

CHAPTER 1
OBJECTIVES, NOMENCLATURE AND TAXONOMY, DESCRIPTION,
STATUS, AND NEEDS FOR SAMPLING

R BRUCE BURY

*US Geological Survey, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson
Way, Corvallis, OR 97331*

HARTWELL H WELSH JR

*US Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory,
1700 Bayview Drive, Arcata, CA 95521*

DAVID J GERMANO

*Department of Biology, California State University, 9001 Stockdale Highway, Bakersfield,
CA 93311*

DONALD T ASHTON

*US Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory,
1700 Bayview Drive, Arcata, CA 95521*

OBJECTIVES

Our main goal in this book is to synthesize the known information about the biology, management, and conservation of the Western Pond Turtle (*Actinemys marmorata*). Our specific objectives are to 1) better determine the current status of its distribution and abundance based on proven sampling designs and techniques, 2) summarize and evaluate known biological information, 3) recommend techniques to detect significant changes in population and habitat condition, and 4) improve monitoring for long-term trends in turtle populations.

Development of sound sampling procedures and methods is based on a variety of sources: published research papers on the species (our first preference for information), judicious use of unpublished reports, and knowledge from several ongoing efforts by individuals interested in this species. We considered all of these sources but attempted to exclude or restrict use of those in the unpublished "gray" literature. Moreover, we do not attempt to provide a set protocol (for example, a standardized design or approach) because there are too many variables at play across the range of the Western Pond Turtle. Instead, we offer techniques that have

worked for us and other biologists, yet we encourage further experimentation to improve these. Although this book may appear to be the "final word" or the largest synopsis of this species, we consider it more as a starting point to address so many unanswered questions about this endemic turtle in western North America.

NOMENCLATURE AND TAXONOMY

This species has until recently been called the Western or Pacific Pond Turtle (*Clemmys marmorata*), but its relationships (phylogeny), and name (taxonomy), are currently in flux. Early phylogenies were based primarily on morphologic, ecologic, and geographic evidence, but more recently molecular and genetic evidence have challenged classic views. Here, we outline the history of its name, some recent taxonomic arguments, and consider subspecific and other variation in the Western Pond Turtle.

The Western Pond Turtle is in the family Emydidae, which is the largest and most diverse family of turtles with 48 species across 3 continents, and 32 or more species are in the New World (Collins and Taggart 2009; Ernst and Lovich 2009). Recent investigations into relationships within the Emydidae have resulted in

taxonomic revisions, but not all authors agree on the placement of the Western Pond Turtle within the family. A final naming decision is deferred pending additional evidence. Its nomenclature in key checklists and publications has varied widely in the last decade.

Scientific Name

The species was first collected in 1841 and later described as *Emys marmorata* by Baird and Girard (1852) based on specimens collected from Fort Steilacoom in the Puget Sound area, western Washington State. This wetland area is just west of the present-day Fort Lewis Military Reservation, just south of Tacoma, Washington.

The first use of *Clemmys marmorata* was by Strauch (1862). Supported by morphological evidence (McDowell 1964; Bramble 1974), this remained the name of favor by most authors for more than a century. Molecular and genetic analyses have indicated *Clemmys* is paraphyletic (a genus that did not include all the descendants of a common ancestor). This prompted a breakup of the genus, sparking the current naming controversy. Following the argument of Holman and Fritz (2001), Iverson and others (2003) recommended *Actinemys marmorata* (and Pacific Pond Turtle) as the standardized name, claiming *Actinemys* best serves to reflect the diversity of this monophyletic group. This placed the species in its own monotypic genus, *Actinemys*, as ascribed more than 150 y ago (Agassiz 1857), just a few years after the original description.

The original description (Baird and Girard 1852) and many recent papers (Cochran 1961; Feldman and Parham 2002; Spinks and others 2003, 2010; Fujita and others 2004; Krenz and others 2005; Spinks and Shaffer 2005) place the species in the genus *Emys*. Today, this arrangement would place the Western Pond Turtle in a genus with the European Pond Turtle (*Emys orbicularis*). This is a great geographical separation with 1 species each in western Europe and in western North America, although this pattern is not unknown for other taxa. For example, different species of limestone salamanders of the genus *Hydromantes* occur only in California, whereas their nearest relatives (recently reassigned to their own genus, *Speleomantes*) are found in Sardinia and Italy. The genus *Emys* may also include the Blanding's Turtle, otherwise known as *Emydoidea* [= *Emys*] *blandingii*.

Several authorities show both names for the genus. For example, Rhodin and others (2008) list this species as "*Actinemys* or *Emys*," but reverse the order in Rhodin and others (2010) as "*Emys* or *Actinemys*." Reynolds and others (2007) use *Emys* [= *Actinemys*].

Stephens and Wiens (2003) discuss conflict between morphological and molecular data, but in the interest of future taxonomic stability they recommend *Actinemys*, predicting description of new species within both *Actinemys* and *Emys*. Central in the debate is whether shell kinesis evolved twice (Feldman and Parham 2002) or was secondarily lost (Holman and Fritz 2001) within the subfamily Emydinae. The scientific name remains in flux and it may require some time for the generic name and relationship of other turtles to stabilize. Most authors agree that the traditional *Clemmys* is paraphyletic, and that the name *Clemmys* should be reserved only for the genus type specimen: the Spotted Turtle (*Clemmys guttata*). There remains debate over the name for the Western Pond Turtle. For this book, we choose the widely recognized name *Actinemys marmorata* (see Iverson and others 2003; Rhodin and others 2008; Ernst and Lovich 2009; Fritz and others 2011).

Common Name

A variety of common names have been used in the past. In the original description, Baird and Girard (1852) did not use a common name for the species. Other early publications referred to "Pacific" in the common name: Van Denburgh (1922) used "Pacific Terrapin," Storer (1930) used "Pacific Fresh-water Turtle," Seeliger (1945) used "Pacific Mud Turtle," and Banta (1963) had "Pacific Pond Terrapin," whereas Pope (1939), Carr (1952), Stebbins (1954), and 12 others since 1970 (Table 1) used "Pacific Pond Turtle." The name "Western Pond Turtle" appears to have been first used in the *Field Guide to Western Reptiles and Amphibians* (Stebbins 1966) and has been the most used name ($n = 37$) since (Table 1). We follow recent convention and use Western Pond Turtle as the common name.

Taxonomy

Even within the species there is taxonomic controversy. Two subspecies were recognized by Seeliger (1945): the Northwestern Pond

TABLE 1. Common names used to describe the Western or Pacific Pond Turtle in recent years.

Common name	Reference
Pacific Pond Turtle	Bury (1972a); Pritchard (1979); Ernst and Barbour (1989); Iverson and others (2001, 2003); Feldman and Parham (2002); Rathbun and others (2002); Spinks and Shaffer (2005); Fritz and Havas (2006); Scott and others (2008); Ernst and Lovich (2009)
Western Pond Turtle	Banks and others (1987); Bury (1970, 1975, 1995); Ernst and Barbour (1972); Collins and others (1978); Nussbaum and others (1983); Holland (1985, 1994); Rathbun and others (1992); Ernst and others (1994); Jennings and Hayes (1994); Gray (1995); Storm and Leonard (1995); Reese and Welsh (1997, 1998a, 1998b); Bury and Germano (1998, 2008); Hays and others (1999); Goodman and Stewart (2000); Germano and Bury (2001); Collins and Taggart (2002); Lovich and Meyer (2002); Spinks and others (2003, 2010); Stebbins (2003); Jennings (2004); Matsuda and others (2006); Bickham and others (2007); Lubcke and Wilson (2007); Germano and Rathbun (2008); Iverson and others (2008); Germano and Bury (2009); Germano (2010); Bury and others (2010); Polo-Cavia and others (2010a)

Turtle (*Clemmys marmorata marmorata*) from north of the American River in central California to Puget Sound, Washington, and the Southwestern Pond Turtle (*C. m. pallida*) from central California south to Baja California. A zone of intergradation was reported to occur in the San Joaquin Valley, California (Seeliger 1945; Stebbins 1985; Jennings and Hayes 1994). However, Seeliger (1945) based subspecific differences on minor changes in presence and shape of the inguinal (a small plastral scute) and coloration (a highly variable feature range wide). Further, presumed subspecific differences may arise from variation within populations rather than being immutable characters. The concept of subspecies has lost favor in recent years, and this is one case where most experts now do not recognize these minor shell and color differences.

Holland (1994) suggested that there are 3 morphologically distinct species in what was earlier recognized as *Clemmys marmorata*. These approximately correspond to the previously described 2 subspecies and a 3rd undescribed species from the Columbia River Gorge, Oregon. His analysis remains unpublished and, thus, is not followed here. We include it to point out that there may be geographic variation in several color and morphological characteristics of the species over its relatively large range.

Analyzing phylogeography and population genetic variation across the range of the species, Spinks and Shaffer (2005) found a distinct northern clade (group) with little genetic variation from the vicinity of San Francisco Bay and northward, but high variation in turtles from southern California and the Central Valley,

California. The northern clade overlaps what has been previously described as Northwestern Pond Turtles (Seeliger 1945), but the intergrade zone and the southwestern "subspecies" appear to form several distinct clades. While there may be 4 clades within this species, Spinks and Shaffer (2005) await more evidence on the number and distribution of phylogenetic taxa before recommending taxonomic revision (for example, naming new species). Recent evidence suggests a strong divergence between the northern and southern groups, with the divide occurring where there earlier was a major marine embayment in central California (Spinks and others 2010).

Here, we do not recognize the subspecies described by Seeliger (1945). Biologists need to be alert to the recent description of 4 clades (groups) proposed by Spinks and Shaffer (2005), especially with 3 of them occurring south of the San Francisco Bay region. We define and discuss the ecology, sampling techniques, survey procedures, or specific conservation issues of populations over broad patterns (for example, northern versus southern groups), yet we do not match these to any described clades or subspecies.

DESCRIPTION

The coloration is very variable. In some specimens the carapace is olive or horn-color with few or no markings. In others a few broken and very irregular black lines are present. These lines frequently have become so numerous that, blending and crossing, they appear as the ground color, or form a very fine network through which the original ground color shows more or less

indistinctly. Sometimes the carapace is almost black.

Van Denburgh (1922)

The Western Pond Turtle is a semiaquatic turtle that reaches a maximum length of 241 mm and maximum weight of approximately 1200 g. Most adults are 160 to 180 mm long and 500 to 700 g in weight. Color and markings vary by geography, ontogeny, and sex (Bury and Germano 2008). However, most are olive to dark brown dorsally, often with darker reticulations (dots, streaks). This color is cryptic as the dorsal color basically resembles a rock in a stream or pond (Bury 1995). Ventrally, they are yellowish, sometimes with dark blotches in centers of the plastral scutes (Bury and Germano 2008). Over most of the range, males have a yellowish to white chin and underside of the throat, whereas females are light brown with dark spots on the chin and throat (Plate 1). Animals in the San Joaquin Valley, California, may have more yellow or pale color on their shell and appendages (Plate 2). Also, color dimorphism is less pronounced or absent in south coastal California (see Bury and Germano 2008) but has not been well described.

Hatchlings are 25 to 31 mm long (carapace length) and weigh 3 to 7 g at the time of emergence from the nest. They tend to be a light brown, darkening with age (Holland 1994). The shell is soft and pliable and their tail is relatively long (Nussbaum and others 1983; Stebbins 1985, 2003; Bury 1995). The young grow rapidly, and the shell is usually fairly hard by 3 to 4 y of age.

Western Pond Turtles display sexual dimorphism at maturity. In the Trinity River, secondary sexual characteristics were present by the time animals attained a carapace length (CL) of 125 mm (Reese 1996; D Holland, pers. comm.). Farther south, they reach maturity at a smaller size, 110- to 120-mm CL (Holland 1994; Germano and Bury 2001). The sex of adults usually can be distinguished reliably using just a few

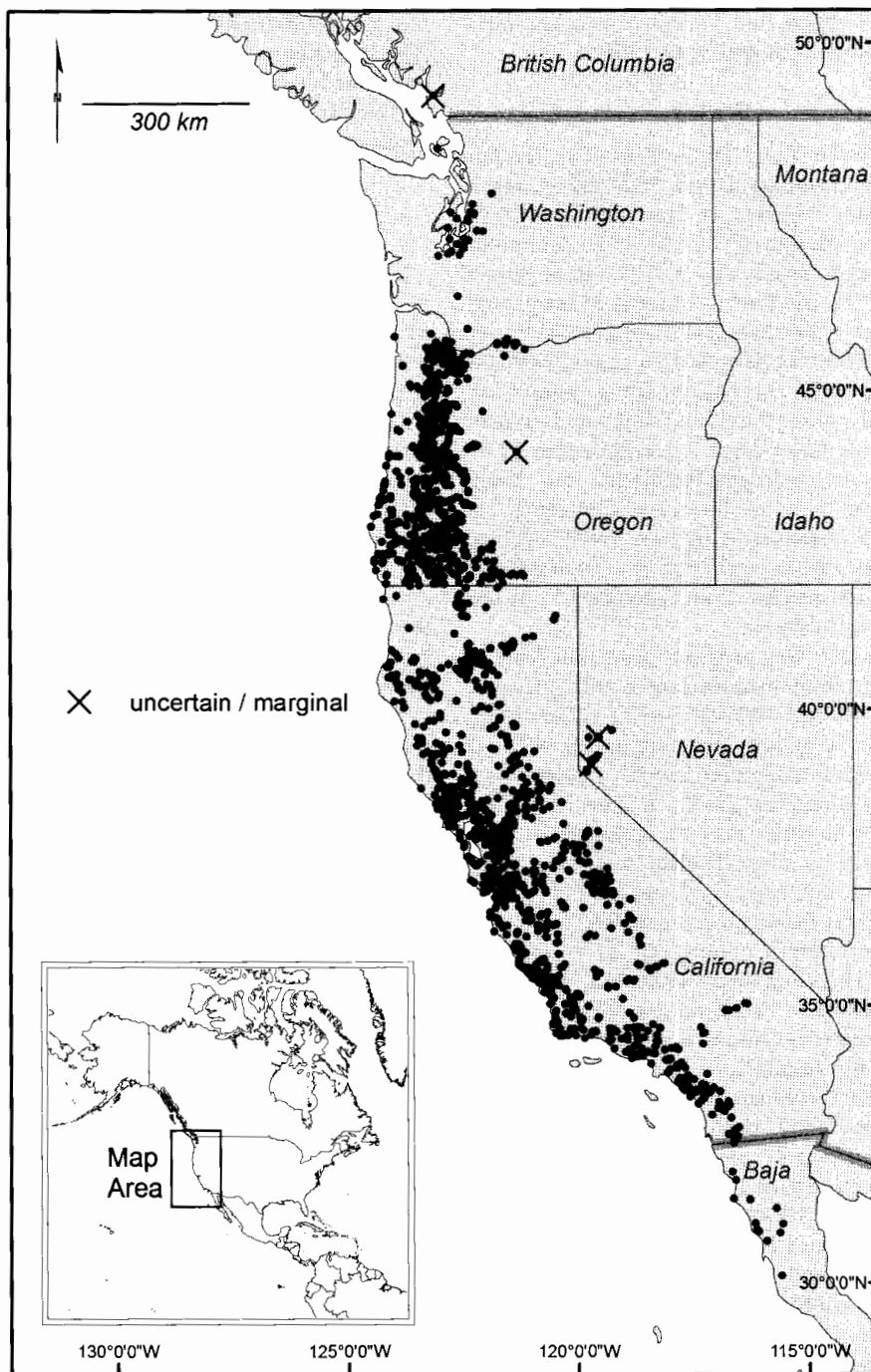
visible features (see Chapter 7). However, adults in southern California may lack the color dimorphism of turtles from farther north. No single characteristic is completely reliable, so it is best to look at several characters to determine sex. Juveniles (about <110- to 125-m CL) of both sexes tend to resemble females with a basic brown coloration with darker dots or reticulations on the head and neck.

DISTRIBUTION

The Western Pond Turtle occurs chiefly west of the Sierra-Cascade crest (Fig. 1) along the Pacific Coast of North America (Bury 1970; Stebbins 2003; Bury and Germano 2008). The first specimens and the type locality were from near Tacoma, in the Puget Sound area of western Washington (Slater 1939; Hays and others 1999). There are some old observations of the turtle in southwestern British Columbia (Gregory and Campbell 1984; Matsuda and others 2006; Saumure 2007), but no recent sightings. In contrast, Cook and others (2005) stated that historical and recent evidence strongly suggests that the Pacific (= Western) Pond Turtle was introduced into British Columbia and never did occur there naturally. The turtle ranges south through the Sierra San Pedro Martir and coastal rivers in Baja California (Smith and Smith 1979; Welsh 1988; Lovich and others 2005, 2007), but there are few records in the southern terminus of its range (Grismer 2002). Some isolated records occur in eastern Oregon (Holland 1994; Bury 1995) and in the Truckee and Carson rivers in western Nevada (La Rivers 1942; Banta 1963), but it is uncertain whether these sites contain native or introduced turtles (Spinks and Shaffer 2005; Bury and Germano 2008). Fossil evidence shows that *A. marmorata* or an ancestor has existed in the western United States since at least the late Pliocene (Hay 1908), and this species occurred in the western parts of the Great Basin in

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FIGURE 1. Distribution of the Western Pond Turtle. Localities within 500 m were consolidated into a single site. X indicates sites with uncertain or marginal occurrences, including extinct sites and sites where (re)introductions have occurred or are suspected. Prepared by Kimberly L Barela (KLB) and Deanna H Olson, US Forest Service, Pacific Northwest Research Station, Corvallis, Oregon, from regional databases including California Natural



Diversity Database, Nevada Department of Wildlife, Oregon Biodiversity Information Center, and Washington Department of Fish and Wildlife. Records for Baja California are from the literature (see Chapter 1). This is part of the Turtle Mapping Project sponsored by Partners in Amphibian and Reptile Conservation and for the senior thesis of KLB, BioResource Research Interdisciplinary Science Program, Oregon State University, Corvallis, Oregon.

Nevada, Oregon, and Washington in the Pleistocene (Brattstrom and Sturn 1959).

STATUS

The Western Pond Turtle is listed as "Endangered" by Washington State, "Sensitive-Critical" by Oregon, "Species of Special Concern" by California, "Sensitive" by the US Forest Service in the Pacific states, and a "Species of Special Concern" by the Bureau of Land Management. In California, Jennings and Hayes (1994) recommended "State Endangered" status in southern California from the Salinas River (near Monterey) south along the coastal slopes and from the Mokelumne River (near Stockton) south in the San Joaquin hydrographic basin, and "State Threatened" level for the rest of California. The California Department of Fish and Game has reduced an earlier possession limit from 2 turtles to 0, and the species is now protected from take or harm in California.

This species was proposed for Federal listing in 1991 but found not warranted at that time by the US Fish and Wildlife Service (USDI 1992). Currently, it is not included on the Federal Threatened/Endangered Species List nor is it listed as a candidate species. It is estimated that population declines may be occurring in more than 80% of its range (Holland 1994), but many areas have not been surveyed and long-term monitoring is lacking. Losses appear to be most severe in northern populations in Washington State (see Hays and others 1999) and, if native, in British Columbia (Matsuda and others 2006) as well as southern California and Baja California, where many populations have been lost (Brattstrom 1988; Goodman and Stewart 2000; Lovich and Meyer 2002). Habitat loss and alteration, isolation of populations, introduction of nonindigenous species, and pollution negatively affect populations of Western Pond Turtles. However, much new habitat has been created in the form of stock ponds and other artificial water features that have benefited the species.

Western Pond Turtles are relatively long-lived and some reach an age of 50 y or more in the wild (RB Bury, unpubl. data). Hatchlings are small at approximately 25 mm long and grow to adults with shells 160 mm or more long. Females in northern populations do not achieve reproductive status until 7 to 12 y of age (Germano and Bury 2001), but can do so in 4

to 6 y in southern areas (Germano and Rathbun 2008; Germano 2010). These population differences are important to consider when designing monitoring plans and for achieving effective conservation strategies for the species.

NEED FOR SURVEY TECHNIQUES AND MONITORING STUDIES

Small, incremental changes in the composition of populations can result in declines or extirpation of species or local/regional genetic stocks. Adult turtles may persist many years after a population has collapsed below the threshold of viability (that is, with little or no recruitment). However, hatchlings and young turtles are difficult to observe in the wild, often are solitary, often use microhabitats that differ from other age classes, and thus are frequently undersampled. Also, some larger turtles may actually be quite young because they have a high rate of growth (Germano and Rathbun 2008; Germano and Bury 2009; Bury and others 2010; Germano 2010). Sampling of Western Pond Turtles requires innovative techniques and a long-term commitment of resources to ensure that all portions of the population are effectively sampled.

Reliable and effective sampling protocols are needed for effective conservation and management efforts of the Western Pond Turtle. Here, we attempt to provide a review of its habitat use, ecology, and conservation as well as examine effective sampling and field techniques based on the input of many experts from different regions and perspectives. Such an approach may assist management to maintain populations of this native turtle and recover those that are depleted. Removing or reducing threats to the species and its habitats may prevent the need to list the Pond Turtle as threatened or endangered. A substantial proportion of the habitat of this species does not occur on public lands; therefore, successful conservation may require state and federal agencies to join in efforts with interested citizens and landowners to monitor and protect this species throughout its range. Inventory and monitoring efforts should employ scientifically rigorous methods yet achieve the greatest possible efficiency to ensure the widest coverage of populations. Consistency in data collection is necessary to allow consolidation and analysis of information from different geographic areas (Anderson and others 1999).

Field surveys may be needed to 1) determine the presence of Western Pond Turtles in an area (or a reasonable determination that they were not found), 2) assess their relative abundance or status with a population estimate based on established criteria (for example, mark and recapture study), 3) provide baseline information on population features (for example, age and sex ratios), and 4) assess population response to habitat changes over time. Effective survey protocols are needed for agency management actions (for example, location of campgrounds along a river on public lands), impact assessments (for example, construction of a bridge over a stream or road construction), and habitat conservation planning (for example, a timber harvest plan around a pond).

The primary purpose of field monitoring is to detect significant changes in demographics and

habitat use over time, and to determine whether management and protective efforts have been successful. Monitoring is needed to assess the effectiveness of conservation measures and identify factors affecting achievement of local or regional objectives. Monitoring designs must attempt to identify the primary causal factors of change in distribution, abundance, and population features of Western Pond Turtles. Ideally, monitoring would occur early enough to allow time for corrective actions to be undertaken that would prevent the need for listing of the species as threatened or endangered in all or parts of its range. The techniques and approaches described in this handbook should help users achieve consistency, efficiency, and reduced or no bias in surveying and monitoring across the range of the Western Pond Turtle, thereby strengthening management and conservation efforts.