WESTERN POND TURTLE
Clemmys marmorata

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Management Status: Federal: USFWS Species of Concern; BLM Sensitive
California: Species of Special Concern (CDFG, 1998)

General Distribution:

The western pond turtle (*Clemmys marmorata*) formerly ranged from extreme western Washington and British Columbia to northern Baja California, mostly to the west of the Cascade-Sierra crest (Ernst et al., 1994). Disjunct populations exist, or existed, in the Truckee, Humboldt, and Carson Rivers in Nevada, Puget Sound, and the Columbia Gorge. Other isolated, but extant, populations are found in the interior draining Mojave River of California at least as far into the Mojave Desert as Afton Canyon, and in the Amargosa River, Los Angeles County. Fossils from the Camp Cady area establish the presence of western pond turtles in the Mojave Desert to at least the Pliestocene (Jefferson, 1968). Scattered records, including the individual reported by Jennings and Hayes (1994) in Andreas Canyon near Palm Springs, California, likely represent introduced specimens (Holland, 1994).

Distribution in the West Mojave Planning Area:

Records are scattered along much of the Mojave River including Yermo and Victorville (Seeliger, 1945). Brattstrom and Messer (1988) speculated that some turtles remain in Deep Creek and reported previous records from the Mojave Narrows near Victorville, and Afton Canyon. The author observed a western pond turtle in a beaver (*Castor canadensis*) pond along the Mojave River below the Victorville sewage treatment plant in 1998. A population exists at Camp Cady and several specimens from there were transplanted to ponds at the Desert Studies Center at Zzyxx (outside the planning area), and the California Desert Information Center (CDIC) in Barstow. It is assumed that the Zzyxx transplant failed, but a few turtles remain at CDIC and have produced offspring. Some of the turtles at Camp Cady may have been introduced from Carbon Canyon, Orange County in the 1970's, but this claim has not been positively substantiated. The author initiated studies on the ecology of western pond turtles in the Mojave River in 1998 and over 30 specimens are now marked at Camp Cady and Afton Canyon. Several recent records (1990, 1995) are listed in the Natural Diversity DataBase for the southwestern Antelope Valley near Elizabeth Lake and the Amargosa River, Los Angeles County. No published literature is available to ascertain the status of these populations but studies have been initiated and a population of over 50 turtles are now marked (David Muth, pers. comm.).

Natural History:

The western pond turtle is a small turtle with a relatively low carapace. The shell may exhibit a pattern of dark spots or lines that radiate from the centers of the scutes, or it may be almost patternless olive brown, dark brown, or grayish. The oval carapace is up to 8.3 inches (21 cm) in large individuals (Holland, 1994). On the Mojave River, at Camp Cady and Afton Canyon,

males have an average carapace length of 5.2 inches (13.1 cm), while females are slightly larger at 5.7 inches (14.5 cm) (Lovich, unpublished data). In the Amargosa River (Los Angeles County), average carapace length of males and females is 5.0 inches (12.8 cm) and 5.4 inches (13.7 cm), respectively (David Muth, unpublished data).

The pale yellow plastron is hingeless and may have dark blotches along the rear margins of the scutes. The skin is gray, with some pale yellow on the neck, chin, forelimbs, and tail. The head is plain or reticulated. Males have a concave plastron, lighter throat coloration, and the anal vent situated posterior to the rim of the carapace.

Two subspecies are recognized. The northwestern pond turtle (*Clemmys marmorata marmorata*) ranges south to San Francisco Bay, and east to Nevada. A pair of well-developed triangular inguinal scutes on the bridge characterizes it, and its brown or grayish neck and head are well marked with dark dashes. The throat is pale in contrast with the sides of the head. The southwestern pond turtle (*Clemmys marmorata pallida*) is found south of San Francisco Bay including the West Mojave Planning Area (WMPA). It is identified by its poorly developed inguinal scutes (absent in 60% of individuals), and by the uniform light color of the throat and neck. The two races intergrade over a large area in central California (Bury, 1970; Stebbins, 1985).

Although the validity of recognized subspecies has been questioned, recent genetic analysis using DNA fingerprinting supports their distinctiveness (Gray, 1995; Janzen et al., 1997). Holland (1992) suggested that there are actually three species in what is currently recognized as *Clemmys marmorata* including a northern species, a southern species (which would include those in the WMPA), and an undescribed species from the Columbia River. Additionally, Janzen et al. (1997) observed several unique genetic variants in southern California and Baja California, suggesting that special care should be taken to preserve and manage these populations. In fact, southern populations may be distinct enough to warrant recognition as separate species (Janzen et al., 1997). However, no formal taxonomic revisions have been published and all populations continue to be recognized as *C. marmorata*. Holland (1992) further suggested, based on preliminary analysis, that turtles in the Mojave River showed a high level of morphological differentiation from other populations in southern California.

Nothing has been published on the ecology of western pond turtle populations in the WMPA, but considerable information has accumulated for the species elsewhere in its range (Ernst et al., 1994; Holland, 1994). The following narrative borrows heavily from these sources and incorporates the results of other studies. Seasonal activity varies geographically and turtles may be active in every month at some localities (Holland, 1994). In the northern portion of its range, western pond turtles are active primarily from February-November (Evenden, 1948; Bury, 1972). In northern California it starts to forage early in the morning and then basks intermittently thereafter with most basking occurring from 0900-1000. During the summer, turtles may forage in the late afternoon or early evening. Western pond turtles in northern California apparently avoid body temperatures over 95^{o} F (34^{o} C), usually terminating aerial basking at about 90-95^{o} F (32-34^{o} C), well below its critical thermal maximum of 104^{o} F (40^{o} C). Most normal activities occur at body temperatures from 75-90^{o} F (24-32^{o} C; Bury, 1972).

Adult males have larger home range sizes and lengths than do adult females and these in turn are larger than those of juveniles. In a population congregated in pools in a northern California stream, male home range size averaged 2.42 acres (0.98 ha) with a mean length of 3,201 feet (976 m). For adult females the figures were 0.62 acres (0.25 ha) and 813 feet (248 m).

Values for juveniles were 0.89 acres (0.36 ha) and 1,191 feet (363 m) (Bury, 1972). During the summer these turtles moved from pool to pool within the stream system; 53.5% of males, 27.5% of females, and 32.6% of juveniles moved upstream, while 34.0% of males, 38.9% of females, and 27.1% of juveniles traveled downstream. The average male moved 1,161 feet (354 m) during Bury's (1972) study, while the average female and juvenile moved only 554 feet (169 m) and 466 feet (142 m), respectively. More than 81% of the males moved over 656 feet (200 m), but only 36.6% of females and 22.5% of juveniles traveled a greater distance than 656 feet (200 m); 26.6% of the males, 6.1% of females, and 6.2% of juveniles migrated over 1,640 feet (500 m). In three years, the average male moved approximately 2,680 feet (817 m). Turtles studied by Bury were capable of moving distances of at least 1 mile (1.6 km) overland to adjacent water bodies and later returning, but Holland (1994) reported overland movements of up to 3.1 miles (5 km). At another site in coastal southern California, four radio-equipped females averaged daily movements of 92 feet (28.0 m), 179 feet (54.6 m), 198 feet (60.5 m), and 286 feet (87.1 m), respectively during the period 20 May to 21 June 1989 (Rathbun et al., 1992). Small movements between adjacent ponds and wetlands have been observed on several occasions at Camp Cady and Afton Canyon, both on the Mojave River (Lovich, unpublished).

Basking western pond turtles engage in a variety of aggressive behaviors to ensure adequate spacing at basking sites (Bury and Wolfheim, 1973). Some turtles bite or ram to push the other turtle off its perch. Most basking aggression takes place before noon (0900-1159 hours).

Bury (1972, 1989) estimated a population density of 529 turtles/acre (214 turtles/ha) and a biomass of 123 pounds/acre (137 kg/ha) in a 2.2 mile (3.5 km) stretch of stream in northern California. Turtles were not distributed uniformly and the greatest densities occurred in pools. Each meter of stream deeper than 1.6 feet (0.5 m) had an estimated 0.6 turtles. The adult sex ratio was 1.7 males for every female and thirty-five percent of the population was composed of juveniles. A sex ratio of about 1:1 was reported by Goodman (1997a) for a population in the West Fork of the San Gabriel River in southern California. The adult sex ratio at Camp Cady and Afton Canyon, both on the Mojave River, is biased at 1.3 males per female (Lovich, unpublished). Under optimal conditions in Oregon population density may approach 202 turtles/acre (500 turtles/ha; Holland, 1994).

The reproductive biology of western pond turtles is poorly known. Females begin laying eggs at a carapace length greater than 4.3 inches (11 cm; Goodman, 1997a,b) and are probably 6-7 years old (Holland, 1994). Courtship and mating have been observed in the field during most of the year except December-January (Holland, 1988; Buskirk, 1991; Goodman, 1997a). Nesting extends from late April through August (Holland, 1994), depending on the latitude, with a peak from late May to early July. At Camp Cady, on the Mojave River, females nest in late May and early June (Lovich, unpublished). Females may travel along a waterway as far as 1.2 miles (2 km) to distant nesting areas if suitable nesting habitat is not available locally (Rathbun et al., 1992). Nests are excavated in either the morning or evening (Storer, 1930) and are usually located along stream or pond margins. However, nests may be located over 328 feet (100 m) from the water on hillsides. All six terrestrial locations where Rathbun et al. (1992) found a radio-equipped female during the nesting season were in open, grassy areas with a southern exposure, as is typical for the species (Holland, 1994). Her sojourns onto land began between 1700 and 2000 hours, and she spent the night ashore, returning to the water the next morning between 0815 and 0900 hours. A second female also made overnight trips to a similar habitat, presumably to nest. Three flask or

pear-shaped nest cavities examined by Rathbun et al. (1992) were 2.6-3.1 inches (6.5-8.0 cm) deep with a 2.6-2.8 inch (6.5-7.0 cm) wide egg chamber and a 1.4-1.6 inch (3.5-4.0 cm) mouth. Nesting forays may require several days on land (Holland, 1994).

Clutch size ranged from 1-13 eggs (mean 6.12) for 168 clutches examined by Holland (1994) and is significantly correlated with body size (Holland, 1994; Goodman, 1997a). Clutch size for 5 gravid females at Camp Cady ranged from 4-6 eggs with an average of 4.8 (Lovich, unpublished). Mean egg width is also possibly correlated with body size (Goodman, 1997b). Western pond turtles are known to produce up to two clutches per year in the Los Angeles Basin of southern California. Goodman (1997b) observed 3 out of 7 females double clutching in one year. First clutches were oviposited between 4 and 14 May and second clutches were oviposited between 10 and 20 June. The internesting intervals between successive clutches were 38, 38, and 41 days. Not all females laid eggs in every year: 1992 - 3 of 8 were gravid, 1993 - 7 of 14 were gravid, and 1994 - 3 of 9 were gravid. Of 15 females of potential reproductive size (carapace length>4.3 inches or 11 cm) studied, only 2 clutched in two consecutive years and only one clutched in three consecutive years. First and second clutch sizes produced in the same year did not differ significantly within individual females, nor did mean egg width.

The natural incubation period is 80-126 days and varies with latitude (Goodman, 1997a; Holland, 1994). Eggs incubated at 77-91^{o} F (25-33^{o} C) by Lardie (1975) and Feldman (1982) hatched in 73-81 days. Feldman (1982) noted that hatchlings did not leave the egg if the temperature exceeded 81^{o} F (27^{o} C), but once moved to a cooler environment emerged within 2-3 hours. Western pond turtles have environmental sex determination with males produced at low incubation temperatures and females at high temperatures. The pivotal temperature is approximately 86^{o} F (30^{o} C; Ewert et al., 1994). Hatching success averages 70% but complete failure of nests is not uncommon in some years or locations (Holland, 1994). Goodman (1997a) reported an 80% hatching success rate for 15 eggs in 3 nests in southern California. In southern California, most hatchlings emerge in the early fall, while some overwinter in the nest. In northern California and Oregon hatchlings remain in the nest through the winter (Holland, 1994). Hatchlings are 0.9-1.2 inches (23-31 mm) in carapace length (Holland, 1994).

Growth rates for hatchlings average 0.13 inches/month (3.29 mm/month) during the first season of growth and then decline to 0.08 inches/month (1.95 mm/month), 0.03 inches/month (0.64 mm/month), and 0.04 inches/month (0.89 mm/month) during the second, third, and fourth growing seasons, respectively. After the fourth growing season growth rates slow to about 0.4 mm/month (Holland, 1994). Age can be estimated in western pond turtles up to about 16 years as deposition of scute rings on the shell is essentially annual (Bury and Germano, 1998). Annual survivorship of 1-3 year age classes is estimated to be 10-15%. Annual mortality of adults averages 3-5% (Holland, 1994).

Western pond turtles eat a wide variety of food items. Known foods include: algae, various plants (including the pods of the yellow water lily), snails, crustaceans (crayfish, *Daphnia*), isopods, insects, fish, frogs (tadpoles and adults), mallard duck carrion, and a mouse fragment (Pope, 1939; Evenden, 1948: Carr, 1952; Holland, 1985; Bury, 1986). Prey size and proportions of prey items differs in the diets of males, females and juveniles. Males consume more insects and vertebrates than do females, who eat more algae, and males seem to prefer larger food items. Juveniles eat smaller foods and take higher numbers of individual prey than do adults (Bury, 1986). Goodman (1998) observed a juvenile western pond turtle feeding on a coyote (*Canis latrans*) scat in a southern California stream.

Archaeological sites in California have produced remains of western pond turtles that may have been eaten by native Americans (Schneider and Everson, 1989).

Habitat Requirements:

The western pond turtle occupies a wide variety of wetland habitats including rivers and streams (both permanent and intermittent), lakes, ponds, reservoirs, permanent and ephemeral shallow wetlands, abandoned gravel pits, stock ponds, and sewage treatment lagoons (Holland, 1994). In streams, pools are the preferred habitat (Bury, 1972). Alteration of channel morphology and flow rates associated with dam construction diminished the quality of habitat for western pond turtles in some tributaries of the Trinity River in northern California (Reese and Welsh, 1998).

Western pond turtles have been collected from brackish estuarine waters at sea level to over 6,717 feet (2,048 m), but the species is uncommon above 5,015 feet (1,529 m; Stebbins, 1954; Bury, 1963; Holland, 1994). Optimal habitat seems to be characterized by the presence of adequate emergent basking sites, emergent vegetation, and the presence of suitable refugia in the form of undercut banks, submerged vegetation, mud, rocks and logs (Holland, 1994).

Holland and Goodman (1996) reported an aggregation of 19 western pond turtles in a crevice of granitic rock near a stream in San Luis Obispo County, California on September 26. The availability of suitable terrestrial shelter sites is necessary to provide protection from predators and thermal extremes. Overwintering and estivation sites are typically located in upland areas and in southern California may be over 197 feet (60 m) from water (Goodman, 1997a).

Population Status:

Populations are declining in southern California and over most of their northern range. Habitat destruction seems to be the major cause of its decline (Brattstrom, 1988; Brattstrom and Messer, 1988). Today only northern California and southern Oregon support extensive populations.

The decline of the western pond turtle in southern California has been recent and rapid. In 1960 there were 87 known localities for the species from Ventura County to the Mexican border. As of 1970, these were reduced to 57. In 1987, 255 sites were inspected of which 53 possessed turtles, and 25 of these were in Ventura County. Of the 53 sites, only 10 were thought to contain reproductively viable populations. South of the Santa Clara River, sites with western pond turtle populations become increasingly rare: Los Angeles County - 10, San Diego County - 8, Orange County - 4, western Riverside County - 3, and southwestern San Bernardino County - 3. Only five of the populations south of the Santa Clara River were thought to be reproductively viable (Brattstrom, 1988; Brattstrom and Messer, 1988).

Populations along the Mojave River were considered to be “small” by Brattstrom and Messer (1988). Holland (1991) estimated that no more than 100 western pond turtles are found in the Mojave River and noted that prospects for re-establishment in the event of extirpation are essentially zero. Ongoing research indicates that at least 34 western pond turtles survive at Camp Cady and Afton Canyon, combined (Lovich, unpublished).

In 1992 the Fish and Wildlife Service was petitioned to consider the species for listing under the provisions of the U.S. Endangered Species Act of 1973 (Fish and Wildlife Service, 1992). After formal review the Service declined to list the species. However, they reclassified

both recognized subspecies as category 2 candidates for listing (Fish and Wildlife Service, 1993), a designation that was later abandoned for all candidate species.

In a recent review of the status of California's amphibian and reptile species of special concern, Jennings and Hayes (1994) recommended that western pond turtles be reclassified as endangered from the Salinas River south along coast, and from the Mokelumne River south and inland in the San Joaquin river basin. Elsewhere in the state, they recommended threatened status.

Threats Analysis:

The greatest single threat to this species is habitat destruction. Over 90 percent of the wetland habitats within the historic range of the species in California alone have been eliminated due to agricultural development, flood control and water diversion projects, and urbanization (Fish and Wildlife, 1992). Associated with these threats has been an increase in habitat fragmentation and its attendant affects on genetic variability discussed below.

Lack of genetic variability may be a significant threat to the continued survival of populations in Oregon and Washington. The genetic similarity of these populations reflects a lack of dispersal and gene flow, and is probably a consequence of habitat fragmentation. In contrast, genetic variability in populations in southern California is much higher (Gray, 1995), but data are not specifically available for turtles in the WMPA. Given the isolated status of populations in the Mojave River, decreased genetic variability is a possible conservation concern for these turtles.

An Upper Respiratory Disease-like syndrome was responsible for the death of 35-40% of the individuals in one of only two known populations in Washington in 1990. Although not positively confirmed elsewhere, a large die-off of 42 western pond turtles in northern California in 1993 suggests that the disease is not confined to Washington (Holland, 1994).

Other localized threats include contaminant spills, grazing, and off-road vehicle use (Fish and Wildlife Service, 1993), and all are real threats to the continued survival of the species in the Mojave River. Significant portions of the Afton Canyon area occupied by western pond turtles have been negatively affected by grazing and off-road vehicle use.

Invasion of exotic pest species into habitats occupied by western pond turtles is another threat to the continued survival of the species in the WMPA. Saltcedar, or tamarisk (*Tamarix ramosissima*), is an invasive pest plant species that is firmly established in the Mojave River system (Lovich et al., 1994). The changes in channel morphology and hydrology associated with saltcedar invasion in the Mojave River have degraded what little western pond turtle habitat exists in the WMPA (Lovich and de Gouvenain, 1998). Dudley and Collins (1995) suggested that the introduction of non-native turtles including red-eared sliders (*Trachemys scripta*) and painted turtles (*Chrysemys picta*) into California threatens western pond turtles, however no data are available to substantiate this claim. The former species is likely to occur in the WMPA because of its ubiquity worldwide (Ernst et al., 1994), but I am aware of no specific records. Holland (1994) suggested that disease might be spread into western pond turtle populations by introduced turtle species.

The bullfrog (*Rana catesbeiana*) is native to eastern North America, but is widely established in California including the WMPA. As gape-limited predators, bullfrogs will eat any live animal they can swallow and this includes hatchling and young western pond turtles (Holland, 1994). The intensity of predation from bullfrogs is great enough to eliminate recruitment in some western pond turtle populations in southern California (Overtree and Collings, 1997; Robert Goodman, personal communication).

Humans widely utilized western pond turtles for food at least until the 1930's, and exploitation continues on a smaller scale in some areas. Turtles are also collected for resale in the pet trade. Bury (1989) reported that one pet wholesaler obtained about 500 western pond turtles from a southern California lake and shipped them to Europe. Roads also take their toll on western pond turtles in some areas through vehicle strikes (Holland, 1994). Exploitation of western pond turtles in the WMPA for these purposes would be devastating.

Biological Standards:

Protection of the western pond turtle in the WMPA will require habitat protection and restoration in the Mojave River system at the minimum. Effective conservation of aquatic turtles requires recognition of the need to protect adjacent terrestrial habitat for nesting (Rathbun et al., 1992), hibernation, and estivation (Burke and Gibbons, 1995). Potential dispersal corridors among aquatic habitats must also be protected (Holland, 1994). For western pond turtles this may mean protecting riparian corridors 500 m or more from the wetland boundary (Holland, 1994).

Grazing and off-road vehicle use should be eliminated from riparian corridors utilized by this species for feeding, nesting, and overwintering/estivation. New roads should not be constructed through or adjacent to habitats occupied by the turtle to prevent additional mortality from road kills.

Ongoing saltcedar eradication efforts by the Bureau of Land Management at Afton Canyon must be continued along with associated revegetation of the area with native plants to restore degraded habitat. Bullfrog control may be necessary to prevent or eliminate excessive predation on hatchling and juvenile turtles.

Construction of small ponds along the floodplain of the Mojave River seem to attract western pond turtles as shown by the case of Camp Cady. Construction of additional ponds may provide valuable refugia to turtles during times of drought or in areas where the stream channel has been severely degraded by saltcedar.

In light of the observation by Holland (1992) regarding the morphological distinctiveness of western pond turtles in the Mojave River, consideration should be given to the possibility of establishing satellite populations in other protected desert wetlands as a hedge against extirpation from some catastrophe caused by a chemical spill, disease, or other factors. Sites that appear to be suitable include artificial wetlands at the Desert Studies Center at Zzyzx and Dos Palmas Oasis in Riverside County. Similar relocations have been implemented successfully for other aquatic vertebrates in the desert including various pupfish and tui chubs.

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