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ARTICLE

First record and extended distribution of *Otothyropsis piribebuy* (Loricariidae: Hypoptopomatinae) in Brazil

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Abstract. Cascudinhos are a group of small benthic fishes included in the Hypoptopomatinae subfamily, inhabiting small to moderate streams and rivers within the Neotropical region, from Venezuela to Northern Argentina. Until now, *Otothyropsis piribebuy* originally described from the rio Paraguay basin, in Paraguay, is the only species of the genus not recorded in Brazil. Recent samples in the rio Tererê, rio Paraguay basin, Brazil, revealed a population of *Otothyropsis* with uncertain taxonomic identity. Therefore, the study aimed to unveil the distribution of *Otothyropsis* within Brazilian territory. External morphology, osteology, measurements, and counts (plates, teeth, and rays) of these specimens from rio Tererê were compared to data from the original description of *O. piribebuy,* and also with specimens of *O. piribebuy* sampled in Paraguayan territory. Observations indicated no differences among the analyzed specimens. Furthermore, a Principal Component Analysis (PCA), carried out using log-transformed measures from Brazilian and Paraguayan specimens, showed no separation of these populations, also indicating that all analyzed specimens pertain to the same species. Based on this, a prediction map of distribution, using Maximum Entropy, was produced. The correct identification of spatial range of occurrence is an essential step to ensure the conservation of species, and the extended distribution of *Otothyropsis piribebuy* was confirmed, enhancing the list of neotropical fish from Brazil.

Key-Words. Cascudinhos; Pantanal; Upper Paraguay basin; Chaco; Ichthyofauna.

INTRODUCTION

Cascudinhos are a group of small benthic fishes included in the Hypoptopomatinae subfamily, inhabiting small to moderate streams and rivers within the Neotropical region, from Venezuela to Northern Argentina (Schaefer, 2003). Within the group, *Otothyropsis* Ribeiro, Carvalho & Melo, 2005 was described to allocate *O. marapoama* Ribeiro, Carvalho, Melo, 2005, a species from the rio Paraná basin. Currently, there are six valid species for the genus, belonging to the rio Paraná and the rio Paraguay basins: *O. alicula* Lippert, Calegari, Reis, 2014, *O. biamnicus* Calegari, Lehmann, Reis, 2013, *O. dialeukos* Calegari, Molis, Reis, 2017, *O. marapoama, O. piribebuy* Calegari, Lehmann, Reis, 2011, and *O. polyodon* Calegari, Lehmann, Reis, 2013.

Otothyropsis piribebuy, from rio Paraguay basin, is known exclusively from Paraguayan territory (Fig. 1 – star, square and triangle). This species is distinguished from the congeners by possessing the lateral middle series of plates truncated before the caudal fin; the inner margin of pectoral

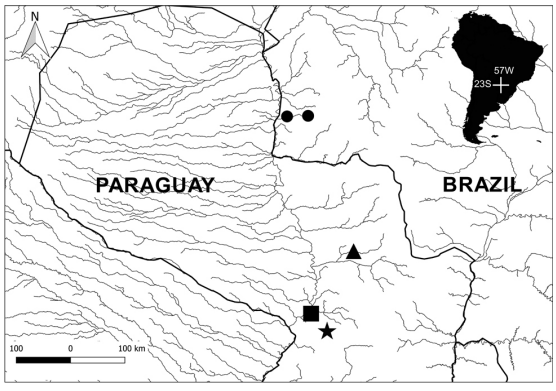

Figure 1. Distribution of *Otothyropsis piribebuy* within the rio Paraguay basin. Star = holotype; square = paratype; triangle = non-type, from Paraguay. Circles = new occurrence in Brazil.

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spine fin smooth; the distal tip of the first ceratobranchial accessory flange pointed; and abdomen with unplated areas in adults (Calegari *et al.,* 2011). Recent examination of specimens sampled in the rio Tererê, rio Paraguay basin, Mato Grosso do Sul, Brazil (Fig. 1 – circles), revealed the first record of *O. piribebuy* in Brazilian territory, extending the occurrence area of the species.

MATERIAL AND METHODS

Sampling occurred in Pantanal floodplain, rio Tereré drainage, transition between the Nabileque subregion and Chaco domain. Fishes were collected on shaded rapids of temporary shallow streams, locally known as "vazantes", usually associated with submerged twigs, and co-occurring with shoals of another Hypoptopomatinae, *Otocinclus bororo* Schaefer, 1997.

Comparison of specimens were based on counts and measurements following Schaefer (1997), and compilation proposed by Martins *et al.* (2014) with additional measurements from Calegari *et al.* (2011). Measurements were obtained using digital calipers (± 0.1 mm), point-to-point, under a stereomicroscope on the left side of 17 specimens [13 from Brazil (ZUFMS 5718) and 4 from Paraguay (MNRJ 26113)]. Morphometric data are expressed as a percent of standard length (SL) for body, or head length (HL) for cephalic subunits. For osteological examination, three specimens were cleared and stained (c&s), following Taylor & Van Dyke (1985) (2 from ZUFMS 5718 and one from MNRJ 26113). All obtained results were compared with data from the original description of *Otothyropsis piribebuy*. Principal Component Analysis (PCA) was carried out using log-transformed measures from the same specimens used in morphometrics analysis, in R environment (R Core Team, 2019), with ggbiplot (Vincent, 2011) and stats (R Core Team, 2019) packages.

Distribution map was produced using QGis (QGIS Development Team, 2019), with dataset from FAO Fisheries & Aquaculture Department (FAO Fisheries & Aquaculture Department, 2019). Prediction of the distribution of species were performed using Maximum Entropy – relying on probability of occurrence based of presence-only data from available sample sites (CZCEN 332, MCP 45754, MNRJ 26113, ZUFMS 5717, ZUFMS 5718) using MaxEnt (Phillips *et al.,* 2019) and environmental datasets – maximum, average and minimum temperature and precipitation, besides a climatic biological dataset (see worldclim.com for detailed information) – from WorldClim (Fick & Hijmans, 2017).

Institutional abbreviations: CZCEN = Colección Zoológica de la Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Asunción, Asunción; MCP = Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre; MNRJ = Museu Nacional, Rio de Janeiro; ZUFMS = Coleção Zoológica de Referência da Universidade Federal de Mato Grosso do Sul, Campo Grande.

RESULTS

To compare the specimens of *Otothyropsis* collected in Brazilian portions of the Paraguay basin (ZUFMS 5718, Fig. 2), specimens of *O. piribebuy* sampled near the type-locality in the Paraguay were examined (MNRJ 11256), as well as the data from the original description given by Calegari *et al.* (2011). Based on comparison of meristic and morphometric data (Tables 1-2), external morphology, and osteological features the specimens were identified as *Otothyropsis piribebuy*.

Principal Component Analysis (PCA), based on populations of *Otothyropsis piribeuy* from Brazilian and Paraguayan portions of rio Paraguay basin, corroborated the conspecificity, indicating no differences between the two populations (Fig. 3). The two distinct groups showed on PCA result were separated based strictly on sexual dimorphism. The first group clustered all females specimens, while the second group united the males. Calegari *et al.* (2011) had already pointed the sexual dimorphism as an important feature of this species.

Considering the sampling locations and their morphoclimatic features, a prediction map was constructed (Fig. 4), which revealed a greater potential extent of occurrence for *O. piribebuy*. The orange areas on the map are regarded as the most probable of occurrence, representing putative sampling sites.

DISCUSSION

The majority of morphometric and meristic features of the specimens from rio Tererê, Brazil, were consistent with those of the type series of *O. piribebuy,* as given by Calegari *et al.* (2011). Also, considering the diagnostic features for *O. piribebuy,* the same patterns were observed in Brazilian specimens, such as the number and truncation of lateral series of plates, lack of serration in internal margin of the pectoral-fin spine, and abdominal pattern of plating. An osteological variation identified in one specimen was the fusion of infraorbitals 2 and 3, revealing an intraspecific exception.

The PCA showed no distinction between the two compared populations from Brazil and Paraguay, but was efficient to separate males and females (Fig. 3), corroborating the sexual dimorphism already known to *O. piribebuy*. Besides the two most common characteristics used to identify sexual dimorphism within Hypoptopomatinae (the fleshy flap above the first pelvic-fin ray and the urogenital papilla), the males also shared other secondary sexual dimorphism features, such as the enlarged nostril and smaller internarial distance as many other Hypoptopomatinae species (*e.g.,* Calegari *et al.,* 2011; Martins & Langeani, 2011).

Otothyropsis congeners have been described from Brazilian waters recurrently (Ribeiro *et al.,* 2005; Calegari *et al.,* 2011, 2013; Lippert *et al.,* 2014) except for *O. dialeukos*, found in rio Paraná basin, and *O. piribebuy,* from rio Paraguay basin, both in Paraguayan territory (Calegari *et al.,* 2011, 2017). This is the first record of *O. piribebuy* in

Brazil, extending the distribution of the species in the rio Paraguay basin. The collecting sites of *O. piribebuy* are relatively distant from each other (Fig. 1). However, a similar distribution pattern, with a large gap between collecting sites in the rio Paraguay basin, was already described for two non-loricariid species – *Tatia neivai* (Ihering, 1930) and *Gymnotus pantanal* Fernandes, Albert, Daniel-Silva, Lopes, Crampton & Almeida-Toledo, 2005 (Sarmento-Soares & Martins-Pinheiro, 2008; Craig *et al.,* 2018).

It is noteworthy that the collections occurred six months apart within two distinct hydrological moments (flood and drought seasons), and despite the effort to locate the species on other habitats, specimens of *O. piribebuy* were only found on those two locations (Fig. 1 – circles). Although the flooding is known as a driver of homogenization of fish communities of floodplain systems(Thomaz *et al.,* 2007), the specificity of occupation observed on *O. piribebuy* emphasizes the need

Figure 2. *Otothyropsis piribebuy,* nontype, first record in Brazilian territory, ZUFMS 5796, 23.8 mm SL, female, Rego d'Água, Porto Murtinho, Mato Grosso do Sul, Brazil.

Table 1. Meristic data of *Otothyropsis piribebuy,* new occurrence, specimens collected in Mato Grosso do Sul, Brazil.

Character	N	Range	Distribution frequency
Teeth in left premaxilla	15	10-17	10(2), 12(2), 13(6), 14(3), 16(1), 17(1)
Teeth in right premaxilla	15	9-16	9(1), 10(1), 12(3), 13(4), 14(4), 15 (1), 16 (1)
Teeth in left dentary	15	9-15	9(1), 10(3), 11(3), 12(3), 13(5), 15(1)
Teeth in right dentary	15	9-16	9(1), 10(2), 11(6), 12(1), 13(2), 14(1), 16(1)
Dorsal plates	2	20-21	20(1), 21(1)
Mid-dorsal plates	2	17	17(2)
Median plates			
Anterior field plates†	2	3-5	3(1), 4(2), 5(1)
Gap field plates†	2	1-2	1(2), 2(2)
Posterior field plates†	2	15-16	15(3), 16 (1)
Midventral plates†	2	17-18	17(2), 18(2)
Ventral plates†	2	17-18	17(1), 18(3)
Total vertebrae	2	27	27(2)
Upper pharyngeal plate teeth†	2	18-19	18(2), 19(2)
Ceratobranchial 5 teeth	2	11	11(2)
Dorsal-fin branched rays	15	6-7	6(1), 7(14)
Pectoral-fin branched rays	15	6	6(15)
Pelvic-fin branched rays	15	5	5(15)
Anal-fin branched rays	15	5	5(15)
Caudal-fin branched rays	15	13-14	13(1), 14(14)
Dorsal procurrent rays	15	1-2	1(4), 2(11)
Ventral procurrent rays	15	1-2	1(13), 2(2)

† Counting in right and left sides.

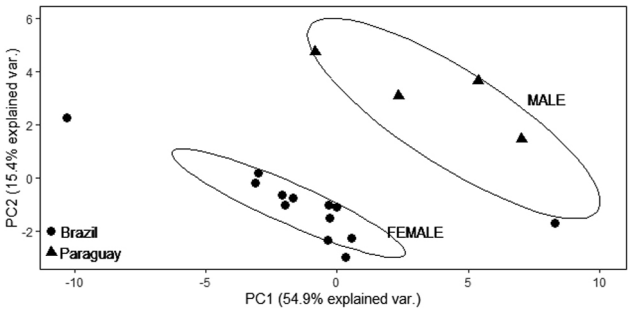

Figure 3. Principal Component Analysis (PCA) using specimens of *Otothyropsis piribebuy* from both Paraguayan (▲) and Brazilian (●) territories. The two distinct clusters represent males and females, evidencing the sexual dimorphism present in the species.

for further fieldworks in upper the rio Paraguay basin environments in order to fill gaps on the ichthyological knowledge of this drainage. This is corroborated by the prediction map of distribution to *O. piribebuy* (Fig. 4), according to which, the species probably exists in other portions of the basin.

CONCLUSION

From the registration of *O. piribebuy* in Brazilian territory, is important to included it on future checklists and consequently evaluate the conservation status of

Table 2. Morphometric data of *Otothyropsis piribebuy.* Data to holotype and paratypes were obtained from original description of the species in Calegari, Lehmann & Reis (2011). Min = minimum, Max = maximum, SD = Standard Deviation.

	Paraguayan territory							Brazilian territory			
	Holotype	Non-type = 19						New occurence = 13			
		Low	High	Min	Max	Mean	SD	Min	Max	Mean	SD
Standart lenght (mm)	28.8	22.3	28.8	20.7	23.2	21.7	—	19.9	26.7	22.7	—
Head length	35.0	33.4	37.8	32.3	36.1	34.2	2.1	35.6	41.1	37.2	1.4
Predorsal length	47.6	46.5	50.5	47.7	49.7	49.0	0.9	47.0	49.9	48.8	1.0
Postdorsal length	40.3	38.8	42.5	24.7	26.3	25.4	0.6	36.2	42.9	38.8	1.9
Preanal length	64.4	63.0	67.4	63.4	65.3	64.4	0.8	63.6	68.0	65.9	1.5
Prepelvic length	43.4	42.2	46.3	43.5	45.7	44.5	1.0	41.9	45.2	43.8	1.0
Cleithral width	23.8	22.5	26.7	20.2	21.5	21.0	0.6	23.7	25.8	24.7	0.7
Thoracic length	17.1	17.1	19.7	5.3	6.4	5.7	0.5	14.3	21.6	19.0	2.7
Abdominal length	22.4	20.8	24.3	14.4	15.5	14.9	0.5	20.1	23.9	21.4	1.1
Dorsal-fin unbranched ray length	24.8	24.8	29.8	26.0	27.3	26.5	0.6	25.3	28.7	27.1	1.1
Dorsal-fin base length	13.2	12.2	14.7	11.5	14.2	13.0	1.2	13.0	15.6	14.1	0.9
Pectoral-fin spine length	24.9	24.9	30.4	26.9	27.4	27.1	0.2	25.3	29.3	27.5	1.1
Pelvic-fin unbranched ray length	15.0	13.7	19.7	15.7	22.3	18.7	2.7	14.8	19.2	16.8	1.3
Anal-fin unbranched ray length	16.6	14.8	19.6	18.2	19.2	18.6	0.4	17.0	20.5	18.7	1.1
Caudal-peduncle length	30.0	28.1	32.3	13.1	17.8	15.5	1.9	25.7	31.0	28.8	1.8
Caudal-peduncle depth	10.1	9.7	11.5	9.7	10.9	10.4	0.5	9.2	10.6	9.7	0.4
Caudal-peduncle width	6.8	5.9	7.4	5.2	8.5	6.3	1.5	6.7	10.6	8.3	1.2
Body depth at dorsal-fin origin	15.8	15.0	19.2	16.0	19.0	17.2	1.3	14.2	16.8	15.4	0.8
Body width at dorsal-fin origin	19.5	16.2	22.7	21.5	21.9	21.7	0.2	16.2	20.8	18.1	1.4
Head depth	45.7	41.4	52.1	43.7	48.4	46.3	1.9	41.2	45.4	43.2	1.6
Snout length	50.2	47.1	53.2	48.4	54.6	51.0	2.6	46.3	52.0	49.5	1.7
Orbital diameter	12.3	12.3	15.1	17.9	19.7	18.7	0.8	15.6	18.1	17.1	0.8
Interorbital width	40.9	38.4	45.8	42.6	45.7	44.2	1.3	38.0	43.5	41.4	1.6
Internareal width	14.4	6.3	15.9	9.0	10.7	9.5	0.8	7.2	10.9	9.8	0.9
Prenasal length	35.8	28.9	36.4	28.5	30.9	29.9	1.0	29.6	34.7	31.9	1.6
Barbel length	9.2	6.4	10.9	4.6	6.7	5.9	0.9	4.9	8.7	6.3	1.2

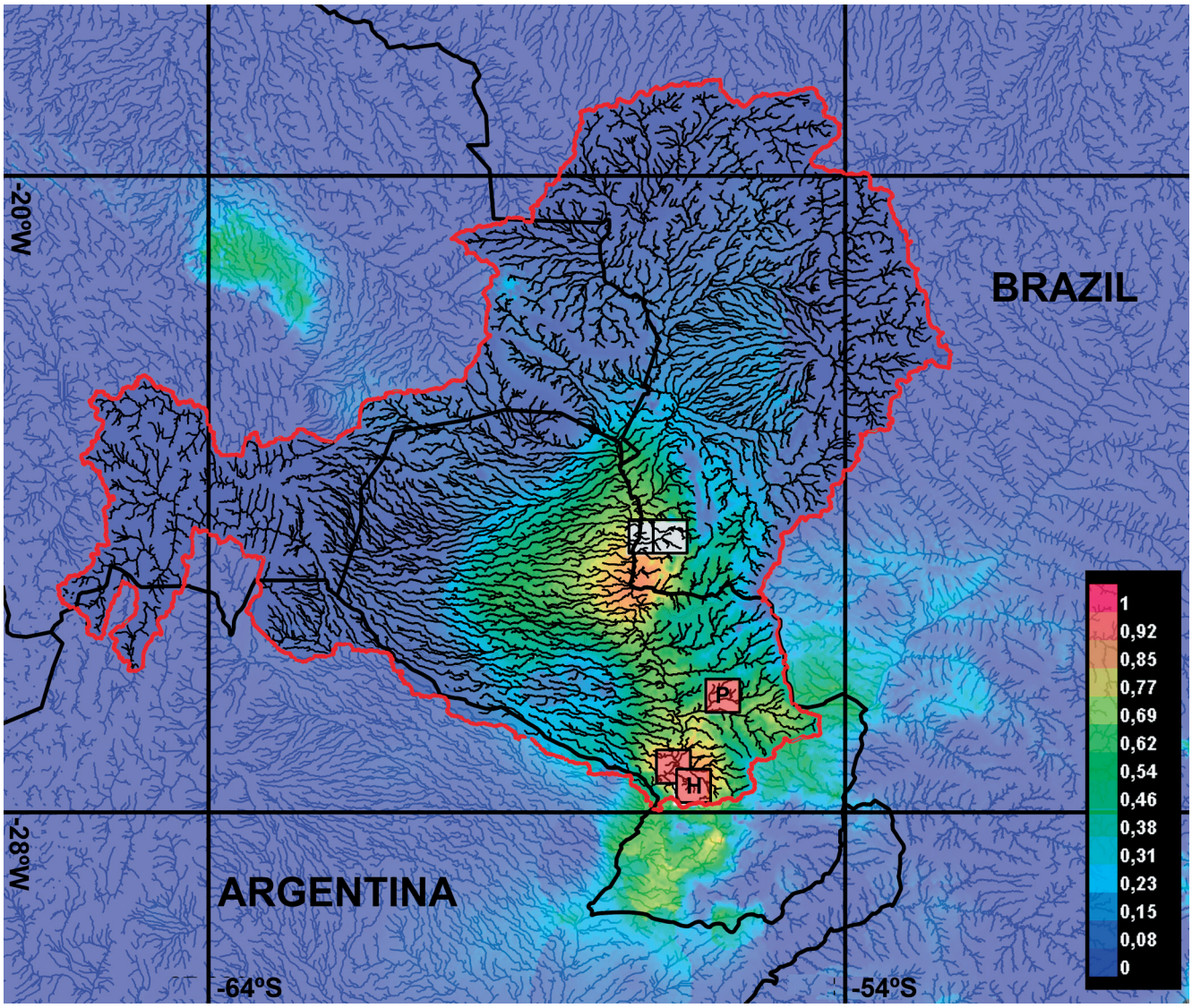

Figure 4. Prediction map of occurrence, with higher values on scale representing chances of captures. Black line: country boundaries. Red line: rio Paraguay basin limits. Red squares: Paraguayan sampling sites – holotype (H), paratypes (P), and non-type specimens examined. White squares: new occurrence in Brazilian territory.

this species in Brazil, based on the International Union for Conservation of Nature (IUCN) categories and criteria, during the next process of evaluation of species promoted by the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio).

MATERIAL EXAMINED

Otothyropsis piribebuy: MNRJ 26113, 5 (1 c&s), 20.68-23.15 mm SL; Arroio Yguarasesauna, Ypacaraí, Cordilhera, Paraguay (25°02'19"S, 57°01'00"W). ZUFMS 5717, 17, Vazante do retiro Piquete, on Farm Tereré, Porto Murtinho, Mato Grosso do Sul, Brazil (21°22'06"S, 57°42'34"W). ZUFMS 5718, 21, Rego d'água on Farm Tereré, Porto Murtinho, Mato Grosso do Sul (21°21'23"S, 57°36'45"W). ZUFMS 5795, 3, Vazante do Retiro Piquete, on Farm Tereré, Porto Murtinho, Mato Grosso do Sul, Brazil (21°22'06"S, 57°42'34"W). ZUFMS 5796, 22, Vazante do Retiro Piquete, on Farm Tereré, Porto Murtinho, Mato Grosso do Sul, Brazil (21°22'06"S, 57°42'34"W).

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