REPTILES & AMPHIBIANS

Xanthism in Three Wild Snakes in Colombia

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Reptiles have diverse color patterns that serve ecological, behavioral, and physiological functions (e.g., camouflage, mimicry, thermoregulation, and warning) (Bechtel 1978; Allen et al. 2013). However, chromatic aberrations resulting in atypical coloration, which have been recorded in a number of species, can reduce survival and fitness (Krecsák 2008; Cyriac and Kodandaramajah 2019; Ascoli-Morrete et al. 2021; Borteiro et al. 2021; Rivas et al. 2022). The most common chromatic aberrations include albinism, in which affected individuals partially or totally lack melanin, resulting in pinkish-white skin and reddish pupils. Leucism is expressed when the affected individuals suffer a partial loss of all types of pigmentation, resulting in pale skin, often with white patches, but having dark eyes. Finally, xanthism and erythrism result in the affected individuals lacking dark pigments but expressing yellow or red pigments, respectively, resulting in largely yellowish or reddish skin (Bechtel 1978; Rivera et al. 2001; Travaglia 2006; Roncolatto et al. 2017; Andrade et al. 2020; Mendonça et al. 2020; Borteiro et al. 2021).

Xanthism has been documented in several viperids, including *Bothrops alternatus*, *B. jararacussu*, *B. jararaca*, *B. cotiara*, and *Crotalus durissus* (Mendonça et al. 2020; Ruiz-Sueiro et al. 2010; Travaglia 2006), but in fewer colubroids (e.g., *Dipsas* sp.) and boids (e.g., *Epicrates cenchria*) (see Hoge and Belluomini 1957; Borteiro et al. 2021).

Snakes in the genus *Bothrops* are medium-to-large (1–2 m) ambush predators that occur in a wide variety of Neotropical habitats and are responsible for most of the lethal snakebites in Central and South America (Sasa et al. 2009; Nina-Cueva et al. 2020). Dipsadids in the genus *Xenodon* are large, active hunters in terrestrial or semi-aquatic habitats (Arzamendia and Giraudo 2009). Although nonvenomous, they can be irascible and aggressive when disturbed (Galvis-Peñuela et al. 2011). Herein we present the first recorded cases of xanthism in nature in the Terciopelo, (*Bothrops asper*; Garman 1883), the Barba Amarilla (*B. atrox*; Linnaeus 1758), and the False Terciopelo (*Xenodon* aff. *rabdocephalus*; Wied-neuwied 1824).

At 1000 h on 16 August 2018, M. Sanchez photographed a yellowish Terciopelo in gallery forest adjacent to the Coello Waterfall near the Magdalena River, Municipality of Coello, Tolima, Colombia (4.19117, -74.54322) (Fig. 1). At 2134 h on 21 July 2020, O.L. Llanos Villegas photographed a yellowish Barba Amarilla with dorsal spots of different pale colors in a fallen trunk in a pasture in the Municipality of Morelia, Caquetá, Colombia (1.2953, -75.4321) (Fig. 2). At 1507 h on 26 June 2023, S. Salinas photographed a predominantly yellowish False Terciopelo in a coffee plantation in the District of García, Municipality of Tello, Huila, Colombia (2.57225, -75.00206) (Fig. 3). According to criteria proposed by Borteiro et al. (2021), we determined that all three snakes expressed xanthism.

Bothrops asper and *B. atrox* are very similar, but can be distinguished by postorbital lines one-to-two scales in width

Figure 1. An adult Terciopelo (*Bothrops asper*) with xanthism at the Coello Waterfall in the Municipality of Coello, Tolima, Colombia. Photograph by Miguel Sanchez.

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contacting only two supralabial scales in *B. asper*, whereas broader postorbital lines contact the last three supralabial scales in *B. atrox* (Campbell and Lamar 1989; Hoyos et al. al. 2003; Díaz-Ricaurte et al. 2018; Quiñones-Betancourt et al. 2018). The two species also are allopatric, with *B. asper* distributed in the Caribbean, Andean, and Pacific regions of Central and northern South America, and *B. atrox* on the other side of the Andes in the Orinoco and Amazon River basins (Galvis-Peñuela et al. 2011; Terán et al. 2014; Díaz-Flórez et al. 2022).

We identified the third snake as *X.* aff. *rhabdocephalus* based on descriptions in Galvis-Peñuela et al. (2011) and Vásquez-Restrepo et al. (2018). False Terciopelos have robust, dorsoventrally flattened bodies, smooth scales, well-differentiated heads with large eyes that have round pupils; coloration in this species is variable but usually tends to be grayish brown with bands forming a dorsal pattern similar to those of *Bothrops* spp. However, more studies of these widely distributed snakes are necessary for clarity about the taxonomy of this species (Myers and McDowell 2014).

Although all three of these species can exhibit considerable variability in coloration, colors such as those described herein have not been documented previously. Such colors are rare in nature, possibly because they result from recessive genes that interfere with normal physiological functions (García-Roa and Martín 2016) or because of a probable increase in mortality due to the resultant reduction in camouflage (Mendonça et al. 2020). Presumably due to the latter factor, chromatic anomalies are more frequently encountered

Figure 2. An adult Barba Amarilla (*Bothrops atrox*) with xanthism in a pasture in the Municipality of Morelia, Caquetá, Colombia. Photograph by Olber Leonardo Llanos Villegas.

Figure 3. An adult False Terciopelo (*Xenodon* aff. r*abdocephalus*) with xanthism in an open area within a coffee plantation in the Municipality of Tello, Huila, Colombia. Photograph by Sebastian Salinas.

in nocturnally active snakes, which are less vulnerable to the loss of advantages conferred by coloration (Ruiz-Sueiro et al. 2010). Nevertheless, despite an apparent increase in vulnerability to predators and a resultant higher mortality rate (Bechtel and Bechtel 1981; Krecsák 2008), all three aberrant snakes described herein were adults, a phenomenon also noted by Pommer-Barbosa et al. (2023) in South American Bushmasters (*Lachesis muta*). Either the negative impact of chromatic anomalies on fitness in snakes is less than has generally been assumed or the interplay among various factors (including coloration) might be more complex than previously thought (e.g., Kuriyama et al. 2020). For example, all three snakes described herein were encountered in environments with some levels of human-mediated disturbances, which have been implicated in habitat fragmentation and alterations that can affect the frequency of some genetic anomalies (e.g., Brown et al. 2017; Wood et al. 2020).

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