

Extending records of albinism and skin disorders in American cownose rays to southeastern Brazil

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Abstract

Albinism is a genetic condition expressed as a lack of integumentary and retinal melanin. Although documented across many vertebrate species, albinism and other skin disorders are rarely observed in elasmobranchs (sharks and rays). The present study describes the first confirmed case of albinism in American cownose ray (*Rhinoptera bonasus*), and three other juveniles of the species with undetermined skin disorders observed in São Paulo, southeastern Brazil. Pigmentation disorders have already been observed in American cownose rays from the North Atlantic, including two cases of leucism and a possible albinism. Based on the results, it was discussed the possible consequences of albinism for the ray survival as well as the possible causes for the undetermined skin disorders.

KEYWORDS

colour pigmentation, elasmobranch, field observation, *Rhinoptera bonasus*, white cownose ray

Pigmentation disorders whether due to a deficiency (*i.e.*, hypomelanosis) or an excess (*i.e.*, hypermelanosis) of pigmentation are rarely observed in the wild, especially in marine animals (Arronte *et al.*, 2022; McCardle, 2012). Examples of hypomelanotic conditions are albinism, a genetic condition expressed as a total lack of integumentary and retinal melanin (Jawad & Ibrahim, 2018), and leucism caused by the expression of recessive alleles, resulting in a total or partial loss of melanin, but with a regular coloration of eyes (Fertl & Rosel, 2009; Leroux *et al.*, 2022). In Chondrichthyes species (sharks, batoids, chimaeras), albinism and leucism are extremely rare and have been documented only in 61 species across 31 families (reviewed by Arronte *et al.*, 2022; Bigman *et al.*, 2016). In the present study, it were reported an albinistic neonate American cownose rays *Rhinoptera bonasus* (Mitchill, 1815), and three other juveniles of the species with undetermined skin disorders observed in São Paulo, southeastern Brazil. Pigmentation disorders have already been observed in American cownose rays, including two cases of leucism (Joseph, 1961; Schwartz, 1959) and a possible albinism (Fisher *et al.*, 2014), all of them in North Atlantic coastal waters.

The American cownose ray is a medium-sized, coastal benthopelagic ray distributed from United States of America to Uruguay (Carlson *et al.*, 2020). Individuals of this species usually live in large

schools, even when residing in nursery areas during their early-life stages (Rangel *et al.*, 2018) and perform large coastal migrations (Ajemian & Powers, 2016; Fisher *et al.*, 2013). Due to the level of exploitation by widespread commercial and artisanal fisheries especially in Southwest Atlantic, it is suspected that the American cownose ray has undergone an overall population reduction of 30%–49%; therefore, it is currently listed as “Vulnerable” by the IUCN (Carlson *et al.*, 2020). Despite that, basic aspects of the species biology remain poorly known in most locations, including in Brazilian coastal waters.

Pigmentation disorders were recorded in four Atlantic cownose rays caught in Bertioiga, a marine protected area on the central coast of São Paulo, South Atlantic Ocean. All records were obtained from rays incidentally caught by the same fishing method using beach seine nets cast 400–600 m from the beach and gathered by hand over a period of c. 40 min (for details: Rangel *et al.*, 2018). Three young-of-the-year (YOY) individuals with undetermined pigmentation disorders were documented on 22 December 2016 at *Jardim Rafael* beach (23° 49' 19" S, 46° 05' 20" W). In this case, captured individuals were removed from the fishing net, held in 50 l plastic containers filled with sea water (2–3 individuals per box) and identified to species level using dental morphological characteristics, and their corresponding disc widths (DW, cm) were recorded. The albino Atlantic cownose ray

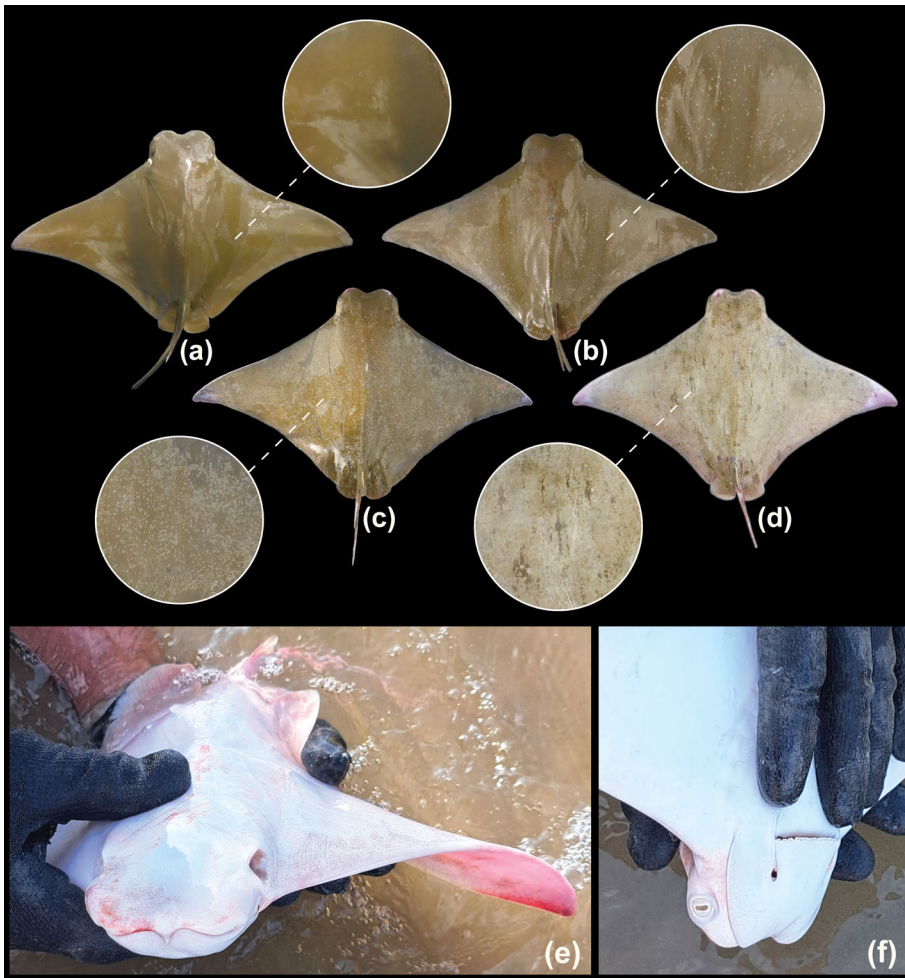


FIGURE 1 (a) Individual Atlantic cownose ray (*Rhinoptera bonasus*) showing common pigmentation. (b–d) Three juvenile cownose rays with undetermined skin disorders. (e, f) Albino neonate cownose ray. All individuals were similar in size and were recorded in the same location, São Paulo, Brazil

was incidentally captured on 19 March 2023 at Indaiá Beach (23° 48' 55" S, 46° 03' 10" W). Unlike the other three individuals, this one was just recorded through images. All rays were released alive after procedures. Research permits were granted by SISBIO (ICMBIO/SISBIO #48572) and the Animal Ethics Committee (CEUA #258/2016) of the Institute of Biosciences, University of São Paulo.

The pigmentation of the four American cownose rays described in this study differed significantly from the pigmentation pattern found in this species (Figure 1). In their normal colour pattern, *i.e.*, the most frequent in the region studied, individuals present the dorsal region in uniform brown colour (Figure 1a) and ventral region in white or yellowish. In addition, they may exhibit dark edges on the disc (ventral region). Of the three rays that showed undetermined pigmentation disorders, a 58.0 cm DW female (Figure 1b) and a 50.0 cm DW male (Figure 1b) exhibited uniform brown colour in the dorsal region and pelvic fins, but with the presence of atypical and lighter dots and spots of varying sizes. The third American cownose ray recorded with undetermined pigmentation disorders, also a 50.0 cm DW male, differed more from the others as it had spots more evident on the skin that extended throughout the dorsal region and pelvic fins. The only individual with pigmentation disorder confirmed was an albino male of c. 40.0 cm DW, which corresponds to a newborn American cownose ray (Rangel *et al.*, 2020). This individual had a completely

depigmented body and eye iris (Figure 1e,f; Supporting Information Video S1).

Although other six American cownose with apparent skin disorders were sighted between December 2016 and January 2017, they were not reported in the present study due to lack of photographic records. A similar case had already been observed between 2015 and 2016 in Baa Atoll, Maldives, in eight YOY *Carcharhinus melanopterus* with abnormal skin pigmentation (Bruckner & Coward, 2018). Given that these types of skin abnormalities were punctual and observed in several individuals at once (three confirmed and six unconfirmed), it is plausible to suggest that skin disorders could be attributed to environmental stress associated with aquatic pollution, as also suggested by Bruckner and Coward (2018). Historically, the coastal region of the study site receives contaminants through the discharge of a channel that connects to the Santos harbour and one of the most important industrial centres of the country (Gonçalves *et al.*, 2013). It is also possible that skin disorders could be attributed to some disease and immunological depression (*e.g.*, dolphins, Harzen & Brunnick, 1997), or exposure to elevated temperatures (*e.g.*, sharks, Gervais *et al.*, 2016). Furthermore, the authors do not discard the possibility of genetic alterations in melanin production (Arronte *et al.*, 2022), or even though the colour variations are just a natural variability, although of the 2086 cownose rays analysed from this population between 2015

and 2023 these conditions have not been observed in rays beyond those described here.

Although the first two reports of pigmentation disorders in American cownose rays had been initially attributed to albinism (i.e., Joseph, 1961; Schwartz, 1959), both were actually cases of leucism based on Clark's (2002) reclassification. More recently, Fisher *et al.* (2014) described a white embryo cownose ray, as possibly an albino individual. Nonetheless, because the embryo exhibited a dark tail and absent eyes due to developmental abnormalities, the authors made no definitive classification. Albinism is a rare condition reported in only 33 Chondrichthyes species, including 19 sharks, 13 rays, and 1 chimera (references in Arronte *et al.*, 2022). Within representatives of the Myliobatiformes, in which the Atlantic cownose ray is placed, albinism was reported only in five species: *Bathytoshia brevicaudatus* (Talent, 1973), *Hypanus americanus* (Wakida-Kusunoki, 2015), *Gymnura micrura* (Lara-Mendoza & Guerra-Jiménez, 2020), *Myliobatis californica* (De Jesús-Roldan, 1990) and *Urotrygon nana* (Anislado-Tolentino *et al.*, 2016). Although the lack of pigmentation does not appear to affect survival in some species with adult individuals reported, most records appear to be in neonates or juveniles (Arronte *et al.*, 2022; Escobar-Sánchez *et al.*, 2014). This suggests that the lack of pigmentation may confer a greater vulnerability to albino animals. In the case of Atlantic cownose rays, the lack of pigmentation could disrupt social interactions (e.g., catfish, Slavik *et al.*, 2015; primates, Leroux *et al.*, 2022) as they show gregarious behaviour (Ajemian and Powers, 2016; Fisher *et al.*, 2013). Furthermore, both prey and predators could easily detect the albino ray (e.g., Sandoval-Castillo *et al.*, 2006).

AUTHOR CONTRIBUTIONS

Conceptualization and data curation: all authors; roles/writing – original draft: A.R. and B.S.R.; formal analysis: A.R. and B.S.R.; methodology: all authors; writing – review and editing: A.R. and B.S.R.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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