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Records of albinism variants in amphibians from Portugal

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Resumen: Las mutaciones de la coloración de la piel son bien conocidas, con numerosas variantes incluyendo el albinismo. El albinismo se refiere a individuos blanquecinos, amarillo–dorados o rosa–rojizos, pero el uso variable del término ha dificultado la interpretación de los casos reportados. En esta nota presentamos nuevos casos de anfibios con variantes albinas en Portugal. Además, discutimos observaciones previas en la peninsula ibérica para clarificar la nomenclatura utilizada por sus autores.

Skin color mutations in amphibians are well documented, with numerous variants, including albinism and its different types of absence of integumentary pigmentation, reported across several species (Rivera *et al.*, 2001). Albinism *sensu lato* refers to an individual with a whitish, yellowish to golden or pinkish to reddish appearance (Henle *et al.*, 2017b), but the variable use of this terminology has made it difficult to interpret the written reports of albinistic animals. We follow Henle *et al.* (2017b), referring to the total lack of all integumentary pigmentation (including in the eyes) as complete albinism (or true albinism), contrasting with other forms of albinism *sensu lato*, where some le-

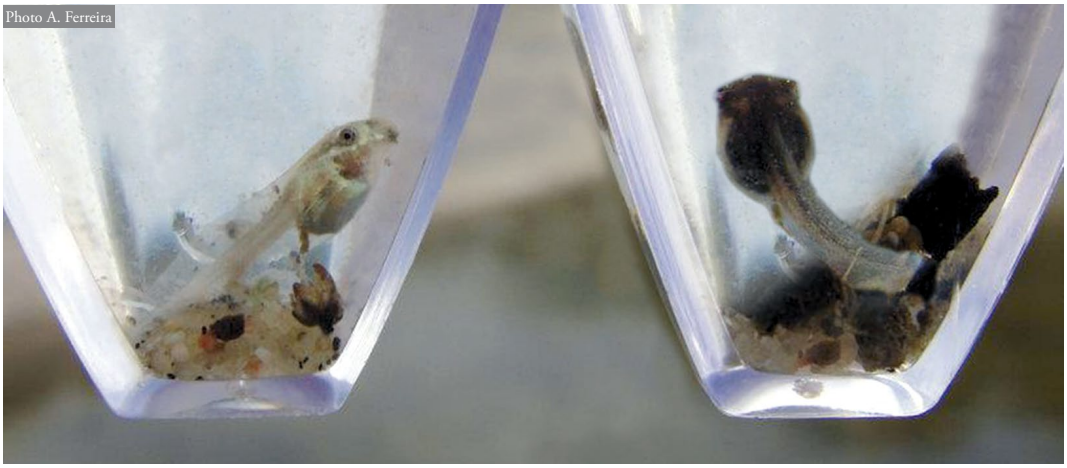

Figure 1: Comparison of the leucistic tadpole (left) and a typical colored one (right) of the Spadefoot toad *Pelobates cultripes*, encountered at 'Mata dos Medos' (Portugal).
Figura 1: Comparación del renacuajo leucístico (izquierda) y otro renacuajo con coloración normal (derecha) del sapo de espuelas *Pelobates cultripes*, encontrado en 'Mata dos Medos' (Portugal).

vel of pigmentation is retained (e.g. leucism, where the eyes are pigmented).

Here, we report on new cases of albinism variants in amphibian species from Portugal, and comment on previous records in the Iberian Peninsula as an attempt to better interpret the nomenclature given by their authors.

Several forms of albinism have been reported in *Pelobates cultripes* (Cuvier, 1829) in Iberia, with completely albino individuals making up the vast majority of the cases in the Spanish territory (Bosch, 1991; Gómez-Serrano, 1994; Donaire-Barroso *et al.*, 1996). All individuals were observed during larval stage and characterized by a golden-yellowish coloration with a translucid ventral area (where the dark color of the intestines becomes visible), and reddish eyes. A single case of flavism was recorded in a larva in Almadén (Ciudad Real) (García-Roa & Sainz, 2012). Torres (2000) reported on a supposed albino larva in La Cortadura (Cádiz), but the white coloration of its tail and dorsal area better fits with the definition of leucism.

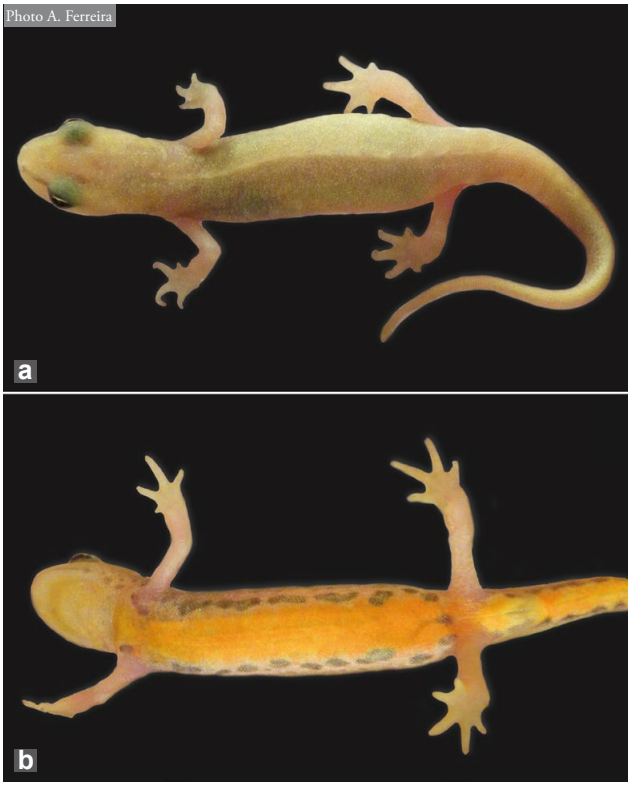

Figure 2: a) Dorsal and b) ventral view of a flavistic adult of *Lissotriton boscai* from Mata da Machada (Portugal).
Figura 2: a) Vista dorsal y b) ventral de un adulto flavístico de *Lissotriton boscai* de Mata da Machada (Portugal).

In 2014, an alleged new case of albinism was reported in Zamora, whereby a single larva presented the typical light-yellowish, translucid coloration with visible dark intestines (Rodríguez, 2016). Campos-Such (2017) re-classified the case as a form of leucism. Yet, unlike the rest of the larvae in the same pond, the individual's dark-brown eye pigment suggested either the cumulative presence of Anomaly N (black-eyedness; Henle *et al.*, 2017b), or that the individual could simply have a type of hypomelanistic mutation.

On 31 March 2017, during a survey of an artificial pond at 'Mata dos Medos' (38.566702° / -9.187037°; 84 masl), 'Costa da Caparica' (Portugal), we observed several spadefoot toad (*P. cultripes*) tadpoles, including a single individual presenting an abnormal coloration. This tadpole was characterized by the absence of all integumentary pigmentation, where the tail, dorsal and ventral area presented a white coloration with translucid tail membranes, throat and snout (Figure 1). The eyes were normally pigmented. This observation likely represents the second documented case of leucism in spadefoot toads (after Torres, 2000), but the first pigmentation anomaly in *P. cultripes* recorded in Portugal. In Iberia, this type of anomaly has been recorded in *Alytes dickhilleni* (Benavides *et al.*, 2000), as well as in caudates: first in a larval *Pleurodeles waltl* observed in 2009 (Busack & Donaire, 2014), and later in neotenic individual (Torres *et al.*, 2016). More recently, Dopereiro & Puras (2018) reported on a leucistic adult *Salamandra salamandra* from Galicia (Spain). Galán (2010) described a leucistic female of Bosca's newt (*Lissotriton boscai*) from Galicia, although its golden-yellowish coloration with normal pigmented eyes better fits the terminology of a flavistic mutation.

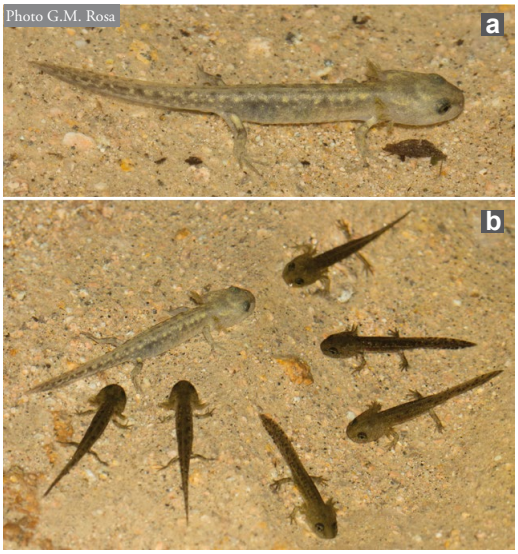

Figure 3: a) Hypomelanistic individual larva of *Salamandra salamandra* (dorso-lateral view) from Serra de Sintra (Portugal). b) Normal phenotype larvae in contrast with a hypomelanistic individual.
Figura 3: a) Individuo hipomelánico en estado larvario de *Salamandra salamandra* (vista dorso-lateral) de 'Serra de Sintra' (Portugal). b) Fenotipo larvario normal, en comparación con el individuo hipomelánico.

On 27 April 2013, during a pond survey at Mata da Machada, Barreiro (Portugal) (38.621113° / -9.040333°; 45 masl) we found flavistic *L. boscai* (Figure 2). The adult male presented an abnormal yellowish coloration throughout its dorsal region, tail, limbs and head, highlighted by the absence of any integumentary pigmentation aside from xanthophores. The ventral coloration presented the typical pattern for this species, characterized by an orange background with black spots, but with a much more faded tone, resulting in the internal organs being slightly visible. The iris was of a golden color, as expected for this species. The individual measured 29 mm (snout-vent length) and it was found alongside 27 other conspecifics, all displaying normal coloration. The observation represents the second case of flavism

in *L. boscai*, a mutation that seems to be less frequently reported.

In contrast, reports of color mutations in *S. salamandra* (Campos-Such, 2017) appear to be more frequent, and several cases of albinism and its different forms have been reported in the Iberian Peninsula. Most of the reports made in Spain refer to both complete albino juvenile and adult individuals (Rivera *et al.*, 1993; Kopetsch, 1997; Fernández-Fernández, 2001; Boada *et al.*, 2011; Campos-Such, 2017) and larvae (Benavides *et al.*, 2000), with Arribas & Rivera (1992) and Thiesmeier (2004) describing different cases in both life stages.

On the 22 December 2017, while surveying a freshwater body in Serra de Sintra (38.792628° / -9.396911°; 314 masl) (Portugal) we observed several *S. salamandra gallaica* larvae, including one individual with an abnormal coloration (Figure 3). This larva was characterized by a reduction of melanophores, giving it a pale coloration, but with some dark markings on the tail and back legs. The eyes were normally colored, making this phenotype fit with the definition of hypomelanism.

An adult female, allegedly collected in Serra de Grândola (Portugal), gave birth to a couple larvae which were kept in captivity and photographed until after metamorphosis (James, 2011). Initially, the larvae presented normally pigmented eyes and a yellowish body coloration, and were identified by the breeder as being flavistic. Post-metamorphosis, the individuals exhibited a more brownish body coloration (showing that melanophores are reduced, but present in the integumentary pigmentation), which fails to meet the criteria for flavism, and instead suggesting a case of hypomelanism. Several other cases were reported in larvae from Badalona (Catalunya, Spain), where individuals presented different degrees of hypomelanism (Rivera *et al.*, 2016). This mutation has also been reported in other caudates in Spain, including *Ichthyosaura alpestris cyreni* and *Triturus marmoratus*, characterized by the lack of certain specific pigments (Rivera *et al.*, 2002).

We have reported three occurrences of albinism variants for three amphibian species in Portugal, suggesting once more that although such color abnormalities are a natural occurrence, they are mostly represented by isolated cases (Henle *et al.*, 2017a). This happens because albinism forms are mostly associated with recessive inheritance, although they can also be caused by external factors such as temperature, diseases, nutrition, chemicals and radioactive pollution (Henle *et al.*, 2017a, 2017b, 2017c). Ultimately, herps presenting such color abnormalities often show developmental problems (Sazima, 1974; Semlitsch *et al.* 1988; Henle *et al.*, 2017c), making them more sensitive to environmental factors, such as the presence of predators (Kornilios, 2014; Miras & Mompart, 2015; Henle *et al.*, 2017b). As a result, identification of such abnormalities is highly dependent on regular monitoring of wild populations (Laurentino *et al.*, 2016). This stresses the importance of long-term monitoring studies to understand trends and, whenever possible, correlate them with internal and external factors that can elucidate the cause of the occurrence (Henle *et al.*, 2017b; Dubois, 2017).

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