



# Description and phylogenetic position of a new species of *Rhyacoglanis* (Siluriformes: Pseudopimelodidae) from the Jamanxim River basin

Correspondence:  
Jefferson Luan Crispim-Rodrigues  
jefferson.crispim@unesp.br

Jefferson Luan Crispim-Rodrigues<sup>1</sup>, Gabriel de Souza da Costa e Silva<sup>1,2</sup>,  
 Oscar Akio Shibatta<sup>3</sup>, Mariana Kuranaka<sup>1</sup> and Claudio Oliveira<sup>1</sup>

Submitted May 13, 2023

Accepted July 13, 2023

by Carlos DoNascimento

Epub August 21, 2023

In this study, a new species of *Rhyacoglanis* is described from the Jamanxim River basin, Tapajós River basin. The new species differs from congeners based on the combination of the following diagnostic characters: two oblique dark bands formed by an agglomerate of melanophores on the predorsal region; dorsal confluence between the dark subdorsal and subadipose bands in large juveniles and adults; ventral confluence between the dark subadipose and caudal peduncle bands; body without conspicuous dark brown spots; complete dark band on caudal peduncle; body with three dark bands; a thin dark caudal-fin band; pectoral-fin spine with anterior serrae distributed along the entire margin; the posterior tip of the post-cleithral process reaching vertical through the base of the dorsal-fin spine; and hypural 5 free of hypural 3 and 4 and pointed caudal-fin lobes. Additionally, our molecular phylogenetic results using ultraconserved elements (UCEs) corroborate the new species as *Rhyacoglanis* and sister to an undescribed species of *Rhyacoglanis* from the Xingu River basin. Moreover, as pointed out in previous studies, we confirm *Cruciglanis* as a sister group to *Pseudopimelodus* plus *Rhyacoglanis*.

**Keywords:** Amazon basin, Bumblebee catfishes, Phylogenomic, South America region, Pseudopimelodinae.



Online version ISSN 1982-0224

Print version ISSN 1679-6225

Neotrop. Ichthyol.

vol. 21, no. 3, Maringá 2023

<sup>1</sup> Laboratório de Biologia e Genética de Peixes, Setor Morfologia, Universidade Estadual Paulista “Júlio de Mesquita Filho”, Instituto de Biociências da Unesp de Botucatu, R. Celso Wagner Zanin, s/n, Rubião Júnior, 18618-970 Botucatu, SP, Brazil. (JLCR) jefferson.crispim@unesp.br (corresponding author), (GSCS) gabriel\_biota@hotmail.com, (MK) mariana.kuranaka@unesp.br, (CO) claudio.oliveira@unesp.br.

<sup>2</sup> Department of Ichthyology, The Academy of Natural Sciences of Drexel University, 1900, Benjamin Franklin Parkway, 19103-1195, Philadelphia, PA, USA.

<sup>3</sup> Museu de Zoologia, Departamento de Biologia Animal e Vegetal, Universidade Estadual de Londrina, Centro de Ciências Biológicas, Rodovia Celso Garcia Cid, 86057-970 Londrina, PR, Brazil. (OAS) oscar.shibatta@gmail.com.

Neste estudo, uma nova espécie de *Rhyacoglanis* é descrita para a bacia do rio Jamanxim, bacia do rio Tapajós. A nova espécie difere de congêneres com base na combinação dos seguintes caracteres diagnósticos: duas faixas escuras oblíquas formadas por um aglomerado de melanóforos na região predorsal, confluência dorsal entre as faixas subdorsais escuras e subadiposas em adultos grandes, confluência ventral entre as faixas subadiposas escuras e do pedúnculo caudal em adultos grandes, corpo sem manchas escuras proeminentes de cor marrom, faixa escura completa no pedúnculo caudal, corpo com três faixas escuras e uma fina faixa escura na nadadeira caudal, espinho da nadadeira peitoral com serrilhas anteriores distribuídas ao longo de toda a margem, extremidade posterior do processo pós-cleitoral atingindo verticalmente a base do espinho da nadadeira dorsal, hipural 5 livre dos hipurais 3 e 4 e lobos da nadadeira caudal pontiagudos. Adicionalmente, nossos resultados filogenéticos moleculares utilizando elementos ultraconservados (UCEs) corroboram a nova espécie como *Rhyacoglanis* é irmã de uma espécie não descrita de *Rhyacoglanis* da bacia do rio Xingu. Além disso, como apontado em estudos anteriores, confirmamos que *Cruciglanis* é um grupo irmão de *Pseudopimelodus* mais *Rhyacoglanis*.

**Palavras-chave:** América do Sul, Bacia Amazônica, Bagrinho-abelha, Filogenômica, Pseudopimelodinae.

## INTRODUCTION

Pseudopimelodidae, a Neotropical catfish family, is characterized by a wide mouth; small eyes without a free orbital margin; pectoral spine serrated anteriorly and posteriorly; and short barbels (Shibatta, 1998, 2003). Recent phylogenetic studies have recovered the monophyly of Pseudopimelodidae (Shibatta, Vari, 2017; Rangel-Mendrano *et al.*, 2021; Silva *et al.*, 2021) and classified this group into two subfamilies (Silva *et al.*, 2021): Batrochoglaninae, composed by the genera *Lophiosilurus* Steindachner, 1876 (= *Cephalosilurus* Haseman, 1911), *Microglanis* Eigenmann, 1912, *Batrochoglanis* Gill, 1858, and Pseudopimelodinae, composed by *Cruciglanis* Ortega-Lara & Lehmann, 2006, *Pseudopimelodus* Bleeker, 1858, and *Rhyacoglanis* Shibatta & Vari, 2017.

*Rhyacoglanis* is a rheophilic genus of Pseudopimelodidae, living in rapids and other swift-flowing waters associated with rock bottoms. The species are distributed across Venezuela, Ecuador, Bolivia, and Brazil along Orinoco, Amazonas, and Paraná-Paraguay river basins (Shibatta, Vari, 2017; Shibatta *et al.*, 2021). The genus is distinguished from all other pseudopimelodids by three synapomorphies: a light blotch on the cheek, a connection between the middle of the dark caudal-fin stripe and the dark caudal peduncle pigmentation, and 30–35 total vertebrae (Shibatta, Vari, 2017).

Currently, the genus has eight valid species: *Rhyacoglanis annulatus* Shibatta & Vari, 2017 from Orinoco River basin, *R. epiblepsis* Shibatta & Vari, 2017 from Madeira River basin, *R. paranensis* Shibatta & Vari, 2017 from Paraná River basin, *R. pulcher* (Boulenger, 1887) from western Amazonian basin, *R. rappydanielae* Shibatta, Rocha & Oliveira, 2021 from the lower Tocantins River basin, *R. seminiger* Shibatta & Vari, 2017

from Juruena River, Tapajós basin, *R. varii* Shibatta & Souza-Shibatta, 2023 from the upper Tocantins basin and *R. variolosus* (Miranda Ribeiro, 1914) from Taquary River, Paraguay basin (Shibatta, Vari, 2017; Shibatta *et al.*, 2021).

Phylogenetic studies have corroborated the monophyly of *Rhyacoglanis* (Shibatta, Vari, 2017; Silva *et al.*, 2021). Based on morphology, the hypothesis proposed by Shibatta, Vari (2017) recovered *R. paranensis* sister to all other remaining *Rhyacoglanis* species that diverged into two sister clades, one composed of *R. epiblepsis* and *R. annulatus*, and the other with *R. seminiger* and *R. pulcher*. Alternatively, in the hypothesis based on molecular data (Silva *et al.*, 2021), *R. pulcher* is the sister group of the other species of *Rhyacoglanis*, forming a clade where *R. paranensis* is the sister to *R. seminiger* plus an undescribed species of *Rhyacoglanis* from Xingu River basin. In a recent expedition in the Jamaxim River, a new Amazonian *Rhyacoglanis* species was discovered and described here.

## MATERIAL AND METHODS

**Molecular analysis.** DNA extraction and sequencing were followed Silva *et al.* (2021) in this study. Sequences of the new species of *Rhyacoglanis*, *Pseudopimelodus bufonius* (Valenciennes, 1840), and *P. charus* (Valenciennes, 1840) were added to the data matrix Silva *et al.* (2021) (Tab. S1), which contained 33 terminal taxa of Pseudopimelodidae and 18 related taxa.

After sequencing, adapter contamination, low-quality bases, and sequences containing ambiguous base calls were trimmed using the Illuminaprocessor software pipeline developed by Faircloth *et al.* (2013). After trimming, we assembled Illumina reads into contigs on a species-by-species basis using the Velvet pipeline (Zerbino, Birney, 2008). We then used a custom Python program (match\_contigs\_to\_probes.py) implemented in PHYLUCE (Faircloth, 2016), integrating LASTZ (Harris, 2007) to align species-specific contigs to the probeUCE set. This last program creates a relational dataset of matches to UCEs loci by taxon. We then used the get\_match\_counts.py program (also included in PHYLUCE) to query the database and generate fasta files for UCE loci identified across all taxa. A custom Python program (seqcap\_align\_2.py) was then used to align contigs using the MUSCLE algorithm (Robert, 2004) and to perform edge trimmings (*i.e.*, cutting edges of each alignment, eliminating highly variable and saturated regions).

We analyzed the Pseudopimelodidae dataset using maximum likelihood (ML; RAxML v8; Stamatakis, 2014). For this analysis, we used the Partition-UCE (Tagliacolo, Lanfear, 2018) and performed model selection in PartitionFinder (Lanfear *et al.*, 2012). Ten alternative runs using the GTRGAMMA model and distinct parsimony-starting trees were performed to find the best ML tree. Pseudo-replicates applied the autoMRE function for the extended majority-rule consensus tree criterion available in RAxML v8 (Stamatakis, 2014) to assess bootstrap support for branches. This option allows tests for bootstrap convergence, determining if pseudo-replicates are getting stable support values (Pattengale *et al.*, 2010).

**Morphological analysis.** Morphological analysis was obtained with digital calipers to the nearest 0.1 mm, measuring variables point to point, following measurements proposed in Shibatta, Vari (2017). The second ray of the dorsal fin and the first ray of the pectoral fin, which were modified into spines, were included in counts as “I” and the first unbranched pelvic, anal, and caudal-fin rays as “i”. Type series were deposited at MZUSP (Museu de Zoologia, Universidade de São Paulo, São Paulo), MZUEL (Museu de Zoologia, Universidade Estadual de Londrina, Londrina), and LBP (Laboratório de Biologia e Genética de Peixes, Universidade Estadual Paulista “Júlio de Mesquita Filho”, Botucatu). Head laterosensory pores were identified, according to Shibatta (2019). For osteological counts, we stained and cleared one specimen following the procedures proposed by Taylor, Van Dyke (1985), and the bones’ nomenclature followed Shibatta (2019). The abbreviation “eth” was assigned to specimens preserved in ethanol, while “C&S” was used to denote the cleared and stained specimen.

## RESULTS

### *Rhyacoglanis beninei*, new species

urn:lsid:zoobank.org:act:66E55031-BDEF-47EA-B578-4F4661A03190

(Figs. 1–4; Tab. 1)

**Holotype.** MZUSP 127014, 59.1 mm SL, Brazil, Pará State, córrego Jussara, tributary of Jamanxim River, municipally of Novo Progresso, Tapajós River basin, 07° 21’08”S 55° 17’45”W, 20 Aug 2022, G. S. C. Silva & T. C. Faria.

**Paratypes.** All from the same locality of holotype. LBP 25081, 5, 26.7–43.7 mm SL, 22 Sep 2017, A. C. Dias, C. S. Souza, C. Souto, N. Flausino Jr. & R. Devidé. LBP 32145, 8, 22.7–50.2 mm SL, the largest specimen was C&S, MZUEL 23049, 4, 29.4–42.6 mm SL, 20 Aug 2022, G. S. C. Silva & T. C. Faria. LBP 32163, 3, 27.0–47.9 mm SL, 22 Aug 2022, G. S. C. Silva & T. C. Faria.

**Diagnosis.** *Rhyacoglanis beninei* can be diagnosed from all congeners by two oblique dorsal dark brown bars on the predorsal region (Fig. 2) (*vs.* absent). Additionally, *R. beninei* is distinguished from some congeners by having a dorsal confluence between the dark subdorsal and subadipose bands in large juveniles and adults (> 28 mm SL) (*vs.* lack dorsal confluence in *R. paranensis*, *R. annulatus*, *R. varii*, and *R. rappydanielae*); ventral confluence between the dark subadipose and caudal peduncle bands (*vs.* lack ventral confluence in *R. annulatus*, *R. epiblepsis*, *R. paranensis*, *R. seminiger*, and *R. rappydanielae*); body without conspicuous dark brown spots (*vs.* conspicuous dark brown spots in *R. epiblepsis* and *R. rappydanielae*); complete dark band on caudal peduncle (*vs.* caudal peduncle-band with a unpigmented central region in *R. annulatus*); body with three dark bands (*vs.* two dark bands in *R. seminiger*); a thin dark caudal-fin bands (*vs.* large caudal-fin bands in *R. paranensis* and *R. epiblepsis*); pectoral-fin spine with anterior serrae distributed along the entire margin (restricted to the proximal half in *R. pulcher* and *R.*



**FIGURE 1** | *Rhyacoglanis beninei*, holotype, MZUSP 127014, 59.1 mm SL, from córrego Jussara, an affluent of Jamaxim River, Tapajós River basin. Scale bar = 10 mm.

*seminiger*); posterior tip of the post-cleithral process reaching vertical through the base of the dorsal-fin spine (*vs.* not reaching in *R. epiblepsis* and *R. rappyydanielae*); hypural 5 free of hypural 3 and 4 (*vs.* hypurals 4 and 5 fused in *R. rappyydanielae*); pointed caudal-fin lobes (*vs.* rounded lobes in *R. epiblepsis*).

**Description.** Morphometric data from *Rhyacoglanis beninei* is available in Tab. 1. In lateral view, straight profile of body from snout tip to dorsal-fin origin followed by a straight profile from dorsal-fin base to caudal-fin insertion. Body ventral surface slightly convex from snout tip to opercular opening region, straight to slightly concave from head posterior end to anal-fin insertion, and straight-angled upward on caudal peduncle.

**TABLE 1** | Morphometric data of *Rhyacoglanis beninei*. N = 21 specimens, including the holotype.

	Holotype	Range	Mean	SD
Standard length (mm)	59.1	22.7–59.1	36.6	–
<b>Percent of standard length</b>				
Head length	30.7	27.5–31.9	30.0	1.3
Pectoral-girdle width	34.1	26.7–34.1	29.2	1.7
Predorsal length	38.4	35.4–42.3	39.0	1.8
Dorsal-fin base length	17.1	13.8–18.4	16.3	1.2
Adipose-fin base length	19.9	15.2–21.2	18.0	1.9
Prepelvic length	53.5	48.7–56.3	51.8	1.6
Distance between pelvic and anal fins	24.9	22.0–27.3	25.6	1.3
Anal-fin base length	11.3	9.1–13.2	10.8	1.0
Caudal-peduncle length	16.2	11.4–16.2	13.0	1.4
Body depth	19.2	16.8–25.1	19.7	2.1
Caudal-peduncle depth	10.3	8.0–11.5	9.9	0.9
Pectoral-fin spine length	15.4	14.8–20.0	17.6	1.4
Dorsal-fin spine length	14.9	11.1–20.2	17.2	2.5
Pelvic-fin length	12.3	11.6–19.7	14.6	2.3
Postcleithral-process length	15.2	9.8–15.7	13.6	1.7
Distance between dorsal and pelvic fins	24.9	19.7–26.9	22.8	1.8
Distance between pelvic fins	13.5	10.4–14.4	11.6	2.8
Distance between pelvic fin and anus	13.9	11.1–14.6	12.5	1.1
Distance between the anus and anal fin	11.2	11.1–17.7	13.9	1.7
<b>Percent of head length</b>				
Eye diameter	8.8	6.5–12.6	9.5	1.7
Interorbital distance	34.1	26.2–44.5	34.2	4.1
Snout length	41.3	32.6–41.3	37.1	2.3
Mouth width	65.2	44.8–65.2	54.8	6.2
Head depth	53.2	30.7–53.2	39.5	5.4
Maxillary-barbel length	90.7	47.5–94.0	72.8	12.2
Distance between anterior and posterior nostrils	18.8	11.4–22.5	16.4	2.9
Distance between the posterior nostril and eye	7.3	3.5–10.1	6.3	1.7
Distance between posterior nostrils	20.2	18.8–25.1	21.5	1.7

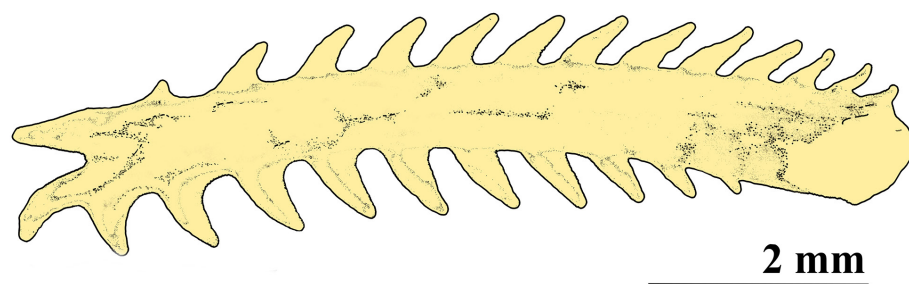


Head depressed with numerous well-developed unculiferous tubercles. Head dorsal profile in a rounded trapezoidal shape, with most anterior region narrower than posterior region. Wide mouth, larger than distance between posterior nostrils. Posterior nostrils opening wider than anterior nostrils. Thick lips with lateral portion extended posteriorly. Dentigerous plates on premaxilla and dentary. Eyes small, covered by skin. Opercular opening covered by a well-developed membrane. Maxillary barbels reaching first branched pectoral-fin ray base. Inner mental barbel small, not reaching isthmus, and outer mental barbel reaching first pectoral-fin ray base. Head laterosensory system bearing conspicuous pores, including six infraorbital, five supraorbital, nine premaxillaries, one premaxillary-postorbital, and one postorbital.

First dorsal-fin ray forming spine locking mechanism. Second dorsal-fin ray modified in a spine, smooth on anterior margin and serrated on posterior margin. Adipose-fin base broad, generally larger than dorsal-fin base. Pectoral and pelvic fins roughly triangular, distal margin larger than base. First pectoral-fin ray as spine with retrorse serrations on anterior and posterior margin (Fig. 3). Pectoral, pelvic, anal, and adipose fins distal margins round. Caudal fin bifurcated with acute dorsal and ventral lobes. Dorsal-fin rays II,6\* (1 C&S, 11 eth); pectoral-fin rays I,6\* (1 C&S, 13 eth); pelvic-fin rays i,5\* (1 C&S, 13 eth); anal-fin rays iii,5 (2 eth), iv,6 (1 C&S) or iii,6 (5), iii,7\* (1); caudal-fin rays i,6,8,i\* (1 C&S, 11 eth) or i,5,7,i (1 eth). Dorsal procurrent caudal-fin rays 16 (1 C&S), ventral procurrent caudal-fin rays 12 (1 C&S). Branchiostegal rays 8 (1 C&S). Total vertebrae 33 (1 C&S). Ribs 9 (1 C&S).



**FIGURE 2** | Pigmentation of oblique dark bars in the predorsal region of *Rhyacoglanis beninei*. **A.** MZUEL 23049, 29.6 mm SL; **B.** LBP 32145, 32.9 mm SL; **C.** LBP 32145, 37.3 mm SL; **D.** MZUEL 23049, 42.6 mm SL; **E.** LBP 32145, 50.2 mm SL. Scale bars = 10 mm.



**FIGURE 3** | *Rhyacoglanis beninei* pectoral-fin spine, paratype, LBP 32145, 50.2 mm SL.

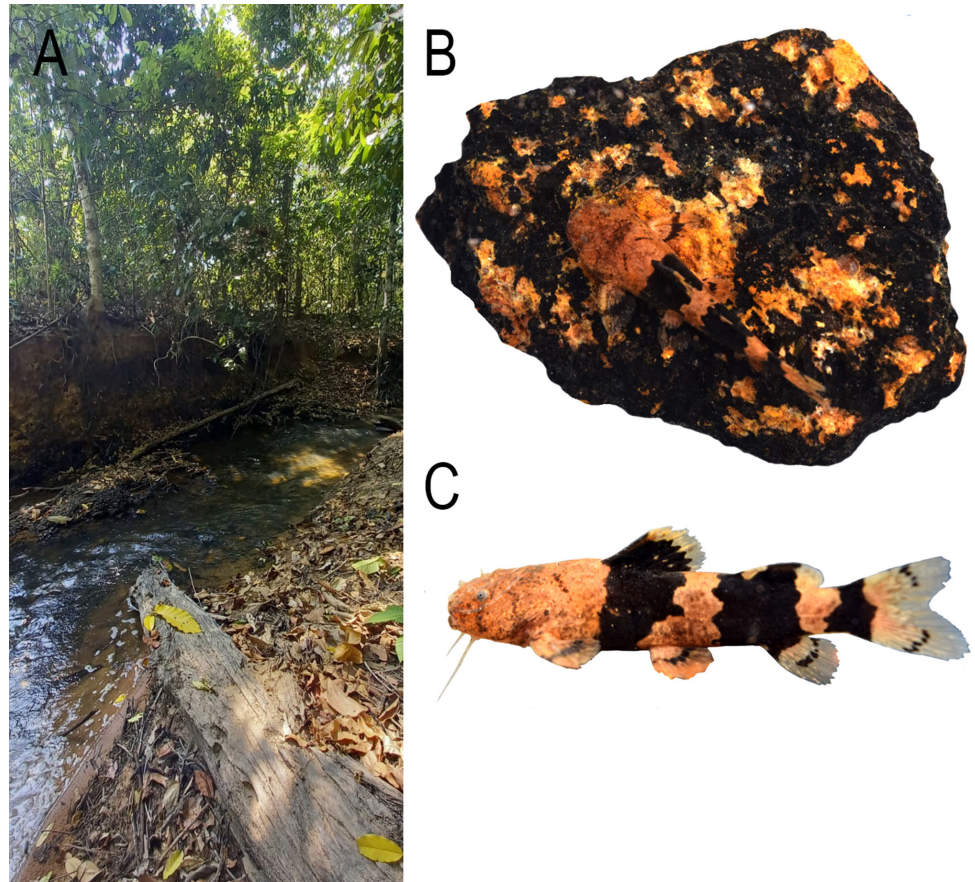
**Coloration in alcohol.** Ground color yellowish to brownish, with three conspicuous dark brown bands on body (Figs. 1, 2, 5). The first dark band under dorsal fin (subdorsal), the second under adipose fin (subadipose), and the third posterior adipose fin, extending to the caudal-fin base. Subadipose and caudal peduncle bands surrounding body; subdorsal band open in ventral region; all bands with variable connections pattern on lateral side (Fig. 5) in individuals of different SL, sometimes not present in small juveniles (< 28 mm SL – Fig. 5C). Two oblique dark brown bands on predorsal region in dorsal view, each beginning just laterally to parieto-supraoccipital process, continuing towards posterior cleithral process (Fig. 2). Pectoral and pelvic fins hyaline with middle dark brown stripe and numerous melanophores dispersed. Anal-fin hyaline with middle dark brown stripe and numerous melanophores spread; fin base with dark brown band and first unbranched ray base with clear dot. Caudal fin hyaline, dorsal, and ventral lobes with middle dark brown stripe and numerous melanophores dispersed. Dorsal-fin dark brown with numerous melanophores on hyaline margin. Adipose fin dark brown, clear dot on anterior base portion with numerous melanophores. Head grayish with lighter region on cheek.

**Coloration in life.** Same as alcohol-preserved specimens, but the light regions brighter, ranging from yellowish to brownish (Fig. 4C).

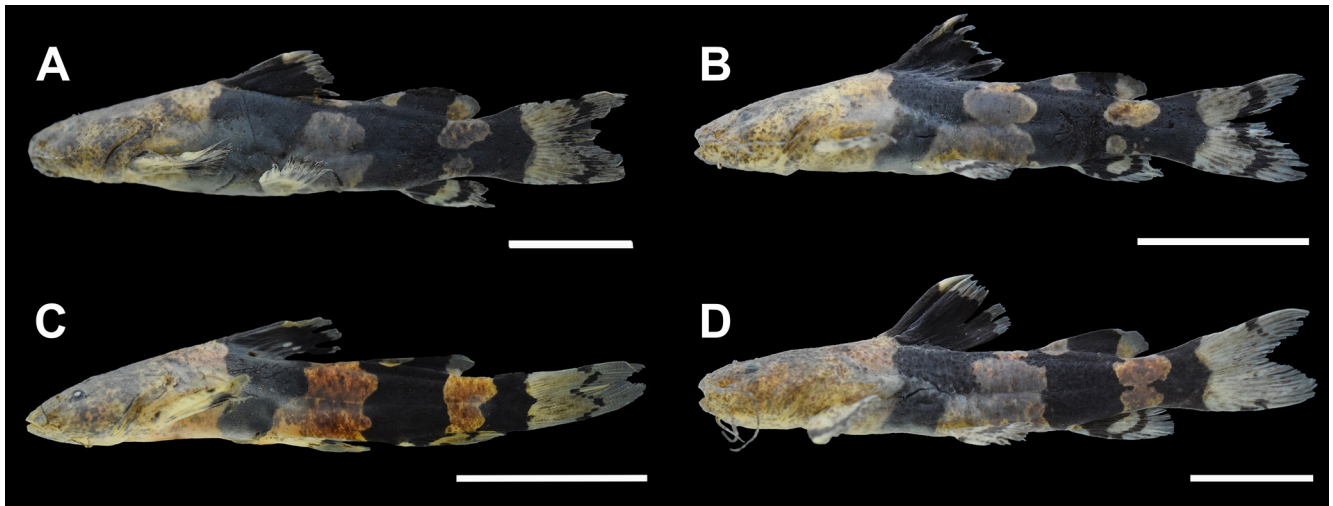
**Geographical distribution.** *Rhyacoglanis beninei* is known only from the type locality in the Jamanxim River, Tapajós River basin, Brazil (Fig. 6). The new species was collected in fast-flowing currents of Córrego Jussara, characterized by clear water and the bottom with rocks and gravels (Fig. 4).

**Etymology.** *Rhyacoglanis beninei* is named in honor of Ricardo Cardoso Benine, Professor at Universidade Estadual Paulista “Júlio de Mesquita Filho”, in recognition of his dedication and remarkable contributions to the knowledge of Neotropical freshwater fishes.

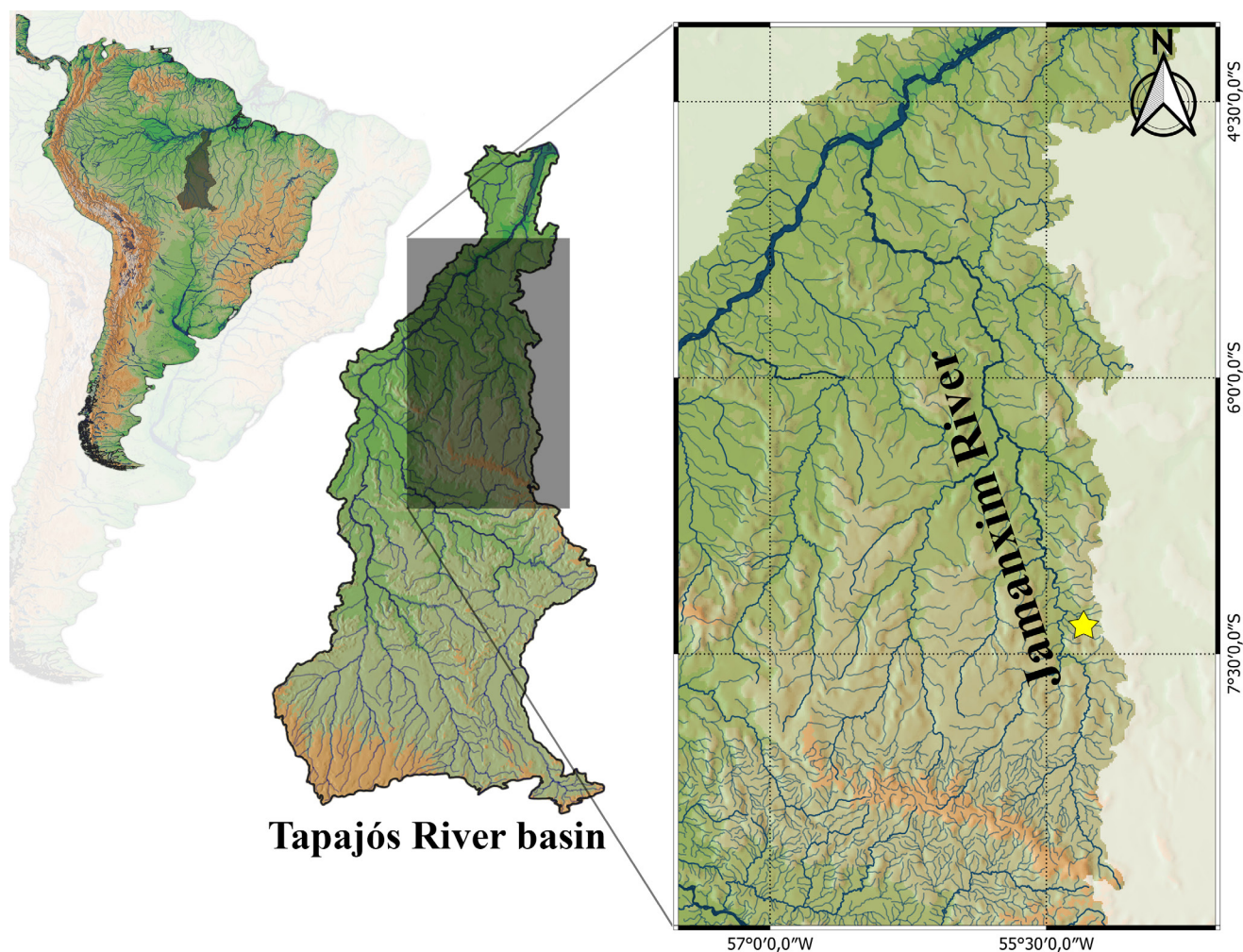




**FIGURE 4** | A. Habitat of *Rhyacoglanis beninei* in córrego Jussara, 07°21'08"S 55°17'45"W; B. A rock where specimens of *R. beninei* were associated; C. Paratype of *R. beninei* just after capture. Photo: Gabriel S. Costa e Silva.



**FIGURE 5** | Variation pattern of dark body bands in *Rhyacoglanis beninei*. A. MZUEL 23049, 42.6 mm SL; B. LBP 32145, 29.8 mm SL; C. LBP 32163, 27.0 mm SL; D. LBP 32163, 42.9 mm SL. Scale bars = 10 mm.

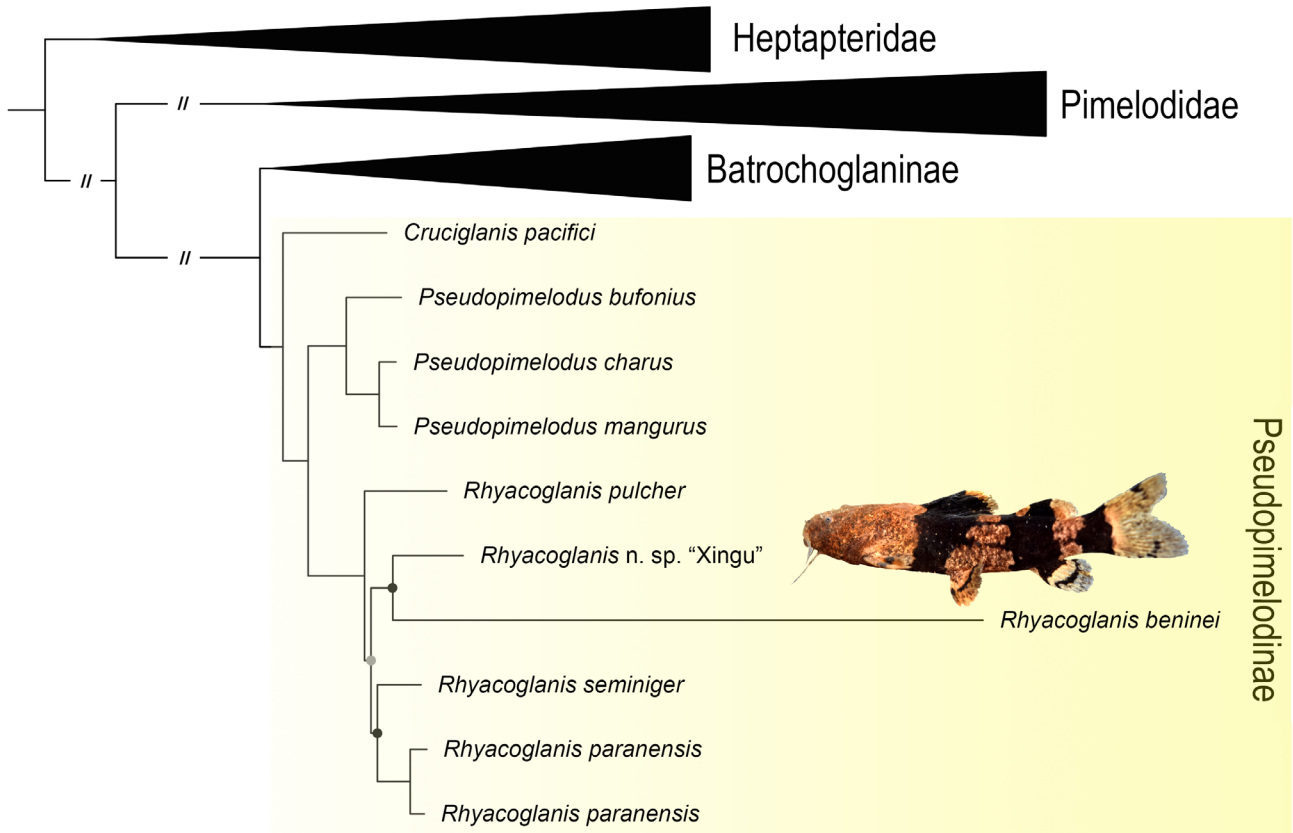


**FIGURE 6** | The type locality of *Rhyacoglanis beninei* in córrego Jussara, 07°21'08\"S 55°17'45\"W (yellow star), Tapajós River basin.

**Conservation status.** All specimens of *Rhyacoglanis beninei* were collected at only one sample site. However, several specimens were collected at the type locality, indicating a common occurrence and no apparent threat of extinction. According to the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN Standards and Petitions Subcommittee, 2023), we propose classifying *Rhyacoglanis beninei* as category Least Concern (LC).

**Phylogeny.** Sequencing and data filtering yielded a 70% complete matrix with 1082 loci and 385,841 bp. Results support the monophyly of Pseudopimelodidae and the monophyly of Pseudopimelodinae and Batrochoglaninae subfamilies. Inside Pseudopimelodinae, *Cruciglanis* is the sister to *Pseudopimelodus* + *Rhyacoglanis*, as supported by Silva *et al.* (2021). Internally to *Pseudopimelodus*, our analysis found *P. bufonius* sister to *P. charus* + *P. mangurus* (Valenciennes, 1835). *Rhyacoglanis* also recovered as a monophyletic group, where *R. pulcher* was recovered as sister to a clade composed of two subclades, the first composed of *R. semininger* + *R. paranensis* and the second composed of *R. beninei* + *Rhyacoglanis* n. sp. “Xingu” (Fig. 7).





**FIGURE 7 |** Maximum likelihood tree of Pseudopimelodidae on the 70% complete matrix (1082 loci, 385,841 bp). Nodes without symbols represent 100% support from 1000 bootstrap pseudo-replicates; nodal support between 99% and 75% denote by black circles; gray nodes indicate support between 75% and 50%.

## DISCUSSION

Among all valid species of *Rhyacoglanis*, *R. beninei* is unique by possessing two conspicuous oblique dark bars on the predorsal portion of the trunk (Fig. 2). *Rhyacoglanis* n. sp. "Xingu" and *R. seminiger* also have a dark blotch in the same region. However, the dark chromatophores on the predorsal region form a paired rounded blotch in those species. In *R. paranensis*, *R. epiblepsis*, *R. pulcher*, and *R. varii* this blotch is absent. Even though these dark bars persist throughout the *R. beninei* development stage of life, in the smaller specimens (< 40 mm SL), this mark is thinner and more conspicuous when compared to larger individuals, which present thicker and more diffuse bars (Fig. 2). According to some Pseudopimelodidae phylogenetic analyses (Shibatta, Vari, 2017; Shibatta *et al.*, 2021; this study), the occurrence of such marks in the predorsal region is a synapomorphy of Pseudopimelodinae, and their absence may have occurred independently in the *Rhyacoglanis* species.

Another conspicuous diagnostic feature is the connections between the three vertical dark brown bands (subdorsal, subadipose, and caudal peduncle). In large juveniles and adults (> 28 mm SL), the subdorsal and subadipose bands and the subadipose and caudal

peduncle bands are frequently united (dorsally and ventrally, respectively) by a dark stripe (Figs. 1, 5A, B, D). In contrast, in the small individual, the three vertical bands are entirely separated (Figs. 4C, 5C) by yellowish regions and without dark brown spots.

Our data confirm the monophyly of *Rhyacoglanis* following previous phylogenetic studies (Shibatta, Vari, 2017; Silva *et al.*, 2021). Furthermore, our results show *R. pulcher* as a sister to a clade containing the remaining species of *Rhyacoglanis*, composed of amazon species *R. seminiger*, *Rhyacoglanis* n. sp. “Xingu”, *R. beninei*, and *R. paranensis* from the upper Paraná River basin. Curiously, *R. beninei* (Jamanxim River) is not a sister to *R. seminiger* (Arinos River), another species described from the Tapajós River basin, but a sister to an undescribed species of *Rhyacoglanis* from the Xingu River basin (Fig. 7). This relationship pattern suggests a historical connection between the headwaters of the western portion of the Xingu River basin and the headwater of the Jamanxim River. Similarly, Shibatta, Souza-Shibatta (2023) observed a close phylogenetic relationship with *R. varii* from upper Tocantins and *R. paranensis* from upper Paraná. Therefore, both studies show the headwaters capturing influencing the distribution of *Rhyacoglanis* species.

We also re-build a phylogeny of *Pseudopimelodus*, using the UCEs matrix dataset published by Silva *et al.* (2021), adding *Pseudopimelodus charus* and *P. bufonius*. In Silva *et al.* (2021), the monophyly of *Pseudopimelodus* was impossible to test since only one species (*P. mangurus*) was included in that phylogeny. Rangel-Mendrano *et al.* (2021), in a genetic analysis using a multi-locus approach, supported the monophyly of *Pseudopimelodus*, with *P. charus* (from the São Francisco basin) sister to *P. bufonius* (Amazon basin) + *P. mangurus* (Paraná basin). Our result also supports the monophyly of *Pseudopimelodus* but places *P. bufonius* sister to *P. charus* plus *P. mangurus*. This arrangement is congruent with other molecular phylogenetic studies, under which monophyletic components from the upper Paraná and São Francisco river basins have been recognized as sister group (Montoya-Burgos, 2003; Roxo *et al.*, 2014; Ochoa *et al.*, 2020).

**Comparative material examined.** All specimens of comparative material are deposited in the LBP collection. **Brazil.** *Rhyacoglanis paranensis*: LBP 11716, 9, 30.9–45.7 mm SL, Paranaíba River, Minas Gerais State; LBP 11743, 1, 29.8 mm SL, Paranaíba River, Minas Gerais State; LBP 11740, 2, 43.4–43.7 mm SL, Paranaíba River, Minas Gerais State; LBP 30034, 4, 52.5–85.6 mm SL, Jaguari River, São Paulo State; LBP 17708, 4, 27.4–34.4 mm SL, Mogi-Guaçu River, São Paulo State; LBP 28747, 6, 28.5–35.0 mm SL, Mogi-Guaçu River, São Paulo State; LBP 18831, 4, 33.7–36.2 mm SL, Sapucaí-Mirim River, São Paulo State; LBP 8083, 3, 47.6–62.7 mm SL, Ivaí River, Paraná State. *Rhyacoglanis seminiger*: LBP 13260, 4, 45.2–61.4 mm SL, Alegre Stream, Mato Grosso State. *Rhyacoglanis variolosus*: LBP32030, 5, 27.8–41.3 mm SL, Jauru River, Mato Grosso do Sul State. *Rhyacoglanis* sp. n. “Xingu”: LBP 15883, 2, 52.1–57.3 mm SL, Coluene River, Mato Grosso State; LBP 15906, 1, 67.6 mm SL, Coronel Vanick River, Mato Grosso State. *Rhyacoglanis* cf. *pulcher*: LBP 25390, 1, 37.4 mm SL, Pimenta Bueno River, Rondônia State. *Rhyacoglanis* sp.: LBP 1567, 2, 22.2–32.6 mm SL, Araguaia River, Mato Grosso State.

## ACKNOWLEDGMENTS

Thanks to A. C. Dias, C. S. Souza, C. Souto, N. Flausino Jr., R. Devidé, and T. Faria for their help during field expeditions. Thanks also to Bruno F. Morales for helping with the map construction. We also thank the research support from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) (JLCR), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, proc. #307951/2021–9 to OAS and proc. 306054/2006–0 to CO), and Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) grant #2020/13433–6 (CO), grants #2021/12979–8 and #2022/13025–0 (GSCS).

## REFERENCES

- **Boulenger GA.** An account of the fishes collected by Mr. C. Buckley in eastern Ecuador. *Proc Zool Soc Lond.* 1887; 274–83.
- **Faircloth BC.** PHYLUCE is a software package for the analysis of conserved genomic loci. *Bioinformatics.* 2016, 32(5):786–88. <https://doi.org/10.1093/bioinformatics/btv646>
- **Faircloth BC, Sorenson L, Santini F, Alfaro ME.** A phylogenomic perspective on the radiation of ray-finned fishes based upon targeted sequencing of ultraconserved elements (UCEs). *PLoS ONE.* 2013; 8(6):e65923. <https://doi.org/10.1371/journal.pone.0065923>
- **Harris RS.** Improved pairwise alignment of genomic DNA. [PhD Thesis]. Pennsylvania: State University The Pennsylvania State University; 2007. Guidelines for using the IUCN Red List categories and criteria. Version 15.1 [Internet]. Gland; 2023. Available from: <https://www.iucnredlist.org/resources/redlistguidelines>
- **Lanfear R, Calcott B, Ho SYW, Guindon S.** PartitionFinder: Combined selection of partitioning schemes and substitution models for phylogenetic analyses. *Mol Biol Evol.* 2012; 29(6):1695–701. <https://doi.org/10.1093/molbev/mss020>
- **Miranda Ribeiro A.** Pimelodidae, Trachycorystidae, Cetopsidae, Bunocephalidae, Auchenipteridae, e Hypophthalmidae; Rio de Janeiro: Comissão de Linhas Telegraficas Estrategicas de Matto-Grosso ao Amazonas. 1914; 5:1–13.
- **Montoya-Burgos JI.** Historical biogeography of the catfish genus *Hypostomus* (Siluriformes: Loricariidae), with implications on the diversification of Neotropical ichthyofauna. *Mol Ecol.* 2003; 12(7):1855–67. <https://doi.org/10.1046/j.1365-294X.2003.01857.x>
- **Ochoa LE, Datovo A, DoNascimento C, Roxo FF, Sabaj Pérez MH, Chang J, Melo BF, Silva GSC, Foresti F, Alfaro M, Oliveira C.** Phylogenomic analysis of trichomycterid catfishes (Teleostei: Siluriformes) inferred from ultraconserved elements. *Sci Rep.* 2020; 10(2697). <https://doi.org/10.1038/s41598-020-59519-w>
- **Pattengale ND, Alipour M, Bininda-Emonds ORP, Moret BME, Stamatakis A.** How many bootstrap replicates are necessary? In: Annual international conference on research in computational molecular biology. Springer, Berlin: Heidelberg; 2009. p.184–200. Available from: [https://link.springer.com/chapter/10.1007/978-3-642-02008-7\\_13](https://link.springer.com/chapter/10.1007/978-3-642-02008-7_13)
- **Rangel-Medrano JD, Ortega-Lara A, Márquez EJ.** Ancient genetic divergence in bumblebee catfish of the genus *Pseudopimelodus* (Pseudopimelodidae: Siluriformes) from northwestern South America. *PeerJ.* 2020; 8:e9028. <https://doi.org/10.7717/peerj.9028>
- **Robert CE.** MUSCLE: multiple sequence alignment with high accuracy and high throughput. *Nucleic Acids Res.* 2004; 32(5):1792–97. <https://doi.org/10.1093/nar/gkh340>

- **Roxo FF, Albert JS, Silva GS, Zawadzki CH, Foresti F, Oliveira C.** Molecular phylogeny and biogeographic history of the armored Neotropical catfish subfamilies Hypoptopomatinae, Neoplecostominae and Otothyridae (Siluriformes: Loricariidae). *PLoS ONE*. 2014; 9(8):e105564. <https://doi.org/10.1371/journal.pone.0105564>
- **Shibatta OA.** Sistemática e evolução da família Pseudopimelodidae (Ostariophysi, Siluriformes), com a revisão taxonômica do gênero *Pseudopimelodus*. [PhD Thesis]. São Carlos: Universidade Federal de São Carlos; 1998.
- **Shibatta OA.** Family Pseudopimelodidae. In: Reis RE, Kullander SO, Ferraris CJ, Jr., editors. Checklist of the freshwater fishes of South America. Porto Alegre: Edipucrs; 2003. p.331–32.
- **Shibatta OA.** New species of bumblebee catfish of the genus *Batrochoglanis* Gill, 1858 (Siluriformes: Pseudopimelodidae) from the Aripuanã River basin. *Zootaxa*. 2019; 4674(2):243–63. <https://doi.org/10.11646/zootaxa.4674.2.6>
- **Shibatta OA, Rocha MS, Oliveira RR.** New species of *Rhyacoglanis* (Siluriformes: Pseudopimelodidae) from rio Tocantins basin, northern Brazil. *Neotrop Ichthyol*. 2021; 19(4):e210083. <https://doi.org/10.1590/1982-0224-2021-0083>
- **Shibatta OA, Souza-Shibatta L.** New species of *Rhyacoglanis* (Siluriformes: Pseudopimelodidae) from the upper rio Tocantins basin. *Neotrop Ichthyol*. 2023; 21(1):e220075. <https://doi.org/10.1590/1982-0224-2022-0075>
- **Shibatta OA, Vari RP.** A new genus of Neotropical rheophilic catfishes, with four new species (Teleostei: Siluriformes: Pseudopimelodidae). *Neotrop Ichthyol*. 2017; 15(2):e160132. <https://doi.org/10.1590/1982-0224-20160132>
- **Silva GSC, Melo BF, Roxo FF, Ochoa LE, Shibatta OA, Sabaj MH, Oliveira C.** Phylogenomics of the bumblebee catfishes (Siluriformes: Pseudopimelodidae) using ultraconserved elements. *J Zool Syst Evol Res*. 2021; 59(8):1662–72. <https://doi.org/10.1111/jzs.12513>
- **Stamatakis A.** RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. *Bioinformatics*. 2014; 30(9):1312–13. <https://doi.org/10.1093/bioinformatics/btu033>
- **Tagliacollo VA, Lanfear R.** Estimating improved partitioning schemes for UltraConserved Elements (UCEs). *Mol Biol Evol*. 2018; 35(7):1798–811. <https://doi.org/10.1093/molbev/msy069>
- **Taylor WR, Van Dyke GC.** Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium*. 1985; 9(2):107–19. Available from: <https://sfi-cybium.fr/en/node/2423>
- **Zerbino DR, Birney E.** Velvet: Algorithms for de novo short read assembly using de Bruijn graphs. *Genome Res*. 2008; 18:821–29. <https://doi.org/10.1101/gr.074492.107>

#### AUTHORS' CONTRIBUTION

**Jefferson Luan Crispim-Rodrigues:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review and editing.

**Gabriel de Souza da Costa e Silva:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review and editing.

**Oscar Akio Shibatta:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review and editing.

**Mariana Kuranaka:** Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing—original draft, Writing—review and editing.

**Claudio Oliveira:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review and editing.





This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

Distributed under Creative Commons CC-BY 4.0

© 2023 The Authors.  
Diversity and Distributions Published by SBI



Official Journal of the  
Sociedade Brasileira de Ictiologia

### ETHICAL STATEMENT

The specimens analyzed in the present study were collected under license number 13843–4, issued by the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio 13843–4). The use of animals in this research was conducted under Brazilian animal welfare laws, and the research was approved by the Ethics Committee on Animal Use of the Instituto de Biociências, UNESP (license number 2325010620).

### COMPETING INTERESTS

The author declares no competing interests.

### HOW TO CITE THIS ARTICLE

- **Crispim-Rodrigues JL, Silva GSC, Shibatta OA, Kuranaka M, Oliveira C.** Description and phylogenetic position of a new species of *Rhyacoglanis* (Siluriformes: Pseudopimelodidae) from the Jamaxim River basin. *Neotrop Ichthyol.* 2023; 21(3):e230051. <https://doi.org/10.1590/1982-0224-2023-0051>