



Fig. 1. Adult Mediterranean Gecko (*Hemidactylus turcicus*) photographed on a front door facing in Fayetteville, Washington County, Arkansas, on the night of 11 November 2024 at ca. 5.04 km from the greenhouse location where the species was first observed in the city. Photo by Leigha Jordan.

NATURAL HISTORY NOTE

Maximum Distance of Pond Turtle (*Actinemys* sp.) Nests From Aquatic Sites, and Management Implications

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Pond turtles, both Northwestern (*Actinemys marmorata*) and Southwestern (*A. pallida*), have been the subject of much study in recent years due to dramatic population declines over the last several decades (Bury et al. 2012, Thomson et al. 2015). As of 2024, the status of both species varies among locations. The Northwestern Pond Turtle is listed as Endangered in Washington State, as Sensitive-Critical in Oregon, and as a Species of Special Concern in California (Hays et al. 1999, Rosenberg et al. 2009, Bury et al. 2012, Thomson et al. 2015). Both species are considered for federal listing under the Endangered Species Act as threatened (USFWS 2023). Although research in recent years has been substantial, significant gaps in knowledge, particularly the nesting ecology, still exist (Rathbun et al. 2002, Lucas 2007, Scott et al. 2008, Rosenberg and Swift 2013, USFWS 2023). Davidson and Alvarez (2020) summarized the characteristics of nesting microhabitat of both species and along with Bury et al. (2012), concluded that the average nesting distance from occupied aquatic habitat was 51 m and 50 m, respectively. This, we contend, does not create a clear understanding of the upland habitat needs of these species, nor does it allow land

managers to appropriately protect nesting habitat (Burke and Gibbons 1995, Semlitsch and Jensen 2001). Herein, we report on the maximum distance reported for nesting pond turtles of both species from numerous investigators in disparate areas.

We conducted a search of published literature, gray literature, our own observations, and those of knowledgeable individuals (Fig. 1). Details from reports that included direct observations of nesting turtles were accepted while suspected nesting, inferred nesting, etc., as well as unconfirmed species or locations were rejected. When possible or necessary, we followed up with personal communications with researchers to confirm their observations, or to request additional data. When accessible, we retrieved data regarding the maximum distance a nest was measured from occupied aquatic habitat, and nesting characteristics (habitat type, slope, aspect, substrate, and other site characteristics). The data were tabulated, and we calculated the range and average distances from occupied aquatic features.

The majority of published work on the species and all personal observations lack detailed individual identification at the genetic level. Additionally, some

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Fig. 1. A female pond turtle (*Actinemys*; species undetermined) in San Mateo County, California, constructing a nest 135 m from the nearest occupied aquatic feature. Photo by Jeff A. Alvarez.

reports come from an area in California where both species may have overlap in their range. Due to the lack of detailed information regarding nesting individuals in the published literature, this literature review and subsequent recommendations includes both *Actinemys* species together.

We identified 18 available reports, two personal observations, and one personal communication that measured and documented the maximum distance at which a confirmed nest was located from water. Of the 27 data points reported, 24 were from published literature and three were from personal communications or personal observations (Table 1). The range of nesting distance (as measured from the wet edge of occupied habitat to the nest location) was 1–457 m, with the average maximum distance measured and reported at 155.5 m. The greatest distance from water at which a nest was measured was 457 m, as reported by Nerhaus (2016).

The previously average nesting distances reported by Bury et al. (2012) and Davidson and Alvarez (2020) were 50 and 51 m, respectively. This, however, paints a very significantly different picture from that of the maximum distance reported. For example, 14 of 27 reports (52%) were found 100 m or more from occupied aquatic features, while 30% were more than 200 m from water, and 19% were more than 300 m (Table 1). The average distance a nest can be found from water is a measure that allows us to understand that turtles of both species are nesting, on average, within approximately 50 m, however, this measurement may be influenced by site-specific conditions. Additionally, based on data from this review, that would encompass all known nests from only 27% of the studies we examined. The maximum distance of known turtle nests offers valuable insight into the extent of upland habitat required by turtles.

Upland habitat use by turtles remains an enigmatic aspect of the natural history of the species. Resource managers are tasked with protecting declining species, such as Northwestern and Southwestern Pond Turtles, yet significant questions remain about upland areas that need protection (Burke and Gibbons 1995, Semlitsch and Jensen 2001). Turtles use upland habitats for dispersal, aestivation (Pilliod et al. 2013, Zargoza et al. 2015), overwintering (Holland 1994), basking (Alvarez 2005, Lambert et al. 2013), refugia (Holland and Goodman 1996, Belli 2016), nesting (Rathbun et al. 1992, Rosenberg et al. 2009), and for additional reasons still not clearly understood (Belli 2016). These areas should be considered core habitat, rather than a buffer zone for the species' natural history (Semlitsch and Jensen 2001). It is critical to keep in mind that each aspect of the natural history of pond turtles is critical for their survival. Nesting habitat, although seemingly the most critical, is only required for population persistence, not for individual survival. Population persistence is a primary objective for land and resource managers, and effective management of upland habitats is essential to ensuring the long-term survival of turtle populations. We content that upland habitat surrounding aquatic features, extending to a distance of 500 m will likely encompass all known nesting habitat for these species. Until more information is known about the maximum distance at which pond turtles can and will construct nests, Nerhaus (2016) remains the best source of information indicating that distance.

We recommend designating the habitat surrounding aquatic features, extending up to 500 m, as occupied nesting habitat. This area may be surveyed for nests; however, Davidson and Alvarez (2020) and Alvarez et al. (2021) suggest that such efforts are challenging or occasionally futile due to nests

Due to the lack of detailed information regarding nesting individuals in the published literature, this literature review and subsequent recommendations includes both *Actinemys* species together.

Table 1. Reported observations of the maximum distance pond turtles (*Actinemys* sp.) may construct a nest from occupied aquatic features.

Author	Max. Reported (m)	Range (m)	Ave. Distance (m)
Alvarez et al. 2014	10	1-10	9.4
Alvarez pers. obs.	91	91	—
Alvarez pers. obs.	135	135	—
Bettlheim et al. 2006	—	6-15	3
Crump 2001	100	30-100	40
Davidson and Alvarez 2020	93.2	1.8-93.2	29.6
Geist et al. 2015	300	2-300	—
Holland 1994	402	3-402	49.2
Holte (site 1) 1998	145.1	27.3-145.1	132.9
Holte (site 2) 1998	58.4	37.5-58.4	48.2
Holte (site 3) 1998	212	125-212	171.1
Holte (site 4) 1998	8.3	3-8.3	5.6
Holte (site 5) 1998	22	0.8-22	5.3
Lovich and Meyer 2002	292.5	8.7-292.5	97.8
Lucus 2007- Columbia River Site	87	13-87	56
Lucus 2007- Puget Sound Site	49	23-49	33
Nerhaus 2016	457	58-457	195
Nussbaum et al. 1983	100	100	100
Rathbun et al. 1992 (Turtle 1)	59.7	21.3-59.7	26.6
Rathbun et al. 1992 (Turtle 4)	19.5	15.2-19.5	16.6
Rathbun et al. 2002	170	6-170	28.2
Reese and Welsh 1997	31	31	31
Riensche et al. 2019	75	2-75	24.4
Rosenburg and Swift 2013	149	9-149	67.8
St. John 2015	332	1-332	226
Storer 1930	420	420	420
Wilcox pers. comm. 2024	379	30-379	—
average	155.54	1-457	77.94

being extremely cryptic. Some upland habitat features, however, that would exclude nesting activity, such as habitat excluded by barriers to movement (Alvarez et al. 2014) or inappropriate habitat (i.e., concrete, asphalt, etc.) can be excluded.

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