



## Leucism in the marbled swamp eel *Synbranchus marmoratus* Bloch, 1795 (Synbranchiformes: Synbranchidae)

Lucas Rezende Penido Paschoal<sup>1,2\*</sup> , Fernando José Zara<sup>1,3</sup>, Lucas Elias Oliveira Borges<sup>4</sup> &

Valter M. Azevedo-Santos<sup>4,5,6</sup> 

<sup>1</sup>Universidade Estadual Paulista, Centro de Aquicultura da UNESP, Faculdade de Ciências Agrárias e Veterinárias, Departamento de Biologia, Laboratório de Morfologia de Invertebrados, Jaboticabal, SP, Brasil.

<sup>2</sup>Faculdades de Inovação e Tecnologia de Minas Gerais, Passos, MG, Brasil.

<sup>3</sup>Universidade Estadual Paulista, Instituto de Biociências de Rio Claro, Programa de Pós-Graduação em Ecologia, Evolução e Biodiversidade, Rio Claro, SP, Brasil.

<sup>4</sup>Universidade Federal do Tocantins, Programa de Pós-Graduação em Biodiversidade, Ecologia e Conservação, Porto Nacional, TO, Brasil.

<sup>5</sup>Grupo de Ecologia Aquática, Belém, PA, Brasil.

<sup>6</sup>Faculdade Eduvale de Avaré, Avaré, SP, Brasil.

\*Corresponding author: [lucasrppaschoal@gmail.com](mailto:lucasrppaschoal@gmail.com)

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**Abstract:** Leucism is an anomaly recorded in fish species as well as in many other groups of animals in natural environments. An individual with leucism is characterized by the loss of brown or black pigmentation over most of the body. Here, we recorded this condition for an individual of marbled swamp eel *Synbranchus marmoratus* (Synbranchiformes: Synbranchidae) captured in the Furnas megareservoir, Grande River basin, in Minas Gerais state, southeastern Brazil. The individual had a general color of the body with shades ranging from pale to intense yellowish, but the eyes were black. We also present a discussion on the influence of leucism on the survival of the individual in this study.

**Keywords:** Color anomaly; fish; Furnas megareservoir; Grande River basin; pigmentation.

## Leucismo em muçum *Synbranchus marmoratus* Bloch, 1795 (Synbranchiformes: Synbranchidae)

**Resumo:** Leucismo é uma anomalia registrada em espécies de peixes assim como em muitos outros grupos de animais em ambientes naturais. Um indivíduo com leucismo é caracterizado pela perda de pigmentação marrom ou preta na maior parte do corpo. Neste trabalho, nós registramos essa condição para um indivíduo de muçum *Synbranchus marmoratus* (Synbranchiformes: Synbranchidae) capturado no megareservatório de Furnas, bacia do Rio Grande, no estado de Minas Gerais, sudeste brasileiro. O indivíduo apresentava coloração geral do corpo com tonalidades que variavam do amarelado pálido ao intenso, mas os olhos eram pretos. Nós também apresentamos uma discussão sobre a influência do leucismo na sobrevivência do indivíduo deste estudo.

**Palavras-chave:** Anomalia na coloração; bacia do Rio Grande; megareservatório de Furnas; peixe; pigmentação.

## Introduction

Neotropical freshwater fishes have been increasingly studied for anomalies. Most existing studies focus on the abnormal color pattern (e.g., Nobile et al. 2016; Azevedo-Santos et al. 2020a; Romano & Pedrosa 2020; Ferraz et al. 2023), but other conditions (e.g., tumors and pughead) have also been documented (e.g., Catelani et al. 2017; Correia-Silva et al. 2024).

There are different color-related anomalies in freshwater fishes. Generally, these conditions attract the attention of the scientific community (e.g., Nobile et al. 2016; Ferraz et al. 2023) and fishermen (e.g., Table S1). Leucism is an anomaly in which there is a total or partial loss of color (hence the chromatophores) on the body of a fish or other animal (McCardle 2013; Henle et al. 2017). However, in leucism, unlike complete albinism (cf. Carvalho & de Pinna 1986; Sazima & Pombal-Jr.

1986; Azevedo-Santos et al. 2020a), the eyes still have pigmentation; and can often be of the same tone as that of non-anomalous animals of the same species (e.g., Nobile et al. 2016; Ferraz et al. 2023). Cases of leucism are documented sparsely in Neotropical freshwater fishes (e.g., Nobile et al. 2016; Anaguano-Yancha 2018; Romano & Pedrosa 2020; Ferraz et al. 2023).

*Synbranchus marmoratus* Bloch, 1795, a species popularly known as “muçum” in Brazil, or marbled swamp eel, is one of the thousands of Neotropical freshwater fishes (~6,200 species *sensu* Albert et al. 2020). Among the synbranchids, it is the species possessing the widest geographic distribution, occurring from Mexico to the northern Argentina, in numerous types of environments, from streams (including headwaters) to artificial lakes (Kullander 2003). In general, the color of the species varies from brown to dark gray, with spots (generally small) distributed throughout its body (Torres et al. 2005; Ota et al. 2018). Recently, we obtained a specimen of *S. marmoratus* with the absence

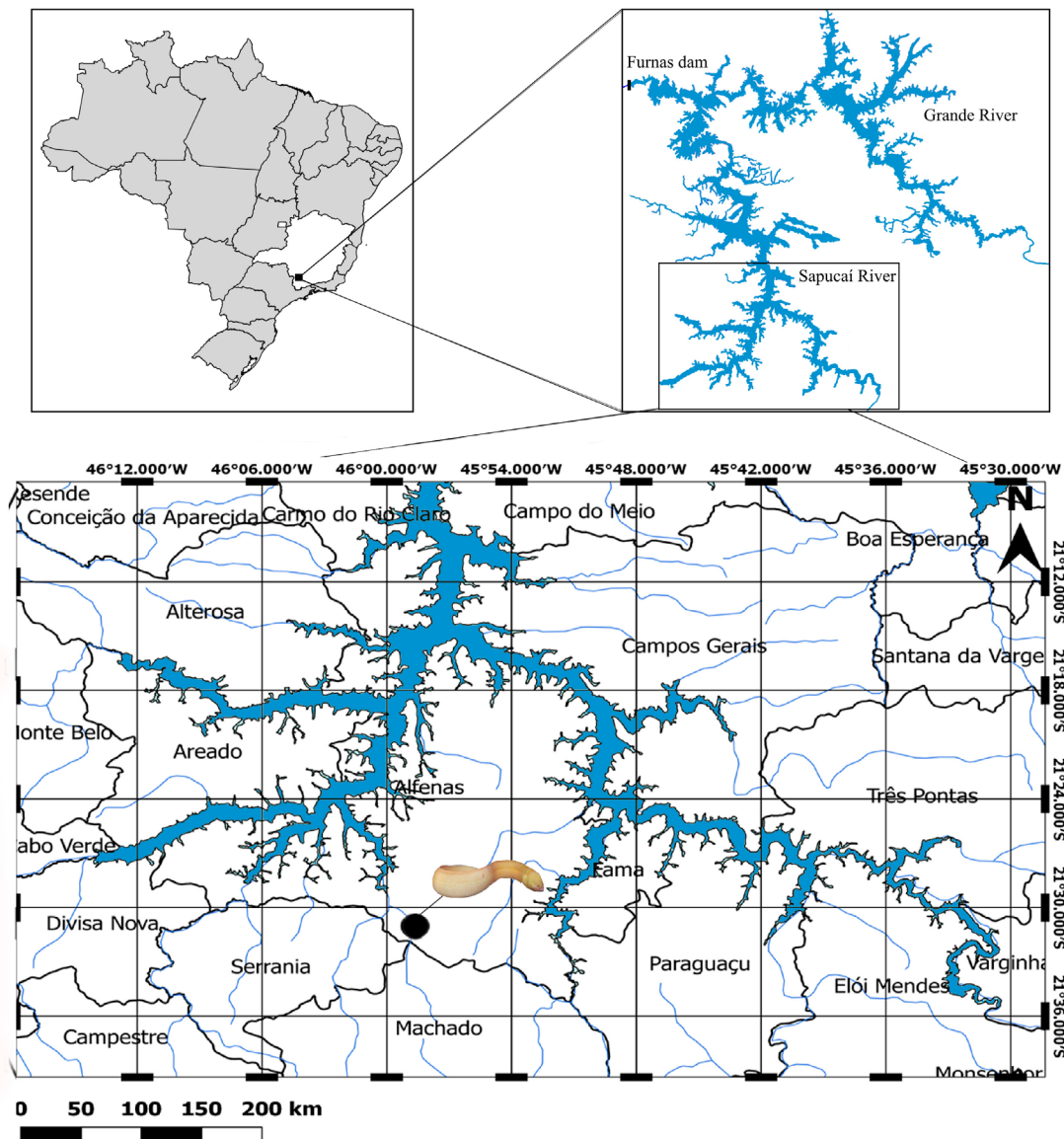
of dark coloration along the body, but with pigmented eyes. So, here, we record and illustrate this case of leucism.

## Material and Methods

### 1. Study area

The Furnas megareservoir, located in Minas Gerais state, southeastern Brazil, was built to generate and supply electrical energy. However, the aquatic environments of the megareservoir are widely used for several activities such as tourism, aquaculture (e.g., tilapia farming), leisure, and fishing (Azevedo-Santos et al. 2011; Chaves et al. 2023).

The specimen was captured in a small channel connected to the initial portion of the impoundment of the left arm of the Sapucaí River in the Furnas megareservoir (coordinates 21°30'27.7"S,



**Figure 1.** Station of the capture of the leucistic *Synbranchus marmoratus* Bloch, 1795, Alfenas, Minas Gerais state, southeastern Brazil.

46°00'09.4"W), Grande River basin, in the municipality of Alfenas (Figure 1). This area shows signs of anthropogenic activities since the region close to the channel is used for tilapia farming. The sediment in the aquatic environment has a clayey-silty nature, and the maximum depth of the channel can reach 10 meters in certain months of the year.

## 2. Sampling and specimen analysis

The specimen was captured on 16 October 2023, using a gill net (40 mm mesh). We measured the total length (TL in cm) of the specimen with an ichthyometer with an accuracy of 1 millimeter. Subsequently, the animal was weighed on a digital scale (accuracy: 0.001 g) and euthanized, fixed, and preserved according to Azevedo-Santos et al. (2020b). Identification of the individual was performed by analyzing external morphology, according to Ota et al. (2018).

The skin color tones of the captured specimen were analyzed and checked using the Pantone® color reference guide (Formula guide Solid Coated – GP1401). We adopted this methodology to standardize the descriptions of the animal's color both in aquatic and external environments – since, in the latter, it was possible to observe a large release of mucus and, consequently, a change in the individual's colorimetric pattern (LRP Paschoal, personal observation). Therefore, the interval between the codes for the lightest and darkest shades of the colors observed on the skin of the animal was used. After all analyses, the specimen was deposited in the scientific collection of the Department of Zoology and Botany of São Paulo State University in São José do Rio Preto (DZSJRP), São Paulo state, southeastern Brazil.

## Results

The leucistic individual of *Synbranchus marmoratus* (DZSJRP 24795) has 105.34 cm of TL and weighs 2.360 kg. The specimen



**Figure 2.** Coloration in life (within the water) of *Synbranchus marmoratus* Bloch, 1795 (DZSJRP 24795): (a) right side and (b) dorsal view. Note the scars in the medial region of the fish's body.



**Figure 3.** Coloration in life (outside the water) of *Synbranchus marmoratus* Bloch, 1795 (DZSJRP 24795): (a) dorsal view and (b) cephalic view.

showed scars on its dorsal region due to entanglement in the gill net (Figures 2 A–B and 3A).

The color of the individual in the aquatic environment was pale yellow (134C, 7506C-7508C), both in lateral and dorsal views; without major changes in colorimetric variation along its length or in its ventral region (Figure 2). When removed from the aquatic environment, the animal showed an intense yellow color (1375C) in its lighter areas, mainly in the dorsal region (Figure 3A); while in darker areas, such as the gill chamber (Figure 3B), the tone was orange (7410C e 7576C). The eyes showed pigmentation in the iris in life (Figures 2 and 3) and after fixation (data not shown here).

## Discussion

The individuals of *Synbranchus marmoratus*, including those that occur in the upper Paraná River basin, exhibit dark brown coloration with several light brown and black spots, a typical pattern for the species (e.g., Fig. 2B in Favorito et al. 2005; Fig. 3M in Lima et al. 2014; Fig. 32A in Ota et al. 2018; Fig. 6E in Azevedo-Santos et al. 2020b). It is important to emphasize that the individual recorded lacked dark pigments (i.e., brown or black); however, its small eyes were pigmented. These characteristics fall within the definition of leucism (*sensu* Henle et al. 2017). This condition is known for Neotropical freshwater fishes (e.g., Anaguano-Yancha 2018), but we did not find records for *S. marmoratus* or any other synbranchid species in the wild.

It can be seen that the specimen of *S. marmoratus* was a large adult, with a significant length when considering the maximum known size for the species (150 cm; see Kullander 2003). Its length suggests that leucism was not considered a deleterious or unfavorable character for the animal to survive in the aquatic environment of the Furnas megareservoir. Recently, Ferraz et al. (2023) demonstrated that for *Heptapterus mustelinus* (Valenciennes, 1835), leucism did not exert or negatively influence the presence of individuals with this condition in the population. In turn, Nobile et al. (2016) also recorded a large individual of *Rhinelepis aspera* Spix & Agassiz, 1829, with

an anomaly determined as “partial albinism” (= leucism herein). Therefore, for these species, survival seems to be better related to other traits than the presence of a normal color pattern. *Synbranchus marmoratus* is a species that usually inhabits cavities (Kullander 2003), which can hardly be overcome by other Neotropical predators with non-cylindrical bodies [e.g., *Cichla* spp., *Galeocharax gulo* (Cope, 1870), *Hoplias* spp., *Salminus* spp.]. Possibly, the habit of living in galleries contributed to the survival of the leucistic individual until the adult phase.

## Supplementary Material

The following online material is available for this article:

Table S1–Videos posted by fishermen presenting anomalous specimens (*sensu* Henle et al. 2017) from Brazilian freshwater environments.

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## Author Contributions

Lucas Rezende Penido Paschoal: obtained the specimen and wrote the first draft.

Fernando José Zara: shipment of the fish to DZSJRP; collaborated with the writing process and funding acquisition.

Lucas Elias Oliveira Borges: collaborated with the writing process.

Valter M. Azevedo-Santos: identified the specimen and collaborated with the writing process.

## Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

## Ethics

The marbled swamp eel was obtained in accordance with the applicable Brazilian environmental legislation (SISBIO permit number 87496-1 issued to LRP Paschoal). The specimen was deposited in the

collection of the Departamento de Zoologia e Botânica, UNESP, São José do Rio Preto, SP, Brazil.

## Data Availability

Supporting data are available at <https://repositorio.unesp.br/items/3cd1bcd1-9cdb-41b6-8713-7405dbf0fc30>.

## References

- ALBERT, J.S., TAGLIACOLLO, V.A. & DAGOSTA, F. 2020. Diversification of Neotropical freshwater fishes. *Annu. Rev. Ecol. Evol. Syst.* 51: 27–53.
- ANAGUANO-YANCHA, F. 2018. Nuevos casos de leucismo en peces andinos del género *Astroblepus* (Siluriformes: Astroblepidae) Leucismo en peces andinos. *Av. Cienc. Ing.* 10(16): 64–73.
- AZEVEDO-SANTOS, V.M., PELICICE, F.M., SAZIMA, I. & HENRY, R. 2020a. A case of complete albinism in the catfish *Cambeva guareiensis* (Siluriformes: Trichomycteridae). *Biota Neotrop.* 20(4): e20201066.
- AZEVEDO-SANTOS, V.M., PELICICE, F.M. & HENRY, R. 2020b. Knowing biodiversity: Fishes from the Guareí River basin, a tributary of the Jurumirim reservoir, Paranapanema River, Brazil. *Biota Neotrop.* 20(3): e20201031.
- AZEVEDO-SANTOS, V.M., RIGOLIN-SÁ, O., PELICICE, F.M. 2011. Growing, losing or introducing? Cage aquaculture as a vector for the introduction of non-native fish in Furnas Reservoir, Minas Gerais, Brazil. *Neotrop. Ichthyol.* 9: 915–919.
- CARVALHO, A.M. & DE PINNA, M.C.C. 1986. Estudo de uma população hipógea de *Trichomycterus* (Ostariophysi, Siluroidei, Trichomycteridae) da gruta Olhos d'Água, MG. *Espeleo-Tema* 15: 53–64.
- CATELANI, P.A., BAUER, A.B., DI DARIO, F., PELICICE, F.M. & PETRY, A.C. 2017. First record of pughead deformity in *Cichla kelberi* (Teleostei: Cichlidae), an invasive species in an estuarine system in south-eastern Brazil. *J. Fish Biol.* 90(6): 2496–2503.
- CHAVES, A.J.P., ZARA, F.J. & PASCHOAL, L.R.P. 2023. Long-term monitoring of the nonnative giant river prawn *Macrobrachium rosenbergii* (De Man, 1879) in the Furnas mega reservoir (southeastern Brazil). *Nauplius* 31: e2023025.
- CORREIA-SILVA, G., CORAZZA, L.Q., OTTONI, F.P., SILVA, C.V., NUNES, A.V.P., KATZ, A.M. & AZEVEDO-SANTOS, V.M. 2024. Anomalous specimens of *Rhamdia quelen* (Siluriformes: Heptapteridae) and *Gymnotus* cf. *sylvius* (Gymnotiformes: Gymnotidae). *Cybium* 48: 177–180.
- FAVORITO, S.E., ZANATA, A.M., & ASSUMPÇÃO, M.I. 2005. A new *Synbranchus* (Teleostei: Synbranchiformes: Synbranchidae) from ilha de Marajó, Pará, Brazil, with notes on its reproductive biology and larval development. *Neotrop. Ichthyol.* 3: 319–328.
- FERRAZ, M., SCHULZ, U.H., LUCENA, C.A.S. & LEHMANN, P. 2023. A case of leucosis in *Heptapterus mustelinus* (Siluriformes, Heptapteridae) among populations of streams in southern Brazil. Has leucosis in *Heptapterus mustelinus* an adaptive value in shaded streams? *Neotrop. Biol. Conserv.* 18(3): 177–189.
- MCCARDLE, H. 2013. *Albinism in Wild Vertebrates*. London: LAMBERT Academic Publishing, 88 pp.
- HENLE, K., DUBOIS, A. & VERSHININ, V. 2017. Commented glossary, terminology and synonymies of anomalies in natural populations of amphibians. *Mertensiella* 25: 9–48.
- KULLANDER, S.O. 2003. Family Synbranchidae (Swamp-eels). In R.E. Reis, S.O. Kullander & C.J. Ferraris (Eds.), *Check list of the freshwater fishes of South America* (pp. 594–595). Edipucers.
- LIMA, S.M.Q., DE PAIVA, R., RAMOS, T. & MENDES, L. 2014. Fish fauna of Prati River coastal microbasin, extreme north Atlantic Forest, Rio Grande do Norte state, northeastern Brazil. *Check List* 10(5), 968–975.
- NOBILE, A.B., FREITAS-SOUZA, D., LIMA, F.P., ACOSTA, A.A. & SILVA, R.J. 2016. Partial albinism in *Rhinelepis aspera* from the Upper Paraná Basin, Brazil, with a review of albinism in South American freshwater fishes. *Rev. Mex. Biodivers.* 87(2): 531–534.

- OTA, R.R., DEPRÁ, G.D.C., GRAÇA, W.J.D. & PAVANELLI, C.S. 2018. Peixes da planície de inundação do alto rio Paraná e áreas adjacentes: revised, annotated and updated. *Neotrop. Ichthyol.* 16: e170094.
- ROMANO, L.A. & PEDROSA, V.F. 2020. Leucism in South American Lungfishes *Lepidosiren paradoxa* Fitzinger, 1837 (Osteichthyes, Dipnoi, Lepidosirenidae) from Argentina. *Braz. J. Vet. Pathol.* 13(1): 51–52.
- SAZIMA, I. & POMBAL-JR, J.P. 1986. Um albino de *Rhamdella minuta*, com notas sobre comportamento (Osteichthyes, Pimelodidae). *Rev. Bras. Biol.* 46(2): 377–381.
- TORRES, R.A., ROPER, J.J., FORESTI, F. & OLIVEIRA, C. 2005. Surprising genomic diversity in the Neotropical fish *Synbranchus marmoratus* (Teleostei: Synbranchidae): how many species? *Neotrop. Ichthyol.* 3(2): 277–284.

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