

SHORT COMMUNICATION

First description of suspected biofluorescent patterns in Mesoamerican tailless whip spiders (Amblypygi: Phrynidae)

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Abstract. Biofluorescence has been reported in all extant chelicerate orders, but genus- or species-specific documentation remains limited. This gap is particularly noticeable in amblypygids (tailless whip spiders), where detailed descriptions of biofluorescence have not yet been fully developed. Here, we present the first description and photographic documentation of suspected biofluorescent patterns in Mesoamerican amblypygids. We collected two specimens, likely belonging to the genera *Paraphrynus* Moreno, 1940 and *Phrynus* Lamarck, 1801, from an urban area on the Pacific coast of Guanacaste, Costa Rica. Under 365 nm light, these specimens appeared to display blue-green fluorescence at the joints and soft cuticle segments. Our findings suggest that further research is necessary to confirm the presence of fluorophores by using techniques such as spectrofluorimetry, to explore the ecological role of biofluorescence, and to describe biofluorescent patterns across amblypygid taxa.

Keywords: Biofluorescence, Guanacaste, UV
<https://doi.org/10.1636/JoA-S-24-033>

Biofluorescence occurs when tissues absorb light energy, typically of wavelengths between 320–390 nm, and remit light at longer wavelengths. Reports of biofluorescence date back to the 1920s (Cockayne 1924) but have drastically increased since then (Jeng 2019). In 2017, Rubin et al. reported

biofluorescence in all extant orders of the chelicerates (including sea spiders, horseshoe crabs, and arachnids), suggesting that biofluorescence is a universal phenomenon within the subphylum. Nevertheless, reports of genus or species-specific biofluorescence in chelicerates remain limited. In tailless whip spiders

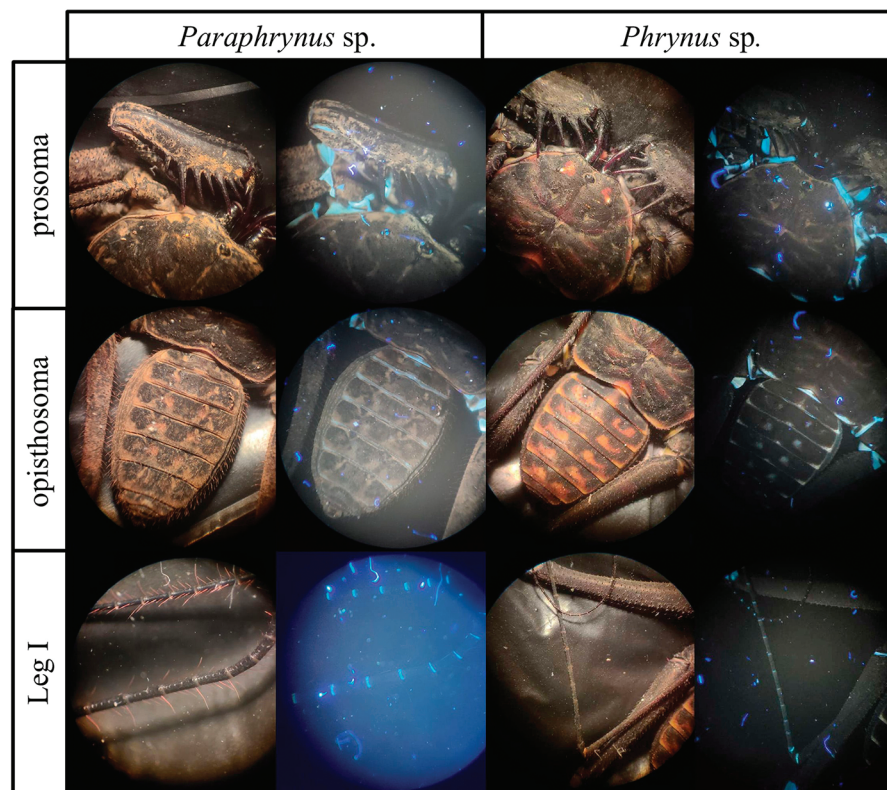


Figure 1.—Dorsal images of Mesoamerican tailless whip scorpions, suspected of belonging to *Paraphrynus* (Specimen I) and *Phrynus* (Specimen II). Specimens were collected in an urban region along the coastline of Guanacaste, Costa Rica and observed under white light and 365 nm UV light, separately.

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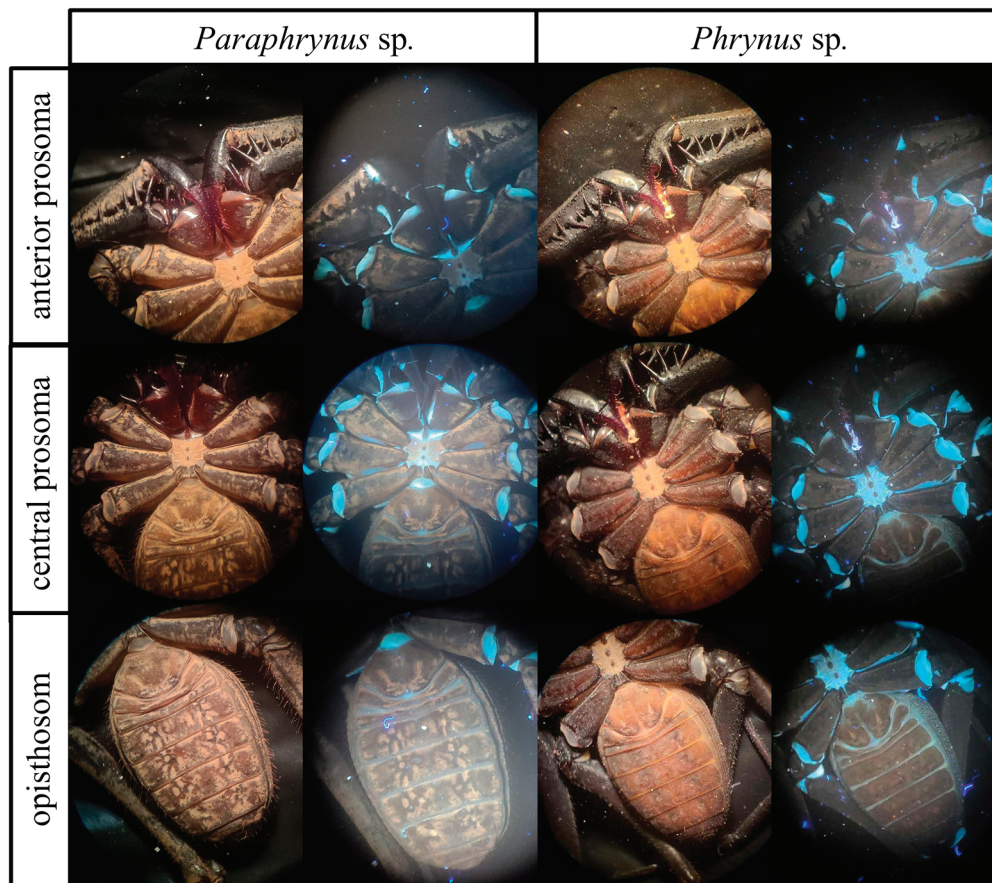


Figure 2.—Ventral images of Mesoamerican tailless whip spiders, suspected of belonging to the genera *Paraphrynus* (Specimen I) and *Phrynus* (Specimen II). Specimens were collected in an urban region along the coastline of Guanacaste, Costa Rica and observed under white light and 365 nm UV light, separately.

(Order: Amblypygi Thorell, 1883), biofluorescence has been reported, albeit without a detailed description or photographic documentation, in two of the five the families (Charinidae Quintero, 1986 and Phrynidae Blanchard, 1852; Rubin et al. 2017) and in the species *Damon variegatus* (Perty, 1834) (Phrynichidae Simon, 1892) (Lawrence 1954). Here, we provide the first description and photographic documentation of suspected biofluorescent patterns in Mesoamerican amblypygids.

In December 2023 we collected two presumably adult amblypygids from an urbanized region along the Pacific coast of Guanacaste, Costa Rica (10.334791, -85.848620). To examine the live specimens, we gently restrained them between a pane of glass and a t-shirt wrapped in a black plastic bag. We identified the specimens according to Viquez & de Armas (2006) and checked for apparent fluorescence using a 365 nm handheld flashlight with a black filter lens (UV301Plus-365nm, LIGHTFE). We photographed each specimen under both white light and the UV light using a mobile phone (Galaxy S20, Samsung) through the ocular lens of a dissecting microscope (Bausch & Lomb). We subsequently released both specimens at their capture site.

Based on characteristics of the pedipalp, the individuals belong to the genera *Paraphrynus* Moreno, 1940 (Specimen I) and *Phrynus* Lamarck, 1801 (Specimen II; Fig. 1). Mesoamerican amblypygid genera can be differentiated by the presence of either one (*Phrynus*) or two (*Paraphrynus*) shorter spines located between the two longest spines of the dorsal pedipalp tibia (Weygoldt 2000; Viquez & De Armas 2006). The specimens displayed homogeneity of blue-green coloration, which is commonly observed in fluorescing arachnids (Jeng 2019). While the apparent fluorescence (hereinafter referred to as fluorescence) was lacking in the hard-shelled regions of the amblypygids, it was evident in the joints and connecting segments, particularly in the soft cuticle between the podomeres of both

the pedipalps and the walking legs. We also noted the presence of fluorescence in the segmented antenniform legs (leg I), where it appeared in the thin rings between the segments. On the dorsal prosoma, we observed fluorescence in the pair of eyes in the center of the anterior portion of the carapace and in the triads of eyes located at the lateral edges of the carapace (Fig. 1). On the ventral prosoma, fluorescence occurred at the tip of, and in between, each coxa, as well as in each of the prosoma sternites (Fig. 2). Additionally, we observed fluorescence in the soft cuticle between the prosoma and opisthosoma, and between the tergites on the dorsal surface of the abdomen.

Spectrofluorimetry—an analytical technique for accurately detecting fluorescence—of spider hemolymph suggests that the blue-green glow seen in arachnids under UV flashlights is due to the presence of fluorophores (fluorescent molecules) in their tissues (Andrews et al. 2007), rather than reflection of the UV flashlight's visible spectrum. However, it remains uncertain whether the blue-green coloration in amblypygids under UV light is due to the accumulation of fluorophores in the soft-tissue or if it results from the thin unsclerotized cuticle allowing fluorescence from underlying hemolymph to be visible.

Regardless of the mechanism, the ecological role of biofluorescence in amblypygids remains unclear. Biofluorescence could aid inter- or intra-specific signaling (Mazel et al. 2004, Lim et al. 2007), provide protection from solar UV (Salih et al. 2000), or have no direct evolutionary advantage. In this instance, we can likely reject protection from solar UV as only a relatively low proportion of the body was fluorescent and amblypygids are primarily nocturnal (Weygoldt 2000). Instead, we suggest that amblypygid fluorescence is either used as a mode of visual signaling or is the result of a physiological byproduct. Sex-specific biofluorescence has been reported in a variety of arthropods (Lim et al. 2007; Jiang et al. 2009; Brandt & Masta

2017; Shade 2018). Although the size of the genital operculum is known to be sexually dimorphic in some species of *Phrynus* (Jiménez & Llinas-Gutiérrez 2005), we were unable to confirm the sex of our specimens. Examples of biochemical composition and physiological conditions leading to biofluorescence in arthropods include the fluorescence of internal organs (Jeng 2019) and associations of biofluorescence with nitrogen content (Weisenborn 2011).

ACKNOWLEDGMENTS

We thank Frank Paladino, director of the Goldring–Gund Marine Biology Laboratory in Costa Rica, for allowing us access to the station and to the dissection microscope used to photograph these specimens. We are also grateful to the peer-reviewers for their time and efforts, which improved the quality of this manuscript.

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Manuscript received 2 September 2024, revised 17 January 2025, accepted 23 January 2025.