NATURAL HISTORY NOTE

Biofluorescence in Adult Western Spadefoot (*Spea hammondii*) in Central California

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Biofluorescence is a key trait in inter- and intra-specific communication in wildlife, may indicate phylogenetic relationships, and can possibly aid in detections during wildlife field surveys (Arnold et al. 2002, Lim et al. 2007, Lourenco 2012, Lagorio et al. 2015, De Brauwer et al. 2018, Kong et al. 2023). Observations of this phenomenon are detected when tissues absorb electromagnetic radiation (i.e., light) at one wavelength and re-emit that light back at lower wavelengths, typically resulting in the emission of light that fluoresces. Many authors have reported this phenomenon in invertebrate and vertebrate fauna (Lawrence 1954, Babu et al. 2002, Honkavaara et al. 2002, Maxwell and Johnson 2002, McGraw and Nogare 2004), but the degree to which this occurs among species and wildlife groups is only recently (within the last 5 years) being investigated. Recent studies have revealed biofluorescence in several amphibian species under ultraviolet and blue light excitation (Lamb and Davis 2020). However, a comprehensive evaluation across all amphibian species is on-going. In California, the California Red-legged Frog (*Rana draytonii*), Foothill Yellow-legged Frog (*R. boylii*), the invasive American Bullfrog (*Lithobates catesbaeiana*), as well as the California Tiger Salamander (*Ambystoma californiense*), have all shown ultra-violet reflectance with biofluorescence emitted from the eyes or the skin (Alvarez et al. 2022, Kong 2023, Alvarez and Perpignani 2024). Biofluorescence in the family Scaphiopidae was first documented in an individual Couch's Spadefoot (*Scaphiopus couchii*) in 2023 (Kuhn 2023). Here we report another member of Scaphiopidae (genus *Spea*), a declining species from California and Baja California, showing biofluorescence in the skin and eyes.

We examined adult and subadult Western Spadefoot (*Spea hammondii*) captured on the eastern end of the northern portion of the Carnegie State Vehicular Recreation Area (SVRA) in Tracy, California. Individuals were captured by hand as they emerged from rodent burrows, soil cracks, piles of rip-rap, and from cover objects. Each individual was handled to identify the species and to determine the age class and sex. On April 20 and 21, 2025, following one hour after sunset, we captured no fewer than 24 sub-adult (likely post-metamorphic individuals), and 36 adult, *S. hammondii* that were moving along the dry soil surface, presumably foraging. Each individual was examined with a white light from a 480-lumen (COAST® PX1 LED) flashlight. We also exposed captive *S. hammondii* to a 365 nm ultraviolet (UV) light (®Convoy C8 + 365nm UV LED Flashlight with Patented Glass Filter) for 5 to 10 seconds.

We immediately noted that that *S. hammondii* had some relatively minor reflectance that we described as blue and pink on the dorsal side (Figs. 1 and 2). When the individual's ventral surface was exposed, the dorsal color (typically white or light cream) reflected brilliant pink (Figs. 3 and 4). We also noted that there was significant variability among individuals, but both sub-adult and adult spadefoot showed similar reflectivity.

Authors have reported biofluorescence from the skin of several amphibians (Taboada et al. 2017b, Gray 2019, Lamb and Davis 2020, Kong 2023), and the role of biofluorescence has been a subject of consideration by researchers (Honkavaara et al. 2002, Lagorio et al. 2015, Taboada et al. 2017a, Lamb and Davis 2020). Interspecific communication, and even interaction among conspecifics has been suggested by several authors (Lim et al. 2007, Sparks et al. 2014, Prötzel et al. 2018, Lamb and Davis 2020). Others have suggested that anurans may use this as a method of predatory avoidance (Lagorio et al. 2015, Kohler et al. 2019). Currently it is unclear how biofluorescence may affect, either positively or negatively, these individual anurans.

Alvarez et al. 2022 suggested that it might be important to determine if other wavelengths of light (e.g., blue light: 440-460 nm) or the use of ocular filters (yellow/orange, especially for photography) may increase detection probability in the field (Lamb and Davis 2020, Kong et al. 2023), which may facilitate survey efforts for these declining species. It may also be informative to determine why there may be significant variation among individuals. Although currently unknown, it may be attributed to prey selection, or possibly a relationship with a second organism that exists in the skin of *S. hammondii*. Investigations into the usefulness of this trait to facilitate detections will likely not be fruitful since the majority of the

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Fig. 1. Dorsal side of adult Western Spadefoot under white light (480 lumens). Photo by Jeff Alvarez.

Fig. 2. Dorsal side of Western Spadefoot adult under UV light (665 nm). Photo by Jeff Alvarez.

Fig. 3. Ventral side of Western Spadefoot under white light (480 lumens). Photo by Jeff Alvarez.

Fig. 4. Ventral side of Western Spadefoot under UV light (665 nm). Photo by Jeff Alvarez.

reflectivity occurs on the ventral side. However, continued investigation may find ways to enhance detection with other wavelengths.

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