

A new unicuspid-toothed species of *Hypostomus* Lacépède, 1803 (Siluriformes: Loricariidae) from the rio Paraguai basin

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A new unicuspid-toothed armored catfish species of *Hypostomus* is described from the Bodoquena Plateau, rio Paraguai basin, Mato Grosso do Sul State, Brazil. The new species is distinguished from its congeners, with exception of *H. fonchii*, by having unicuspid teeth (vs. bicuspid teeth); from *H. fonchii* it is distinguished by having median series of lateral plates with 26-27 (vs. 28); by lower number of premaxillary and dentary teeth (7-10 vs. 18-21; 8-13 vs. 18-25, respectively); for possessing more depressed head (head depth 15.8-18.1% SL vs. 19.1-22.0% SL); and by the presence of median buccal papilla (vs. absence).

Uma espécie nova de cascudo do gênero *Hypostomus* com dentes unicuspidados é descrita da Serra da Bodoquena, bacia do rio Paraguai, estado do Mato Grosso do Sul, Brasil. A espécie nova é distinta de suas congêneres, com exceção de *H. fonchii*, pela presença de dentes unicuspidados (vs. bicuspidados); de *H. fonchii* é distinta por apresentar a série mediana de placas laterais com 26-27 (vs. 28); pelo menor número de dentes pré-maxilares e no dentário (7-10 vs. 18-21; 8-13 vs. 18-25, respectivamente); por possuir cabeça mais deprimida (altura da cabeça 15.8-18.1% CP vs. 19.1-22.0% CP) e pela presença de papilas bucais medianas (vs. ausência).

Key words: Armored catfish, Bodoquena Plateau, Cascudo, Hypostominae, Taxonomy.

Introduction

Hypostomus Lacépède is the most species-rich genus of the Loricariidae, which currently comprises 130 valid species (Garavello *et al.*, 2012; Zawadzki *et al.*, 2013). There are 11 nominal valid species described from the rio Paraguai basin: *H. cochliodon* (Kner), *H. ternetzi* (Boulenger), *H. borellii* (Boulenger), *H. boulengeri* (Eigenmann & Kennedy), *H. latirostris* (Regan), *H. variostictus* (Miranda Ribeiro), *H. latifrons* Weber, *H. piratatu* Weber, *H. mutuae* Knaack, *H. peckoltoides* Zawadzki, Weber & Pavanelli, and *H. careopinnatus* Martins, Marinho, Langeani & Serra. In addition, *H. regani* (Ihering), originally described from the upper rio Paraná basin also occurs in the upper rio Paraguai basin (Weber *et al.*, 1992; Veríssimo *et al.*, 2005; Zawadzki, Renesto, Peres & Paiva, 2008).

The Bodoquena region is drained by the Apa, Formoso, Formosinho, Perdido, Miranda, rio do Peixe, Salobra, and Sucuri rivers, all part of the rio Paraguai basin (Boggiani,

1999; Salles *et al.*, 2006). According to Boggiani (1999) some of those rivers flow through calcareous terrain resulting in a low turbidity and very clear waters. The region is known for its large aquatic biodiversity and endemism (Scremin-Dias *et al.*, 1999). Sabino & Trajano (1997) described *Ancistrus formoso*, an albino cave dwelling armored catfish and, then, ten years later Ribeiro *et al.* (2007) published the discovery of a new characin *Oligosarcus perdido* from that region.

Examination of specimens of the genus *Hypostomus* from the rio Perdido, a tributary to rio Apa of the rio Paraguai basin, revealed a population with an unusual pattern of unicuspid teeth. The aim of this paper is to establish it as a new species of *Hypostomus* from the Bodoquena Plateau.

Material and Methods

Measurements were made with digital calipers to the nearest 0.1 mm. Methodology and terminology for measurements

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follow Boeseman (1968) with modifications by Weber (1985) and Zawadzki *et al.* (2008). Plate counts and nomenclature follow Schaefer (1997), with the modifications of Oyakawa *et al.* (2005). Vertebral counts were taken on cleared-and-stained (c&s) specimens, according to Taylor & Van Dyke (1985) procedures. The vertebral complex of the Weberian apparatus and the compound caudal centrum were counted as a single element (Lundberg & Baskin, 1969). Osteological nomenclature follows Schaefer (1987). Standard length (SL) is expressed in millimeters; some measures are expressed as percents of SL; some as percents of head length (HL) and additionally, some other percents are according to Zawadzki *et al.* (2010). Meristic and morphometric ranges of the type series of *Hypostomus fonchii* Weber & Montoya-Burgos cited in the diagnosis section of the present work are from Weber & Montoya-Burgos (2002). In Table 1, range is composed by the minimum and maximum values of the holotype, plus 19 paratypes. Institutional abbreviations are: ANSP, Academy of Natural Sciences of Drexel University, Philadelphia; BMNH, Natural History Museum, London; CPUFMT, Coleção de Peixes da Universidade Federal do Mato Grosso, Cuiabá; INPA, Instituto Nacional de Pesquisas da Amazônia, Manaus; MCP, Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre; MHNG, Museum d'histoire naturelle, Geneva; MNHN, Muséum National d'histoire naturelle, Paris; MNRJ, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro; MZUSP, Museu de Zoologia, Universidade de São Paulo, São Paulo; NUP, Coleção Ictiológica do Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura da Universidade Estadual de Maringá, Maringá; RMNH, Naturalis Biodiversity Center, Leiden; UMSS, Universidad Mayor de San Simón, Cochabamba; ZSM, Zoologische Staatssammlung München, Munich; ZUEC, Museu de Zoologia da Universidade Estadual de Campinas "Adão José Cardoso", Campinas; ZUFMS-PIS, Coleção Zoológica de Referência da Universidade Federal de Mato Grosso do Sul, Campo Grande.

Results

Hypostomus perdido, new species

Figs. 1-2a,c

Hypostomus sp. 2-Rio Perdido NUP 4249: Cereali *et al.*, 2008: 587 (cytogenetic data, karyotype).

Holotype. MZUSP 111064, 159.1 mm SL, Brazil, Mato Grosso do Sul, Bodoquena, rio Paraguai basin, rio Perdido, 21°17'09"S 56°41'47"W, 8 Sep 2005, O. Froehlich.

Paratypes. All collected with the holotype (61 specimens). ANSP 193370, 2, 163.6-171.3 mm SL. CPUFMT 1500, 2, 152.5-170.3 mm SL. INPA 37689, 1, 144.4 mm SL. MCP 47141, 2, 133.9-147.9 mm

SL. MNRJ 40094, 2, 126.0-153.1 mm SL. NUP 12143, 10, 136.4-166.3 mm SL. NUP 12144, 18, 109.1-152.4 mm SL. NUP 14406, 1 c&s, 124.0 mm SL. ZSM 41828, 1, 149.5 mm SL. ZUEC 7254, 2, 140.2-141.7 mm SL. ZUFMS-PIS 1468, 20, 126.6-181.0 mm SL.

Diagnosis. *Hypostomus perdido* is distinguished from all congeners, except *H. fonchii*, by having unicuspid teeth (vs. bicuspid teeth). From *H. fonchii* it is distinguished by having fewer dermal plates in the median series of lateral plates (26-27 vs. 28), fewer premaxillary teeth (7-10 vs. 18-21), fewer dentary teeth (8-13 vs. 18-25), a more depressed head (head depth 15.8-18.1% in SL vs. 19.1-22.0%), and by the presence of median buccal papilla (vs. its absence).

Description. Measurements and counts in Table 1. Dorsal profile of head convex from tip of snout to supraoccipital posterior end; straight from that point to dorsal-fin origin. Head elevated and compressed. Snout narrow and compressed, covered by irregular series of several small plates. Mesethmoid forming conspicuous bulge from snout tip to nares. Upper orbital margin not elevated. Eye laterodorsally positioned. Interorbital region wide and flat in frontal view. Very slender keel on upper portion of pterotic-supracleithrum just posterior to orbit. Opercle considerably large and somewhat ellipsoidal; its horizontal length similar to orbital diameter; odontodes slightly larger on posterior margin. Predorsal region almost flat; usually with one single larger plate surrounding supraoccipital followed by two narrow plates in front of dorsal-fin spinelet. Dorsal profile of trunk tapering straight from dorsal-fin insertion to caudal peduncle posterior portion; ascending to caudal fin. Adipose fin long, almost same length of minimum caudal peduncle depth. Maximum body width at region of dorsal-fin origin; profile gradually tapering from this point to caudal fin. Caudal peduncle somewhat ellipsoid in cross-section; dorsal and ventral caudal peduncle region slightly flattened.

Dorsal fin II,7; distal margin slightly convex to straight; origin at vertical two plates before pelvic-fin insertion; adpressed rays not reaching adipose-fin spine. Pectoral fin I,6; distal margin straight and almost reaching from one-third to half pelvic-fin length, odontodes more developed on distal dorsal region. Pelvic fin I,5; distal margin straight to slightly convex; distal portion of unbranched pelvic-fin ray reaching or slightly surpassing anal-fin insertion when adpressed to body. Anal fin I,5; distal border rounded. Caudal fin I,14,I, posterior margin truncate to slight emarginated; lower lobe slightly longer than upper lobe. Vertebrae 27; ribs 9, first rib relatively larger than others.

Dorsal and lateral surface of head and body covered with dermal plates, except snout tip and area surrounding dorsal-fin base. Plates on lateral margin of head, from snout tip to pterotic-supracleithrum small and irregular. Five lateral

series of plates on trunk. Dorsal, mid-dorsal, median, mid-ventral and ventral series without keels. Lateral line complete on median lateral series. Mid-ventral series moderately

bent on anterior portion. Ventral region of body with small platelets bearing odontodes, except area beneath lower lip, insertion of pectoral and pelvic fins, and anterior region of



Fig. 1. *Hypostomus perdido*, holotype, MZUSP 111064, 159.1 mm SL, Brazil, Mato Grosso do Sul State, Bodoquena, rio Paraguai basin, rio Perdido. Dorsal (top), lateral (middle), and ventral (bottom) views.

anus. Naked areas reduced on larger specimens. Lips round; covered with dense papillae, which decrease in size to distal border. Median buccal papilla *sensu* Armbruster (2003, fig. 3) present. Buccal skin internally bordering premaxilla and dentary with unorganized series of flat enlarged papillae (Fig. 2a,c). Maxillary barbel elongate and proximately joined to labial border by membrane; distal tip free. Premaxilla with 7 to 10 teeth, dentary 8 to 13 teeth; teeth robust, moderate in length, unicuspid, crown short and continuous to stalk (without notch between stalk and crown). Dentary rami straight and angled 82 to 94° from each other ($n = 20$ specimens; mean = 85.8°).

Color in alcohol. Dorsal ground color of body and fins

grayish brown. Trunk and fins densely covered by faint darker spots; spots smaller on head and larger on fins and posterior portions of body. All spines and unbranched-fin rays with spots. Dorsal, pectoral, and pelvic fins with one series of spots on each interradiation membrane. Dorsal-fin spots usually larger than spots in remaining fins and usually aligned to form five to seven horizontal bands; spots mottled in some specimens. Anal-fin spots more faded than remaining fin spots. Abdominal region pale yellowish. Ventral surface of body and paired fins spotless.

Distribution. The new species is known from its type locality, the rio Perdido, tributary to the rio Apa, rio Paraguai basin, Mato Grosso do Sul State, Brazil (Fig. 3).

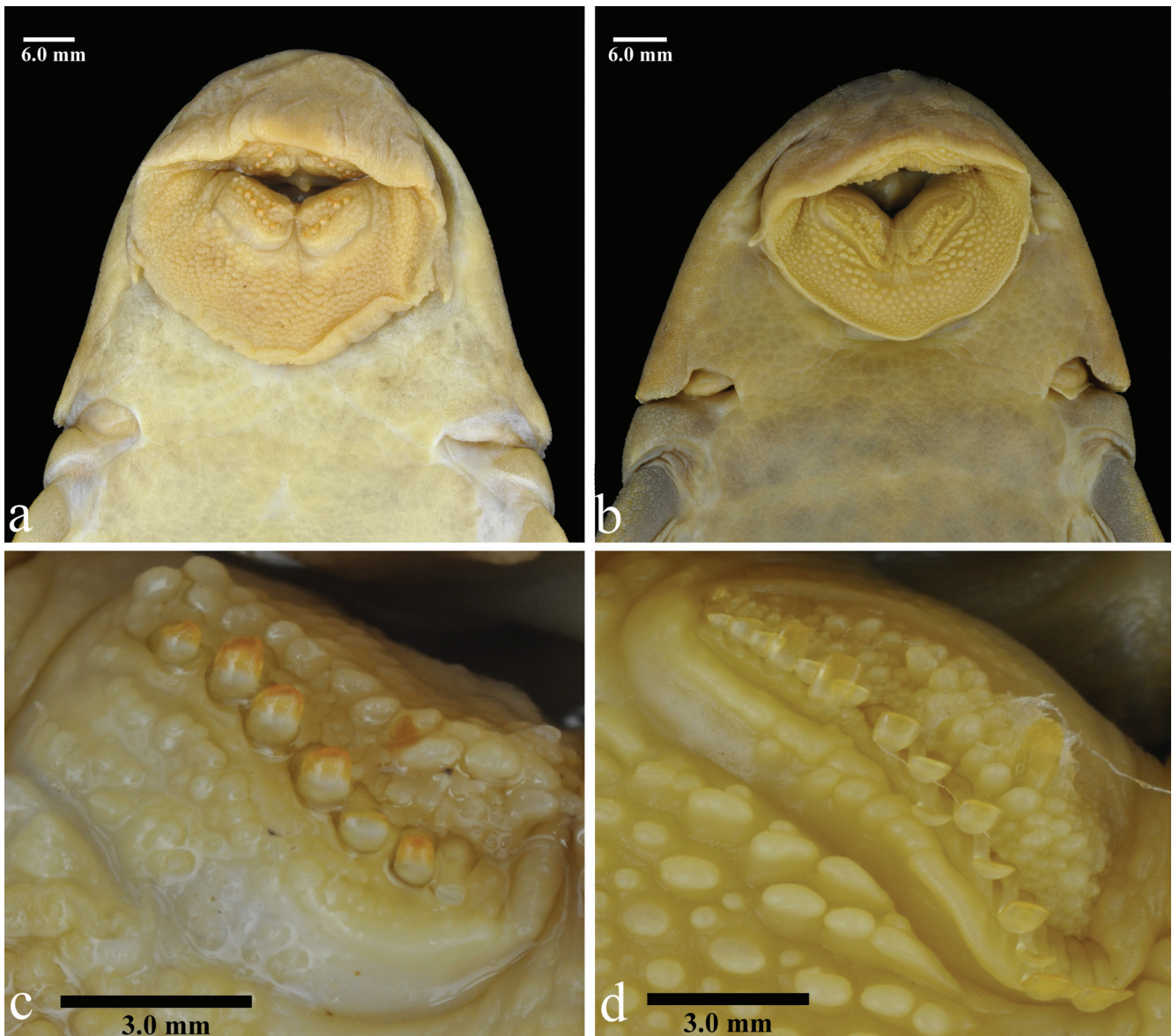


Fig. 2. Mouth and right dentary close up of *Hypostomus perdido*, paratype, CPUFMT 1500, 170.3 mm SL (a and c) and of *Hypostomus fonchii* UMSS 00360, 154.0 mm SL (b and d), respectively.

Table 1. Morphometric data and counts of *Hypostomus perdido*. SD = standard deviation; N = holotype plus 19 specimens.

	Holotype	Range	Mean/SD
Standard length	159.1	137.3-171.3	154.6 ± 10.1
Percents of standard length			
Predorsal length	37.0	36.1-39.2	37.7 ± 0.9
Head length	30.1	28.7-31.6	30.4 ± 0.8
Cleithral width	25.9	25.9-27.9	27.1 ± 0.6
Head depth	16.8	15.8-18.1	17.0 ± 0.7
Interdorsal length	16.3	14.9-18.7	16.5 ± 0.9
Thoracic length	21.3	17.4-25.1	20.9 ± 0.9
Abdominal length	24.1	21.7-25.3	23.5 ± 0.9
Dorsal-fin spine length	26.1	23.4-29.7	26.8 ± 1.6
Pectoral-fin spine length	26.6	26.2-29.0	27.7 ± 0.7
Pelvic-fin unbranched ray length	23.4	23.0-26.2	24.7 ± 0.8
Caudal-peduncle length	34.3	30.0-35.8	33.5 ± 1.1
Caudal-peduncle depth	9.0	8.6-10.1	9.3 ± 0.3
Percents of head length			
Cleithral width	89.8	84.3-94.8	89.4 ± 2.4
Head depth	55.7	52.3-60.2	56.0 ± 2.0
Snout length	63.5	60.2-67.4	62.8 ± 1.6
Orbital diameter	15.7	15.1-17.8	16.1 ± 0.6
Interorbital width	36.7	32.7-39.3	36.1 ± 1.8
Mandibullary width	13.2	13.2-18.4	15.6 ± 1.4
Other percents			
Orbital diameter in snout length	24.7	24.7-27.1	25.8 ± 1.0
Orbital diameter in interorbital width	42.6	42.6-47.3	44.8 ± 2.0
Mandibullary width in interorbital width	35.8	35.8-46.9	40.5 ± 5.0
First dorsal-fin spine length in predorsal length	70.6	69.7-75.4	71.5 ± 2.7
First pectoral-fin spine length in predorsal length	72.1	72.1-75.4	74.3 ± 1.5
Lower caudal-fin unbranched ray length in predorsal length	85.2	81.2-88.3	85.2 ± 3.0
Adipose-fin spine length in caudal-peduncle depth	96.5	96.5-105.9	99.7 ± 4.2
Caudal-peduncle depth in caudal-peduncle length	26.2	26.2-29.1	27.5 ± 1.2
Mandibullary width in cleithral width	14.7	14.7-19.2	16.4 ± 2.0
Interdorsal length in dorsal-fin base length	67.7	62.7-73.3	67.9 ± 4.6
Lower lip width in lower lip length	35.5	31.1-42.6	36.0 ± 4.8
Counts			
	Holotype	Range	Mode
Median plate series	26	26-27	26
Predorsal plates	3	3	3
Plates bordering supraoccipital	1	1	1
Dorsal plates below dorsal-fin base	7	7	7
Plates between dorsal and adipose fin	8	6-8	7
Plates between adipose and caudal fin	7	7-8	7
Plates between anal-fin base and caudal fin	11	11	11
Premaxillary teeth	8	7-10	9
Dentary teeth	8	8-13	10

Ecological notes. The upper 50 km of the rio Perdido flows from elevations of 550 m to 350 m through the calcareous Bodoquena Plateau. It initially flows to the southeast, passes about 2 to 3 km as subterranean portion, then turns roughly southwards and bisects the Parque Nacional da Serra da Bodoquena, where the river flows confined in open folds of the Paraguai Fold Belt. Then the river turns to the southwest, descends the plateau escarpments and flows 250 km further before discharging in the rio Apa, at roughly 100 m altitude. In the plateau, the river is 10 to 12 m wide and is dammed by several calcareous tufa deposits, some of them forming waterfalls from one to five meters high. The dammed sections can be as deep as 12 m, with vertical rock banks and very slow flow; the substrate is a whitish calcareous clay on which lay many submerged logs, branches and even whole trees. The water is very clear throughout the dry season. However, transparency is significantly reduced in the rainy season,

mainly due to suspended clay. Specimens of *Hypostomus perdido* were collected in stretches of sluggish to still waters.

Etymology. The specific name *perdido* alludes to the type locality rio Perdido. From the Portuguese “perdido”, which means lost. An adjective nominative, masculine, and singular.

Discussion

The unusual teeth morphology of *Hypostomus perdido* distinguishes the new species not only from its congeners from the rio Paraguai basin, but from nearly all species of the genus. The only exception is *H. fonchii*, described from the west tributaries to the middle rio Ucayali in Peru, which also has unicuspid teeth (Fig. 2b and 2d). *Hypostomus fonchii* (Fig. 4) also inhabits Bolivian streams flowing to the rio Mamoré. Despite the tooth similarity, *H. perdido* is more depressed than

H. fonchii, has less dermal plates on the median series and less teeth on premaxilla and on dentary. Weber & Montoya-Burgos (2002) addressed *H. fonchii* to the *H. cochliodon* group due to its unicuspid tooth pattern. Armbruster (2003) noted that the species of *H. cochliodon* group did not possess unicuspid teeth but bicuspid teeth with lateral cusp usually fused to mesial cusp and rejected a close relationship with *H. fonchii* because the body morphology did not agree with the typical body shape of the members of the *H. cochliodon* group. Armbruster (2003) also commented that specimens of *H. fonchii* were not examined by him, in that work. Herein, we verified the tooth morphology of *H. fonchii* finding clearly unicuspid teeth, but it is anyway much slender than the teeth of *H. perdido*.

Montoya-Burgos *et al.* (2002) performed a phylogenetic analysis based on mitochondrial D-loop sequences data and recovered *Hypostomus fonchii* within the *H. cochliodon* group of species, corroborating the initial proposition of Weber & Montoya-Burgos (2002). The position of *H. fonchii* within the *H. cochliodon* group of species was also maintained in Montoya-Burgos (2003). Therefore, we consider *H. fonchii* somewhat morphologically compatible with the *H. cochliodon* group species. Contrary to *H. fonchii*, *H. perdido* indeed does not resemble representatives of the *H. cochliodon* group of species, since it possesses slender body (*vs.* robust) and

rounded snout (*vs.* triangular). In addition, the new species presents dentary rami angled to each other from 82 to 94° *versus* less than 80° in the species of the *H. cochliodon* group. To elucidate the phylogenetic relationships of the new species a cladistic analysis based on morphological and/or molecular data would be necessary. However, considering the aforementioned differences, it would be plausible that unicuspid teeth character had arisen independently.

Cytogenetic data are already available to *Hypostomus perdido*. The species was named as “*Hypostomus* sp 2-Rio Perdido NUP 4249” by Cereali *et al.* (2008). Except *H. perdido*, the diploid number in *Hypostomus* ranges from 54 to 82 (Bueno *et al.*, 2012). Cereali *et al.* (2008) found *H. perdido* with 84 chromosomes ($2n = 84$), as the greatest diploid number known in *Hypostomus* (Martinez *et al.*, 2011; Rubert *et al.*, 2011; Endo *et al.*, 2012; Bueno *et al.*, 2013).

Comparative material. *Hypostomus ancistroides*. **Brazil.** São Paulo State. Rio Paraná basin. MZUSP 2131, 4, 95.6-165.1 mm SL, rio Tatuí. *Hypostomus borellii*. **Bolivia.** Rio Paraguai basin. BMNH 1897.1.27.19, 1, 153.1 mm SL, syntype, rio Pilcomayo. *Hypostomus boulengeri*. **Brazil.** Mato Grosso State. Rio Paraguai basin. NUP 414, 3, 165.8-175.6 mm SL; NUP 3273, 8, 110.0-166.0 mm SL; NUP 8695, 1, 170.0 mm SL, rio Manso. NUP 1078, 2, 210.0-220.0 mm SL, rio Manso Reservoir. NUP 8692, 1, 190.0

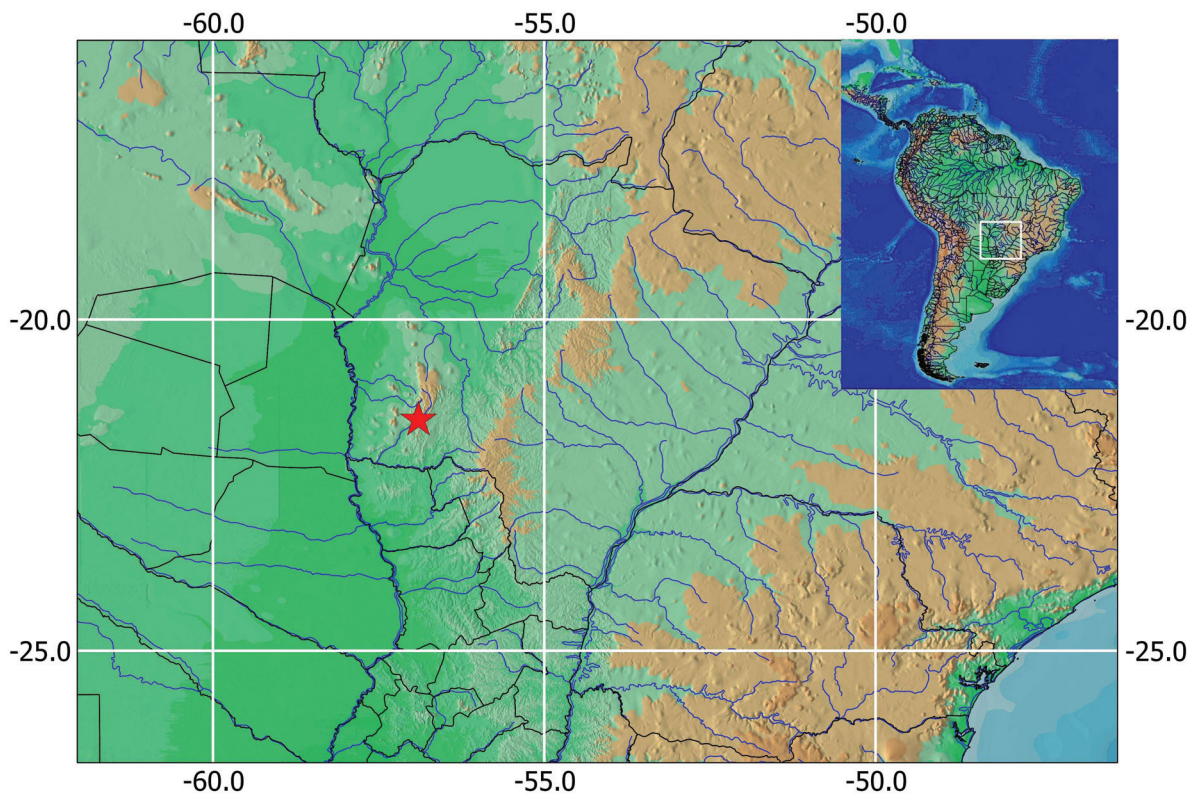


Fig. 3. Distribution of *Hypostomus perdido*. Red star symbol represents its type locality, the rio Perdido, rio Paraguai basin, Mato Grosso do Sul State, Brazil. Inset in the right upper corner highlights the area into a South American perspective.



Fig. 4. Lateral view of *Hypostomus fonchii*, UMSS 00360, 154.0 mm SL, río Chipiriri, río Mamoré basin, Bolivia.

mm SL, río Quilombo. *Hypostomus careopinnatus*. **Brazil.** Mato Grosso State. Rio Paraguai basin. NUP 11257, 5, 30.2-53.8 mm SL, paratypes, tributary of rio Ariranha. *Hypostomus cochliodon*. **Brazil.** Mato Grosso State. Rio Paraguai basin. NUP 2274, 2, 42.2-200.4 mm SL; NUP 3602, 1, 153.8 mm SL; NUP 2274, 2, 42.2-200.4 mm SL, rio Manso. *Hypostomus commersoni*. **Uruguay.** Montevideo Department. Río de La Plata basin. MNHN A.9444, 1, 425.00 mm SL, holotype, río de la Plata. *Hypostomus dlouhyi*. **Paraguay.** Alto Paraná Department. Río Paraná basin. MHNG 2229.43, 1, 139.5 mm SL, holotype, río Yguazú. *Hypostomus fonchii*. **Bolivia.** Río Mamoré basin. UMSS 00360, 1, 154.0 mm SL, río Chipiriri. **Peru.** San Martin Department. Río Ucayali basin. MHNG 2613.066, 141.0 mm SL, holotype, Quebrada John, near mouth of río Pauya. *Hypostomus laplatae*. **Argentina.** Río de La Plata basin. BMNH 1908.8.29.17, 1, 207.3 mm SL, río de La Plata. *Hypostomus latifrons*. **Brazil.** Mato Grosso State. Rio Paraguai basin. NUP 1039, 3, 240.0-260.0 mm SL, rio Manso Reservoir. NUP 3405, 1, 270.0 mm SL, Sinhá Mariana bay. **Paraguay.** Presidente Hayes Department. Río Paraguai basin. MHNG 2256.67, 228.2 mm SL, holotype, río Araguay-guazú. *Hypostomus latirostris*. **Brazil.** Mato Grosso State. Rio Paraguai basin. BMNH 1892.4.20.26-27, 2, 137.2-159.3 mm SL, syntypes, rio Jangada. NUP 12203, 1, 113.0 mm SL, rio Casca. NUP 12204, 1, 55.0 mm SL, rio Manso. NUP 12205, 2, 75.0-120.0 mm SL, rio Cuiabá; NUP 12206, 1, 104.0 mm SL, rio Palmeiras; NUP 12323, 1, 109.0 mm SL, rio Cuiabazinho. *Hypostomus microstomus*. **Paraguay.** Itapua Department. Río Paraná basin. MHNG 2367.90, 197.5 mm SL, holotype, río Paraná. *Hypostomus mutucaae*. **Brazil.** Mato Grosso State. Rio Paraguai basin. MCP 28669, 67.7 mm SL, holotype, rio Mutuca. NUP 6641, 13, 52.4-109.2 mm SL; NUP 6642, 4, 62.1-98.1 mm SL, rio Claro. *Hypostomus nigromaculatus*. **Brazil.** São Paulo State. Rio Paraná basin. MZUSP 22674, 9, 43.8-75.9 mm SL, cachoeira de Emas, rio Mogi-Guaçu. *Hypostomus paranensis*. **Argentina.** Cordoba Department. Río Paraná basin. BMNH 1878.4.4.1, 178.3

mm SL, holotype of *Plecostomus cordovae*, río Paraná. MZUSP 23805, 6, 47.5-111.3 mm SL, rio Segundo, Pilar, rio Paraguay basin. *Hypostomus peckoltoides*. **Brazil.** Mato Grosso State. Rio Paraguai basin. NUP 5216, 2, 88.9-92.8 mm SL; NUP 5217, 3, 85.5-98.2 mm SL; MZUSP 105226, 110.7 mm SL, holotype, rio Cuiabá. *Hypostomus piratatu*. **Paraguay.** Paraguari Department. Río Paraguay basin. MHNG 2265.03, 214.0 mm SL, holotype, rio Paraguai. *Hypostomus plecostomus*. **Suriname.** RMNH 18240, 1, 121.4 mm SL, Suriname Rivier. *Hypostomus regani*. **Brazil.** Mato Grosso State. Rio Paraguai basin. NUP 1032, 3, 260.0-270.0 mm SL, Manso Reservoir. NUP 7917, 3, 92.0-107.0 mm SL, rio Ariranha. NUP 8325, 1, 130.0 mm SL, córrego Roncador. Mato Grosso do Sul State. Rio Paraguai basin. NUP 9820, 2, 129.5-37.7 mm SL, córrego da Onça. São Paulo State. Rio Paraná basin. BMNH 1905.6.7.3, 174.2 mm SL, holotype, rio Piracicaba. *Hypostomus ternetzi*. **Brazil.** Mato Grosso State. Rio Paraguai basin. BMNH 1895.5.17.64, 210.2 mm SL, holotype, rio Paraguai.

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