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SHORT COMMUNICATION

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FIRST RECORD OF LEUCISM IN THE BRAZILIAN LARGE-EYE STINGRAY Hypanus marianae (GOMES, ROSA & GADIG, 2000) (CHONDRICHTHYES: DASYATIDAE)

Primeiro registro de leucismo na raia mariquita *Hypanus marianae* (Gomes, Rosa & Gadig, 2000) (Chondrichthyes: Dasyatidae)

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ABSTRACT

This is the first report of leucism in the Large-eye Stingray *Hypanus marianae* (Gomes, Rosa and Gadig, 2000), an endemic species from Northeastern Brazil. The leucistic specimen was a three-year-old subadult female, and morphometric analysis revealed no differences between the leucistic individual and pigmented conspecifics.

Keywords: elasmobranch; partial albinism; Myliobatiformes.

RESUMO

Este é o primeiro registro de leucismo na raia mariquita Hypanus marianae *(Gomes, Rosa e Gadig, 2000), uma espécie endêmica do nordeste do Brasil. O espécime leucístico era uma fêmea subadulta de três anos, e a análise morfométrica não revelou diferenças entre o indivíduo leucístico e conspecíficos pigmentados.*

Palavras-chave: *elasmobrânquios; albinismo parcial; Myliobatiformes.*

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INTRODUCTION

Chromatophores are specialized dermal cells responsible for integumentary coloration in fish (Fujy, 2000). In elasmobranchs, the most abundant type of chromatophores is melanophores, which produce the brown-black pigment melanin (Gelsleichter and Evans, 2012), responsible for the dark pigmentation of the skin of these fish (Kemp, 1999). Disorders in melanin system cause albinism, a congenital hypopigmentation condition due to a genetic mutation in different chromosomes (Carden et al., 1998). The most obvious phenotype of albinism is the lack of retinal, and integumentary pigmentation (Clark, 2002). Furthermore, Slavik et al. (2016) reported an association between hypopigmentation and physiological and behavioral alterations, such as lower aggressiveness and reduced shoaling behavior in juvenile catfish *Silurus granis*. Pigmentation of the retina and skin is derived from chromatophores with diverse embryonic origins (Hall, 2009), controlled by different pathways, leading to various forms of albinism, including total, incomplete, imperfect and partial (Berdeen & Otis 2011).

Leucism is a form of partial albinism, characterized by the lack of integumentary pigmentation but the presence of iris pigmentation (Betchell, 1995), controlled by a single recessive allele (Owen and Shimmings, 1992). In Chondrichthyes, the occurrence of complete albinism and leucism was reviewed by Clark (2002) and more recently by Bigman et al. (2015). Albinism and leucism in Chondrichthyan species are relatively rare and appear to be more common in teleosts than in elasmobranchs (Bottaro et al., 2005; Wakida-Kusunoki, 2015). According to Weigman (2016), there are 1188 described valid Chondrichthyan species across 61 families, with total and partial albinism recorded so far in 44.2% of families and 4.2% of Chondrichthyan species. Of these, at least eight species have more than one recording (Bigman et al., 2015).

Among batoids, the Myliobatiformes order has more albinism records than Rajiformes, Torpediniformes and Rhinobatiformes, with 40% of the records related to members of Dasyatidae family (Diatta et al., 2013; Bigman et al., 2015). Around 3.6% of Dasyatidae species have albinism and leucism cases registered in literature, including *Bathytoshia brevicaudata* (formerly *Dasyatis brevicaudata*) (Talent, 1973), *Dasyatis pastinaca* (Capapé & Panstoustier, 1975) and *Hypanus americanus* (formerly *Dasyatis americana*) (Schwartz and Safrit, 1977; Wakida-Kusunoki, 2015).

In this study, we report the first occurrence of leucism in *Hypanus marianae* (Gomes, Rosa and Gadig, 2000), a medium-sized stingray endemic to northeastern Brazil. This species, which is captured by the artisanal fleet, is associated with macroalgae beds and coral reefs of the northeastern Brazilian continental shelf (Gomes et al., 2000; Costa et al., 2015). *H. marianae* exhibits sexual and ontogenetic segregation, reaching the size of first maturation for males and females at 24.0 cm and 27.0 cm of Disc Width, respectively (Yokota and Lessa, 2007; Costa et al., 2015; Nunes et al, 2019). The diet of this species primarily comprises shrimp (Shibuya and Rosa, 2011), classifying it as a specialist predator with a trophic level of 3.6 (Costa et al., 2015; Queiroz et al., 2019).

The coloration of the live specimen was described by Gomes et al. (2000). The most noticeable characteristic is a yellowish-brown color, with dark brown blotches on the scapular and posterior parts of the disc on the dorsal surface. On the white ventral surface of the disc, there is a dark, kidney-shaped blotch on the side of the branchial region and another in the abdominal area.

MATERIAL AND METHODS

On 13 August 2013, the leucistic *Hypanus marianae* (Figure 1) was collected from artisanal fishing landings targeting the mutton snapper, *Lutjanus analis* (Cuvier, 1828), in Pernambuco State, Brazil (Figure 2). The specimen was brought to the Laboratório de Dinâmica de Populações Marinhas (DIMAR) at Universidade Federal de Pernambuco (UFRPE), where morphometric measurements were obtained according to Gomes et al. (2000). All measurements were recorded in millimeters relative to the Disc Width (DW). Morphometrics data from holotype of *H. marianae* (MNRJ 7967) (Gomes, Rosa and Gadig, 2000) are provided as a reference. Additionaly, measurements from twenty-four normally pigmented individuals (ten females and fourteen males of *H. marianae*) collected at the same landing site were taken for comparison. Values are presented as means with standard deviations. Maturation and age were assessed according to ICES (2013) and Lessa et al. (1999), respectively. After examination, the specimen was preserved in 10% formalin and deposided in the DIMAR-UFRPE collection under catalog number RL32.

Figure 1 - *Hypanus marianae* (Author: Nogueira, R. M., 2020).

RESULTS

The color of the leucistic *Hypanus marianae* (Figure 3a and 3b) differed from that of pigmented individuals (Figure 3c and 3d) by the absence of some of the species-specific diagnostic features. The stingray exhibited a dorsal surface of the disc and pelvic fins covered in a pale yellowish color and pinkish margins, lacking blue edges and pigmented irises (Figure 3a). In pigmented individuals, the margins of the disc and pelvics fins are blue (Figure 3c). The

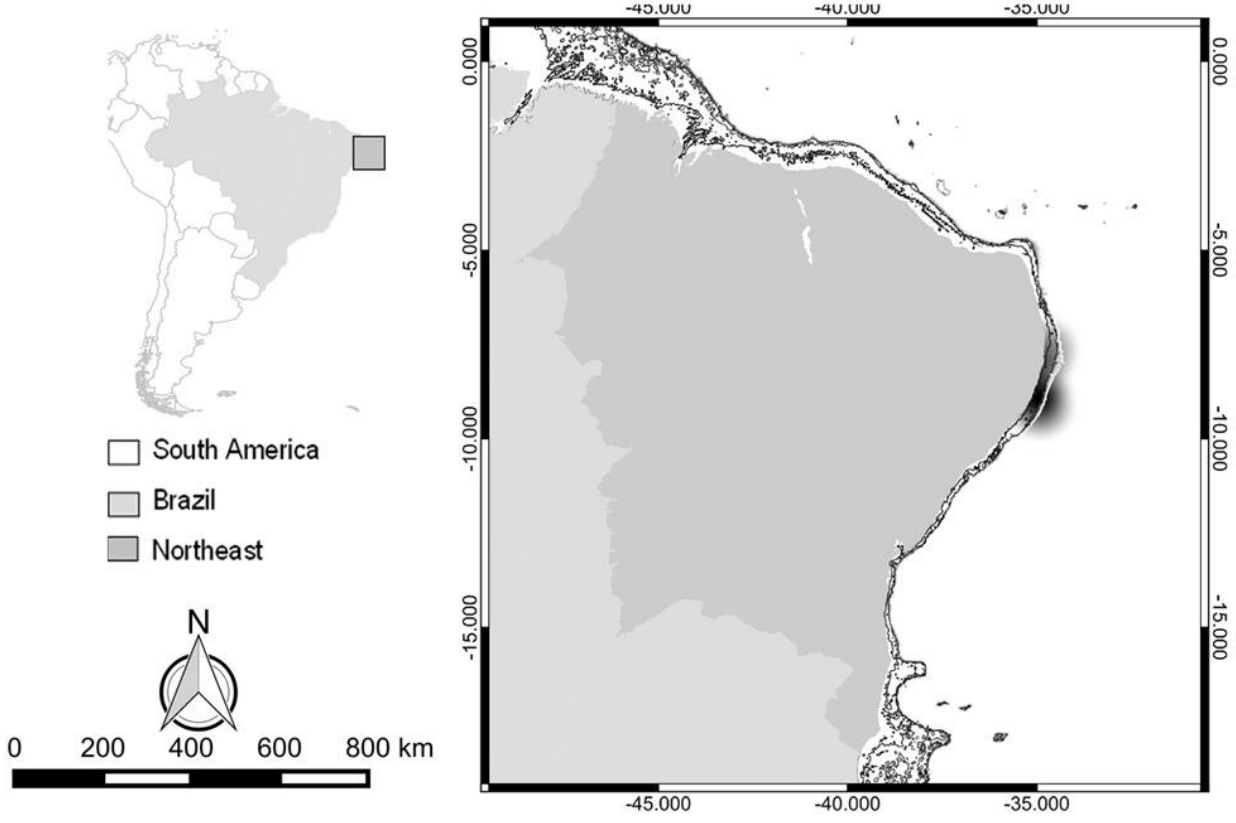
leucistic individual did not exhibit dark blotches between the spiracles, or on the scapular and precaudal areas of the disc (Figures 3a and 3c).

Ventrally, the disc and pelvic fins were white, except at the margins, where a reddish color was observed. The two symmetrical pairs of dark markings, typical of the branchial region, were absent from the ventral surface of the disc (Figure 3b and 3d).

The individual was an immature female. The macroscopic appearance of the left ovary, with translucent and small yellowish follicles, and the uterus, containing tiny trophonemata, allowed us to classify the specimen as being in the developing stage of the reproductive cycle (ICES, 2013). The size class of the partial albino disk width was 290.0-300.0 and 47% of pigmented females were mature. We estimated the age of the leucistic specimen to be 3 years.

Morphometry data indicated that the measurements of the leucistic animal are similar to those of normally pigmented conspecifics found in the same landings. Comparative morphometrics are also similar to those of the holotype specimen. The observed measurements fall within the range of known intraspecific variation for the paratype listed by Gomes et al. (2000), except for the spiracle length (Table 1).

Figure 2 – Sampling area for *Hypanus marianae* (in black) on the Northeastern Coast of Brazil.



DISCUSSION

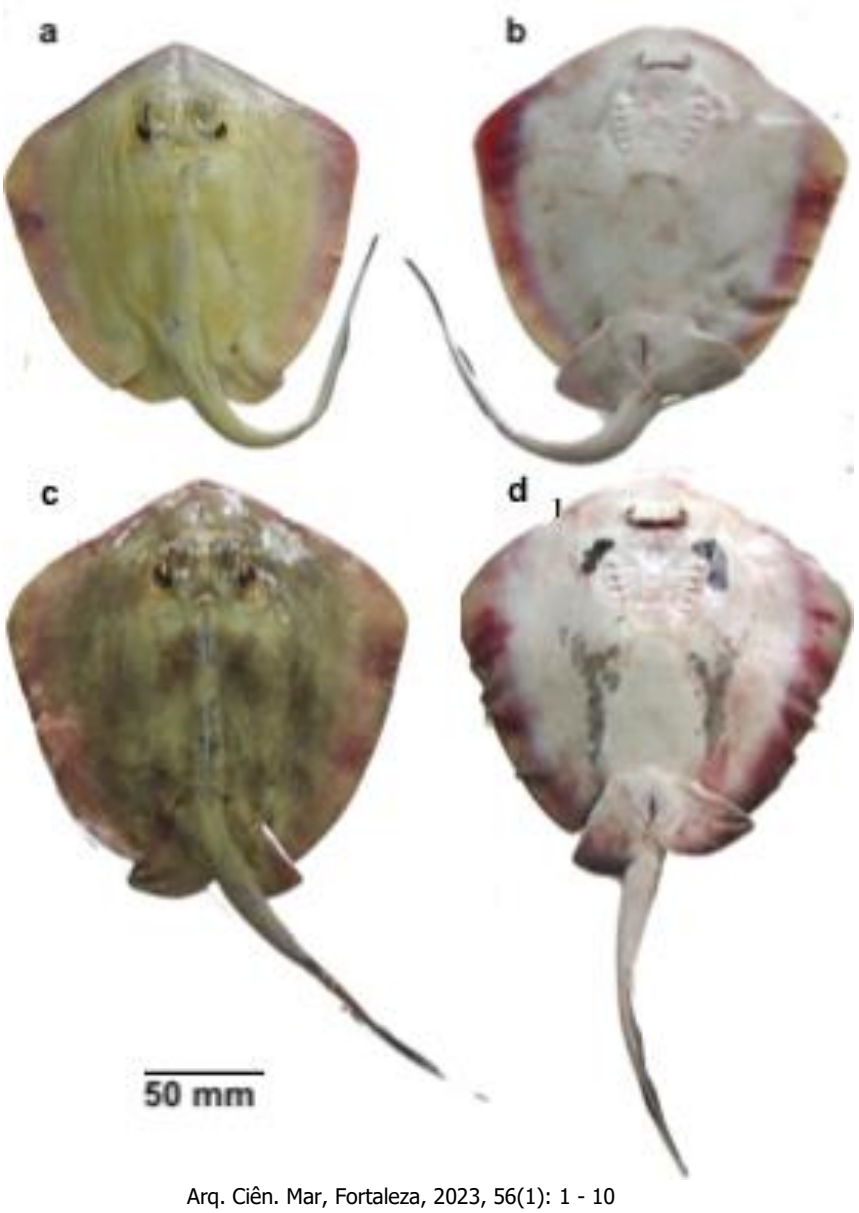
Among batoids, the order Myliobatiformes has more records of albinism than Rajiformes, Torpediniformes and Rhinobatiformes, with 40% of these records related to members of the Dasyatidae family (Diatta et al., 2013; Bigman et al., 2015). Approximately 3.6% of Dasyatidae species have documented cases of albinism and leucism, including *Bathytoshia brevicaudata* (Talent, 1973), *Dasyatis pastinaca* (Capapé and Panstoustier, 1975) and *Hypanus americanus*

(Schwartz and Safrit, 1977; Wakida-Kusunoki, 2015). In the Dasyatidae family, the leucistic form appears to be the most prevalent form of color aberration. This partial form of albinism was observed in 75% of the cases where different types of albinism were identified (Bigman et al., 2015).

Albinism is usually the result of combinations of homozygous recessive mutation from pigmented parents (Carden et al., 1998). Prado-Martinez et al. (2013) suggested that the small population size of great ape Western Lowland *Gorilla gorilla gorilla* could cause the inbreeding in the wild population, which would explain the occurrence of albino phenotype in one male of this species. In fish albinism can be due to contamination effects; random genetic alterations; or genetic alteration due to small population size (Leal et al., 2013; Kadir et al., 2015).

Hypanus marianae is a medium-sized stingray endemic to the Northeast of Brazil. This species has a geographic range corresponding to the major reef formations along the Brazilian coast (Gomes et al., 2000; Rocha & Rosa, 2001; Feitoza et al., 2005; Costa et al. 2015). Other coastal habitats are listed as critical in the life cycle of this species such as seagrass beds, sandbanks, and estuaries (Costa et al., 2015; Yokota and Lessa, 2006; Gomes et al., 2000).

Figure 3 - Dorsal view of (a) and ventral view of (b) leucistic *Hypanus marianae*. Dorsal view of (c) and ventral view of (d) pigmented *H. marianae*



Anthropogenic actions, such as tourism and fishing operations, impact many of these habitats (Santos et al., 2000; Sampaio and Rosa, 2005; Grotta and Sampaio, 2007; Yokota and Lessa, 2007; Rangelei et al., 2010; Pinto et al., 2015; Marinho-Soriano, 2016). The Large-eye Stingray is a specialist predator with a carcinophagic preference and high environmental specificity (Costa et al., 2015). These features, along with low fecundity (1 embryo/female) (Yokota and Lessa, 2007; Mota et al., 2009; Nunes et al, 2019), contribute to the existence of small populations along its geographic distribution. According to Bender et al. (2013), *H. marianae* has a 75% probability of being threatened within its home range.

The most likely cause of leucism in H. marianae is random genetic alterations, as observed in *Mustelus californicus* (Talent, 1973), *Chiloscyllium plagiosum* (Clark, 2002), *Galeocerdo cuvier* (Sandoval-Castilho et al., 2006) and *Squatina californica* (Escobar-Sánchez et al., 2014).

In the last two decades, records of albinism cases in elasmobranchs have increased (Escobar-Sánchez et al., 2014). These findings are the result of reports requirements from fishing monitoring (Ball et al., 2013), but pollution and the increase in the fishery pressure over populations might be involved (Leal et al., 2013). Wakida-Kusunoki (2015) suggested that high fishing pressure on *Hypanus americanus* in Mexico could have led to a reduction in population size, and the total albinism observed in this species was a result of inbreeding.

Morphometric analyses did not reveal any difference between the leucistic individual and pigmented conspecifics. The same result was reported for other batoid species, such as *Hypanus americanus* (Schwartz and Safrit, 1977), *Rhinobatos halavi* (Souissi et al., 2007), *Gymnura micrura* (Reis et al., 2013), *Zanobatus schoenleinii* (Diatta et al., 2013), *Bathyraja aleutica* and *B. trachura* (Bigman et al., 2015).

The leucistic *H. marianae* represents another record of a subadult albino elasmobranch. Other records of albino skates and rays, such as *Raja montagui* and *Raja clavata* (Ball et al., 2013), *Zanobatus schoenleinii* (Diatta et al., 2013) and *Hypanus americanus* (Wakida-Kusunoki, 2015), were of adult or individuals close to sexual maturity (Souissi et al., 2007). This statement suggests that albinism is not deterrminant in the survival and reproductive capacity of the organism (Sandoval-Castillo et al. 2006). Other species listed with albinism in adults and subadults include *Stegostoma fasciatum* (Talent, 1973), *Nebrius concolor* (Taniuchi and Yanasigawa, 1987) and *Mustelus schimitti* (Teixeira and Araújo, 2002).

Partial albinism apparently does not affect the survival of elasmobranch fishes. However, future studies on susceptibility to disease and poor vision should be conducted to better understand this genetic alteration and its impact on species survival.

Table 1: Morphometric measurements for the holotype and paratype (Gomes et al, 2000), one partially albino (leucistic), and ten females and fourteen males normally pigmented specimen of *Hypanus marianae*; measurements are expressed as a percentage of disc width (% DW).

Measure	Leucistic Specimen	Holotype*	Partaype* Range	Female Mean ± s.d.	Male Mean±s.d.
Disc width	292.0	235.0	110-310	290.8±24.2	262.6±23.2
Disc length	98.3	105.1	94.4-107.9	100.1±1.7	98.4±4.4
Total length	181.5	184.2	169.4-202.7	185.3±6.7	183.6±36.8
Disc length to axil of pectoral fin	86.6	91.5	81.8-94.3	88.4±1.7	82.3±30.3
Preoral length	20.3	21.7	20.4-23.4	22.0±0.7	22.6±0.7
Snout to cloaca	89.4	88	79.6-91.3	84.7±1.5	82.3±6.1
Cloaca to sting base	36.3	34.4	29.6-40.9	40.5±11.8	47.7±1.3
Tail length	96.9	89.7	75.3-149.6	95.0±6.3	108.9±0.4
Tail height	2.1	1.2	1.2-2.7	1.7±0.2	1.9±0.2
Height of dorsal finfold	1.4	1.2	1.0-2.7	1.4±0.1	1.7±0.1
Height of ventral finfold	2.5	2.1	2.0-3.0	2.5±0.3	2.8±0.3
Eye diameter	8.2	8	6.5-8.9	8.6±2.8	8.2±1.3
Spiracle length	5.1	8	7.5-10.0	5.7±1.9	5.8±1.5
Cranial interorbital	9.6	8.5	7.8-9.2	8.9±2.3	9.5±0.2
Interspiracular	18.5	18.7	16.1–19.0	16.3±2.3	18.9±1.9
Internarial	10.4	12.3	9.8-12.3	10.4±0.6	11.1±1.2
Mouth width	9.9	11.4	8.8 -11.6	10.1±0.4	10.6±1.1
Distance between the first pair of gill slits	19.8	20	18.1-20.6	19.3±0.3	18.9±0.6
Distance between first and fifth-gill slits	11.6	14.4	12.5 - 14.5	13.0±0.4	13.3±0.5
Pelvic fin anterior margin	22.3	20	17.0-23.3	19.3±1.7	18.2±1.2
Pelvic fin posterior margin	16.0	11.9	11.8 - 19.8	17.9±0.8	14.7±1.4
Adult clasper length	-	18.2	17.4 - 22.9	-	16.5±0.8

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