

SHORT COMMUNICATION

New occurrence of a non-native ornamental cichlid in the Paranapanema River, southern Brazil

Nova ocorrência de ciclídeo ornamental não nativo no rio Paranapanema, sul do Brasil

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Abstract

Fish introductions are common practices due to intentionally or unintentionally translocations of species between watersheds. Herein we report the spread of the non-native cichlid *Laetacara araguaiae* OTTONI & COSTA 2009 in the Paranapanema River basin, southern Brazil. Native from the Araguaia River (Central Brazil), this species was probably introduced by releases made by aquarists. Its new area of occurrence is characterized as natural nursery and important for the life cycle of native fish. Due to its biological characteristics, the species has the ability to cause a negative impact on the aquatic biota through possible interactions, such as predation of eggs, larvae and juveniles of native fish, and spread of parasites.

Keywords: biological invasion, Cichlinae, fish, exotic species, Upper Paraná River basin.

Resumo

As introduções de peixes são práticas comuns, devido às translocações intencionais ou não de espécies entre bacias hidrográficas. É relatada a dispersão do ciclídeo não nativo *Laetacara araguaiae* OTTONI & COSTA 2009 na bacia do rio Paranapanema, sul do Brasil. Nativa do rio Araguaia (Brasil Central), esta espécie foi provavelmente introduzida por solturas realizadas por aquaristas. Sua nova área de ocorrência é caracterizada como berçário natural e importante para o ciclo de vida de peixes nativos. Devido às suas características biológicas, a espécie tem a capacidade de causar impacto negativo na biota aquática por meio de possíveis interações, tais como a predação de ovos, larvas e juvenis de peixes nativos, além de disseminação de parasitos.

Palavras-chave: invasão biológica, Cichlinae, peixe, espécies exóticas, bacia do Alto rio Paraná.

Considered as one of the richest group of vertebrates, the family Cichlidae is comprised by 1,702 valid fish species (Eschmeyer and Fong, 2016). The genus *Laetacara* KULLANDER 1986 includes seven species of small size (standard length up to 110 mm), which are diagnosed by the morphology of the hyoid bone, bearing a deep notch on the dorsal margin of the anterior ceratohyal (Kullander, 1986). Most *Laetacara* species are originally distributed within the Amazon and Tocantins River basins, except for *Laetacara dorsigera* (HECKEL 1840) that also occurs in the Paraguay, Lower Paraná and Uruguay River basins (Kullander, 2003; Ottoni and Costa, 2009; Lanés *et al.*, 2010; Eschmeyer *et al.*, 2016).

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Native to the Araguaia River basin, in Central Brazil, *Laetacara araguaiae* OTTONI & COSTA 2009 is popularly known as “carazinho” (Figure 1) and has a high, compressed body. *Laetacara araguaiae* differs from its congeners by having fewer rays in dorsal fins ($N = 7-8$). At the start of the 1990s, *L. araguaiae* was caught in the Upper Paraná River basin and catalogued in scientific fish collections. The species was listed as *Laetacara* sp. (Graça and Pavanelli, 2007; Langeani *et al.*, 2007). However, previous studies still had not registered its introduction to the Paranapanema River basin (Casatti *et al.*, 2003; Pelicice *et al.*, 2005; Ferrareze and Nogueira, 2011; Kipper *et al.*, 2011). Only one specimen had been registered at the Rosana Hydroelectric Reservoir in April of 2012 (NUP 13838) (Figure 2). This study records its presence specifically in the Upstream Rosana Reservoir, which is the last in a series of eleven reservoirs at the Paranapanema River mainstem.

In the Upper Paraná River basin, *L. araguaiae* is classified as an omnivore because it feeds on algae, vegetable fragments, and invertebrates. The female fertility varies between 338 and 1,602 oocytes (Souza-Filho and Casatti, 2010), which is considered high in relation to its size, and in comparison to other cichlids, i.e., *Cichlasoma paranaense* KULLANDER 1983, *Crenicichla haroldoi* LUENGO & BRITSKI 1974, *Crenicichla niederleini* (HOLMBERG 1891), *Crenicichla britskii* KULLANDER 1982 and *Geophagus*

brasiliensis (QUOY & GAIMARD 1824) native to the Paranapanema River (Casatti *et al.*, 2003; Pelicice *et al.*, 2005; Ferrareze and Nogueira, 2011; Orsi, 2010). Spawning occurs in circular nests located at sandy bottoms, and next to roots and macrophyte leaves. For *L. araguaiae*, biparental care is a cooperative activity between the males and females, who alternate between rearing the brood and defending their territory. However, the females invest more into nest constructing, while the males defend the territory (Teresa and Gonçalves-de-Freitas, 2011). In addition, this species is capable of tolerating a high rate of parasitism, such as digeneans (Platyhelminthes) that are ectoparasites for which the fish act as intermediate hosts (Souza-Filho and Casatti, 2010). The parasite-host interaction increases the risk of predation, a competitive disadvantage for resources, as well as inhibits sexual maturation (Wootton, 1998). Therefore, it is possible that *L. araguaiae*, besides being adversely affected by the parasite-host interaction, could also become a vector of pathogens and parasites for native fishes (Kurchevski *et al.*, 2010).

Laetacara araguaiae was detected in a floodplain lake connected to the Paranapanema River (22°36'42.27"S, 52°09'31.81"W) located in the area of influence of the Rosana Hydroelectric Power Plant (Figure 2). Fish were captured by seine (6.0 m², with 2.0 mm of mesh) and sieve (0.4 m², 0.5 mm of mesh). This study is part of a broad



Figure 1. *Laetacara araguaiae*, MZUEL 13166, 32.9 mm standard length, from Rosana Reservoir, Lower Paranapanema River, border of the states of São Paulo and Paraná, southern Brazil.

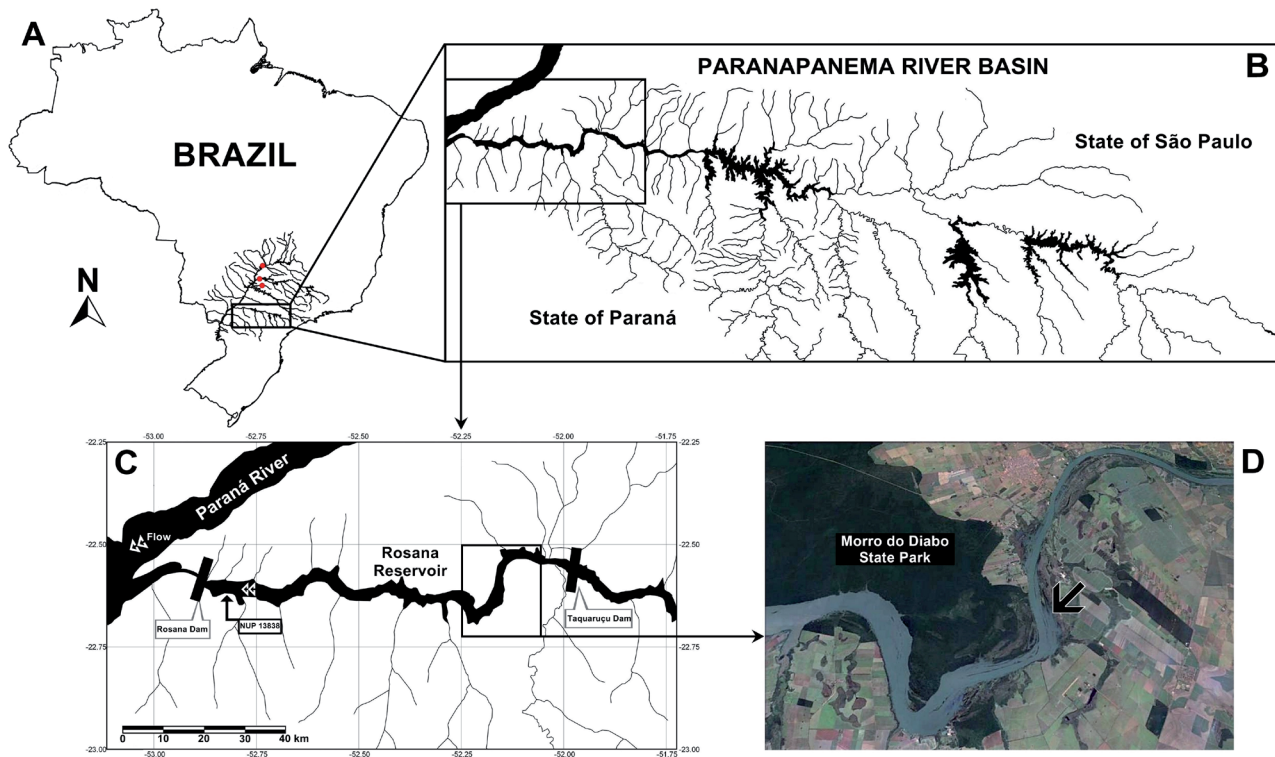


Figure 2. Sites of occurrence of *Laetacara araguaiae* in the Upper Paraná River basin, southeast Brazil: previous detections (red circles) in the basin (A) and detail of the Paranapanema River basin (B) and Rosana Reservoir (C), which is the site of the new occurrence. Satellite image (Google Earth) with arrow indicating the sampling site, near the Morro do Diabo State Park (D).

project with the objective to detect natural spawning and nursery areas and to evaluate reproduction of the native fish assemblages in the Paranapanema River basin.

All captured fishes were euthanized by exposure to saturated clove oil, measured (mm) and weighed (g). Then, they were fixed in 10% formalin for 48 hours and afterwards preserved in 70% alcohol. Three morphological measurements were taken and compared with literature for species identification (Ottoni and Costa, 2009): number of dorsal fin rays, presence of a dark spot on the caudal peduncle and absent on the dorsal fin, and presence of cycloid scales on the side of the head. Voucher specimens were added to the Museu de Zoologia da Universidade Estadual de Londrina's ichthyology collection (MZUEL 13164-13166), where a specialist confirmed the identification (Dr. F.C. Jerep, Universidade Estadual de Londrina, Paraná, Brazil). The collection license is N° 16578, and the UEL Ethics Committee for Animal Use authorized the sampling collections (N° 21149.2012.53).

Samplings performed in December of 2013, February and December of 2014, and February of 2015 unexpectedly captured nine individuals of *L. araguaiae*. Taking into account that this species reaches the first gonadal maturation with 20 mm standard length (Santos-Silva *et al.*, 2015), off the total captured, one fish was juvenile and eight were

adults. Since the first detection in December of 2013, this species became more frequent in other samples. The relative abundance, or the percentage number in relation to all other species was 4.8%. The standard length of the individuals varied between 15 and 43 mm (average of $28 \text{ mm} \pm 0.9$) and the total weight was between 0.1 and 2.1 g (average of $0.9 \text{ g} \pm 0.7$).

Based on the present record, we report the spread of the *L. araguaiae* in the Paranapanema River basin. However, it has already been collected outside of its natural distribution in the floodplain of the Upper Paraná River (Graça and Pavanelli, 2007) and tributaries, such as the São José dos Dourados (Casatti *et al.*, 2006), Grande (Souza-Filho and Casatti, 2010) and Paranaíba rivers (Fagundes *et al.*, 2015). The new record of *L. araguaiae* caught our attention because it is the tenth cichlid species to have been introduced to the Paranapanema River (Brandão *et al.*, 2009; Orsi, 2010; Britton and Orsi, 2012).

The presence of *L. araguaiae* in Paranapanema River basin is troublesome, since its new area of occurrence is adjacent to a conservation area (Morro do Diabo State Park) belonging to the hotspot Atlantic Forest (Reaser *et al.*, 2005). This section of the basin is composed of floodplain lakes that are considered natural spawning and nursery areas for many native fish species (Ferrareze and

Nogueira, 2011; Kipper *et al.*, 2011; Frantini-Silva *et al.*, 2015). Thus, this new occurrence of *L. araguaiae* is important, since the floodplain lakes located upstream to Rosana Reservoir play a relevant role on the early development and growth of fishes.

The parental care, courtship behaviour, and territoriality are pre-adaptations favoured by the new conditions, which were provided by river damming. Thus, the parental care becomes effective in habitats with high transparency and small oscillations in water level and other limnological variables (such as turbidity, nutrients, and pH), as seen upstream to the Rosana Reservoir (Ferrareze *et al.*, 2014). Therefore, this behaviour favours the establishment of the species in this new area.

In Brazil, the aquarium industry is a significant source of aquatic introductions that threaten the biodiversity (Magalhães and Vitule, 2013). In the Upper Paraná River basin, various species of ornamental fish were introduced because of intentional releases by aquarists. Among these species are: *Gymnocorymbus ternetzi* (BOULENGER 1895), *Hyphessobrycon eques* (STEINDACHNER 1882), *Poecilia reticulata* PETERS 1859, *Xiphophorus hellerii* HECKEL 1848, and *Xiphophorus maculatus* (GÜNTHER 1866) (Graça and Pavanelli, 2007; Langeani *et al.*, 2007; Ortega *et al.*, 2015). This practice is futile and points out the urgency to raise aquarists' awareness about the problems caused by introduced and invasive species.

Cichlids are kept as ornamental fish in aquariums because of their varied behaviour, attractive coloration, and moderate size (Kullander, 2003). We believe that the occurrence of *L. araguaiae* in the area is a result of releases by aquarists, since this fish is often found in the aquarium trade of the region. Therefore, the increase in the commercialization of the species may enhance the propagule pressure and the risk of invasion (Magalhães and Jacobi, 2013).

Even though the *L. araguaiae* is present in the new area we still cannot conclude that the species is established, since the presence of males and females engaging in reproductive activity, capable of maintaining a self-sustaining population, has not been proven (Blackburn *et al.*, 2011). However, its omnivorous habit and reproductive characteristics may favour the establishment process and consequent invasion principally in the investigated location. Thus, the risk of invasion cannot be overlooked, especially in locations close to conservation areas (Morro do Diabo State Park, Figure 2) and in floodplain lakes which have an important ecological role in the fishes' recruitment.

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