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First record of the "Matrinxã" *Brycon amazonicus* (Agassiz 1829) (Characiformes: Bryconidae) in the Rio Paranapanema mouth region, Upper Rio Paraná basin, Brazil

Primeiro registo do "Matrinxã" *Brycon amazonicus* (Agassiz 1829) (Characiformes: Bryconidae) na região da foz do Rio Paranapanema, bacia do Alto Rio Paraná, Brasil

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Abstract: The Rio Paranapanema is one of the most important tributaries of the Upper Rio Paraná, and in recent decades there has been a marked decline in the population of native species due to the development of a series of reservoirs and the introduction of many non-native fish species. This study presents the first record of the non-native *Brycon amazonicus* in the mouth region of the Rio Paranapanema. One specimen was collected in May 2024 in the Porto Maringá region, Marilena municipality, Paraná state, Brazil. The specimen was euthanized with benzocaine, fixed in 10% formalin, and later preserved in 70% ethanol. Morphometric measurements were taken using a digital caliper, and meristic data were recorded according to specific literature. Our results show that the *Brycon* specimen collected in the region of the mouth of the Rio Paranapanema fits the diagnosis of the non-native *Brycon amazonicus*. The presence of this species raises concerns regarding its potential impact on native *Brycon* species, especially *Brycon orbignyanus*, which is critically endangered. Introduction of *Brycon amazonicus* in this region may be associated with accidental escapes from aquaculture, sport fishing, or stocking programs in reservoirs. The record of *Brycon amazonicus* in this highly impacted environment underscores the need for continuous monitoring and management strategies to mitigate potential threats to native ichthyofauna and preserve the ecological integrity of the Upper Paraná ecoregion.

Keywords: endemic fish species; extinction risk; invasive species; reservoir cascades; Upper Rio Paraná floodplain.

Resumo: O Rio Paranapanema é um dos mais importantes afluentes do alto Rio Paraná e nas últimas décadas houve um declínio acentuado na população de espécies nativas devido ao

desenvolvimento de uma série de reservatórios e à introdução de várias espécies de peixes não nativas. Este estudo apresenta o primeiro registro da espécie não nativa *Brycon amazonicus* na região da foz do rio Paranapanema. Um espécime foi coletado em Maio de 2024 na região do Porto Maringá, Município de Marilena, estado do Paraná, Brasil. O espécime foi eutanasiado com benzocaína, fixado em formaldeído 10% e depois preservado em álcool 70%. Medidas morfométricas foram realizadas com auxílio de paquímetro digital e dados merísticos foram realizados de acordo com literatura especifica. Nossos resultados mostram que o espécime de *Brycon* coletado na região da foz do rio Paranapanema se encaixa na diagnose de *Brycon amazonicus*. A presença dessa espécie levanta preocupações sobre seu impacto potencial nas espécies nativas de *Brycon*, especialmente *B. orbignyanus*, que está criticamente ameaçada de extinção. A introdução de *Brycon amazonicus* nessa região pode estar associada a escapes acidentais da aquicultura, pesca esportiva ou programas de peixamento em reservatórios. O registro de *Brycon amazonicus* nesse ambiente altamente impactado ressalta a necessidade de monitoramento contínuo e de estratégias de manejo para mitigar possíveis ameaças à ictiofauna nativa e preservar a integridade ecológica da ecorregião do alto Paraná.

Palavras-chave: espécies de peixes endêmicos; risco de extinção; espécie invasora; cascata de reservatórios; planície de inundação do Alto Rio Paraná.

Introducing species, in conjunction with other environmental changes such as urbanization, deforestation (*i.e.* removal of riparian vegetation), dam construction, and pollution poses a significant threat to native ichthyofauna (Ganassin et al., 2021a; Moi et al., 2021; Magalhães et al., 2025). Fish introductions into freshwater environments can have catastrophic ecological consequences. Non-native fish species have been associated with substantial environmental damage and biodiversity loss (Vitule et al., 2009; Pelicice et al., 2018; Moi et al., 2021) due to their deleterious effects on native fauna, including competition, predation, extinction/extirpation, and habitat alteration, hybridization, parasitism, changes in food chains, nutrient cycling,, biotic homogenization/differentiation, and ecosystem function (Vitule et al., 2009; Simberloff & Rejmánek, 2011; Gois et al., 2015; Rodrigues et al., 2018; Ganassin et al., 2021a; Moi et al., 2021; Magalhães et al., 2025).

Despite the documented scientific evidence highlighting the detrimental consequences of non-native fish species introductions, several species continue to be introduced into aquatic environments within the Neotropical region (Gubiani et al., 2018; Bueno et al., 2021; Doria et al., 2021; Magalhães et al., 2025). The upper Rio Paraná ecoregion is one of the largest basins in Brazil and harbors the nation's primary metropolitan centers, transforming it into a focal point for biological invasions (Dagosta et al., 2024). Furthermore, the construction of numerous hydroelectric dams along the main rivers of the basin has further intensified the pressure of invasions on native communities (Orsi & Britton, 2014; Pelicice et al., 2018; Daga et al., 2020). A total of 128 non-native species has been documented among the freshwater fish, constituting the Neotropical ecoregion with the highest number of introduced species (Gubiani et al., 2018; Bueno et al., 2021; Dagosta et al., 2024).

One of the main tributaries on the left bank of the Rio Paraná is the Rio Paranapanema, which has experienced significant anthropogenic influence and contains 11 cascading reservoirs (Garcia et al., 2018). In recent decades, there has been a marked decline in the population of native fish species due to the development of a series of reservoirs along the Rio Paranapanema (Ganassin et al., 2021a). Introducing non-native species, in conjunction with anthropogenic disturbances such as habitat degradation and river fragmentation, jeopardizes the viability of native species within the Rio Paranapanema basin (Pelicice & Agostinho, 2009; Ganassin et al., 2021a). Presently, the Rio Paranapanema basin has been identified as one of the locations with the highest number of non-native species within the upper Rio Paraná ecoregion (60 species) (Jarduli et al., 2020), and is regarded as an invasion hotspot (Garcia et al., 2018).

Bryconidae is one of the fish families with the highest number of threatened species in the Rio Paranapanema basin (Jarduli et al., 2020), including "Piracanjuba" *Brycon orbignyanu*s (Valenciennes 1850) as CR (Critically Endangered) (Brasil, 2022). The primary factors contributing to the decline in population sizes of *Brycon* species include the degradation of riparian vegetation (due to their diet consisting of terrestrial plants) and the construction of dams (which prevent the recruitment of migratory species) (Nunes et al., 2015; ICMBio/MMA, 2018; Tonella et al., 2019). The native species within these systems face heightened vulnerability to competition from non-native species that occupy analogous ecological niches. (Gois et al., 2015; Rodrigues et al., 2018; Ganassin et al., 2021b;

Xu et al., 2024). Following recent collections, the aim of this paper is to present the first record of the non-native species "Matrinxã" *Brycon amazonicus* (Agassiz 1829) in the Rio Paranapanema mouth region, Upper Rio Paraná system.

One specimen of *B. amazonicus* was collected in May 2024 by the Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura (Nupélia) staff, in the Porto Maringá - 22°39'57.6"S 53°05'41.7"W) Marilena municipality, Paraná State. Samples were conducted following the policies of the Ethical Conduct Committee on Animal use (CEUA #7283090823) by the Universidade Estadual de Maringá, Brazil. The specimen was euthanized with benzocaine as per Resolution 1000/2012 of the Federal Council of Veterinary Medicine, Brazil, and fixed in 10% formalin. Afterward, the specimen was transferred to 70% ethanol and cataloged in the Coleção Ictiológica do Nupélia (voucher: NUP 25799).

Counts and measurements were taken according to the adaptation of Lima (2017), following Fink & Weitzman (1974). Measurements were taken with a digital caliper, near 0.1 mm, except for standard length, made with a divider and a rule, near 1.0 mm. The data acquired were compared with data from the cis-Andean species of *Brycon* carried by Lima (2017). Data from species collected in the Upper Rio Paraná basin, *Brycon hilarii* (Valenciennes 1850), *B. orbignyanus* (Valenciennes 1850), and *B. nattereri* Günther 1864 were based only in the literature following Ota et al. (2018), Reis et al. (2020), and Dagosta et al. (2024).

Material examined: NUP 25799, 1 specimen, 372.0 mm SL, Paraná State, mouth of Rio Paranapanema, Upper Rio Paraná basin, 22°39'57.6"S 53°05'41.7"W (Figures 1, 2).

Morphology: Perforated scales in lateral line 72; scale series between lateral line and dorsal-fin origin 13; scale series between lateral line and pelvic-fin origin 8; scales series around caudal peduncle 20. Premaxilla teeth in three rows: nine small tricuspid on the outer row; middle row with four teeth tricuspid and inner row with two teeth tricuspid. Four enlarged teeth on dentary near symphysis. Dorsal-fin rays ii,9; principal caudal-fin rays 9/9; pectoral-fin rays i,14; pelvic-fin rays i,8; anal-fin rays iii, 26. Morphometric data on Table 1.

The specimen collected fits the diagnosis of *Brycon amazonicus* by having the fifth infraorbital bone higher than wide; the presence of several narrow and wavy longitudinal stripes along the dorsolateral surfaces of the body; dark pigmented pectoral fin and base of the anal fin; and dark diffuse blotch on caudal fin, and concentrated on the ventral region of caudal peduncle (Lima, 2017). The specimen can be distinguished from the species already collected on the upper portion of the Rio Paraná basin by the possession of 72 pored scales on the lateral line (*vs*. 52 to 63 pored scales on the lateral line in *B. orbignyanus*), absence of broad midlateral stripe along the posterior half of body (*vs*. presence of broad midlateral stripe along the posterior half of body in *B. hilarii*), and presence of several narrow and wavy longitudinal stripes along the dorsolateral surface of the body, and presence of dark pigmented pectoral and base of the anal fin (*vs*. absence of body stripes and absence of dark pigmented pectoral and anal fin in *B. nattereri*). Therefore, we assume that the specimen analyzed here is conspecific with *Brycon amazonicus*, which has its native distribution range in the cis-Andean sub-basins of Rio Amazonas and Rio Orinoco (Lima, 2017).

Figure 1. Lateral view of "Matrinxã" *Brycon amazonicus*, 372.0 mm SL, NUP 25799.

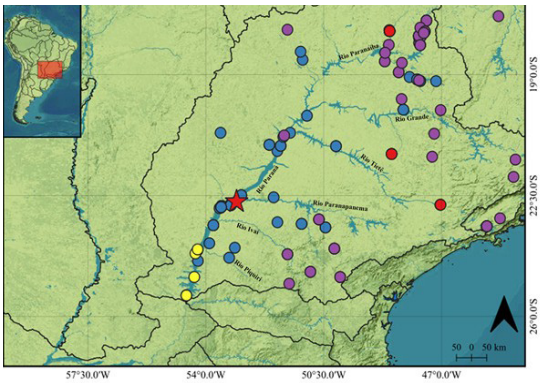

Figure 2. Map of South America showing Upper Paraná ecoregion *sensu* Abell et al. 2008 and distribution of *Brycon*. New record of *Brycon amazonicus* (red star), and previous records for the Upper Paraná ecoregion (red circle), *Brycon orbignyanus* (blue circle), *Brycon nattereri* (purble circle), and the non-native *Brycon hilarii* (yellow circle).

Table 1. Morphometric data of *Brycon amazonicus* collected in the mouth of Rio Paranapanema, Upper Rio Paraná system. Measurements in millimeters.

Measurement	Value
Standard length (mm)	372.0
Percents of Standard Length	
Depth at dorsal-fin origin	31.3
Snout to dorsal-fin origin	46.5
Dorsal-fin base length	12.0
Posterior terminus of dorsal fin to adipose fin	26.2
Posterior terminus of dorsal fin to hypural joint	44.3
Snout to pelvic-fin insertion	42.9
Snout to anal-fin origin	62.5
Anal-fin base length	23.0
Caudal peduncle length	15.8
Dorsal-fin height	21.4
Pectoral-fin length	18.6
Pelvic-fin length	15.5
Caudal peduncle depth	9.6
Head length	21.2
Percents of Head Length	
Head height	83.8
Snout length	35.4
Upper jaw length	47.4
Horizontal eye diameter	17.9
Post-orbital length	53.8
Least interorbital width	51.8

With the first record of *Brycon amazonicus* for the Rio Paranapanema region, at the confluence with the Rio Paraná, four species of *Brycon* have been recorded in the area, two natives *Brycon nattereri* and *B. orbignyanus*, the latter being at risk of extinction (CR, Critically endangered; Brasil, 2022), and *Brycon hilarii,* a non-native species (Ota et al., 2018; Jarduli et al., 2020). The introduction of this species could be attributed to accidental escapes from fish farms, sport fishing, or restocking, particularly in regions with high rates of fish release into reservoirs (Ortega et al., 2015; Garcia et al., 2018; Ota et al., 2018). The introduction of *Brycon amazonicus* to the region could have direct consequences for the population of native species in the genus, especially given the threatened status of *Brycon orbignyanus*, and could lead to genetic loss (*e.g.* in case of hybridization), competition for trophic resources and habitats, and introduction of diseases and parasites (Júlio Júnior et al., 2009; Pelicice & Agostinho, 2009; Vitule et al., 2012; Orsi & Britton, 2014; Daga et al., 2015; Ortega et al., 2015). However, alternative post-invasion scenarios should also be tested in the future, considering that the species may fail to establish due to intrinsic characteristics, as observed in other regions by Lima (2017), or, after establishment, it may overlap the niche of another invasive species in the region, such as *B. hilarii*, or it may not overlap the niche of any local species.

Although the species has already been recorded in the upper portion of the Rio Paraná (Rio Paranaíba basin, Rio Grande, and Rio Tietê, see Lima, 2017 and Figure 2), there are no records for a stretch of 700 km (Figure 2). So far, these accidental or deliberate introductions have not provided evidence of self-sustaining or established populations (*i.e.* recruitment: presence of fry or young) in all Upper Paraná ecoregion (Lima, 2017). However, introducing the species into a highly impacted area with the presence of endangered congeneric species, which has economic and ecological importance (*e.g.* seed dispersal) for the region (Lima, 2017; Ota et al., 2018; Tonella et al., 2019), is concerning for the future of native congeneric species, given that several invasive fish species are already present in the region (Garcia et al., 2018; Jarduli et al., 2020).

Downstream of the Rio Paranapanema reservoir cascades is the last stretch of the Rio Paraná without dams, the Upper Rio Paraná floodplain, a region with unique abiotic and biotic characteristics, protected by a conservation unit (Thomaz et al., 2004; Agostinho et al., 2007; Osório & Rodrigues, 2021). Nevertheless, the presence of *B. amazonicus* downstream of the last dam on the Rio Paranapanema suggests a potential spread of the species into this area, which even under the protection of the conservation unit has not prevented the invasion of non-native species (Júlio Júnior et al., 2009; Ota et al., 2018; Dagosta et al., 2024). For this reason, long-term monitoring for all non-native fish species is advisable

to prevent further damage to local biodiversity, especially for the non-native *B. amazonicus* concerning *B. nattereri* and *B. orbignyanus*.

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Data availability

The entire data supporting the results of this study has been published in the article itself.

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