (*Salicornia subterminalis*).

Site Factors: Very similar to Northern Coastal Salt Marsh but with warmer water and air temperatures. (*Frankenia*), (*Suaeda*), and/or (*Salicornia subterminalis*) often occur along the upper, landward edges of the marshes; (*Salicornia bigelovii*), (*S. virginica*), and (*Batis maritima*) at middle elevations; and (*Spartina*) closest to open water.

Characteristic Species: dwarf coastweed (*Amblyopappus pusillus*), Watson’s saltbush (*Atriplex watsonii*), turtleweed (*Batis maritima*), spreading alkaliweed (*Cressa truxillensis*), saltmarsh dodder (*Cuscuta salina*), saltgrass (*Distichlis spicata*), buckthorn (*Frankenia grandifolia*), salt heliotrope (*Heliotropium curassavicum*), marsh jaumea (*Jaumea carnosa*), spiny rush (*Juncus acutus sphaerocarpus*), heliotrope (*Heliotropium limonium californicum*), fig (*Carpobrotus aequilateralis*), iceplant (*Mesembryanthemum crystallinum*), slenderleaf iceplant (*M. nodiflorum*), shoregrass (*Monanthochloe littoralis*), dwarf saltwort (*Salicornia bigelovii*), saltwort (*Salicornia* spp.), CA cordgrass (*Spartina foliosa*), wooly seablite (*Suaeda californica*).

Distribution: Bays, lagoons, and estuaries along the coast from about Point Conception to the Mexican border. Intergrades broadly with Northern Coastal Salt Marsh (52110) along the south central coast. Nowhere as extensive as the larger northern marshes, and now considerably reduced by land development activities. Good to fair examples occur at Goleta Slough and near Carpinteria, Santa Barbara Counties; Point Mugu, Ventura County; Upper Newport Bay, Orange County; and several small areas in San Diego County.

BRACKISH MARSH

Element Code: (52200)

Description: Dominated by perennial, emergent, herbaceous monocots to 2 m tall. Cover is often complete and dense. Similar to Salt Marshes (52100) and to Freshwater Marshes (52400) with some plants characteristics of each.

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Site Factors: Similar to Coastal Salt Marshes, but brackish from freshwater input. Salinity may vary considerably, and may increase at high tide or during seasons of low freshwater runoff or both. Usually intergrades with Coastal Salt Marshes toward the ocean and occasionally with freshwater Marshes (52400) at the mouths of rivers, especially in the Sacramento-San Joaquin River Delta.

Characteristic Species: Harford's sedge (*Carex harfordii*), slough sedge (*Carex obnupta*), sedge spp. (*Carex* spp), saltgrass (*Distichlis spicata*), rush (*Juncus* spp.), saltwort (*Salicornia* spp.) bogrush (*Scirpus* spp.), cattail (*Typha latifolia*).

Distribution: Usually at the interior edges of coastal bays and estuaries or in coastal lagoons. Adjacent to several Salt Marshes (52110 and 52120). Most extensively developed around Suisun Bay at the mouth of the Sacramento-San Joaquin Delta.

MONTANE FRESHWATER MARSH

Element Code: (52430)

Description: Similar to Coastal and Valley Freshwater Marsh (52430) and to Bogs and Fens (51000), with which many species are shared.

Site Factors: Similar to Coastal and Valley Freshwater Marsh but with a shorter growing season due to cold winters. Less acidic and nutrient-rich than Bogs or Fens.

Characteristic Species: slenderbeak sedge (*Carex athrostachya*), Nebraska sedge (*C. nebracensis*), cottongrass (*Eriophorum*), bogrush (*Scirpus acutus*), (*S. americanus*), others?

Distribution: Widely scattered throughout Montane CA, though less frequent in the Transverse and Peninsular ranges.

MONTANE MEADOW

Element Code: (45100)

Description: Dense growth of sedges and other perennial herbs, usually from 0.5 – 1 m high, but with some taller herbs to 2 m. Main growth period from late spring through summer (summer only at higher elevations); flowering mostly in summer; dormant in winter (from fall through spring at higher elevations). Montane Meadows are subdivided into Wet (45110) and Dry (45120) subtypes. Wet Montane Meadows have soils that remain saturated throughout the year.

Site Factors: On fine-textured, more or less permanently moist or wet soils. May be associated with Bogs (51100), Fens (51200) or Freshwater Swamps (52600) in more extremely waterlogged soils. Adjacent forest or scrub are on coarser, better drained soil, and characterized by young trees encroaching from the margins. On seasonally driers, but still fine-textured Valley and foothill Grasslands (42000) in the North Coast Ranges, Great Basin Grassland (43100) or Great Basin Sagebrush (35200) in northeastern CA. Both Wet and Dry types may occur in a given meadow.

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Characteristic Species: small camas (*Camassia guamash*), sedge (*Carex bolanderi*), (*C. rostrata*), (*C. vesicaria*), Sierra shootingstar (*Dodecatheon jeffreyi*), mannagrass (*Glyceria elata*), needle spikerush (*Eleocharis acicularis bella*), cowparsnip (*Heracleum sphondylium* spp. *montanum*), Sierra rush (*Juncus nevadensis*), bigleaf lupine (*Lupinus polyphyllus* ssp. *superbus*), pullup muhly (*Muhlenbergia filiformis*), western brackenfern (*Pteridium aguilinum*), scirpus (*Scirpus congdonii*), (*S. Criniger*), CA false hellebore (*Veratrum californicum*), (*V. fimbriatum*, in North Coast Ranges).

Distribution: Scattered within the North Coast Coniferous forests (8200), Lower Montane Forests (84000), and Upper Montane Forest (85000) of the North coast ranges, Klamath Ranges, Cascade Ranges, Sierra Nevada, Transverse and Peninsular Ranges. Elevation from 1000 - 7000 feet (300 - 2130 m) in the north to 5000 – 9000 feet (1520 -2740 m) in the south.

PAVEMENT PLAIN

Element Code: (47000)

Description: Herb and grass-dominated openings in Jeffrey Pine Forests (85100) or Pinyon-Juniper Woodland (72300). Total cover usually is low (CA 35%), composed of scattered, short, cushion-forming plants, and dominated by several taxa endemic to the San Bernardino Mountains.

Site Factors: Dense, clay soils armored by a lagg-gravel of quartzite pebbles. Frost action, and wind and water action, prevent large, woody vegetation from establishing.

Characteristic Species: low pussytoes (*Antennaria dimorpha*), Bear Valley sandwort (*Arenaria ursine*), black sagebrush (*Artemisia nova*), Kern buckwheat (*eriogonum kennedyi*), silverhair mousetail (*Ivesia argyrocoma*), (*Poa incurva*).

Distribution: Restricted to about 30 pavements in the area around Big Bear Lake and Holcomb Valley in San Bernardino County. Elevation about 6500 - 7000 feet.

URBAN/INVASIVE

ARUNDO SCRUB/FOREST

Element Code: (RNF01)

Description: A dense monoculture dominated by arundo also known as the giant reed (*Arundo donax*). This is a very invasive grass that was introduced to CA in the 1880's. This species persist in riparian areas, and reduces or replaces native species.

TAMARISK SCRUB

Element Code: (63810)

Description: A weedy, virtual monoculture of any of several Tamarix species, usually supplanting native vegetation following major disturbance.

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Site Factors: Sandy or gravelly braided washes or intermittent streams, often in areas where high evaporation increases the streams saltiness. Tamarisk is a strong phreatophyte and a prolific seeder, attributes which predispose the species to be aggressive competitors in disturbed riparian corridors.

Characteristic Species: big saltbush (*Atriplex lentiformis*), Palmer's coldenia (*Coldenia palmeri*), salt grass (*Distichlis spicata*), arrow-weed (*Pleuchea sericea*), sandbar willow (*Salix exigua*), tamarix (*Tamarix chinensis*), (*T. ramosissima*).

Distribution: Widely scattered and increasing its range, throughout the drier parts of CA from the rain shadow east of the Inner North Coast Ranges south through the Great Valley to southern CA and across the deserts to Nevada, Arizona and beyond.

EUCALYPTUS WOODLAND

Element Code: (11100)

Description: eucalyptus is the sole or dominate tree in the canopy; few other species present. Trees are greater than 50 m tall creating a continuous canopy. Shrubs are infrequent and ground layer is sparse.

OTHER NON-NATIVE COMMUNITY

Element Code: (11000)

Description: A dense monoculture dominated by an invasive species other than arundo, tamarix, or eucalyptus.

URBAN/DEVELOPMENT

Element Code: (12000)

AGRICULTURE

Element Code: (18000)

FIELD/PASTURE

Element Code: (18310)

UNVEGETATED

Element Code: (13000)

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Appendix 4. Paper data form.

Turtle: Visual Survey Form

Date _____

Project Code _____ Observer1 _____ Obsv1 Task observer/recorder/processor Block _____

Survey Type visual/trapping Observer2 _____ Obsv2 Task observer/recorder/processor Site _____

Start Time _____ Observer3 _____ Obsv3 Task observer/recorder/processor Site Photo

Y	N
---	---

End Time _____ Observer4 _____ Obsv4 Task observer/recorder/processor # photos _____

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

Weather:

Temperature	_____
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>

Start Water Fields:

Water Present	Y/N
Latitude	_____
Longitude	_____
Water Temperature	_____
pH	_____
Conductivity	_____
DO % Saturation	_____
DO mg/L	_____
Remarks	_____

Expected Species List:

Pacific Chorus Frog	D	N	X
Western Toad	D	N	X
California Newt	D	N	X
Southwestern Toad	D	N	X
Mosquitofish	D	N	X
Crayfish	D	N	X
California Treefrog	D	N	X
Bullfrog	D	N	X
African Clawed Frog	D	N	X
Western pond turtle	D	N	X
Notes	_____		

All Animals:

Observ Method	Lat./Long	Type	Species	Age Category	Disposition				Phot#	Photos
1 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
2 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
3 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
4 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
5 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
6 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
7 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
8 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
9 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	
10 audio/hand/trap/vis				A,J,Mm,L1,L2,H,Em,U	R	D	E	C	Y/N	

Additional Fields for Non-native Turtles:

Trap Number (if applicable)	Sex				Length (mm)	Notched		Tissue	
1	M	F	U	X		Y	N	Y	N
2	M	F	U	X		Y	N	Y	N
3	M	F	U	X		Y	N	Y	N
4	M	F	U	X		Y	N	Y	N
5	M	F	U	X		Y	N	Y	N
6	M	F	U	X		Y	N	Y	N
7	M	F	U	X		Y	N	Y	N
8	M	F	U	X		Y	N	Y	N
9	M	F	U	X		Y	N	Y	N
10	M	F	U	X		Y	N	Y	N

Additional Fields for Pond Turtles:

	Carapace Width (mm)	Carapace Length (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

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Appendix 5. 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 Turtle (*Clemmys marmorata*) Library:

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