

# Common use of Atypical Breeding Habitat in the Western Spadefoot (*Spea hammondii*), in Central California

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The Western Spadefoot (*Spea hammondii*) is a small upland-adapted anuran that has been long believed to focus its breeding activity on seasonal wetlands, and specifically, vernal pools (Storer 1925, Thomson et al. 2016). Dodd (2013) expressed concern that much of the published literature for *S. hammondii* was based on populations of *S. multiplicata*, of which *S. hammondii* was originally a subspecies. Further, those natural history accounts may be extrapolated from early accounts based on observations that may have been in the Great Plains states, or outside of the current range for this species (K. Dodd, pers. comm.). We have found that some natural history accounts were indeed originally attributed to populations outside of the current range of *S. hammondii*, and more recent accounts of the species natural history, with observations from the current range, were necessary (Alvarez and Kerss 2023).

Herein, we report on observations of breeding activity of the *S. hammondii* outside of typical habitat—vernal pools. We contend that these observations add to the natural history for the species, particularly in its current range, and that these observations may have significant management implications.

Corral Hollow Creek is an intermittent creek flowing from the Diablo Range, eastward into the Central Valley of California. This is a high-gradient stream in the upper watershed, converting to a low gradient stream as it leaves Alameda County flowing to and through San Joaquin County, where it lays within the northern portion of Carnegie State Vehicular Recreation Area (Carnegie SVRA). The park has established exclusionary fencing along Corral Hollow Creek. Outside of this protected stream buffer, the park is primarily used for off-road recreation by motorcycle riders and other off-road uses. This ephemeral creek typically begins flowing during winter, with increased velocities during rain events. During the prolonged drought between 2016 and 2022 the creek remained mostly dry with only intermittent pools and no continuous flow. Corral Hollow Creek is sparsely vegetated with patches of individual Fremont cottonwood (*Populus fremontii*) and intermittent patches of mule fat (*Baccharis salicifolia*) and coyote brush (*B. pilularis*). The creek substrate is fine silt, with long series of cobble and pebble micro-habitat. Corral Hollow Creek meanders at a less than 5° degree slope for approximately 5-6 km through Carnegie SVRA. During the 2023 water year there was 20.06 inches of rainfall, twice the typical amount, and the Corral Hollow Creek flowed from January to early June.

To assess potential habitat for special-status herpetofauna, including California red-legged Frogs (*Rana draytonii*), Southwestern Pond Turtle (*Actinemys pallida*), and California Tiger Salamander (*Ambystoma californiense*), visual encounter and dipnet surveys for amphibians were conducted twice annually in 2023, primarily within sediment basins and stock ponds in Carnegie SVRA. Water presence in Corral Hollow Creek, either flowing or pooled, lead to weekly surveys for *S. hammondii*. Weekly surveys for *S. hammondii* were conducted for the duration of water presence in Corral Hollow Creek in 2023.

On April 17<sup>th</sup> mixed groups of Western Toad (*Anaxyrus boreus*) and *S. hammondii* tadpoles were first observed in Corral Hollow Creek. At the time of observations, the creek was continuously flowing, and numerous runs and pools were noted throughout the length that lay within the Carnegie SVRA. Clusters of many hundreds of larvae were found within small pools and slow sections of the creek (Figure 1). As the season progressed larvae transformed to post-metamorphic spadefoot individuals that numbered in groups of 30-200. In 2023, the creek supported 45 individual pockets of spadefoot larvae and post-metamorphs (Figure 1). Post-metamorphic *S. hammondii* moved away from the breeding site and into surrounding uplands by late May of 2023, which was slightly later than the populations of spadefoot that reproduced in pools adjacent to, but outside of the creek, during the same reproductive year. These floodplain pools outside of the creek dried earlier than the creek in 2023, by 5 weeks. We also noted (visual estimation) that larvae transforming in the creek habitat were visually larger than those transforming from pools.

These observations are supported by earlier opportunistic observations of the same behaviors in 2014-2016 but were not well documented or mapped (Alvarez and Kerss 2023). Other reproductive habitat exists on this site, including vernal pools and puddles used by this species, as well as two separate stock ponds where *S. hammondii* have been observed breeding and successfully metamorphosing. This is the first year that metamorphosis has been documented by 100s of individual *S. hammondii*, that reproduced from Corral Hollow Creek.

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**Fig. 1.** A 5-km section of Corral Hollow Creek, with locations of subpopulations of larvae and post-metamorphic Western Spadefoot (*Spea hammondii*). Alameda County on the left of the figure with San Joaquin County on the right of the figure, June 2023.

micro-habitats, such as intermittent streams, may be used by this species for breeding with more regularity than previously believed. This may offer some level of resilience in the face of climate change. We also found that the individuals that metamorphosed from creek habitats appeared to metamorphose later and as larger individuals, which may suggest that the creek habitat provided more resources (i.e., hydroperiod, food, space, etc.) for individuals that developed there. Future work will use tadpole size as a proxy for fitness and use body measurements and water quality to determine if breeding in the Corral Hollow Creek is more advantageous than the floodplain.

Management considerations are equally important to these observations. The need to manage intermittent creeks for the species, if present, may include limiting open creek crossings during the breeding season (i.e., install box culverts to reduce crossing through occupied habitat), minimizing silt flows in creeks during the breeding and rearing season, and including this type of habitat and microhabitat in survey efforts designed to detect the species presence.

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