

## NOTES

## POTENTIAL INJURY AND MORTALITY IN *ACTINEMYS (EMYS) PALLIDA* DURING RESTORATION AND MAINTENANCE ACTIVITIES

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**Abstract.**—Losses of uncommon or declining species are frequently mitigated through habitat restoration, enhancement, management, and/or replacement. These actions require maintenance that is seldom considered a concern for the species being managed. On two sites in central California, both of which were undergoing habitat management activities in support of southwestern pond turtle populations, maintenance activities, especially mowing, appeared to have an unanticipated negative impact on two life stages of this at-risk species. At both sites, turtles were either killed or seriously injured when mowing occurred in uplands occupied by turtle nests or adults turtles. Minor adjustments to equipment may reduce or eliminate turtle injury or mortality on sites where maintenance is required.

**Key Words.**—conservation; declining; management; mowing; risk; Southwestern Pond Turtle

The Western Pond Turtle (*Actinemys marmorata*) is a species of special concern in California, a critically sensitive species in Oregon, and an endangered species in Washington State (Washington Department of Fish and Wildlife 1993; Oregon Department of Fish and Wildlife 2008; Thompson et al. 2016). Until recently the Western Pond Turtle contained two subspecies: the Northwestern Pond Turtle (*Actinemys m. marmorata*) and the Southwestern Pond Turtle (*A. m. pallida*; Jennings and Hayes 1994; Bury et al. 2012). In 2014, the Western Pond Turtle was split into at least two separate species (Spinks et al. 2014): *Actinemys (Emys) marmorata* to the north and *A. (E.) pallida* to the south, and possibly a third, unnamed species, into central Baja California, Mexico. The range of *Actinemys marmorata* is north of the San Francisco Bay into the State of Washington, east into all of the Central Valley of California, and farther east along the Sierra Nevada (Spinks et al. 2014). *Actinemys pallida* occurs along the South Coast Range of California and into extreme northern Baja California, Mexico. This latter species has been in decline for decades due to habitat destruction (Brattstrom 1988), road mortality (Gibbs and Shriver 2002), predation from mesocarnivores (Alvarez et al. 2014), collection for the pet trade (Bury et al. 2012), introduced predatory and/or competitive species such as predatory fish and non-native turtles (Moyle 1973), water diversions, and other factors (Jennings and Hayes 1994; Thompson et al. 2016). Here, we describe another demonstrable risk to this (and other) turtle species: the undertaking of habitat restoration and maintenance activities.

Habitat restoration and enhancement for many protected species in California is typically undertaken for

compliance with the California Environmental Quality Act of 1970. While conducting restoration and habitat maintenance work on two sites in coastal California, we documented two instances in which Southwestern Pond Turtles were either killed or injured by tow-behind mowing equipment (tractor pulling a rotary mower) used during the project. In 2012, on a riparian restoration site in coastal Santa Cruz County, California, mowing was planned and implemented in the levee-confined flood plain of the Pajaro River to facilitate structural (e.g., log and boulder) placement and vegetation planting, as well as to enhance site use for nesting (Rosenburg and Swift 2013). In the wake of the mowing, we detected a heavily damaged *A. pallida* nest. It appeared that either the mower blade had been set too low or the equipment had made too many or ill-defined passes over the site. In any event, the mower blade or wheels removed the nest plug and clipped the top of the nest, exposing two near-hatchlings and several eggs (Fig. 1). On the next day, all eggs had been taken or damaged by predators, and at least five hatchlings had died by direct strike, subsequent exposure, or predation by mesocarnivores.

We found additional injury to *A. pallida* at Moorhen Marsh in Contra Costa County, California, which is a constructed wetland maintained as wildlife habitat by the Mt. View Sanitary District. Maintenance on the site includes mowing for invasive and noxious vegetation 3–4 times per year to reduce non-native annual grasses, Perennial Pepperweed (*Lepidium latifolium*), Yellow Star Thistle (*Centaurea solstitialis*), and other weedy vegetation. Mowing is also used to enhance microhabitat for turtle nesting (i.e., reducing vegetative structure) and hatchling movements on the site (Rosenburg and Swift



**FIGURE 1.** Southwestern Pond Turtle (*Actinemys pallida*) near-hatchling after being struck by a rotary disc mower along the Pajaro River in Santa Cruz County, California. The nest and the remainder of hatchlings were predated by unidentified mesocarnivores following the mower strike. (Photographed by Gary Kittleson).



**FIGURE 2.** Adult Southwestern Pond Turtle (*Actinemys pallida*) struck by rotary-disc lawn mower in Moorhen Marsh, California. The anterior portion of the carapace was dislocated, with additional injuries sustained during the incident (the turtle is under sedation). (Photographed by Louisa Asseo).

2013). During an annual spring trapping event in 2013, we found a severely injured pond turtle. Its carapace was completely broken from a slicing-type injury above the left forelimb and across to the right forelimb, and was displaced anterior to the original position. The fractured carapace rubbed against the right forelimb, causing raw abrasion (Fig. 2). Additionally, a previously incurred, entrenched bacterial abscess had formed on the neck of the turtle just posterior to the head. The turtle was immediately delivered to a veterinarian specializing in reptiles (Louisa Asseo), where it was sedated, the abscess was surgically removed, and the carapace edge was filed to reduce abrasion to the right forelimb (Fig. 3).

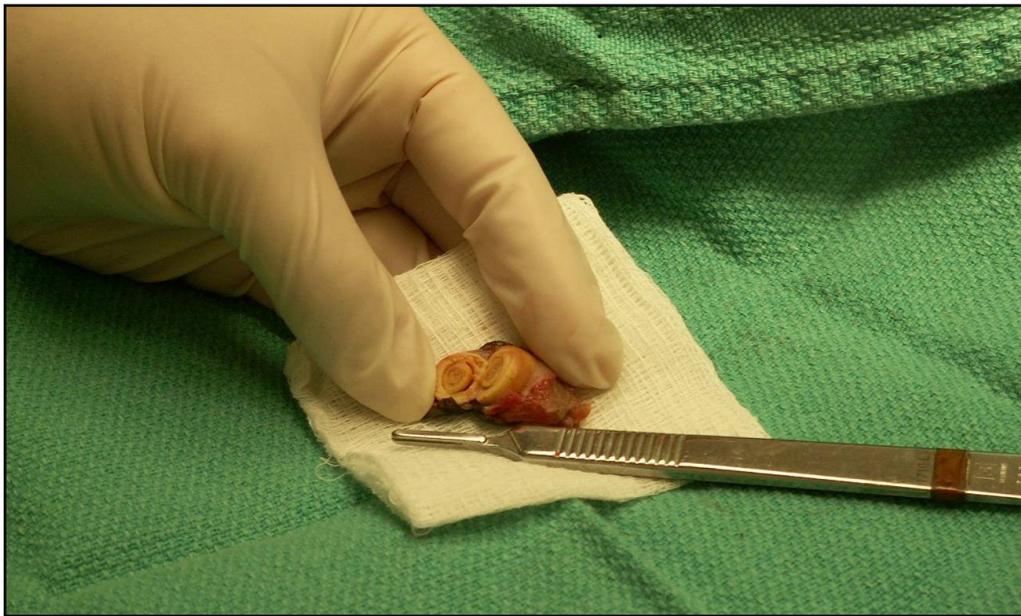
During veterinary inspection the primary injury was diagnosed as a mower strike. We surmised that the animal had moved from the aquatic habitat up onto upland habitat into the project site, and had been struck on the anterior portion of the carapace by a blade during a mowing event three weeks prior. The nature of the abscessed wound on the neck was also surmised to have been directly or indirectly caused by mower blade. Fifteen days after surgery, we returned the turtle to the site of collection and released it. Similar damage to the carapace of an adult female had been observed in Moorhen Marsh earlier that year, but the injury was fully healed by the time of observation and did not require veterinary treatment. The appearance of the carapace scarring on this female turtle also suggested a mower strike.

Saumure et al. (2006) reported carapace mutilation injuries and mortalities for a similar species, the Wood Turtle (*Glyptemys insculpta*), whose injuries were believed to come from mowers and other agricultural machinery. In their study, injury estimates ranged from 87 to 93%, and total mortality ranged from 10 to 18%. Mowers have been suspected in the mortality and injury

of box turtles (*Terrapene* spp.; Dodd 2001; Hester et al. 2008), and in Hermann's Tortoises (*Testudo heermanni*; Melidone and Sellari 2008), but have not been reported for *A. marmorata*.

On our sites, these two incidents likely reflect only a percentage of the mortality and/or injury to turtles during these types of activities. At Moorhen Marsh, mowing has occurred two to four times annually for several decades. The potential impact of these activities on the population of this site was not measured and is currently unknown.

Ecological restoration projects, critical to the recovery of wildlife habitat and declining species throughout North America, often use similar methods and equipment to those employed in agriculture. This suggests that monitoring for turtle mortality and injury on restoration sites would be beneficial; the presence of monitors able to spot turtle nests and collect injured turtles greatly increased the detection of mortalities and injuries on our two described active restoration sites. In the case of the incidents we observed, either the site was undergoing significant survey efforts for *A. marmorata* (Moorhen Marsh), or else management and maintenance activities required that biologists be on site daily or near-daily (Pajaro River floodplain). Mitigating measures can be taken and are strongly encouraged. Saumure et al. (2006) recommended that mower height be adjusted to 100 mm in areas where wood turtle use of uplands is presumed likely. We suggest that mowers being used within 100 m of occupied aquatic refuge, foraging, and wintering habitat be adjusted to a height of 125–150 mm, which allows clearance for typically sized juvenile to adult pond turtles. Added benefits of raising blade height, as reported by Saumure et al. (2006), are reduced soil erosion and machinery wear, which might make this an attractive measure for equipment users. On projects



**FIGURE 3.** Bacterial granuloma removed from the neck of a Southwestern Pond Turtle (*Actinemys pallida*) struck by a rotary-disc lawn mower in Moorhen Marsh. (Photographed by Louisa Asseo).

on which human monitors can be employed to survey in advance of mowing equipment, turtles are even more likely to be avoided.

We also recommend that soil disking (i.e., fire lines) not occur within 100 m of occupied aquatic habitat unless critical to the preservation of life and property. These activities should also include monitors walking in advance of machinery, whenever possible. In some cases, using grazing animals (i.e., goats, sheep, etc.) to

mow may be more appropriate than use of machinery in areas with significant populations of nesting turtles. Bury et al. (2012) also suggested prescribed fire as a means of maintaining vegetation cover. This may be a reasonable alternative in some areas, while in others, monitored mowing may accomplish the goal (i.e., weed control, fire break, etc.) with few to no permitting requirements. Mowing should be excluded from areas when nestling turtles are emerging (typically March and early April; Rosenburg and Swift 2013), but can vary throughout the range, and from year to year (Storer 1930; Holte 1998). Avoidance of mowing during the period when nesting females use uplands, from early May to early July in central coastal California (Bury et al. 2012), could greatly reduce injury or mortality. A focused use of grazing animals or dedicated biological monitors walking in advance or the mowing equipment could function as a surrogate to avoid this period completely.

The presence of turtles in upland systems should be carefully considered during restoration and maintenance activities. This is particularly important in areas of isolated and declining populations, such as those of pond turtles in California. We feel that with appropriate measures to reduce or eliminate injury or mortality, activities for maintaining or restoring habitats not only should continue, but will contribute to the persistence of turtle populations.

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**FIGURE 4.** Adult Southwestern Pond Turtle (*Actinemys pallida*) 15 d after surgery, tumor removal, and carapace filing following mower injury at Moorhen Marsh, Martinez, California. The turtle was released following being photographed. (Photographed by Kelly Davidson).

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**GARY KITTLESON** has been working as an Aquatic Resources Biologist in Santa Cruz County for 17 y. His work includes common and special-status amphibians, reptiles, raptors, and other species, as well as the habitats in which they live. Among many other projects, Gary worked on the Pajaro River Restoration project and conducted a radio telemetry-based study on pond turtle movement. (Photographed by Justine DaCosta).



**KELLY DAVIDSON** has been employed as the District Biologist for Mt. View Sanitary District, Martinez, California, since 2010. She manages 65 ha of wetlands in the San Francisco East Bay, which provides habitat for several special-status species including the Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*), pond turtles, and California Black Rail (*Laterallus jamaicensis coturniculus*). She has a M.S. degree from California State University, East Bay, and completed an Master's of Natural Resources from Oregon State University in Corvallis in 2017, where she is researched the use of artificial habitats by pond turtles in California. (Photographed by Sheri Riddle).



**LOUISA M. ASSEO** is a Veterinarian and the founder and owner of Oasis Veterinary Hospital in Martinez, California. She received her D.V.M. degree from the University of California, Davis, in 2002. She has a special focus in reptile and amphibian medicine. As such, she is an active member of the Association of Reptilian and Amphibian Veterinarians and is currently serving on the Board of Directors. In addition to a focus in reptile medicine, Dr. Asseo achieved specialty certification in dog and cat medicine from the American Board of Veterinary Practitioners in 2015. She is the current president of the Contra Costa Veterinary Medical Association. (Photographed by Louisa Asseo).