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Biofluorescence in the Madeiran Wall Lizard, *Teira dugesii* (Milne-Edwards, 1829)

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Biofluorescence is a phenomenon where organisms absorb ultraviolet (UV) radiation and re-emit it at longer, visible wavelengths (Lamb and Davis, 2021). Biofluorescence has been described across a broad range of taxa, including cnidarians, arthropods, amphibians, reptiles, birds, and mammals (Prötzel et al., 2018; Lamb and Davis, 2021; Travouillon et al., 2023). In squamate reptiles, this fluorescence can originate either from the skin or underlying structures, like bones, particularly due to the fluorescent properties of collagen (Bachman and Ellis, 1965). In species with translucent skin, such as some geckos, skeletal fluorescence may be visible externally (Top et al., 2020; Manunza and Colombo, 2022). Reports of UV fluorescence in reptiles have increased in recent years, expanding our understanding of its distribution and potential ecological roles (Prötzel et al., 2018, 2021; Top et al., 2020; Manunza and Colombo, 2022; Maria et al., 2022; Barends and Bester, 2023; Scanarini et al., 2023). As a result, screening for biofluorescence has become a routine part of specimen examination. Within the family Lacertidae, however, only a few recent records exist, such as in *Holaspis guentheri* and *H. laevis* (Brecko and Pauwels, 2024).

The Madeiran Wall Lizard, *Teira dugesii*, is a lacertid endemic to the Madeira Archipelago and the Selvagens Islands. It is a diurnal species with an average snout–vent length (SVL) of 64 mm (Cook, 1979). Currently, four subspecies are recognized: *T. d. dugesii*, found on Madeira Island; *T. d. selvagensis* (Bischoff et al., 1989), restricted to the Selvagens Islands; *T. d. jogeri* (Bischoff et al., 1989), endemic to Porto Santo Island; and *T. d. mauli* (Mertens, 1938), occurring in the Desertas Islands (Brehm et al., 2003; Jesus et al., 2009).

In order to determine whether *T. dugesii* exhibits biofluorescence, we captured 21 *T. d. dugesii* (10 males, 11 females) using pitfall traps, following the method described by Câmara and Jesus (2025) at two sites near the University of Madeira: (1) Campus da Penteada near the university garden (32.6583°N, 16.9239°W, elevation 153 m), where the buckets were placed along a wall with ornamental and introduced plants; and (2) Caminho da Barreira (32.6770°N, 16.9492°W, elevation 554 m), a small agricultural field where traps were placed along stone walls. The captured individuals were then transported in shaded plastic containers to the lab, a trip of approximately 9 min. We also captured 23 *T. d. jogeri* (15 males, eight females) in Salões, Porto Santo (33.0667°N, 16.3347°W, elevation 42 m) using the same method of capture. We examined these lizards near the site of capture.

We tested lizards for biofluorescence using a Darkbeam DKL-V4 flashlight (emitting UVA light at a wavelength of 365 nm), equipped with an integrated ZWB2 filter to block visible light and enhance fluorescence detection. Lizards were exposed from multiple angles in a completely dark room, and observations were documented using a Nikon P1000 digital camera. The camera captures images within the visible spectrum and was not modified to detect ultraviolet or infrared light.

We observed fluorescence exclusively in males, specifically in their femoral pores (Fig. 1), and we recorded male snout–vent length (SVL) using a ruler to determine body size (to the nearest mm). Individuals with an SVL < 50 mm were considered juveniles and released immediately at their capture site without further examination. SVL values for the Porto Santo and Madeira Island populations are presented in Table 1. All adults were released at their site of capture shortly after observations were completed.

We found that males, but not females, displayed biofluorescence in the region of the femoral pores when exposed to UV light (Fig. 1A–D). The fluorescence emitted varied in intensity among individuals. In both subspecies, larger males in seemingly better body condition tended

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to exhibit more intense fluorescence than smaller males (Fig. 1E–H). Although fluorescence intensity was assessed visually, this variation appeared consistent and may reflect underlying physiological or morphological differences. However, while the individuals we examined suggest a trend toward lower fluorescence in smaller individuals, this may not be universally true across the species, and further investigation is needed to confirm whether this pattern holds more broadly. Interestingly, in *T. d. dugesii*, the difference in fluorescence intensity between the largest and smallest males was less pronounced than in *T. d. jogeri*.

Femoral pores are holocrine glands located on the inner thighs of lacertid lizards (Jesus et al., 2009) that secrete a waxy substance composed of lipophilic and protein-based compounds (Baeckens et al., 2018). These secretions are involved in intraspecific chemical communication and are known to absorb UV light and fluorescence in the green spectrum. A similar observation was made by Alberts (1990) for the desert iguana (*Dipsosaurus dorsalis*), who proposed that the contrast between UV-absorbing secretions and the background substrate might enhance the visibility of scent marks. To our knowledge, this is the first report of such fluorescence in femoral secretions for lacertid lizards.

Table 1. Snout–vent length (SVL, in mm) and fluorescence intensity (FI) in male *Teira dugesii dugesii* and *jogeri*. Fluorescence intensity was visually classified as either "High" or "Low".

No.	Taxon	SVL	FI
1	*jogeri*	72	High
2	*jogeri*	55	Low
3	*jogeri*	56	Low
4	*jogeri*	67	High
5	*jogeri*	69	High
6	*jogeri*	70	High
7	*jogeri*	71	High
8	*jogeri*	68	High
9	*jogeri*	73	High
10	*jogeri*	61	Low
11	*jogeri*	59	Low
12	*jogeri*	56	Low
13	*jogeri*	61	Low
14	*jogeri*	58	Low
15	*jogeri*	60	Low
16	*dugesii*	56	Low
17	*dugesii*	63	High
18	*dugesii*	59	Low
19	*dugesii*	70	High
20	*dugesii*	64	High
21	*dugesii*	69	High
22	*dugesii*	58	Low
23	*dugesii*	60	Low
24	*dugesii*	55	Low
25	*dugesii*	62	High

The presence of UV fluorescence raises important questions about its potential function. Given that femoral gland activity typically peaks during the reproductive season (Cole, 1966), and that both femoral pore size and fluorescence intensity appear to vary among males of *T. dugesii*, it is plausible that these glands play a role in sexual selection, potentially influencing female mate choice (Baeckens et al., 2018). The observed variation in fluorescence intensity (Fig. 1) may reflect differences in glandular activity or secretion volume, possibly serving as an additional visual signal.

One possibility is that the fluorescence of the femoral pores themselves is under selection, functioning as a direct visual indicator of male condition or social status. However, given the ventral position of these pores on the thighs – where they are rarely visible during social interactions – this seems unlikely but cannot be ruled out without targeted behavioural studies. Alternatively, it may be the secretion produced by the femoral glands that is fluorescent, and this fluorescence could enhance the efficiency of chemical signalling. If so, the visual component of the secretion could act in synergy with olfactory cues to increase the detectability of scent marks against UV-reflective natural substrates. This interpretation would be consistent with studies suggesting that the composition of femoral secretions can influence signal detectability (Alberts, 1990; Penner et al., 2021). A third possibility is that fluorescence serves no particular function and is simply a by-product of pore tissue composition or of the biochemical nature of the secretions. Similar non-adaptive interpretations have been proposed for other vertebrates where biofluorescence is present but not clearly linked to behaviour (Prötzel et al., 2018; Travouillon et al., 2023). Further investigation is needed to determine whether UV fluorescence in *T. dugesii* functions primarily as a communication signal, such as mate attraction or territorial signalling, or whether it whether it is simply coincidental.

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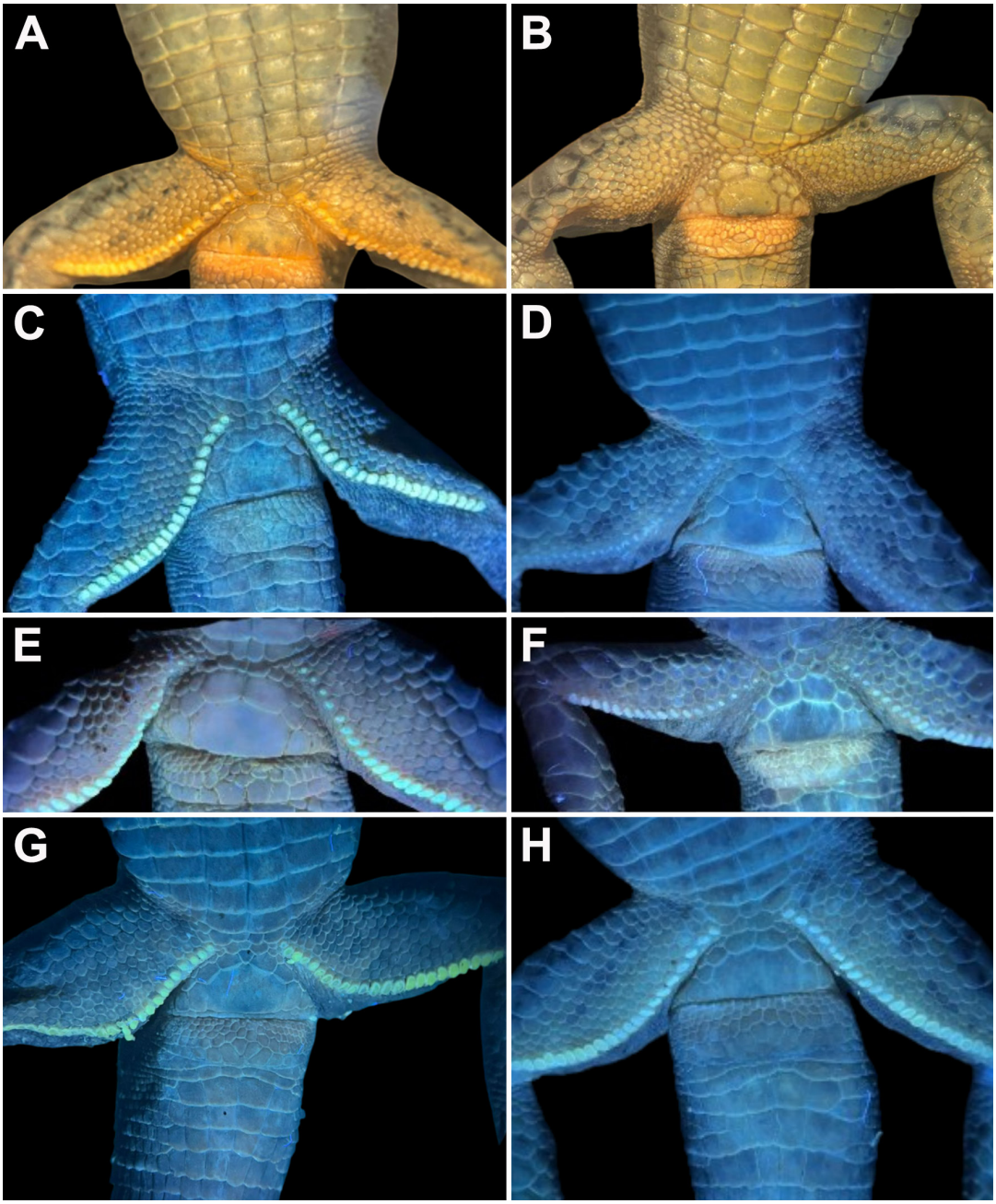

Figure 1. Biofluorescence in *Teira dugesii*. In the top row, we show sexual dimorphism in femoral pores under white light, with (A) well-developed femoral pores in a male *T. d. dugesii* and (B) smaller, less-developed ones in a female. In the second row, we show this phenomenon under UV light, with (C) fluorescent femoral pores in a male *T. d. dugesii* and (D) no biofluorescence in an adult female. In both examined subspecies, fluorescence intensity appears to differ ontogenetically, as indicated by snout–vent length (SVL), with (E) a large male *T. d. jogeri* (Lizard 9; SVL 73 mm) showing stronger fluorescence than (F) a smaller male (Lizard 10; SVL 61 mm SVL), and (G) a large male *T. d. dugesii* (Lizard 21; SVL 69 mm) fluorescing more strongly than (H) a smaller male (Lizard 24; SVL 55 mm). There is no difference overall in the fluorescence intensity between the subspecies.

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