NATURAL HISTORY NOTE

Microhabitat Use by Post-metamorphic Western Spadefoot (*Spea hammondii*) in Central California

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The western spadefoot (*Spea hammondii*) is a secretive amphibian that is believed to spend the majority of the year underground in small, cryptic burrows of up to 1 m deep (Stebbins and McGinnis 2012). Due, in part, to the difficulty in finding refuge sites, most members of the genus, including the western spadefoot, are under-studied (Jennings and Hayes 1994). To date, few reports on Western spadefoot have focused on upland habitat use, habitat associations, and microhabitat site selection. Baumberger et al. (2019) found that the western spadefoot populations that they worked with burrowed in uplands that were dominated by duff, shrub, grass, leaf litter and forb, in that order of preference. Additionally, they found that sand and silt were preferred soil types over clay soils. Understanding the habitat and microhabitat needs of a species is critical to facilitating population persistence on managed landscapes.

While conducting generalized reptile and amphibian surveys at Carnegie State Vehicular Recreation Area (SVRA; i.e., off-road vehicle park), 7.4 miles southwest of Tracy, CA, we frequently encountered larval and post-metamorphic (metamorph) western spadefoot in seasonal pools, in stock ponds, and in Corral Hollow Creek. In Winter 2015-2016, breeding occurred between late January and early March and larvae grew rapidly for two to five months. Metamorphosis occurred from late March through mid-June. The El Niño winter of 2016 (21.3 cm of rain post-breeding) resulted in successful juvenile production in seven of nine known breeding pools, both in higher numbers and in larger body masses than previous observed (California State Parks, unpublished data). Metamorphs were visible on the soil surface immediately adjacent to aquatic breeding habitat for at least two weeks following metamorphosis. Animals appeared to be feeding and seeking refuge in surface microhabitat during this period.

Our observations of western spadefoot metamorphs using this habitat suggested that the specific microhabitat, which consisted of a deeply cracked and incised silt layers of dry pool-bottoms, was an important refuge site for this species. The silt/clay mix, when completely dry, created desiccation cracks up to 10 cm deep. Since the metamorph snout-vent lengths averaged approximately 2.5 cm, this microhabitat offered suitable cover for post-metamorphic western spadefoot, which were found approximately 5–7 cm from the soil surface (Fig. 1).

During early spring nocturnal surveys in 2016 and subsequent years, metamorphs were observed exploring up to 7 m from these refuge sites. This behavior was observed during both above- and below-average rainfall years, suggesting that seeking refuge in and around drying breeding pools is part of the dispersal process.

Many amphibians have the ability to obtain moisture from damp soils (Stebbins 1945, Stille 1958, Cohen 1952, McClanahan 1972, Winokur and Hillyard 1992). These metamorph western spadefoot are likely extracting moisture from deep within the dry pool-bed cracks—soil moisture content appeared high deeper in the cracks, based on darker coloration, see Fig. 1), but may also be avoiding predation, direct solar exposure, and/or evaporative water loss by remaining below the surface. Other herpetofauna, too, have been reported to use this type of habitat as refuge, to presumably avoid extreme climactic conditions (Alvarez 2004, Wolf et al. 2015). Utilization of this microhabitat may enable this species to remain in the aquatic breeding area until more favorable conditions (i.e., nightfall, higher humidity, lower winds speeds, rain events, etc.) permit safe movement.

We found that after western spadefoot grew in size, exceeding the width of desiccation cracks, they appeared to press themselves between the thin surface crust and the associated damp soils below, and partially buried themselves in a moist soil layer (Fig. 2). This longer-term use of the desiccated soils on the dried pond bottom lasted 4 to 6 weeks, post metamorphosis.

We noted that Stebbins (1951) and Dodd (2013) suggested that western spadefoot used deep desiccation cracks for refuge. These observations, however, made by Stebbins from Maggie Creek, Nevada, USA, are within the current range of the Great Basin spadefoot (*S. intermontana*) and are currently referring to that species (K. Dodd, pers. com.). We believe our observations are the first published report of western spadefoot utilizing desiccation cracks.

Observations of western spadefoot using this type of microhabitat are significant for several reasons: 1) this species is a California State species of concern and is in rapid decline. Understanding aspects of its natural history, including at different life stages, is critical to appropriate management; 2) lands upon which the species occurs may be managed, and its dried breeding habitat unknowingly altered through grading or dredging; and 3), in particular, at Carnegie SVRA, vehicular access may include driving over/

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through dried pools before or shortly after surface waters have disappeared. Given our observations, entire cohorts may be killed or injured, and habitat may be compressed, altered, or disturbed, making the area unsuitable for a critical phase in the life history of the species.

Recent surveys, and the subsequent management strategies used to respond to survey results have supported two key actions: 1) targeted nocturnal surveys, which are crucial to locating breeding pools as well as detecting metamorph spadefoot, and 2) the seasonal protection of these breeding pools from the time of first inundation to up to several weeks following detection of metamorphosis. We found that searching under dried silt slabs can reveal surface active animals, which should be absent prior to allowing vehicular access to these sites (Fig. 2). These protection efforts may be critical to preserving the microhabitat on which post-metamorphic spadefoot evidently rely on for or until dispersal (Dodd 2013).

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Fig. 1. Post-metamorphic *Spea hammondii* seeking refuge in desiccation cracks, Alameda County, CA, 2016. Photo by Jeff A. Alvarez.

Fig. 2. Three post-metamorphic *Spea hammondii* seeking refuge under dried silt slabs within a previously dried aquatic breeding site, Alameda County, CA, 2016. Photo by Tara S. Kerss.

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