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SHORT COMMUNICATION

Distributional expansion of *Serrapinnus notomelas* to the Iguaçu River basin: natural or human-mediated introduction?

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ABSTRACT. Recent sampling efforts documented the occurrence of *Serrapinnus notomelas* (Eigenmann, 1915) at two different sites in the Iguaçu River basin, one in the upper portion and another in the lower stretch of the river, expanding the geographical range of this small-sized Cheirodontinae species to an important tributary of the left margin of the Paraná River. The new records likely result from a recent, human-mediated accidental introduction associated with stocking programs. This finding is relevant for species inventories and for analyses of freshwater fish diversity patterns.

KEYWORDS. Aquatic ecoregion, Atlantic Forest, characin, freshwater fish, Neotropical region.

Cheirodontinae Eigenmann, 1915 is a monophyletic subfamily of small characins that occur in most Neotropical river basins (Malabarba 1998, 2003), comprising 18 genera and 63 valid species (Fricke et al. 2025). This subfamily, supported by morphological and molecular evidence (Malabarba 1998, Mariguela et al. 2013, Mirande 2019, Melo et al. 2024), is diagnosed by the following synapomorphies: the presence of a large triangular pseudotympanum, lack of humeral spot, pedunculated teeth largely expanded and compressed distally, and premaxilla with a single regular and perfectly aligned tooth row (Malabarba 1998).

Serrapinnus Malabarba, 1998 was proposed to host a monophyletic assemblage of small characins species previously assigned to *Cheirodon* Girard, 1855. The genus is the most species-rich and geographically widespread Cheirodontinae, diagnosed by a series of synapomorphies related to the sexual dimorphism, such as the number and shape of the ventral procurrent caudal-fin rays and the ventral curvature of the caudal peduncle on males (Malabarba 1998). Recently, Mariguela et al. (2013) proposed *Serrapinnus* as polyphyletic based on molecular phylogenetics. However, Jerep and Malabarba (2014) and Chuctaya et al. (2018) stated that Mariguela et al. (2013) ignored important characteristics associated with the primary and secondary sexual systems in their phylogenetic analyses, which supports the recognition of the tribes Cheirodontini and Compsurini (sensu Malabarba 1998), as well as several Cheirodontinae genera. *Serrapinnus notomelas* (Eigenmann, 1915) was described as *Cheirodon notomelas* by Eigenmann (1915) in his monograph on Cheirodontinae, with the examination of material from the rio Tietê, upper rio Paraná. The black pigmentation on the anterior and proximal border of the dorsal fin usually distinguishes *S. notomelas* from its congeners (Jerep and Malabarba 2014). The species is widely distributed in the upper Paraná River Basin (Dagosta et al. 2024).

Recent samples in the Iguaçu River basin—an important tributary of the Lower Paraná River—revealed the presence of *Serrapinnus notomelas* in two sites, one located

in the upper portion of the basin and the other in the lower stretch of the Iguaçu River (Fig. 1). Such specimens (N = 24) represent the first records of the family Cheirodontinae for this aquatic ecoregion (sensu Abell et al. 2008). Here, we document and discuss these distribution records.

Seven specimens of *S. notomelas* (30.4–33.6 mm of standard length) were sampled in a small tributary of the right margin of Rio Itaqui, upper Iguaçu River basin, 25°34'20.46"S 49°39'17.97"W, municipality of Balsa Nova, state of Paraná, on 9 Feb 2021 (Table 1). The other 17 specimens (31.8–34.9 mm of standard length) were sampled in the Salto Caxias Reservoir, Lower Iguaçu River, 25°34'5.91"S 53°7'27.8"W, municipality of Nova Prata do Iguaçu, state of Paraná, on 10 Feb 2024 (Table 1). Voucher specimens were deposited in the ichthyological collection of the Museu de História Natural Capão da Imbuia (MHNCI) under catalog numbers MHNCI 13047 (N = 7) and 13048 (N = 17), available at http://www.splink.org.br/. Fieldwork was conducted under the permit SISBIO #10320-8.

Measurements to the nearest 0.01 mm were made using a digital caliper following Fink and Weitzman (1974), under a dissecting microscope and are presented as percentages of standard length (SL) or head length (HL). Osteological observations of jaws and teeth, ventral procurrent caudal-fin rays, and anal-fin rays were made on one specimen cleared and stained (c&s) for bone and cartilage following the protocol by Taylor and Van Dyke (1985).

We based our specimen's identification on the original description in Eigenmann (1915) and the identification key provided by Géry (1977), considering that there is not an appropriate taxonomic characterization of *S. notomelas* and some diagnostic features provided by Ota et al. (2018) differ from the original description. We also measured 10 individuals of *S. notomelas* collected in Ribeirão dos Toledos, a tributary of the Piracicaba River, Tietê River basin, municipality of Santa Bárbara D'Oeste, state of São Paulo, upper Paraná River basin (MHNCI 13049) (Table 1).

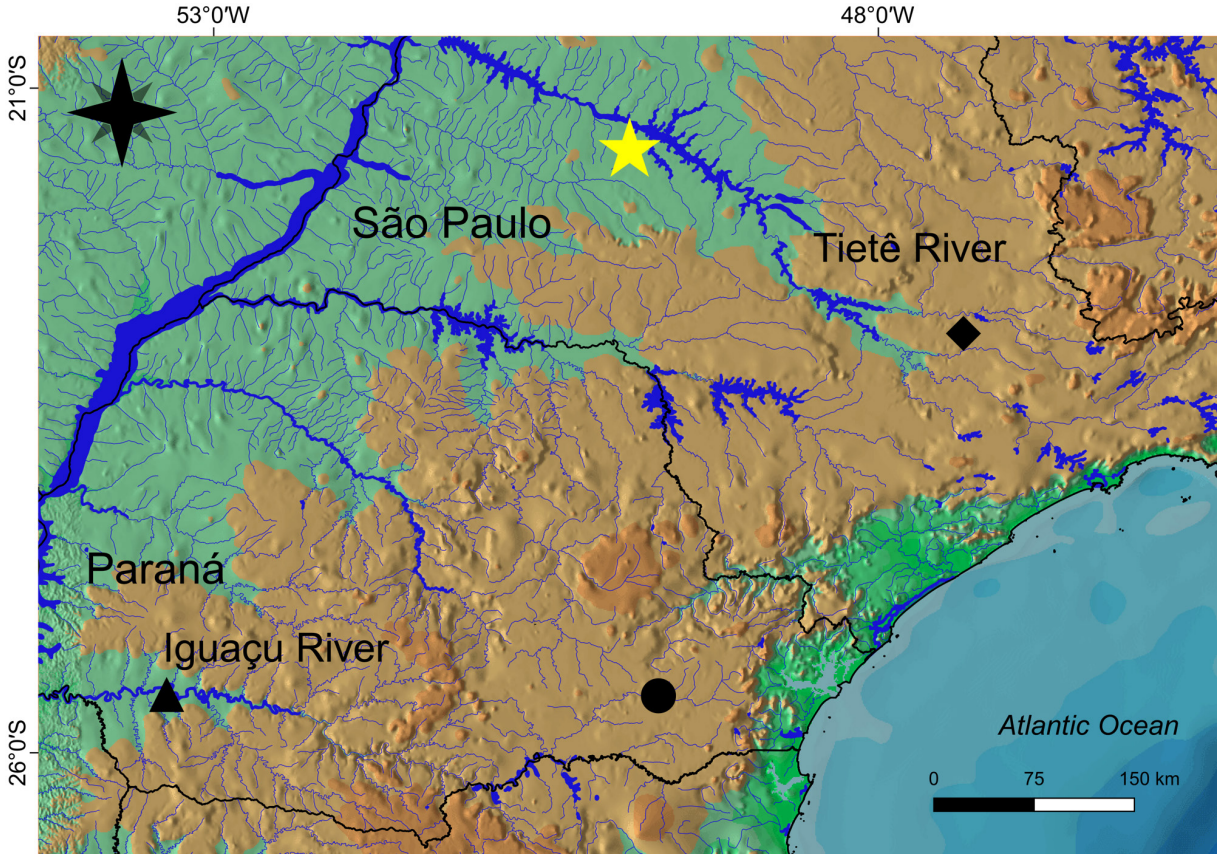


Figure 1. Geographic distribution of the collection records of *Serrapinnus notomelas* in the upper portion (black circle) and lower stretch of Iguaçu River basin (black triangle) and Tietê River basin (black diamond) in southeastern Brazil. Yellow star, type locality cited in the literature (Avanhandava municipality, São Paulo State).

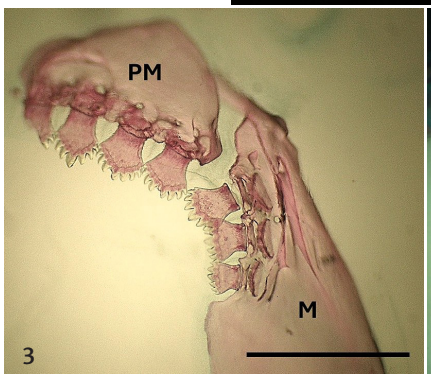
Table 1. Morphometric data of *Serrapinnus notomelas* obtained in Iguaçu River basin, Southern Brazil. Standard deviation (SD).

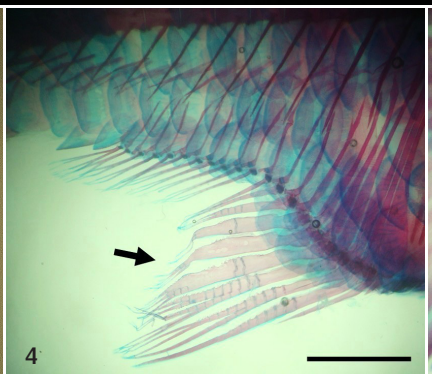
Variables	*Serrapinnus notomelas*								
	Upper Iguaçu River basin MHNCI 13047 (n = 7)			Lower Iguaçu River basin MHNCI 13048 (n = 17)			Tietê River basin MHNCI 13049 (n = 10)		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
Standard length	30.4–33.6	32.1		30.9–35.1	33.3		25.9–28.8	27.2	
Percentages of standard length									
Head length (HL)	23.8–26.8	25.1	1.1	22.6–24.8	23.5	0.6	23.3–25.2	24.3	0.6
Bony head length	22.1–24.5	23.3	0.9	21.3–23.4	22.2	0.6	21.7–23.5	22.7	0.6
Snout-anal fin distance	61.2–66.4	63.2	1.9	59.6–66.3	63.0	1.9	61.8–66.9	64.2	1.5
Snout-dorsal fin distance	47.6–51.3	49.9	1.3	48.1–53.8	51.3	1.7	49.8–53.8	51.9	1.3
Snout-pelvic fin distance	40.1–44.9	42.7	1.7	39.8–47.1	43.8	1.8	42.5–46.3	44.4	1.1
Snout-pectoral fin distance	23.5–26.1	24.6	0.9	22.1–25.2	23.6	0.9	23.1–25.7	24.7	0.7
Dorsal-fin base length	9.4–12.7	11.3	1.2	11.9–14.2	12.9	0.6	10.9–12.6	11.9	0.5
Anal-fin base length	22.7–24.5	23.5	0.8	22.2–27.6	24.9	1.7	25.8–27.4	26.6	0.5
Length of caudal peduncle	11.8–14.8	13.6	0.9	11.9–16.0	14.5	1.1	11.4–15.1	13.2	1.1
Depth of caudal peduncle	10.4–12.8	11.9	0.8	11.9–14.5	12.8	0.8	10.3–12.3	10.9	0.7
Body depth at dorsal fin	30.5–33.1	31.8	1.2	30.8–36.3	33.1	1.8	31.5–37.1	33.8	1.5
Dorsal-fin length	26.3–29.7	27.6	1.2	25.7–31.4	27.1	1.5	27.4–30.1	28.7	0.9
Pelvic-fin length	18.9–21.8	20.5	1.3	17.7–22.0	19.4	1.2	16.7–21.1	18.7	1.3
Pectoral-fin length	17.1–20.5	19.1	1.2	18.2–21.5	19.8	0.9	18.1–21.5	19.7	1.1
Percentages of head length									
Snout length	15.7–21.6	19.2	1.8	16.8–22.6	20.0	1.9	17.0–23.4	20.9	1.8
Upper jaw length	21.4–26.1	22.8	1.6	21.9–29.3	27.2	1.9	24.8–30.5	28.2	1.9
Horizontal orbit diameter	32.8–37.9	35.5	1.6	34.4–39.2	36.6	1.3	32.6–38.5	36.3	1.7
Interorbital width	32.6–36.5	34.9	1.5	35.6–39.7	37.6	1.3	35.9–39.7	37.7	1.2

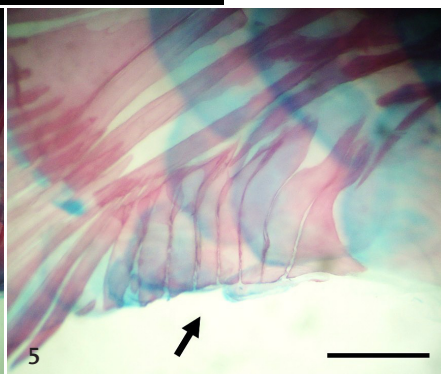
All specimens from the Iguaçu River basin showed the main taxonomic characteristics consistent with the description of *S. notomelas*: compressed body, black pigmentation on the anterior and proximal border of the dorsal fin (Fig. 2); premaxilla with four teeth aligned in one single row and maxilla with two teeth, all pedunculated and distally expanded (Fig. 3); twenty-two anal-fin rays (iii, 19), fourth to ninth anal rays of males expanded, with hooks posterolaterally arranged (Fig. 4); males also with hypertrophied and ventrally exposed procurrent caudal-fin rays (Fig. 5). Morphometric measures of individuals from the upper and lower Iguaçu River basin highly overlap with specimens from Tietê River basin, upper Paraná River basin (Table 1).

The discovery of *S. notomelas* in the lower and upper stretches of the Iguaçu River basin seems to represent a recent human-mediated accidental introduction instead of faunal exchange and range expansion associated with headwater capture events between the neighboring drainages. The upper Paraná and Iguaçu Aquatic Ecoregions have shown some cases of sharing of species previously considered endemic to the Iguaçu River basin: *Psalidodon bifasciatus* (Frota et al. 2020, Neves et al. 2020), *Rhamdiopsis moreirai* (Hoffmann et al. 2015), and *Cambeva davisi* (Nascimento et al. 2017). Furthermore, this species (or any other Cheirodontinae) has not been reported in several ichthyofaunal surveys performed in the Iguaçu River basin (e.g., Haseman 1911a, 1911b, Godoy 1979, 1987, Severi and Cordeiro 1994, Garavello et al. 1997, Ingenito et al. 2004, Baumgartner et al. 2012, Daga et al. 2016, Frota et al. 2016, Delariva et al. 2018, Reis et al. 2020, Mezzaroba et al. 2021, Freitas and Abilhoa 2023).

The introduction of *S. notomelas* in the Iguaçu River basin might be caused by the release of contaminated batches of species from adjacent ecoregions, aiming at fish stocking programs, aquaculture, or sport fishing. That is the case of *Colossoma macropomum* (Cuvier, 1816), *Prochilodus lineatus* (Valenciennes, 1837), *Megaleporinus macrocephalus* (Garavello & Britski, 1988), *Megaleporinus obtusidens* (Valenciennes, 1837), and *Salminus brasiliensis* (Cuvier, 1816). In fact, aquaculture, aquarium trade, and fish stocking are the main vectors of introductions, either intentional or







Figures 2–5. *Serrapinnus notomelas*, mature male, MHNCI 13047, 32.2 mm SL from Balsa Nova municipality, upper Iguaçu River basin, Paraná State, Brazil: (2) habitus; (3) clear and stained upper jaw showing right side of premaxilla (PM) and maxilla (M), lateral view; (4) clear and stained anal fin with hypertrophied anal-fin rays and hooks shape and arrangement. Lateral view; (5) clear and stained ventral procurrent caudal-fin rays, lateral view. Scale bar 1 mm.

unintentional, of nonnative fish species in the Iguaçu River basin (Daga et al. 2016). Although fish stocking is a common management action used worldwide and encouraged by government initiatives in Brazil (Pelissoli et al 2023), the outcomes of this management technique have been highly controversial, producing the dissemination of pathogens and parasites, impacts on the structure and functioning of communities, and the introduction of nonnative species of aquatic organisms (Agostinho et al. 2010).

Despite the lack of evidence to determine the origin of some fish species from the Iguaçu River basin in the comprehensive compilation of records available from ichthyological collections performed by Reis et al. (2020) and Mezzaroba et al. (2021), the number of nonnative fish is increasing, and the recent discovery of new endemic species (Reis et al. 2021, Alonso et al. 2023, Costa et al. 2024) and records of *S. notomelas* and other freshwater genera and species (e.g., *Pimelodella meeki*, *Poecilia vivipara*, *Hollandichthys multifasciatus*) in the Iguaçu River basin reveal how insufficiently the freshwater ichthyofauna is known.

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Competing Interests

The authors have declared that no competing interests exist.

Data Availability

Datasets generated or analyzed in this study are available from the corresponding author on reasonable request.

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