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NATURAL HISTORY NOTE

# Biofluorescence from the Skin Toxin in the California Red-legged Frog in Central California

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Reports of biofluorescence in wildlife have included numerous species of mammals, birds, reptiles, amphibians, and invertebrates (Lawrence 1954, Babu et al. 2002, Honkavaara et al. 2002, Maxwell and Johnson 2000, McGraw and Nogare 2004, Lagorio et al. 2015). Authors have reported that biofluorescence typically occurs when tissues absorb electromagnetic radiation (e.g., ultraviolet light) at a relatively high wavelength, which are then re-emitted at a lower wavelength, with visually detectable fluorescing light from specific tissues. Biofluorescence has been shown in a number of amphibian (Deschepper et al. 2018, Whitcher 2020) and reptile species (Gruber and Sparks 2015, Seiko 2019, Fuentes Magallón et al. 2021), typically under ultraviolet light (UV) excitation (Lamb and Davis 2020). Several authors reported biofluorescence from the bones of frogs and lizards (Prötzel et al. 2018, Goutte et al. 2019, Alvarez et al. 2025a), but the majority of reports of biofluorescence has been restricted to the skin (Taboda et al. 2017, Gray 2019, Kong et al. 2023, Alvarez et al. 2025b), or reflectance from the eyes (Alvarez et al. 2022, Alvarez and Perpignani 2024).

A wide variety of toxins have been found in the skin on frogs and toads. They are thought to be defensive but need to be concentrated in large quantities to be effective (Duellman and Trueb 1994). California anurans appear

**Fig. 1.** A California Red-legged Frog placed in a bucket of pond water, within 10 seconds of PIT tag placement, illuminated with an ultra-violet light showing the skin exudate biofluorescence. Photo by Jeff A. Alvarez.

**Fig. 2.** The same California Red-legged Frog 30 seconds following placement of a PIT tag showing little to no biofluorescence under an ultra-violet light. Photo by Jeff A. Alvarez.

to have a skin toxin that may have a unique odor that is detectable by humans. For example, the Arroyo Toad (*Anaxyrus californica*) can smell like raw peanuts (*Achris hypogaea*), the Foothill Yellow-legged Frog (*Rana boylii*) like the plant poison hemlock (*Conium maculatum*), and the California Red-legged Frog (*R. draytonii*) like burning rubber or plastic (pers. obs.). In the case of the California Red-legged Frog, I report that the skin toxin also appears to have the ability to be biofluorescent when exposed to ultraviolet light.

During a long-term study of California Red-legged Frogs that were the subjects of translocation from Sonoma County to Napa County, California, we collected adult and post-metamorphic (young of the year) frogs for processing. Each frog was weighed, measured and a Passive Integrated Transducer (PIT) tag was inserted under the dorsal skin surface for later identification. PIT tags were placed by gathering 1-2 mm of loose skin on the dorsal surface, approximately at the shoulder of each individual. The loose skin was then incised with a small pair of fine scissors such that a 2 mm opening was created into which a PIT tag could be inserted with canulated forceps. The tag was then manually manipulated posteriorly so that the PIT tag rested posterior to the sacral hump. Each frog was then place in a bucket of pond water and allowed to recover for approximately 30 minutes.

When frogs were placed in buckets and exposed to ultra violet light—a 365 nm ultraviolet (UV) light (®Convoy C8 + 365nm UV LED Flashlight with Patented Glass Filter) for 5 to 10 seconds I noted the freshly PIT tagged frogs, which showed no signs of toxic exudate and no indication of blood under white light, showed clear indications of biofluorescence at the wound site for the first 10-15 seconds (Fig. 1). This reflective exudate slowly subsided and became less detectable by approximately 30 seconds (Fig. 2), and undetectable thereafter. We also noted the adults, when initially capture by hand, and exuding the skin toxin to the extent that it could easily be detected olfactorily, also emitted a biofluorescence in areas that appeared to be toxic exudate.

Many authors have reported biofluorescence from the skin of amphibians, while under ultraviolet light (Taboada et al. 2017, Gray 2019, Lamb and Davis 2020), but the ecological role of fluorescence is the subject of much consideration (Honkavaara et al. 2002, Lagorio et al. 2015, Taboada et al. 2017). Several authors have reported that a range of species may be using this type of biofluorescence as a means of interspecific communication, and even interaction among conspecifics (Lim 2007, Sparks et al. 2014, Prötzel et al. 2018). It is possible that the California Red-legged Frog, and other species of California anuran, use this type of biofluorescence as a type of aposematic communication to predators that molest the animals, although that remains limited to speculation.

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***Acknowledgements***—The Land Trust of Napa County granted access to the site where California Red-legged Frogs were PIT tagged. Frog handling and tagging was permitted under California Department of Fish and Wildlife policies: Department Bulletin 2017-04 (Captive Propagation of Fish, Wildlife and Plants for Conservation Purposes) and 2017-05 (Policy and Procedures for Conservation Translocations of Animals and Plants). I also wish to thank Nina Jackson for her assistance in capturing and PIT tagging California Red-legged Frogs.

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NATURAL HISTORY NOTE

# Late Fall Activity in the Gray Treefrog (*Hyla versicolor*) in Northwestern and Central Arkansas


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We prepared this note to feature an example of an anuran species exhibiting an extended activity season and one that displays secretive and opportunistic behavior while inhabiting urban and suburban areas dominated by humans. For example, we have previously reported some of the activities of the Gray Treefrog (*Hyla versicolor* = *Dryophytes versicolor*, Family Hylidae) on an urban residential lot in the city of Little Rock, Pulaski County, Arkansas (Walker et al. 2022). Herein, we stress fall activity of the species in two cities in Arkansas. In the northwestern corner of the state of one of us (JMW) has lived on the same suburban residential property of 55 × 55 m for