Phenotypic abnormalities in coloration patterns can occur in individuals of a certain species usually due to genetic or environmental factors that cause an excess or deficit in the metabolism of dermal pigmentation, restricted to a region or throughout the entire body (Duellman and Trueb, 1994; Hayley-McCardle, 2012). Several divergent classifications for these events are based on extent of pigmentation loss, but among the main recognized types we can cite the piebaldism, leucism and albinism (Miller, 2005; Abreu et al., 2013). Piebaldism occurs when there are depigmented blotches along the animal’s body (Acevedo et al., 2009) and leucism when the animal’s body is partially or totally depigmented, with remaining margins of the body and eyes pigmented, as albinism occurs in animals with complete absence of pigmentation, including the eyes, which becomes reddish or pink (Fertl and Rosel, 2002; Miller, 2005). Although many cases of depigmentation for the major vertebrates lineages are documented, such as for fishes (e.g., Teixeira and Araújo, 2002), birds (e.g., Nogueira and Alves, 2011), reptiles (e.g., Abegg et al., 2014; Erickson and Kaefer, in press), mammals (e.g., Abreu et al., 2013) and amphibians (e.g., Toledo et al., 2011; Elgue et al., 2013), these events are rare in natural populations (Bechtle, 1995), since the loss of pigmentation makes individuals more susceptible to visually-oriented predators (Parsons and Bonderup-Nielsen, 1995) or is associated with morphological and immunological abnormalities (e.g., Turkozan and Durmus, 2001; Sanabria et al., 2010).

The genus Anomaloglossus comprises 29 species that inhabit tropical forests of northern Amazon region, with only four species recorded from Brazil: A. baebatracus (Boistel and de Massary, 1999), A. roraima (La Marca, 1997), A. stepheni (Martins, 1989) and A. tamacuarensis (Myers and Donnelly, 1997) (Frost, 2015). Anomaloglossus stepheni is a small-sized (14-18 mm) frog distributed along the French Guiana, Suriname and Brazil and is one of the most abundant amphibians in the forest litter from the region of Presidente Figueiredo and Manaus municipalities in Amazonas State, Brazil (Deichmann et al., 2010; Lima et al., 2012).

On 09 June 2014, we found an adult, unvouchered male of A. stepheni with some level of depigmentation but retention of eye color, configuring a case of leucism. The specimen was found active at 10:55 am in the leaf litter of a primary dense forest area located in the municipality of Presidente Figueiredo (-1.9877, -60.0591). This location is inside the limits of a protected touristic complex settled around the Igarapé Santa Cruz, a large tributary of the Negro River. The only other species of criptically colored aromobatid found in this region are Allobates sumtuosus (Morales, 2002), that differs morphologically of A. stepheni principally by more slender appearance (robust in A. stepheni) the presence of a continuous dark band from rostrum to cloaca (interrupted in the middle of body in A. stepheni) and the different hind limb coloration compared with dorsum (similar in A. stepheni) (Martins, 1989; Lima et al., 2012). Despite the depigmentation on the registered individual of A. stepheni, these diagnostic characters can be noted. The specimen showed a marked reduction of dark pigment (melanin) in the whole body skin, as compared to a normal coloration specimen (Fig. 1), thus lacking the large dark bands present in rostral
and lateral regions, the transverse dark bars of limbs, and the dark spots present along the dorsal region. Nevertheless, the dorsal brownish coloration typical of this species probably remained due to other types of chromatophores (Browder, 1968). We discarded the possibility of such depigmentation be caused by diseases due to the large amount of the body dominated by white color, since depigmentation caused by parasitic, fungal or bacterial diseases in amphibians occurs in a punctual and scattered manner along the body (Pessier, 2002). In addition, the animal had a healthy appearance and moved normally under the leaf litter, showing no signs of rash, itch, weight loss or fatigue.

As coloration patterns play an important role in life history of individuals, any phenotypic abnormality can affect them positively or negatively (Hoffman and Blouin, 2000; Vitt and Caldwell, 2013). Studying color anomalies in snakes, Sazima and Di-Bernardo (1991) suggested that the survival rate is lower in depigmented individuals of species with diurnal activity, as they are more subject to selective pressures related to visually-oriented diurnal predators. This seems to be the reason why the loss of pigmentation is little documented for adults of diurnal species of the frog superfamily Dendrobatoidae (Dendrobatidae + Aromobatidae), which shelters lineages that depend of their normal coloration pattern for both defense (aposematic coloration) and camouflage (cryptic coloration), such as the species recorded in this study. We hypothesized that this depigmented individual of *A. stepheni* reached adulthood because the loss of dark pigmentation mainly affected its ventrolateral region, with retention of

**Figure 1.** Comparative dorsolateral, ventral and lateral views of leucistic (A, B, C) and normal (D, E, F) adults of *Anomaloglossus stepheni* (Martins, 1989) from Central Amazonia. Photos by L.J.C.L. Moraes (A, B, C, D, F) and Lima et al., 2012 (E).
most of its dorsal cryptic coloration, and consequently maintenance of its camouflage function. However, further development of this hypothesis depends on new records of diurnal frogs with loss of pigmentation in natural populations or experimental studies with these species under controlled conditions, so that we can better understand this phenomenon and its physiological and ecological implications.

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References


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