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Ichthyofaunal inventory of a sand pit lake in the Municipality of Tremembé, state of São Paulo, southeastern Brazil

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ABSTRACT

This study evaluated the composition of the ichthyofauna in an artificial lake formed by sand mining in the floodplain of the Paraíba do Sul River, municipality of Tremembé, state of São Paulo, southeastern Brazil. Although anthropogenic in origin, sand pit lakes may provide suitable conditions for the establishment of diverse fish communities, including native, non-native, and exotic species. Monthly sampling was conducted from May 2021 to September 2022 at five sites distributed around the lake, using fishing rods, trap nets, cast nets, and sieves. A total of 32 species were recorded, belonging to seven orders, 13 families, and 31 genera. Characiformes (31.3%), Cichliformes (28.1%), and Siluriformes (25.0%) were the most representative orders. The high proportion of non-native taxa highlights the ongoing transformation of the regional ichthyofauna and raises concerns regarding potential ecological impacts on native communities. These findings reinforce the importance of continuous monitoring of artificial lentic systems and the assessment of species introductions, contributing to conservation planning and sustainable management strategies within the Paraíba do Sul River Basin.

Keywords: fish species richness, invasive species, Paraíba do Sul River Basin.

Inventário da ictiofauna de um lago de cava de areia no município de Tremembé, estado de São Paulo, sudeste do Brasil

RESUMO

Este estudo avaliou a composição da ictiofauna em uma lagoa artificial formada pela extração de areia na planície de inundação do rio Paraíba do Sul, no município de Tremembé, estado de São Paulo, sudeste do Brasil. Embora de origem antrópica, lagoas de cava de areia podem oferecer condições adequadas para o estabelecimento de comunidades de peixes diversificadas, incluindo espécies nativas, não nativas e exóticas. As amostragens foram realizadas mensalmente entre maio de 2021 e setembro de 2022, em cinco pontos distribuídos ao redor da lagoa, utilizando varas de pesca, armadilhas, tarrafas e peneiras. Ao todo, foram registradas 32 espécies, pertencentes a sete ordens, 13 famílias e 31 gêneros. As ordens mais representativas foram Characiformes (31,3%), Cichliformes (28,1%) e Siluriformes (25,0%). A elevada proporção de táxons não nativos evidencia a transformação em curso da ictiofauna regional e suscita preocupações quanto aos possíveis impactos ecológicos sobre as comunidades nativas. Esses resultados reforçam a importância do monitoramento contínuo de sistemas lênticos artificiais e da avaliação das introduções de espécies, contribuindo para o planejamento da conservação e para estratégias de manejo sustentável na bacia do rio Paraíba do Sul.

Palavras-chave: Bacia do Rio Paraíba do Sul, espécies invasoras, riqueza de espécies de peixes.

1. INTRODUCTION

According to the Vertebrate Genomes Project (2025), vertebrates encompass an estimated diversity of about 70,000 living species, with fish representing the group with the greatest number of species. It is estimated that more than 16,500 species of fish inhabit freshwater environments, accounting for approximately half of all fish species (Miqueleiz *et al.*, 2025), and new species are regularly being discovered (Froese and Pauly, 2026). This highlights the significant contribution of these animals to global biodiversity and their importance in maintaining aquatic ecosystems (Altowairqi and Shafi, 2024).

The Neotropical Region is recognized as the area with the highest diversity of freshwater fish in the world (Pelicice *et al.*, 2021), hosting more than 6,300 valid species (Albert *et al.*, 2025). These species play a key role in the maintenance of aquatic ecosystems and are of great importance for the livelihoods of many human communities (McIntyre *et al.*, 2016). Within this biogeographic region, South America stands out for having the greatest species richness (Reis *et al.*, 2016), with approximately 3,000 species occurring within Brazilian territory (Jézéquel *et al.*, 2020).

The Paraíba do Sul River basin covers an area of approximately 55,500 km², extending across portions of the states of Minas Gerais, Rio de Janeiro, and São Paulo. The Paraíba do Sul River, the main watercourse of this basin, has been the focus of several studies aimed at characterizing its ichthyofauna (Bizerril, 1999; Teixeira *et al.*, 2005; Moraes *et al.*, 2017).

Among the main economic activities carried out along the banks of the Paraíba do Sul River, sand mining stands out as a major contributor to the region’s socioeconomic dynamics (Mechi and Sanches, 2010). This activity, predominantly conducted through underwater excavation in floodplain areas, has led to significant landscape transformations, converting naturally floodable stretches into artificial lakes (Reis *et al.*, 2006).

However, this activity causes substantial environmental changes, including the formation of sand pits which, although initially perceived as a negative environmental impact, have the potential to support biodiversity (Estaiano, 2007), as lakes formed through sand extraction processes can sustain considerable levels of diversity (Kolar *et al.*, 2021).

According to Estaiano (2007), these artificial water bodies may exhibit limnological and ecological attributes similar to those found in natural environments. For this reason, they may become suitable habitats for the establishment of various fish species.

The importance of studying the ichthyofauna of sand pit lakes lies in their potential to serve as refuges for native species from different groups, especially amid the ongoing freshwater biodiversity crisis (Conversano *et al.*, 2025). This global phenomenon is characterized by the rapid loss of aquatic species and habitats due to threats such as dams, pollution, biological invasions, overfishing, and climate change (Dudgeon *et al.*, 2006; Albert *et al.*, 2021; Harrison *et al.*, 2018). Recent studies reveal that approximately one-quarter of freshwater fauna is threatened with extinction, with persistent declines despite conservation efforts, driven by emerging pressures such as urbanization and acidification (Reis *et al.*, 2019; Sayer *et al.*, 2025). Studies such as those by Ottoni *et al.* (2023; 2025) emphasize the need for multidisciplinary approaches, while global initiatives such as the Alliance for Freshwater Life seek to unite scientific efforts to reverse this trend; recovery plans aim to "bend the curve" of biodiversity loss (Darwall *et al.*, 2018; Tickner *et al.*, 2020; Dudgeon and Strayer, 2025).

Against this backdrop, research indicates that anthropogenic lentic systems may sustain high levels of species diversity, including species typically associated with lotic systems.

This pattern can be explained by resource availability and the absence of highly specialized predators or competitors, allowing these species to adapt to new ecologic conditions (Agostinho *et al.*, 2016; Tonella *et al.*, 2018). Furthermore, the presence of non-native and exotic species is common in these habitats, potentially altering community composition and posing threats to native fauna (Agostinho *et al.*, 2016; Alves *et al.*, 2018).

2. MATERIAL AND METHODS

2.1. Location

The selected lagoon is located on the left bank of the Paraíba do Sul River, in the municipality of Tremembé, state of São Paulo, southeastern Brazil, and was formed as a result of commercial sand extraction.

The company Porto Rio Verde - Extr. e Comércio de Areia Ltda was established in September 1998 and operated within the Rio Verde site, with its main activity being the extraction of sand, gravel, and pebbles, along with associated processing and support activities for the extraction of non-metallic minerals. The company operated for four years and ceased its activities in December 2002.

2.2. Study Area

For the proper environmental characterization of the study area, five sampling points (designated P1 to P5) were established around a lagoon formed from the deactivation of a sand pit located in the municipality of Tremembé, state of São Paulo, southeastern Brazil (Figure 1). The lagoon has approximate dimensions of 580 meters in length and 230 meters in width, with variations depending on the dry and rainy seasons. The points were selected based on visible shoreline conditions and specific environmental and anthropogenic aspects: P1 (22°56'49.45" S - 45°33'31.27" W) and P5 (22°57'0.18" S - 45°33'38.82" W) are the most affected by human activity, being located near buildings and roads, respectively. P2 (22°56'48.82" S - 45°33'35.18" W) shows an intermittent connection with the Rio Verde through a small stream. P3 (22°56'52.12" S - 45°33'38.83" W) corresponds to an area with minimal anthropogenic interference, while P4 (22°56'55.08" S - 45°33'44.42" W) was selected because it contains submerged aquatic macrophyte beds (Figure 2a–e). Aquatic macrophytes were consistently observed at all sampling points, predominantly represented by free-floating and emergent morphotypes, which at times hindered sampling. The distances between sampling points were as follows: P1–P2 (100 m), P2–P3 (150 m), P3–P4 (180 m), and P4–P5 (220 m).

The lagoon is located 1,036 meters from the Paraíba do Sul River, and similar sand pit lakes occur in the surrounding area. The selected site was prioritized based on logistical and operational criteria, including ease of access and proximity to Tremembé, which reduced risks and costs associated with nocturnal displacement and field activities. Authorization for sampling was formally obtained for the selected lagoon, ensuring legal compliance for data collection. Other sand pit lakes in the region presented constraints such as private ownership without authorized access, safety concerns, or complex logistics for the transport and operation of sampling equipment.

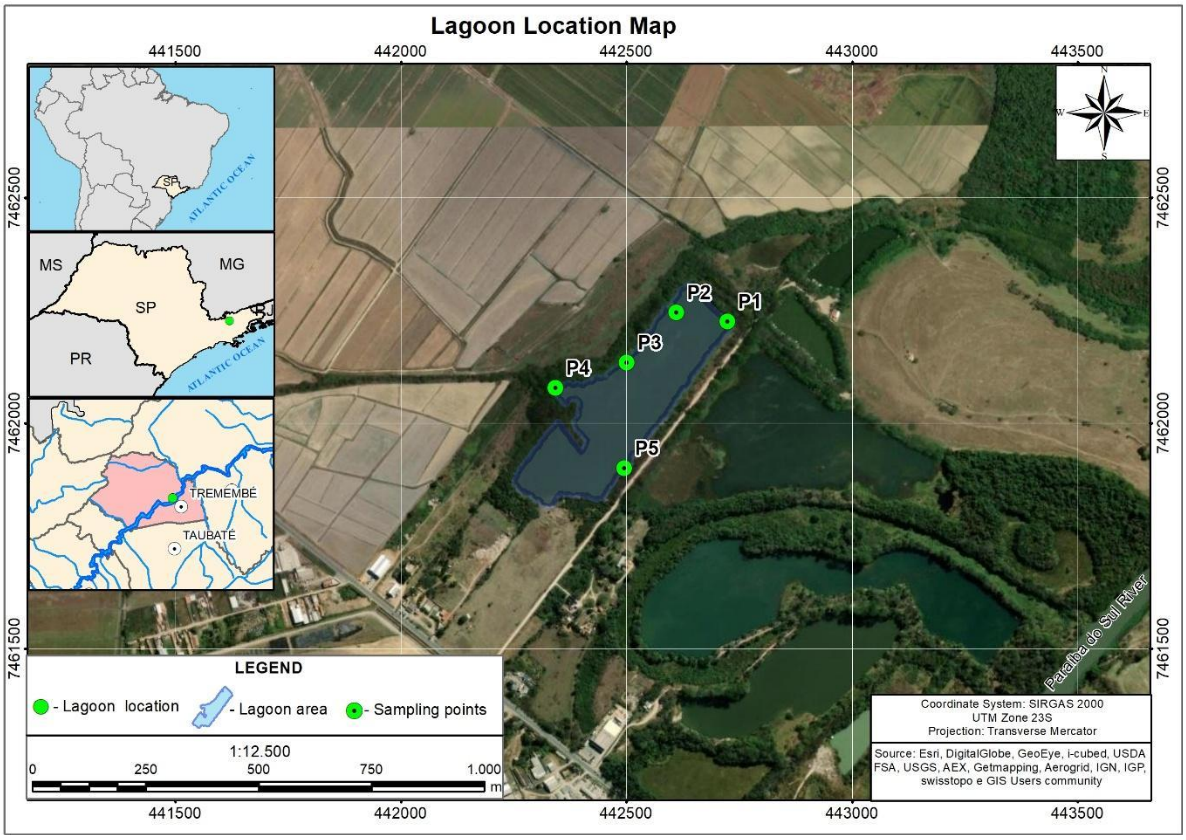

Figure 1. Geographic location of the study area in relation to the Paraíba do Sul River and the municipality of Tremembé.

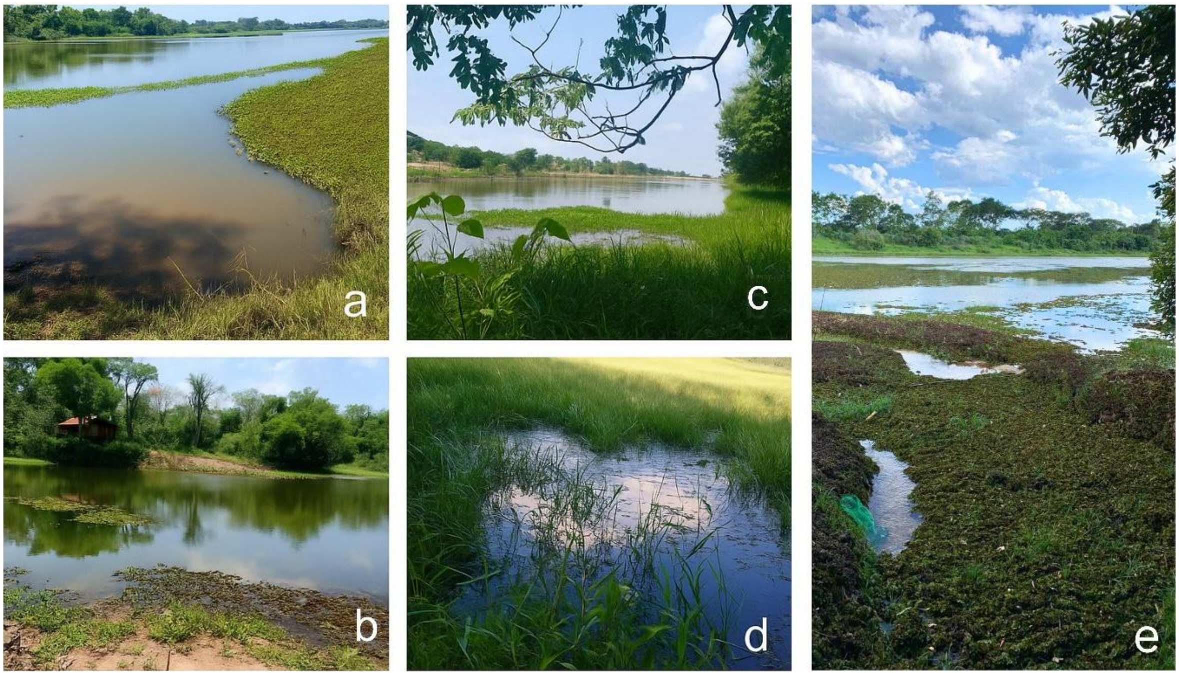

Figure 2. Overview of the five sampling sites along the sand pit lagoon of Porto Rio Verde, Tremembé, state of São Paulo, southeastern Brazil. a) P1 – 22°56'49.45" S – 45°33'31.27" W b) P2 – 22°56'48.82" S – 45°33'35.18" W c) P3 – 22°56'52.12" S – 45°33'38.83" W d) P4 – 22°56'55.08" S – 45°33'44.42" W e) P5 – 22°57'0.18" S – 45°33'38.82" W.

2.3. Fish Sampling

Sampling was carried out monthly between May 2021 and September 2022, totalling 17 months of collection, along 25-meter stretches for six hours per day (starting at 2 p.m.), to encompass both diurnal and nocturnal periods of fish activity. Different capture methods were employed to encompass the diversity of the ichthyofauna present: three nylon traps (90 × 63 × 35 cm, with six openings), six fishing rods with line and hook, one cast net with a two-meter diameter and 12 mm mesh stretched mesh (with ten throws per stretch), and two sieves (50 cm in diameter, steel mesh with 2 mm mesh size) for sampling in marginal vegetation. Voucher specimens were deposited in the Scientific Collection of the Zoology Laboratory at the University of Taubaté (CCLZU/Unitau).

2.4. Taxonomic Identification and Classification

The identification of the specimens was based on specialized literature for each genus, identification guides, and taxonomic keys (e.g., Kullander, 1983; Bizerril, 1999; Van der Sleen and Albert, 2018; Melo *et al.*, 2024; Dias *et al.*, 2025), as well as consultation with specialists when necessary. The taxonomic classification followed Fricke *et al.* (2025a; 2025b), and species names and author citations were verified according to Fricke *et al.* (2025b).

3. RESULTS AND DISCUSSION

A total of 32 freshwater fish species belonging to seven orders, 13 families, and 31 genera were recorded (Table 1, Figure 3, Figure 4).The order Characiformes (31.3%, n = 10 species) was predominant in terms of species richness, followed by Cichliformes (28.1%, n = 9 species), Siluriformes (25.0%, n = 8 species), Cyprinodontiformes (6.3%, n = two species), and Acanthuriformes, Gymnotiformes, and Synbranchiformes (3.1%, n = 1 species each).

Of the 32 species collected, 13 are considered non-native to the Paraíba do Sul River Basin: *Bryconamericus iheringii*, *Megalamphodus eques*, *Pseudocorynopoma heterandria*, *Serrapinnus notomelas*, *Cichla kelberi*, *Cichlasoma dimerus*, *Cichlasoma portalegrense*, *Saxatilia britskii*, *Metynnis lippincottianus*, *Pimelodus maculatus*, *Plagioscion squamosissimus*, *Osteogaster aenea*, and *Pterygoplichthys ambrosettii (*Fricke *et al.*, 2025b). Three species were considered exotic because they are native to regions outside Brazil: *Coptodon rendalli*, *Oreochromis niloticus* (Fricke *et al.*, 2025b), and *Poecilia reticulata* (Bragança *et al.*, 2020).

Deuterodon giton, *Oligosarcus hepsetus*, *Psalidodon parahybae*, *Hoplias malabaricus*, *Australoheros oblongus*, *Geophagus brasiliensis*, *Gymnotus sylvius*, *Hoplisoma nattereri*, *Hoplosternum littorale*, *Pimelodella lateristriga*, *Rhamdia quelen*, and *Hypostomus affinis* are native species of the Paraíba do Sul River Basin (Fricke *et al.*, 2025b).

Astyanax aff. *bimaculatus*, *Bujurquina* sp., *Phalloceros* cf. *harpagos*, and *Synbranchus* aff. *marmoratus* cannot have their native status definitively established due to the lack of precise species-level identification.

Cichlidae was the most species-rich family (9 species), a pattern commonly reported in Neotropical lentic ecosystems. Acestrorhamphidae was the most abundant family (59.2%), followed by Cichlidae (10.5%). *Megalamphodus eques* was the most abundant species (31.8%), followed by *Astyanax* aff. *bimaculatus* (21.4%) and *Serrapinnus notomelas* (18.0%).

The most abundant species recorded was *Megalamphodus eques* (31.8%), whose dominance can be attributed to a set of ecological characteristics, such as gregarious — commonly observed in schools of 20 to 30 individuals—a generalist diet, and high tolerance to environmental variations. These factors favor its wide distribution and ecological success in small- to medium-sized lentic environments. Additionally, it is a species of interest in the ornamental trade due to its small size and reddish coloration, which make it attractive for aquarists (Furlan-Murari *et al.*, 2022).

Table 1. Taxonomic list of the species collected in the sampling areas of the sand pit, Paraíba do Sul River valley, São Paulo, from May 2021 to September 2022. (*) non-native species, (**) exotic species.

Order	Family	Species
Acanthuriformes	Scianidae	*Plagioscion squamosissimus* (Heckel, 1840) *
Characiformes	Acestrorhamphidae	*Astyanax* aff. *bimaculatus*
		Deuterodon giton Eigenmann, 1908
		Megalamphodus eques (Steindachner, 1882) *
		Oligosarcus hepsetus (Cuvier, 1829)
		Psalidodon parahybae (Eigenmann, 1908)
	Characidae	*Serrapinnus notomelas* (Eigenmann, 1915) *
	Erythrinidae	*Hoplias malabaricus* (Bloch, 1794)
	Serrasalmidae	*Metynnis lippincottianus* (Cope, 1870) *
	Stevardiidae	*Bryconamericus iheringii (*Boulenger, 1887) *
		Pseudocorynopoma heterandria Eigenmann, 1914 *
Cichliformes	Cichlidae	*Bujurquina* sp.
		Australoheros oblongus (Castelnau, 1855)
		Cichla kelberi Kullander & Ferreira, 2006 *
		Cichlasoma portalegrense Kullander, 1983 *
		Cichlasoma dimerus (Heckel, 1840) *
		Coptodon rendalli (Boulenger, 1897) **
		Geophagus brasiliensis (Quoy & Gaimard, 1824)
		Oreochromis niloticus (Linnaeus, 1758) **
		Saxatilia britskii (Kullander, 1982) *
Cyprinodontiformes	Poeciliidae	*Phalloceros* cf. *harpagos*
		Poecilia reticulata Peters, 1859 **
Gymnotiformes	Gymnotidae	*Gymnotus sylvius* Albert & Fernandes-Matioli, 1999
Siluriformes	Callichthyidae	*Hoplisoma nattereri* (Steindachner, 1876)
		Hoplosternum littorale (Hancock, 1828*)*
		Osteogaster aenea (Gill, 1858) *
	Heptapteridae	*Pimelodella lateristriga* (Lichtenstein, 1823)
		Pimelodus maculatus Lacépède, 1803 *
		Rhamdia quelen (Quoy & Gaimard, 1824)
	Loricariidae	*Hypostomus affinis* (Steindachner, 1877)
		Pterygoplichthys ambrosettii (Holmberg, 1893) *
Synbranchiformes	Synbranchidae	*Synbranchus* aff. *marmoratus*

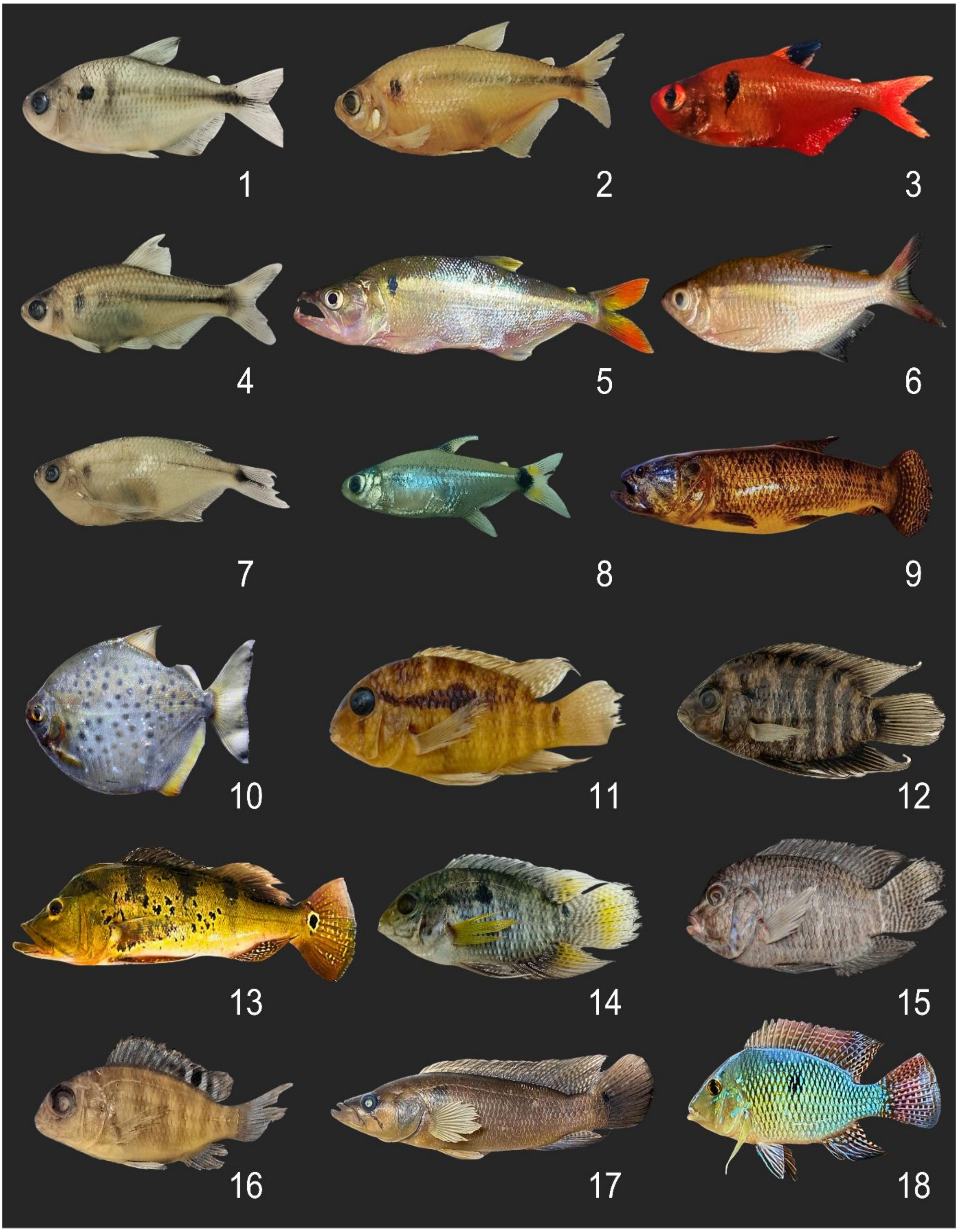

Figure 3. Species recorded in the sand pit from May 2021 to September 2022. Standard length (SL) in millimeters: 1) *Astyanax* aff. *bimaculatus*, 80.1 mm; 2) *Deuterodon giton*, 67.0 mm; 3) *Bryconamericus iheringii*, 25.3 mm; 4) *Megalamphodus eques*, 26.1 mm; 5) *Oligosarcus hepsetus*, 142.7 mm; 6) *Psalidodon parahybae*, 72.3 mm; 7) *Pseudocorynopoma heterandria*, 54.0 mm; 8) *Serrapinnus notomelas*, 25.2 mm; 9) *Hoplias malabaricus*, 288.9 mm; 10) *Metynnis lippincottianus*, 101.0 mm; 11) *Bujurquina* sp., 71.3 mm; 12) *Australoheros oblongus*, 53.4 mm; 13) *Cichla kelberi*, 375.8 mm; 14) *Cichlasoma dimerus*, 60.5 mm; 15) *Cichlasoma portalegrense*, 91.3 mm; 16) *Coptodon rendalli*, 28.3 mm; 17) *Saxatilia britskii*, 131.7 mm; 18) *Geophagus brasiliensis*, 115.2 mm.

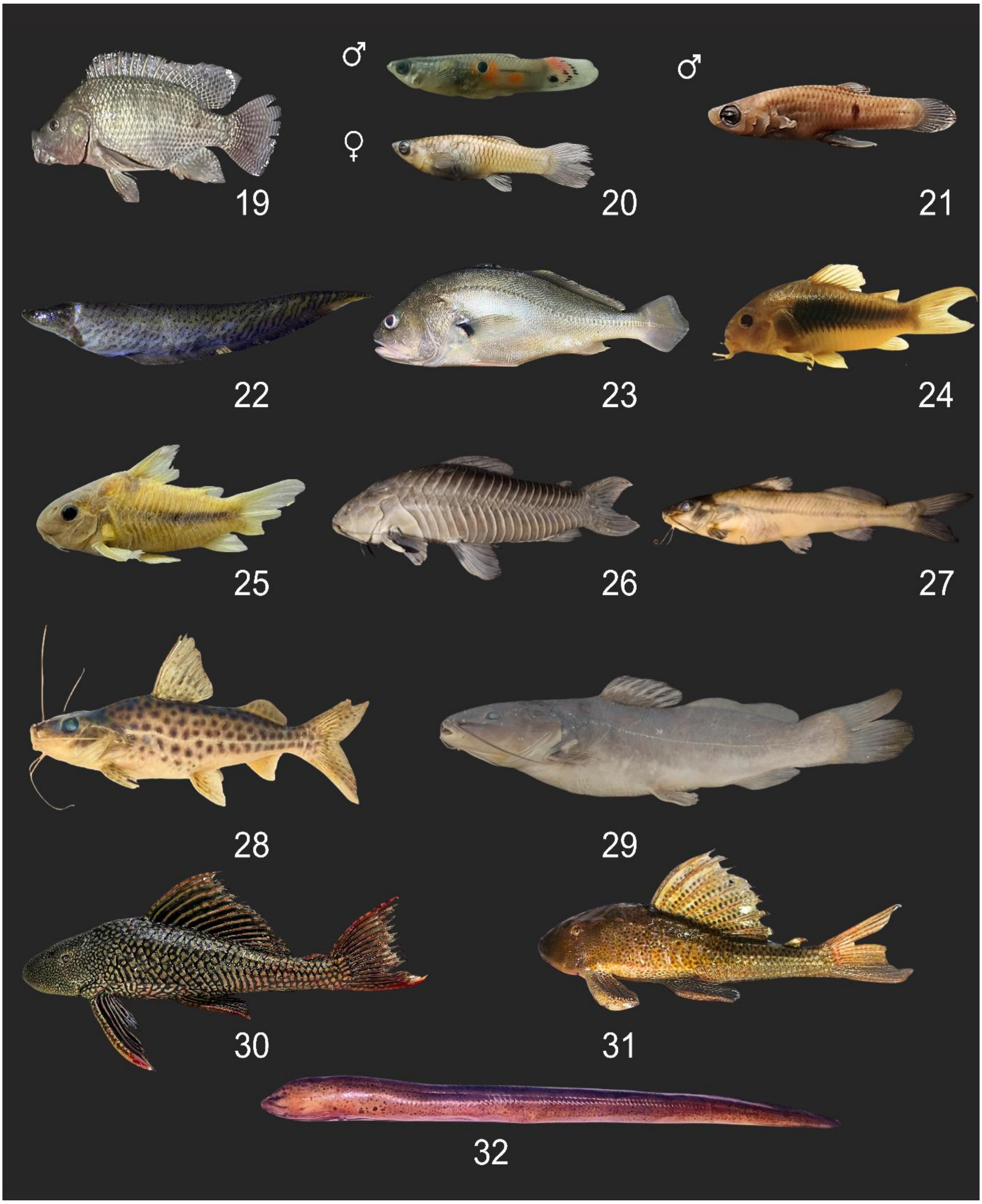

Figure 4. Species recorded in the sand pit from May 2021 to September 2022. Standard length (SL) in millimeters: 19) *Oreochromis niloticus*, 320.1 mm; 20) *Poecilia reticulata*, male – 16.5 mm, female – 21.0 mm; 21) *Phalloceros* cf. *harpagos*, 17.2 mm; 22) *Gymnotus sylvius*, 285.6 mm; 23) *Plagioscion squamosissimus*, 291.6 mm; 24) *Osteogaster aenea*, 33.0 mm; 25) *Hoplisoma nattereri*, 30.4 mm; 26) *Hoplosternum littorale*, 183.1 mm; 27) *Pimelodella lateristriga*, 116.1 mm; 28) *Pimelodus maculatus*, 203.5 mm; 29) *Rhamdia quelen*, 307.9 mm; 30) *Pterygoplichthys ambrosettii*, 289.8 mm; 31) *Hypostomus affinis*, 322.3 mm; 32) *Synbranchus* aff. *marmoratus*, 734.4 mm.

The native or non-native status of *Hoplosternum littorale* and *Pimelodus maculatus* within the Paraíba do Sul River Basin remains a subject of debate in the literature. According to Moraes *et al.* (2017), there is evidence suggesting the possible introduction of these species into the basin, which raises questions about their native status. Bartolette *et al.* (2018) classify *Pimelodus maculatus* as native, while considering *Hoplosternum littorale* to be introduced. In turn, Fricke *et al.* (2025b) recognize *H. littorale* as native to the Paraíba do Sul Basin and restrict the natural distribution of *P. maculatus* to the Paraná and São Francisco river basins. Given its broad distribution across South America and Moraes *et al.* (2017) proposed its possible introduction as a hypothesis, and in the absence of conclusive evidence supporting human-mediated introduction, *Hoplosternum littorale* is herein considered native to the Paraíba do Sul River Basin. The high representativeness of the family Cichlidae, with 9 recorded species, is a pattern frequently observed in surveys of Neotropical lentic environments, including marginal lagoons, reservoirs, and other low-flow water bodies (Ramos *et al.*, 2018; Oliveira *et al.*, 2024). This group stands out for its wide adaptive capacity to different environmental conditions, resulting from evolutionary processes that have favored diversification and rapid speciation within the family (Kocher, 2004). Such success is associated with reproductive strategies involving parental care (Balshine and Abate, 2021) and a generalist diet (Novakowski *et al.*, 2016).

The non-native species *Pseudocorynopoma heterandria*, *Serrapinnus notomelas*, *Cichlasoma dimerus*, *Saxatilia britskii*, and *Pterygoplichthys ambrosettii* represent ichthyofaunal components originally distributed in the Paraná River Basin, encompassing its upper, middle, and lower sections (Fricke *et al.*, 2025b). Their occurrence in the Paraíba do Sul River may be explained by the historical development of this system, which, according to Bizerril (1999), originated from the intersection of the original drainage with rivers connected to coastal basins and to the Upper Paraná and Tietê basins. These watersheds, now separated by drainage divides, suggest past river capture events that may have facilitated the introduction of such species into the Paraíba do Sul system.

Megalamphodus eques, *Cichlasoma dimerus*, *Osteogaster aenea*, *Pterygoplichthys ambrosettii*, and *Serrapinnus notomelas* are widely traded in the ornamental fish industry, which may facilitate their introduction (Garcia *et al.*, 2012; Paula *et al.*, 2018; Geller *et al.*, 2020; Furlan-Murari *et al.*, 2022).

The introduction of species linked to the aquarium trade is often associated with the improper release of ornamental fish, a common practice in urban and peri-urban areas near artificial water bodies (Ferraz *et al.*, 2019; Geller *et al.*, 2020). Another route of introduction is the escape of individuals from aquaculture facilities, either due to structural failures, inadequate management, or natural events that allow farmed fish to reach adjacent water bodies (Ortega *et al.*, 2015; Agostinho *et al.*, 2018).

The introduction of ornamental fish species into the Paraíba do Sul River Basin is associated with the strong development of ornamental fish farming in the region, particularly in the Minas Gerais portion of the basin, which hosts Brazil's main production center (Magalhães *et al.*, 2002). This area stands out as the largest producer of ornamental fish in South America, supplying more than 70% of the national demand for aquarium species (Magalhães *et al.*, 2021). According to Latini *et al.* (2016), another relevant factor contributing to species introductions into aquatic systems is sport fishing, driven by the high interest in species such as *Cichla kelberi* and *Plagioscion squamosissimus*, both recorded in the study area.

Oreochromis niloticus and *Coptodon rendalli*, both commonly known as tilapias, have historically been promoted for their high economic value in aquaculture, despite the widely documented negative impacts on native aquatic biodiversity (Moraes *et al.*, 2017; Agostinho *et al.*, 2018). These species exhibit remarkable ecological plasticity, high reproductive rates, and territorial and aggressive behavioural traits that enhance their adaptation to artificial environments and facilitate their subsequent dispersal into natural ecosystems (Agostinho *et al.*, 2018; Yongo *et al.*, 2023).

Poecilia reticulata is an invasive exotic species originally restricted to northern South America and Central America (Bragança *et al.*, 2020). Its introduction into various aquatic environments is mainly attributed to its use in the biological control of disease-vector mosquitoes, due to its diet based on the consumption of aquatic insect larvae, as well as improper release of individuals from the ornamental fish trade (Aquino, 2016).

The high proportion of non-native species recorded in the sand pit lagoon reveals a marked anthropogenic reshaping of the regional ichthyofauna. With 50% of the assemblage composed of allochthonous or exotic taxa, the system exhibits clear signs of biotic homogenization. This pattern aligns with the broader basin context, where Bueno *et al.* (2021) reported the highest proportion of introduced species among southeastern Brazilian river basins (43%).

The ichthyofauna recorded in the sand pit lagoon of Sítio Rio Verde is highly similar to that reported for the Paraíba do Sul River Basin by Bizerril (1999), Teixeira *et al.* (2005), Moraes *et al.* (2017), and Honorio and Martins (2018), with 25 of the 32 species previously listed for this hydrographic basin. Considering only the São Paulo portion of the basin, Oyakawa and Menezes (2011) recorded 73 species, 15 of which are present in this inventory.

The total number of species found (32) is significant, especially considering that this is the first ichthyofaunal inventory conducted in sand pit lakes in the Paraíba do Sul Valley region (São Paula, Brazil). When compared to inventories of natural environments in the region, such as the Una River, a tributary of the Paraíba do Sul River, the diversity observed here is comparable or even higher (Honorio and Martins, 2018), reinforcing the ecological importance of these artificial habitats. This diversity likely reflects a combination of factors, including hydrological connectivity with the regional drainage network, habitat heterogeneity, lake age, and natural colonization dynamics.

Based on the results obtained, it is possible to state that sand pits, despite their anthropogenic origin, function as viable refuges for regional ichthyofauna, encompassing both native and non-native species. Therefore, this study contributes to the understanding of the freshwater fish fauna of sand pit lakes in the Paraíba Valley, filling knowledge gaps regarding the composition and structure of fish communities in these increasingly common environments due to mining activity. Moreover, it aligns with Sustainable Development Goal 15 (Life on Land) by promoting the conservation and sustainable use of aquatic ecosystems, thereby contributing to the maintenance of regional biodiversity and environmental restoration.

4. CONCLUSIONS

The ichthyofaunal survey conducted in a sand pit lake in the municipality of Tremembé, Paraíba do Sul Valley, revealed considerable species richness (n = 32), comparable to that recorded in natural aquatic systems within the Paraíba do Sul River Basin. The results demonstrate that artificial lentic environments resulting from sand mining can function as refuges for both native and non-native fish species. However, the high proportion of non-native and exotic taxa indicates that these systems are also susceptible to biological invasions. These findings underscore the need to monitor artificial aquatic habitats and evaluate the ecological consequences of species introductions on native assemblages.

5. DATA AVAILABILITY STATEMENT

Data availability not informed.

6. ACKNOWLEDGEMENTS

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