Two new, remarkably colored species of the Neotropical catfish genus *Cetopsorhamdia* Eigenmann & Fisher, 1916 (Siluriformes, Heptapteridae) from Chapada dos Parecis, western Brazil, with an assessment of the morphological characters bearing on their phylogenetic relationships

Flávio A. Bockmann¹ & Roberto E. Reis²

¹ Universidade de São Paulo (USP), Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (FFCLRP), Departamento de Biologia (DB), Laboratório de Ictiologia de Ribeirão Preto, Programa de Pós-Graduação em Biologia Comparada. Ribeirão Preto, SP, Brasil. ORCID: http://orcid.org/0000-0002-1200-1487. E-mail: fabockmann@ffclrp.usp.br

² Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Laboratório de Sistemática de Vertebrados. Porto Alegre, RS, Brasil. ORCID: http://orcid.org/0000-0003-3746-6894. E-mail: reis@pucrs.br

**Abstract.** Two new species of heptapterid catfish genus *Cetopsorhamdia* are described from close localities in western Brazil, at Chapada dos Parecis, an area with extremely high level of endemism. One species is from the upper Rio Madeira system, Rondônia State, and the other from the upper Rio Tapajós system, Mato Grosso State. The two species are diagnosed, among several other features, by their markedly distinctive color patterns, with the former having well-defined quadrangular marks in trunk flanks while the latter bearing irregular, vertical bars along the trunk. The monophyly of *Cetopsorhamdia* is discussed, with two putative synapomorphies being proposed to support the genus. Potentially informative morphological characters to resolve the internal relationships of the genus are presented and discussed. Despite the striking external differences between the two species herein described, they are found to likely form a clade.

**Keywords.** Systematics; Ichthyology; Taxonomy; South America.

**INTRODUCTION**

One of the most diversified and widely distributed Neotropical catfish families is Heptapteridae, currently totaling 23 valid genera and 228 valid species (*Phreatobius* Göldi, 1905 has been excluded and assigned to its own family – Sullivan et al., 2013; Lundberg et al., 2014). Heptapterids inhabit freshwater water bodies draining into the Atlantic Ocean from northern Mexico to southern Argentina and to the Pacific Ocean from northern Mexico to southern Peru (Bockmann & Guazzelli, 2003; Bockmann & Ferraris-Jr., 2005; Fricke et al., 2021). Fishes of this family are generally small to medium-sized and prefer small rivers with shallow, fast waters although there are forms living in deep channels of large rivers and in calm waters inside caves (Heptapteridae bears the second largest diversity of troglomorphic fishes in the Neotropics) (Bockmann & Guazzelli, 2003; Bockmann & Castro, 2010).

Among heptapterids, the genus *Cetopsorhamdia* was erected by Eigenmann & Fisher in Eigenmann (1916: 83) for a single species, *C. nasus*, described in the same paper and originally designed as its type species (Eigenmann & Fisher in Eigenmann, 1916). The type locality established for *C. nasus* is “Honda, Colombia” [= Honda, Colombia, Magdalena River System] (Eigenmann & Fisher in Eigenmann, 1916: 83), but the species is presently known to occur in the upper and mid courses of the Río Magdalena basin, including in the upper Río Cauca, in Colombia (Ortega-Lara, 2004, 2012; Mojica et al., 2006; Ortega-Lara et al., 2006; Villa-Navarro et al., 2006). In addition to its type species, nine other nominal species have been described for *Cetopsorhamdia*, namely: *C. boquillae* Eigenmann & Fisher in
Eigennmann, 1922, from the Río Caucá basin of Colombia; *C. filamentosa* Fowler, 1945, from the Río Tulumayu basin, upper Ucayali drainage of Peru; *C. iberini* Schubart & Gomes, 1959, from the upper reaches of the Río Paraná and Río São Francisco of Brazil; *C. molinai* Miles, 1943, from the Río Magdalena basin of Colombia; *C. orinoco* Schultz, 1944, from the Río Orinoco basin of Venezuela; *C. phantasia* Stewart, 1985, from the Río Napo basin of Ecuador and Río Madeira of Brazil; *C. picklei* Schultz, 1944, from the Lago Maracaibo basin, Venezuela; *C. pipersi* Hoedeman, 1961, from the Corantijn River basin of Suriname; and *C. shermani* Schultz, 1944, from the Río Magdalena basin of Colombia, Río Orinoco basin of Venezuela, and Río Tocantins of Brazil (Eigennmann & Fisher in Eigennmann, 1922; Miles, 1943; Schultz, 1944; Fowler, 1945; Schubart & Gomes, 1959; Hoedeman, 1961; Stewart, 1985; Bockmann & Guazzelli, 2003; Ruiz-C. & Román-Valencia, 2006; Bockmann & Slobodian, 2013).

Schultz (1944) recombined four additional species formerly described in other heptapterida genera into *Cetopsorhamdia* (their geographic distributions are cited according to Bockmann & Guazzelli, 2003), namely: *Chasmocorcanus rosae* Eigenmann, 1919, from the Río Meta basin of Colombia; *Imparfinis hasemani* Steindachner, 1915, from the Río Branco and Río Tapajós basins of Brazil; *Imparfinis insidiosus* Steindachner, 1915, from the Río Branco of Brazil; and *Imparfinis mirini* Haseman, 1911, from the upper Río Araguaia and upper Río Paraná basins of Brazil (the placement of *I. hasemani*, *I. insidiosus*, and *I. mirini* in *Cetopsorhamdia* had been previously suggested by Gosline (1941) but not formally implemented by him) (Haseman, 1911; Steindachner, 1915; Eigenmann, 1919; Bockmann & Guazzelli, 2003).

Based on the phylogenetic analysis of the family performed by Bockmann (1998), a stricter definition of the genus *Cetopsorhamdia* has been proposed. Consequently, several of these species must have been assigned to different genera of Heptapteridae, some yet to be described (cf. Bockmann, 1998; Zuanon et al., 2006; Bockmann & Slobodian, 2018). Therefore, five nominal species are currently recognized as belonging to *Cetopsorhamdia*: *C. boquillae*, *C. iberini*, *C. insidiosa*, *C. nasus*, and *C. picklei*.

As is the case for the whole family Heptapteridae (Bockmann, 1998; Bockmann & Guazzelli, 2003), the alpha diversity of *Cetopsorhamdia* is considerably underestimated, containing at least eight species pending description, some of which have already been listed in catalogs and faunistic works (cf. Bockmann & Slobodian, 2013; Ohara & Lima, 2015; Ohara & Loeb, 2016; Ohara & Marinho, 2016; Ohara et al., 2016). During the Brazilian leg of the Transcontinental Catfish Expedition, funded by the All Catfish Species Inventory Project, carried out mainly across the upper Paraguay, upper Tapajós, upper and middle Madeira and Purus, at least 38 new catfishes have been unveiled (Reis, 2005). About one-third of all new species are heptapterids and, among them, there were two beautifully colored species that were putatively assigned to *Cetopsorhamdia*. Furthermore, in the last 15 years, collections carried out by the teams of the ichthyology laboratories of the Federal University of Rondônia and Museu de Zoologia da Universidade de São Paulo have brought to light additional material of these two species. In order to help fill the taxonomic gap of the family Heptapteridae (Dubois, 2010; Raposo et al., 2020) and, in particular, of the genus *Cetopsorhamdia*, in this work we describe these two new forms. As a basis for the observations made, comments on potentially informative morphological characters are presented to diagnose the genus and elucidate its internal relationships.

**MATERIAL AND METHODS**

Measurements and counts were made on the left side of specimen whenever possible. All measurements were taken point-to-point with digital calipers and expressed to the nearest 0.1 mm. Methodology and terminology for measurements followed Bockmann & de Pinna (2004) and Bockmann & Castro (2010), excluding the nasal barbel length which is inapplicable due to the absence of that structure. Subunits of the head were presented as proportions of head length (HL), except for measurements of barbels, which were converted to proportions of standard length (SL). Head length and measurements of trunk parts were given as proportions of SL.

Methodology and terminology for taking meristic data and fin position followed Bockmann & de Pinna (2004) and Bockmann & Castro (2010). All anal-fin rays were counted individually, including the anterior splints and the two most posterior rays inserted in the same base. When a ray is distally broken or ill-formed, this element is counted and its branching pattern is, whenever possible, presumed according to the adjacent rays. Vertebral counts encompassed all vertebrae, including the first five modified into the complex vertebrae and the compound caudal centrum (PU1+U1) counted as a single element—cf. Lundberg & Baskin (1969). Counts of serial elements (branchiostegals rays, basal radials, pleural ribs, rays associated to caudal skeleton, procurent rays, and vertebrae), and records of the first vertebra bearing a complete hemal spine and of fin positions (in relation to vertebral number) were taken from cleared and stained preparations and radiographs. The landmarks of the fin origin and terminus are always the total vertebrae (i.e., the first five vertebrae associated with the Weberian complex are considered). Numbers of fin rays and branchiostegal rays were also verified in alcohol-preserved specimens with aid of transmitted illumination. In the descriptions, holotype counts are followed by an asterisk.

Cleared and counterstained specimens were prepared according to Taylor & Van Dyke (1985). Radiographs were obtained at FMNH, LIRP, MZUSP, and USNM (see list of institutional acronyms below). Most radiographs were obtained using a digital radiography cabinet-x-ray equipment Faxitron, model LX-60-DC12, hosted at the Laboratório de Ictiologia de Ribeirão Preto (LIRP), belonging to the Center for Biodiversity Documentation, Department of Biology, FFCLRP/University of São Paulo, Ribeirão Preto, SP, Brazil. All radiographs were stored at
LIRP and digital copies were sent to each institution holding radiographed specimens. Notations cited throughout the text are ‘c&s’ for cleared and stained specimens, ‘ms’ for measured specimens, ‘SL’ for standard length, and ‘x’ for x-rayed specimens.

In addition, for further examination of the skeleton, the holotypes of the two species herein described were scanned by using a GE high-resolution X-ray CT, model Phoenix V|TOMEIX S 240, housed at the Center for Biodiversity Documentation. The scans were taken from the snout tip through the fifth post-Weberian centrum, using a nanofocal X-ray source. CT-Scan details are presented in Supplementary information. Visualization of the CT data was performed using the software package VGStudioMax, version 3.0 (64-bit) (https://www.volumegraphics.com/en/products/vgstudio.html; Volume Graphics, Heidelberg, Germany).

Osteological terminology follows Bockmann & Miquelarena (2008). The general nomenclature for cephalic laterosensory canals herein employed considers ontogenies and homologies of their components, as summarized by Pastana et al. (2020). Especially for siluriforms, homologies for supraorbital and infraorbital lateral sensory canal systems, and resulting terminology, follow Arratia & Huaquin (1995); and for preoperculomandibular laterosensory canal system follow Bockmann & Miquelarena (2008). The nomenclature of foramina in the mandibular suspensorium for the branches of the trigeminal and facial nerves follows Herrick (1899, 1901).

It has not been possible to borrow any specimen of *Cetopsorhamdia nasus*, the type species of the genus *Cetopsorhamdia*, from Colombian collections, so that the holotype was the only representative of this species we have directly examined. Fortunately, a redescription of *C. nasus* by Ortega-Lara (2012), including its skeleton, has confidently provided all the necessary information for comparative analyses herein undertaken. The conservation status of the new species was assessed following the categories and criteria of the International Union for Conservation of Nature (IUCN Standards and Petitions Sub-Committee, 2019).

**Institutional abbreviations:** AMNH, American Museum of Natural History, New York; ANSP, Academy of Natural Sciences of Drexel University, Philadelphia; CAS, California Academy of Sciences, San Francisco; CM, Carnegie Museum of Natural History, Pittsburgh; CZUEJ, Museu de Zoologia da Universidade Estadual de Londrina, Londrina; FMNH, Field Museum of Natural History, Chicago; INPA, Instituto Nacional de Pesquisas da Amazônia, Manaus; IU, Indiana University, Bloomington; LIRP, Laboratório de Ictiologia de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto; MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre; MNRJ, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro; MZUSP, Museu de Zoologia da Universidade de São Paulo, São Paulo; NMW, Naturhistorisches Museum Wien, Wien; NUP, Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura, Universidade Estadual de Maringá, Maringá; UFRJ, Laboratório de Sistemática e Evolução de Peixes Teleósteos, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro; UFRO-I, Universidade Federal de Rondônia, Laboratório de Ictiologia e Pesca, Porto Velho; USNM, National Museum of Natural History, Smithsonian Institution, Washington, D.C.

**Anatomical abbreviations in figures:** AC, anterior ceratothal; AF, anterior fontanel; AN, antorbital; AP, autopalatine; AT, antorbital tubule; BB2-3, basibranchials 2 and 3; BL, Baudelot’s ligament; BO, basioccipital; BR, branchiostegal rays; CB1-5, ceratobranchials 1 to 5; EB1-4, epibranchials 1 to 4; EN, entopterygoid; EP, epipatracapital; ES, extrascapula; EX, exoccipital; FR, frontal; HB1-2, hypobranchials 1 and 2; HF, hyomandibular facet; HFen, foramen for entrance of the *ramus hyoides facialis*; HFeF, foramen for exit of *ramus hyoides facialis*; HK, hyomandibular keel; HMen, foramen for entrance of hyodeomandibular nerve trunk; HY, hyomandibula; i1, infraorbital laterosensory branch 1; i3-6, infraorbital laterosensory branches 3 to 6; IH, interhyal; IO, interopercle; LE, lateral ethmoid; II1-4, lateral line sensory branches 1 to 4; ME, mesethmoid; MFen, foramen for entrance of the *ramus mandibularis VII*; MFex, foramen for exit of the *ramus mandibularis VII*, MT, metapterygoid; MX, maxilla; NA, nasal; OF, optic foramen; OP, opercle; OS, orbitosphenoid; PA, parapophyseid; PB3-4, pharyngobranchials 3 and 4; PC, posterior ceratothal; PF, posterior fontanel; PM, premaxilla; PM1-10, preoperculomandibular laterosensory branches 1 to 10; PO, prootic; po1+pm11, postotic-preoperculomandibular complex laterosensory branch (postotic laterosensory branch 1+ preoperculomandibular laterosensory branch 11); po2, postotic laterosensory branch 2 (pterotic or temporal branch); po3, postotic laterosensory branch 3; PR, preopercle; PS, pterosphenoid; PT, pterotic; QU, quadrate; RPR1, rigid part of the first pectoral-fin ray; s1-3, supraorbital laterosensory branches 1 to 3; s2+i2, supraorbital-infraorbital complex sensory branch (supraorbital sensory branch 2+ infraorbital sensory branch 2); s6+s6, supraorbital complex laterosensory branch 6 (left and right epiheyesal branches 6 fused); s8, supraorbital laterosensory branch 8 (parietal branch); SB, subpreopercle; SC, supracleithrum; SP, sphenotic; SPR1, soft part of the first pectoral-fin ray; ST1-4, suborbital tubules 1 to 4; SU, supraoccipital; TF, trigemino facial foramen; TP, tooth plate; UH, urohyal; VH, ventral hypohyal; VL, ventrolateral limb of supracleithrum; VM, ventromedial limb of supracleithrum; and VO, vomer.

**RESULTS**

*Cetopsorhamdia clathrata* sp. nov.

http://zoobank.org/03CD1517-2543-4698-BDF0-9212BDEBDF4A

(Figs. 1-4, Table 1)

*Cetopsorhamdia* new species 1. – Bockmann & Reis, 2011 [distribution – upper Rio Madeira basin, in State of Rondônia: unnumb. p.; brief characterization based
|                         | Rio Ji-Paraná (or Machado) basin | Rio Roosevelt basin | TOTAL          |
|-------------------------|---------------------------------|---------------------|----------------|
|                         | Range                           | Range              | Range          |
| Total length (mm)       | H Min 25.6 Max 76.4 SD 13 13 | H Min 45.4 Max 93.8 SD 3 | H Min 35.5 Max 72.7 SD 3 |
| Standard length (mm)    | 50.8 Min 20.3 Max 61.2 SD 13 13 | 53.3 Min 72.7 Max 111.1 SD 3 | 50.8 Min 20.3 Max 61.2 SD 13 13 |
| 1. Predorsal length     | 43.1 Min 36.5 Max 50.5 SD 3 | 42.1 Min 36.5 Max 50.5 SD 3 | 40.6 Min 36.5 Max 50.5 SD 3 |
| 2. Preanal length       | 46.9 Min 39.5 Max 54.3 SD 3 | 46.9 Min 39.5 Max 54.3 SD 3 | 46.9 Min 39.5 Max 54.3 SD 3 |
| 3. Prepelvic length     | 42.0 Min 34.5 Max 51.5 SD 3 | 42.0 Min 34.5 Max 51.5 SD 3 | 42.0 Min 34.5 Max 51.5 SD 3 |
| 4. Predopside length    | 72.9 Min 69.5 Max 76.4 SD 3 | 72.9 Min 69.5 Max 76.4 SD 3 | 72.9 Min 69.5 Max 76.4 SD 3 |
| 5. Caudal-peduncle length | 20.7 Min 16.7 Max 25.3 SD 3 | 20.7 Min 16.7 Max 25.3 SD 3 | 20.7 Min 16.7 Max 25.3 SD 3 |
| 6. Caudal-peduncle depth | 9.2 Min 8.5 Max 10.5 SD 3 | 9.2 Min 8.5 Max 10.5 SD 3 | 9.2 Min 8.5 Max 10.5 SD 3 |
| 7. Adipose-fin length   | 14.4 Min 13.7 Max 16.2 SD 3 | 14.4 Min 13.7 Max 16.2 SD 3 | 14.4 Min 13.7 Max 16.2 SD 3 |
| 8. Adipose-fin depth    | 3.9 Min 3.4 Max 5.7 SD 3 | 3.9 Min 3.4 Max 5.7 SD 3 | 3.9 Min 3.4 Max 5.7 SD 3 |
| 9. Dorsal-fin to adipose-fin | 18.3 Min 15.1 Max 20.5 SD 3 | 18.3 Min 15.1 Max 20.5 SD 3 | 18.3 Min 15.1 Max 20.5 SD 3 |
| 10. Anal-fin base       | 1.3 Min 1.2 Max 1.5 SD 3 | 1.3 Min 1.2 Max 1.5 SD 3 | 1.3 Min 1.2 Max 1.5 SD 3 |
| 11. Snout-anus distance | 51.0 Min 49.4 Max 52.5 SD 3 | 51.0 Min 49.4 Max 52.5 SD 3 | 51.0 Min 49.4 Max 52.5 SD 3 |
| 12. Snout-urogenital papilla distance | 52.8 Min 50.6 Max 54.4 SD 3 | 52.8 Min 50.6 Max 54.4 SD 3 | 52.8 Min 50.6 Max 54.4 SD 3 |
| 13. Anus-urogenital papilla distance | 1.7 Min 0.8 Max 2.7 SD 3 | 1.7 Min 0.8 Max 2.7 SD 3 | 1.7 Min 0.8 Max 2.7 SD 3 |
| 14. Length of first dorsal-fin ray (unbranched) | 13.4 Min 12.6 Max 14.9 SD 3 | 13.4 Min 12.6 Max 14.9 SD 3 | 13.4 Min 12.6 Max 14.9 SD 3 |
| 15. Length of rigid part offirst dorsal-fin ray | 4.0 Min 3.4 Max 5.9 SD 3 | 4.0 Min 3.4 Max 5.9 SD 3 | 4.0 Min 3.4 Max 5.9 SD 3 |
| 16. Length of second dorsal-fin ray (first branched) | 15.2 Min 14.6 Max 16.2 SD 3 | 15.2 Min 14.6 Max 16.2 SD 3 | 15.2 Min 14.6 Max 16.2 SD 3 |
| 17. Length of third dorsal-fin ray (second branched) | 15.4 Min 14.8 Max 16.3 SD 3 | 15.4 Min 14.8 Max 16.3 SD 3 | 15.4 Min 14.8 Max 16.3 SD 3 |
| 18. Dorsal-fin base     | 10.2 Min 9.5 Max 10.7 SD 3 | 10.2 Min 9.5 Max 10.7 SD 3 | 10.2 Min 9.5 Max 10.7 SD 3 |
| 19. Length of first pectoral-fin ray (unbranched) | 14.1 Min 14.6 Max 15.4 SD 3 | 14.1 Min 14.6 Max 15.4 SD 3 | 14.1 Min 14.6 Max 15.4 SD 3 |
| 20. Length of rigid part offirst pectoral-fin ray | 5.1 Min 3.4 Max 7.0 SD 3 | 5.1 Min 3.4 Max 7.0 SD 3 | 5.1 Min 3.4 Max 7.0 SD 3 |
| 21. Length of second pectoral-fin ray (first branched) | 15.5 Min 15.2 Max 15.9 SD 3 | 15.5 Min 15.2 Max 15.9 SD 3 | 15.5 Min 15.2 Max 15.9 SD 3 |
| 22. Length of third pectoral-fin ray (second branched) | 15.5 Min 15.2 Max 15.9 SD 3 | 15.5 Min 15.2 Max 15.9 SD 3 | 15.5 Min 15.2 Max 15.9 SD 3 |
| 23. Length of first pelvic-fin ray (unbranched) | 11.2 Min 10.8 Max 11.8 SD 3 | 11.2 Min 10.8 Max 11.8 SD 3 | 11.2 Min 10.8 Max 11.8 SD 3 |
| 24. Length of second pelvic-fin ray (first branched) | 13.1 Min 12.7 Max 14.3 SD 3 | 13.1 Min 12.7 Max 14.3 SD 3 | 13.1 Min 12.7 Max 14.3 SD 3 |
| 25. Length of third pelvic-fin ray (second branched) | 14.0 Min 13.7 Max 14.6 SD 3 | 14.0 Min 13.7 Max 14.6 SD 3 | 14.0 Min 13.7 Max 14.6 SD 3 |
| 26. Length of dorsal caudal-fin lobe | 2.3 Min 1.9 Max 2.8 SD 3 | 2.3 Min 1.9 Max 2.8 SD 3 | 2.3 Min 1.9 Max 2.8 SD 3 |
| 27. Length of ventral caudal-fin lobe | 2.3 Min 1.9 Max 2.8 SD 3 | 2.3 Min 1.9 Max 2.8 SD 3 | 2.3 Min 1.9 Max 2.8 SD 3 |
| 28. Body depth          | 16.6 Min 15.9 Max 17.0 SD 3 | 16.6 Min 15.9 Max 17.0 SD 3 | 16.6 Min 15.9 Max 17.0 SD 3 |
| 29. Body width          | 12.8 Min 12.3 Max 13.6 SD 3 | 12.8 Min 12.3 Max 13.6 SD 3 | 12.8 Min 12.3 Max 13.6 SD 3 |
| 30. Girth width         | 17.8 Min 16.2 Max 18.1 SD 3 | 17.8 Min 16.2 Max 18.1 SD 3 | 17.8 Min 16.2 Max 18.1 SD 3 |

**Table 1.** Morphometric features of *Cetopsis rhodinga clathrata*, taken from the holotype MCP 36064, and the paratypes in ANSP 188921, LIRP 10032, MCP 36063, MNRI 35877, UFRO-I 10968, UFRO-I 10979, UFRO-I 122921, and UFRO-I 23004. Morphometric data 1-34 are expressed as percent of Standard Length and 35-45 as percent of Head Length. Abbreviations: H = holotype; Min = minimum value; Max = maximum value; N = number of specimens; SD = standard deviation.
on body coloration: unnumb. p.; phylogenetic relationships: unnumb. p.;

Cetopsorhamdia sp. n. 3. – Bockmann & Slobodian, 2013 [likely endemic of part of the Rio Madeira system: 19; photograph in left lateral view: 24 (UFRO-I 10968, 72.7 mm SL); distribution – Rio Machado and Roosevelt, Brazil: 25; material cited – UFRO-I 10869 (misspelled catalog number; actually UFRO-I 10968; part of lot currently at LIRP 10032): 25; brief description: 25; in key of identification of heptapterids of Rio Madeira basin: 72; in list of heptapterids reported to the Mamoré/Beni/Madre de Dios/Madeira system – geographic distribution; additional material (MCP 36063, MCP 36064): 74, unnumb. tab.]; Ohara & Lima, 2015 [ecological notes of the collecting site – Brazil, Rondônia, Vilhena, rio Madeira basin, upper rio Machado, tributary of igarapé Piracolina, near road BR-364, 12°48′56.5″S, 60°06′37.6″W – UFRO-I 22918: 566]; Ohara & Marinho, 2016 [ecological notes of the collecting site – Brazil, Rondônia, Vilhena, rio Madeira basin, upper rio Machado, tributary of igarapé Piracolina, near road BR-364, 12°48′56.5″S, 60°06′37.6″W – UFRO-I 22918: 41]; Ohara et al., 2016 [ecological notes of the collecting site – Brazil, Rondônia, Vilhena, rio Madeira basin, upper rio Machado, tributary of igarapé Piracolina, near road BR-364, 12°48′56.5″S, 60°06′37.6″W – UFRO-I 22918: 547]. Undescribed species of Cetopsorhamdia. – Ohara et al., 2016 [endemic to the Rio Madeira basin: 549].

Holotype: MCP 36064, 50.8 mm SL in ethyl alcohol (ms and xr), Brazil, Rondônia State, Vilhena, Igarapé Piracolina, Rio Ji-Paraná (or Machado) basin, Rio Madeira drainage, ca. 6 km W of Vilhena, near highway BR-364, at Chapada dos Parecis, 12°43′33″S, 60°11′34″W, coll. R.E. Reis, P.A. Buckup, A.R. Cardoso, E.H.L. Pereira, 14 Jul 2004.

Paratypes: All specimens from Brazil, Rondônia State, Vilhena: ANSP 188921, 2 ex. in ethyl alcohol (21.3-55.0 mm SL, ms and xr), collected with holotype; LIRP 10032 (ex UFRO-I 10968), 2 ex. in ethyl alcohol (35.5-40.1 mm SL, ms and xr), unnamed igarapé affluent of Rio Roosevelt, Rio Madeira drainage, ca. 6 km W of Vilhena, near highway BR-364, at Chapada dos Parecis, 12°24′43″S, 60°11′34″W, coll. Reis, P.A. Buckup, A.R. Cardoso, E.H.L. Pereira, 14 Jul 2004.
10979, 2 ex. in ethyl alcohol (24.7–53.9 mm SL, ms and xr), unnamed igarapé affluent of Rio Ji-Paraná (or Machado), Rio Madeira drainage, near Vilhena, towards Porto Velho, at Chapada dos Parecis, 12°42′54.1″S, 60°21′35.6″W, coll. Laboratório de Ictiologia e Pesca/UNIR team, 3 Sep 2011; UFRO-I 22918, 12 ex. in ethyl alcohol (21.7–34.0 mm SL), unnamed igarapé affluent of Igarapé Piracolina, Rio Ji-Paraná (or Machado) basin, Rio Madeira drainage, at Chapada dos Parecis, 12°48′56.5″S, 60°06′37.6″W, coll. W.M. Ohara, D.B. Hungria, B.S. Barros, 14 Sep 2013; UFRO-I 22921, 1 ex. in ethyl alcohol (61.2 mm SL, ms and xr), unnamed igarapé affluent of Igarapé Piracolina, Rio Ji-Paraná (or Machado) basin, Rio Madeira drainage, at Chapada dos Parecis, 12°40′04″S, 60°15′58″W, 29 July 2013, coll. I.D. Costa; UFRO-I 23004, 1 ex. in ethyl alcohol (28.3 m SL, ms and xr), unnamed stream affluent of Igarapé Piracolina, where crossed by highway BR-364, in the road next to the telecom tower, at Chapada dos Parecis, 12°40′51″S, 60°13′36.9″W, coll. Laboratório de Ictiologia e Pesca/UNIR team, 14 Sep 2013.

**Diagnosis**

*Cetopsorhamdia clathrata* differs from its congeners, and all other heptapterids, by a unique color pattern of trunk constituted by two longitudinal rows of 10-12 quadrangular marks which gives the fish a crisscross appearance (evident in specimens 27.8 mm SL and larger). Such a color pattern is produced by two presumably independent features: 9-11 transverse bars of interrupted pigmentation and an unpigmented stripe along the mid-lateral portion of trunk (vs. body homogeneously darkly pigmented or with different color pattern). Specimens of all sizes of *C. clathrata* are further distinguished from...
Figure 3. Developmental series of *Cetopsorhamdia clathrata*, lateral view, paratypes, showing ontogenetic color pattern changes; Brazil, Rondônia State, Vilhena: Igarapé Piracolina, Rio Madeira basin: MCP 36063, (A) 21.5 mm SL, (B) 22.1 mm SL, (C) 22.4 mm SL, (D) 27.8 mm SL; and MNRJ 35877, (E) 40.9 mm SL.
Figure 4. Developmental series of *Cetopsorhamdia clathrata*, dorsal view, paratypes, showing ontogenetic color pattern changes; Brazil, Rondônia State, Vilhena: Igarapé Piracolina, Rio Madeira basin: MCP 36063, (A) 21.5 mm SL, (B) 22.1 mm SL, (C) 22.4 mm SL, (D) 27.8 mm SL; and MNRJ 35877, (E) 40.9 mm SL.
other species of *Cetopsorhamdia* by possessing a higher number of vertebrae, 40-42, usually 41 (vs. 37 in *C. boquillae*; 37-39, usually 37-38, in *C. iheringi*; 35-38, usually 36-37 in *C. insidiosa, C. nasus*, and *C. picklei*; 39-40 in *C. spilopleura*). It can be distinguished from most species of *Cetopsorhamdia*, except *C. spilopleura*, by having: very short maxillary barbel, not reaching posterior margin of opercle in specimens 22.4 mm SL or longer (vs. reaching the first third of pectoral fin in *C. insidiosa* and *C. nasus*; reaching the second third of pectoral fin in *C. iheringi* and *C. picklei*; and surpassing the posterior margin of pectoral fin in *C. boquillae*); dorsal fin more posteriorly located, with first basal radial articulated with the bifid dorsal process of vertebrae 11-12 (vs. 8-9 in *C. boquillae*, *C. iheringi*, *C. insidiosa, C. nasus*, and *C. picklei*); anal fin situated more posteriorly, with its first basal radial normally articulated between hemal spines of vertebrae 23-25 (vs. 21-22 in *C. boquillae* and *C. insidiosa*, 21-23 in *C. iheringi* and *C. nasus*; and 20-23, usually 20-22, in *C. picklei*); and whitish ovoid areas on both caudal-fin lobes (vs. caudal fin lobes homogeneously dark in other species). *Cetopsorhamdia clathrata* is further distinguished from *C. spilopleura* by having fins narrow, with marked concave posterior margins (vs. fins broad, with convex posterior profiles); a long and complete lateral line, extending to slightly beyond the caudal-fin base (vs. lateral line fragmented as isolated patches behind the level of the adipose-fin origin, reaching the level of the anterior portion of the caudal plate); and the laterodorsal and lateroventral regions of the trunk with continuous dark pigmentation (not forming two unpigmented lateral streaks), except for the intervals between the squares (vs. laterodorsal and lateroventral regions of trunk devoid of dark pigmentation).

**Description**

Morphometrics of holotype and some paratypes in Table 1. See Figs. 1-4 for general body shape. Body relatively elongated, its cross-section oval predorsally, becoming gradually more compressed caudally. Anterior dorsal profile of body gently convex, with sometimes discrete hump at posterior limit of head. Dorsal profile of head gently convex, continuous with dorsal profile of trunk. Dorsal profile of trunk posterior to dorsal-fin base approximately straight to base of caudal fin. Ventral profile of head approximately straight and continuous with abdominal region. Ventral trunk contour slightly convex or straight from pelvic-fin origin to end of anal-fin base, and straight to base of caudal fin. Posterior body depth gradually decreasing caudally. Axillary pore minute, just dorsal to pectoral-fin base, and ventral to first pore of lateral line. Urogenital and anal openings adjacent to each other; anal opening approximately on vertical through middle of pelvic fin.

Head longer than broad, depressed, and subtriangular to trapezoidal in dorsal view (Figs. 1-5). Anterior and posterior cranial fontanelles short, separated from each other by broad bridge, about two times longer than each fontanel (Fig. 6B). Eye small, laterodorsally located, approximately equidistant from snout tip and supraoc-
Dorsal fin with i,6 (17*) rays. First dorsal-fin ray (spinel-et) absent. Second dorsal-fin ray unbranched, with basal third stiffened and unsegmented and distal two thirds flexible and segmented. Second dorsal-fin ray slightly shorter than third and fourth rays (first and second branched rays, respectively). Origin of dorsal fin slightly anterior to vertical through pelvic-fin origin. Dorsal fin with 7 (17*) basal radials. Anteriormost dorsal-fin basal radial on neural spine of vertebra 11 (3), on space between neural spines of vertebrae 11 and 12 (2), or on neural spine of vertebra 12 (12*). Posteriormost dorsal-fin basal radial on space between neural spines of vertebrae 15 and 16 (10), on neural spine of vertebra 16 (3), or between neural spines of vertebrae 16 and 17 (4*).

Pectoral fin with distal margin straight to slightly convex (Figs. 1-4), with i,7 (2) or i,8 (15*) rays. First pectoral-fin ray with basal third rigid and unsegmented and distal two thirds flexible and segmented (Fig. 9). First pectoral-fin ray slightly shorter than second (first branched) and third (second branched) rays, whose tips project slightly beyond tip of first ray. Pectoral fin lying parallel to main body axis when expanded and slightly directed upwards when adpressed to body.

Pelvic fin wide, with distal border straight to slightly rounded (Figs. 1-3), with i,5 (17*) rays. Origin of pelvic-fin base slightly posterior to vertical through dorsal-fin origin, on vertical through space between insertions of first (unbranched) and second (first branched) dorsal-fin
rays (8*), or on vertical through insertion of second (first branched) dorsal-fin ray (9). Inner margins of pelvic-fin bases apart from each other. Tip of adpressed pelvic fin falling at mid distance between pelvic- and anal-fin origins. Lateralmost ray unbranched, completely flexible, segmented, and with tip distinctly falling short of tips of second and third rays (first and second branched rays, respectively). Origin of pelvic fin on vertical through region between centra 13 and 14 (1), on vertical through vertebral centrum 14 (5), on vertical through region between centra 14 and 15 (7), or on vertical through vertebral centrum 15 (4*).

Anal fin deeper than adipose fin, with short base and distal border slightly rounded (Figs. 1-3), with 12 (9*), 13 (7), or 14 (1) total rays, including 7 (3), 8 (12*), or 9 (2) branched rays. Anal-fin rays with following branching pattern: iv,8 (6*), iv,9 (2), v,7 (3), or v,8 (6). Two anteriormost anal-fin rays vestigial, unsegmented, embedded

---

**Figure 6.** Neuroranium and associated structures of *Cetopsorhamdia clathrata*, MCP 36064, 50.8 mm SL, holotype (CT reconstructions). (A) left lateral view; (B) dorsal view; (C) ventral view. Cartilage not represented. Scale bars = 2 mm.
Figure 7. Hyoid arches of *Cetopsorhamdia clathrata*, MCP 36064, 50.8 mm SL, holotype (CT reconstruction). Ventral view. Cartilage not represented. Scale bar = 2 mm.

Figure 8. Branchial arches of *Cetopsorhamdia clathrata*, MCP 36064, 50.8 mm SL, holotype (CT reconstruction). Dorsal view. Dorsal elements of left arches not shown. Cartilage not represented. Scale bar = 2 mm.

Adipose fin moderately deep and short, highest approximately at midpoint (Figs. 1-3). Adipose fin merging gradually with back anteriorly, with imprecise origin. Distance from dorsal-fin base to adipose fin approximately twice length of dorsal-fin base. Origin of adipose fin slightly posterior to origin of anal fin, on vertical through insertion of last unbranched anal-fin ray (5), on vertical through insertion of first branched anal-fin ray (9), or second branched anal-fin ray (2*). Posterior limit of adipose fin well-defined, with distinct free, rounded lobe. Vertical through end of adipose-fin base at or slightly posterior to tip of posteriormost anal-fin ray. Origin of adipose fin on vertical through vertebral centrum 26 (5), on vertical through region between centra 26 and 27 (3), on vertical through vertebral centrum 27 (7), or on vertical through region between centra 27 and 28 (2*). End of adipose-fin base on vertical through vertebral centrum 34 (1), on vertical through region between centra 34 and 35 (4), on vertical through vertebral centrum 35 (9*), on vertical through region between centra 35 and 36 (2), or on vertical through centrum 36 (1).

Caudal fin forked, with ventral lobe longer than dorsal lobe (Figs. 1-3). Dorsal lobe with 7 (17*) branched rays; ventral lobe with 8 (16*) branched rays, rarely 7 (1). Total caudal fin-rays 39 (1), 40 (1), 41 (4), 42 (1), 43 (2), 44 (5*), 45 (1), 46 (1), or 47 (1), being 18 (1), 20 (6), 21 (4*), 22 (4), or 23 (2) rays in dorsal lobe, and 20 (1), 21 (6), 22 (4), 23 (5*), or 24 (1) rays in ventral lobe. Dorsal caudal plate (uroneural and hypurals 3, 4, and 5) with 8 (17*) rays, arranged as follows: 6 rays on hypural 3+4 and 2 rays on hypural 5 (16*), or 8 rays on hypural 3+4+5 (1). Ventral caudal plate (parhypural plus hypurals 1 and 2) with 8 (16*), rarely 9 (1) rays, arranged as follows: 1 ray on parhypural and 7 rays on hypural 1+2 (6), 2 rays on parhypural and 6 rays on hypural 1+2 (9*), 8 rays on parhypural + hypural.
dorsally and laterally. Cheeks (except for its anterior
stered melanophores (Figs. 1‑4). Head mostly dark‑brown
tral region mostly unpigmented except for few scat
Body pigmented with brown melanophores dorsally
tered, with faint unpigmented area (with milky hue) (Figs. 1, 4). Midportion of snout, between anterior and posterior nares, with faintly unpigmented area, more evident in juveniles (Fig. 4). Region between corner of mouth and cheek unpigmented, with milky tonality (Figs. 1‑3). Maxillary barbel with brown melanophores dorsally, mental barbels yellow (Figs. 1‑4). Dark stripe along region from base of maxillary barbel to region right posterior to eye (Figs. 1‑4). Elongate, roughly rectangular white or yellow band ventral to eye (Figs. 1‑3). Posterior portion of head, from posterodorsal region of opercle to posterior limit of branchiostegal membrane, with very dark mark extending ventrally along branchiostegal membrane (Figs. 1‑3), reaching level of pectoral‑fin base in larger specimens (50.8 mm SL or larger). Area immediately dorsal to terminus of opercular cleft with unpigmented, milky, oval spot (Figs. 1‑4). Posterior border of supraoccipital of 22.1 mm SL or larger specimens with unpigmented (of milky hue), wide‑angled “V” streak, extending laterally to about level of eyes (Figs. 1, 4); such unpigmented nuchal mark missing in 20.3 mm SL or smaller specimens and almost unperceivable in 21.5 mm SL specimen (Fig. 4A). Larger individuals with two longitudinal, wide rows (one laterodorsal and one lateroventral) of 10‑12 brown, quadrangular marks on flanks, interspersed by 9‑11 vertical unpigmented lines or bars and one unpigmented stripe along its midlateral region, giving criss‑cross appearance (Figs. 1‑2, 3D‑E, 4D‑E). Marks on both sides not perfectly symmetrical, meeting each other in midline dorsally (Figs. 1, 4). Quadrangular marks arranged as follows: three or four anterior to dorsal fin, one approximately below dorsal‑fin base, two approximately between dorsal‑ and adipose‑fin bases, three approximately below adipose‑fin base, and one or two along caudal peduncle (Figs. 1‑2, 3D‑E, 4D‑E). Trunk of small specimens (21.5 mm SL or smaller specimen) homogeneously brown colored, lacking unpigmented vertical bars (Figs. 3A, 4A), which become progressively more conspicuous in somewhat larger specimens (22.1 mm SL or larger specimens) (Figs. 3B‑E, 4B‑E). Larger specimens (50.8 mm SL or larger) with anteriormost quadrangular mark divided into two sections by extra vertical, unpigmented bar or lines (Figs. 1‑2); also, quadrangular marks on caudal peduncle trend to subdivide in larger specimens, over ontogeny. Dark laterodorsal and lateroventral regions of trunk continuous or separated by narrow, short, unpigmented midlateral streak to adipose‑fin origin, in small specimens (21.5 mm SL or smaller) (Fig. 3A); midlateral unpigmented stripe progressively wider and longer, reaching caudal region, over ontogeny (Figs. 3B‑E). Anterior border of pseudotympanum wall, above pectoral‑fin base, with dark brown, vertical mark (extending ventrally to level of pectoral‑fin base); mark progressively darker and more defined in larger specimens (Fig. 3). Lateral wall of pseudotympanum densely pigmented, except for its central region in smaller specimens (21.5 mm SL or smaller), becoming progressive-

1+2 (1), or 2 rays on parhypural and 7 rays on hypural
Number of vertebrae 40 (6), 41 (10*) or 42 (1); first
completely formed hemal spine on centrum 16 (6)
or 17 (11*); and ribs 8/8 (10) or 9/9 (7*). Last four (4*),
five (7), or six (6) precaudal vertebrae with discrete neu-
processes. Last precaudal vertebra (1), or last two (5),
three (6), or four (5*) precaudal vertebrae with very dis-
crete, almost imperceptible, neural processes.

Laterosensory system

Head laterosensory canals with simple (non‑dendriti-
canals anteriorly connected to optic and infraorbital laterosensory canals posteriorly. Supraorbital laterosensory canal usually with 5 branches and pores: s1, s2, s3, s6 (epiphyseal branch), and s8 (parietal branch and pore). Contralateral epiphyseal branches (s6) fused to each other, bearing single symphyseal pore (s6+s6) (Fig. 5B). S4, s5, and s7 (postorbital) branches and pores absent. Supraorbital and infraorbital laterosensory canals anteriorly connected to each other through s2 and i2 branches (forming complex s2+i2 pore) (Fig. 5B). Otic laterosensory canal short, without pores, and continuous with posterior limits of supra- and infraorbital laterosensory canals, anteriorly, and with anterior limit of postotic laterosensory canal, posteriorly. Postotic (or temporal) laterosensory canal extends from posterior or limit of otic laterosensory canals to anterior limit of lateral line, with 3 branches and pores (po1, po2, and po3) (Fig. 5A‑B). Infraorbital laterosensory canal with 6 branches and pores, with s2 fused to i2 (see above). Preopercular mandibular laterosensory canal with 11 branches and pores (Fig. 5A‑C); anteriormost preopercu-
mandibular laterosensory branch (pm1) independent from its symmetrical; posterioriormost preopercul-
mandibular laterosensory branch (pm11) fused to po1 branch forming complex po1+pm11 branch and pore (Fig. 5A‑B). Lateral line sensory canal continuous with postotic laterosensory canal anteriorly and not inter-
rupted posteriorly (Fig. 5A‑B). Lateral line sensory canal long, with posterior limit extending to vertical through anterior half of caudal plate in smaller specimens and to origin of caudal‑fin rays in larger specimens (27.8 mm SL or larger). First lateral line pore ventral to level of adja-
cent pores of lateral line. One pair of short, anteriorly convergent, lines of neuromasts, with two neuromasts each, between anterior and posterior nares. One short neuromast line, with single neuromast, just posterior to each parietal branch (s8).

Pigmentation in alcohol and in life

Background body coloration withish pale or yellow. Body pigmented with brown melanophores dorsally and laterally, except for regions described below; ventral region mostly unpigmented except for few scattered melanophores (Figs. 1‑4). Head mostly dark‑brown dorsally and laterally. Cheeks (except for its anterior portion), ventral portion of opercle, and entire ventral surface of head unpigmented (Figs. 1‑4). Anterior border of snout, anterior to anterior nares, with faint unpigmented area (with milky hue) (Figs. 1, 4). Midportion of snout, between anterior and posterior nares, with faintly unpigmented area, more evident in juveniles (Fig. 4). Region between corner of mouth and cheek unpigmented, with milky tonality (Figs. 1‑3). Maxillary barbel with brown melanophores dorsally, mental barbels yellow (Figs. 1‑4). Dark stripe along region from base of maxillary barbel to region right posterior to eye (Figs. 1‑4). Elongate, roughly rectangular white or yellow band ventral to eye (Figs. 1‑3). Posterior portion of head, from posterodorsal region of opercle to posterior limit of branchiostegal membrane, with very dark mark extending ventrally along branchiostegal membrane (Figs. 1‑3), reaching level of pectoral‑fin base in larger specimens (50.8 mm SL or larger). Area immediately dorsal to terminus of opercular cleft with unpigmented, milky, oval spot (Figs. 1‑4). Posterior border of supraoccipital of 22.1 mm SL or larger specimens with unpigmented (of milky hue), wide‑angled “V” streak, extending laterally to about level of eyes (Figs. 1, 4); such unpigmented nuchal mark missing in 20.3 mm SL or smaller specimens and almost unperceivable in 21.5 mm SL specimen (Fig. 4A). Larger individuals with two longitudinal, wide rows (one laterodorsal and one lateroventral) of 10‑12 brown, quadrangular marks on flanks, interspersed by 9‑11 vertical unpigmented lines or bars and one unpigmented stripe along its midlateral region, giving criss‑cross appearance (Figs. 1‑2, 3D‑E, 4D‑E). Marks on both sides not perfectly symmetrical, meeting each other in midline dorsally (Figs. 1, 4). Quadrangular marks arranged as follows: three or four anterior to dorsal fin, one approximately below dorsal‑fin base, two approximately between dorsal‑ and adipose‑fin bases, three approximately below adipose‑fin base, and one or two along caudal peduncle (Figs. 1‑2, 3D‑E, 4D‑E). Trunk of small specimens (21.5 mm SL or smaller specimen) homogeneously brown colored, lacking unpigmented vertical bars (Figs. 3A, 4A), which become progressively more conspicuous in somewhat larger specimens (22.1 mm SL or larger specimens) (Figs. 3B‑E, 4B‑E). Larger specimens (50.8 mm SL or larger) with anteriormost quadrangular mark divided into two sections by extra vertical, unpigmented bar or lines (Figs. 1‑2); also, quadrangular marks on caudal peduncle trend to subdivide in larger specimens, over ontogeny. Dark laterodorsal and lateroventral regions of trunk continuous or separated by narrow, short, unpigmented midlateral streak to adipose‑fin origin, in small specimens (21.5 mm SL or smaller) (Fig. 3A); midlateral unpigmented stripe progressively wider and longer, reaching caudal region, over ontogeny (Figs. 3B‑E). Anterior border of pseudotympanum wall, above pectoral‑fin base, with dark brown, vertical mark (extending ventrally to level of pectoral‑fin base); mark progressively darker and more defined in larger specimens (Fig. 3). Lateral wall of pseudotympanum densely pigmented, except for its central region in smaller specimens (21.5 mm SL or smaller), becoming progressive-
ly less pigmented in 22.1 mm SL and larger specimens (Fig. 3). Several small (one to half size of eye), rounded, unpigmented areas dispersed all over dorsal surface of trunk, fewer ventral to lateral line, in 27.8 mm SL and larger specimens (Figs. 1, 3-4); 22.4 mm SL and smaller specimens devoid of such unpigmented spots (Figs. 3-4).

Middorsal region of trunk with three unpigmented, milky blotches (Figs. 1-4): one predorsal, rounded, and medium-sized mark (equal or slightly larger than eye size) just anterior to dorsal fin and around base of its first ray; one very discreet postdorsal mark just posterior to dorsal-fin base; and one inconspicuous preadipose mark; post-adipose and pre-caudal marks absent. First dorsal-fin ray light but proximal third of remaining rays and base of adipose fin brown. Base of dorsal fin darkly pigmented. Base of pectoral fin dark dorsally. Fin rays brown, fading distally, in larger individuals, with dark pigmentation restricted to their proximal thirds or almost absent, with few dark chromatophores, in smaller specimens; interradial membranes mostly hyaline. Muscular base of pectoral, dorsal, and anal fins dark brown. Caudal peduncle with dark-brown, blackened, vertical mark, extending posteriorly to limit of skin on base of caudal-fin rays and most evident at base of principal rays (Figs. 1-3); peduncular mark more conspicuous in smaller individuals (Fig. 3). Base of caudal fin lobes with large, oval or rounded unpigmented spots, with milky aspect (Figs. 1-3).

**Etymology**

The specific epithet is from the Latin “clathratus”, meaning latticed, screened, or reticulate, in allusion to the network color pattern of its flanks. An adjective.

**Geographic distribution and habitat**

The species is known from the headwaters of the Rio Ji-Paraná (or Machado) and Rio Roosevelt basins, both belonging to the upper Madeira system, draining the northern slope of the Chapada dos Parecis, near Vilhena, Rondónia State, Brazil (Fig. 10). The body proportions of these two sets of geographically separated samples, both here assigned to *C. clathrata*, intermingle (Table 1), as well as the other morphological characteristics, such as color and meristic data, so that there is no reason to treat them as distinct species. The Igarapé Piracolina, where the holotype (MCP 36064) and several paratypes (ANSP 188921, MCP 36063, MNRJ 35877) of *C. clathrata* were caught, is a small river with sandy bottom, interspersed with sections of gravel and pebbles, and rich aquatic vegetation, with clear waters and moderate to strong current (Fig. 11). Similar habitat and environmental conditions have been reported by Ohara & Lima (2015) and Ohara & Marinho (2016) for *C. clathrata* (identified as *Cetopsorhamdia* sp. 3; UFRO-I 22918) in a
tributary of the Igarapé Piracolina, near highway BR-364 (12°48′56.5″S, 60°06′37.6″W), where it was collected together with Ancistrus verecundus Fisch-Muller, Cardoso, Silva & Bertaco, 2005, Bryconops piracolina Wingert & Malabarba, 2011, Hyphessobrycon lucenorum Ohara & Lima, 2015, Hyphessobrycon aff. melanostichos Carvalho & Bertaco, 2006, Hyphessobrycon sp., Moenkhausia parecis Ohara & Marinho, 2016, Corydoras sp. (= C. hephaestus Ohara, Tencatt & Britto, 2016) and Pyrrhulina sp. That tributary was categorized as a “terra-firme igarapé” (= highland creek), with its sampled stretch located at 585 m above sea level, described as being small, 1.5-2.5 m wide and 0.3-1.5 m deep, with clear and swift waters, and bottom composed of sand and dead leaves, with little preserved riparian vegetation and surrounded by large plantation fields (mostly soy and corn) (Ohara & Lima, 2015: fig. 4; Ohara & Marinho, 2016: fig. 4).

**Conservation assessment**

The extinction risk of Cetopsorhamdia clathrata is preliminarily assessed as high. The species is known from six localities in headwater streams of the upper Rio Ji-Paraná and one in a headwater creek of the Rio Roosevelt, both part of the Madeira Drainage, with an Extension of Occurrence (EOO) calculated by the convex polygon of 696 square kilometers. The area is severely converted and heavily impacted by deforestation, suffering effects from erosion, silting, and increased turbidity, with extensive agriculture of cotton, soybean, and other commodities that heavily rely on herbicides, pesticides, and fertilizers. There are no estimates of population size or population decline, and no rational can be used to determine the number of locations. For these reasons, C. clathrata is tentatively assessed as Near Threatened (NT) approaching Endangered by the criterion B1(biii), according to the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN Standards and Petitions Sub-Committee, 2019).

Cetopsorhamdia spilopleura sp. nov. http://zoobank.org/AE5243DF-EEE7-4ED1-A0F5-4B7C10671F11 (Figs. 12-15, Table 2)

Cetopsorhamdia new species 2. – Bockmann & Reis, 2011 [distribution – upper Rio Tapajós drainage, in State of Mato Grosso: unnumb. p.; brief characterization based on body coloration: unnumb. p.; phylogenetic relationships: unnumb. p.].

Cetopsorhamdia sp. – Bertaco & Carvalho, 2005a [collected in Brazil, Mato Grosso, Comodoro, rio
Mutum on road BR-364 to cidade de Vilhena, tributary of rio Juruena, upper rio Tapajós drainage, 13°05′08″S, 59°53′32″W: 442; Bertaco & Carvalho, 2005b [collected in the headwaters of the rio Tapajós drainage, in Chapada dos Parecis, Mato Grosso, Brazil: 145].

**Cetopsorhamdia** sp.3. – Ohara & Loeb, 2016 [Upper rio Juruena on Chapada dos Parecis, Mato Grosso, Brazil, in sampling station 1 (igarapé Mutum located at BR-364, 13°05′08″S, 59°53′32″W – MZUSP 115478) and sampling station 4 (tributary of Rio Doze de Outubro located near BR-364, 12°57′50″S, 60°01′40″W – MZUSP 115498, part of specimens of this lot currently in MZUSP 121503 and LIRP 13992); 5, table 1].

**Cetopsorhamdia** sp. 3. – Ohara & Loeb, 2016 [photography of live specimen in left lateral view: 5, fig. 4].

**Holotype:** MZUSP 121503, 47.9 mm SL (ms and xr) in ethyl alcohol, Brazil, State of Mato Grosso, Comodoro, unnamed stream affluent of Rio Doze de Outubro, Rio Tapajós drainage, about 25 km from Vilhena (Rondônia State), on highway BR-364, at Chapada dos Parecis, 12°57′50″S, 60°01′40″W, coll. W. Ohara, 3 Sep 2014.

**Paratypes:** All specimens from Brazil, Mato Grosso State, Comodoro: LIRP 13992, 1 ex. in ethyl alcohol (50.9 mm SL, ms and xr), 1 ex. c&s (40.2 mm SL, ms and xr), collected with holotype; MZUSP 115498, 2 ex. (34.8-41.8 mm SL, ms and xr), collected with holotype; MCP 35993, 1 ex. in ethyl alcohol (24.9 mm SL, ms and xr), 1 ex. c&s (22.4 mm SL), Rio Doze de Outubro, between Comodoro and Vilhena, on highway BR-364, Rio Tapajós drainage, at Chapada dos Parecis, 12°58′39″S, 60°00′30″W, coll. R.E. Reis, P.A. Buckup, A.R. Cardoso, E.H.L. Pereira, 14 Jul 2004; MCP 41057, 1 ex. in ethyl alcohol (30.5 mm SL, ms and xr), collected with MZUSP 35993; MZUSP 118307, 1 ex. in ethyl alcohol (58.9 mm SL, ms and xr), unnamed stream affluent of Rio Doze de Outubro, Rio Tapajós drainage, at Luar do Sertão farm, between Comodoro and Vilhena, at Chapada dos Parecis, 12°57′46.60″S, 60°01′45.16″W, coll. F.C.P. Dagosta, W.M. Ohara, V. Giovanetti, 13 Nov 2014.

**Diagnosis**

*Cetopsorhamdia spilopeura* differs from its congeners, and all other heptapterids, by having a unique color pattern of trunk constituted by 18-22 irregular, vertical brown bars, sometimes resembling inverted “v”, “y” or “x”. In addition, it can be separated from other species of *Cetopsorhamdia* by having: 7 branched pectoral-fin rays (vs. 8 in *C. clathrata*; 8-9 in *C. boquillae*; 8-10, usually 9, in *C. iheringi*, *C. nasus*, and *C. picklei*); and lateral line fragmented as isolated patches posterior to vertical through the level of adipose-fin origin, reaching to anterior portion of caudal plate (vs. long and complete lateral line, extending to slightly beyond the caudal-fin base in all other species of *Cetopsorhamdia*). It is further distinguished from other *Cetopsorhamdia*, except *C. clathrata*, by having: very short maxillary barbel, not reaching posterior margin of opercle (vs. reaching the first third of pectoral fin in *C. insidosa* and *C. nasus*; reaching the second third of pectoral fin in *C. iheringi* and *C. picklei*, and surpassing the posterior margin of pectoral fin in *C. boquillae*); dorsal fin situated more posteriorly, with first basal radial normally...
inserted on bifid dorsal process of vertebra 12 (vs. 8-9 in *C. boquillae*, *C. iheringi*, *C. insidiosa*, *C. nasus*, and *C. picklei*); a more posteriorly located anal fin, with first basal radial articulated between hemal spines of vertebrae 22-24 (vs. 21-22 in *C. boquillae* and *C. insidiosa*, 21-23 in *C. iheringi* and *C. nasus*; and 20-22, in *C. picklei*); and whitish ovoid areas on both caudal-fin lobes (vs. caudal fin lobes homogeneously dark in other species). *Cetopsorhamdia spilopleura* differs further from *C. clathrata* by possessing: fins broad, with convex posterior profiles (vs. fins narrow, with marked concave posterior borders); the midlateral region of trunk darkly pigmented (vs. midlateral region devoid of pigmentation, forming a white stripe along the lateral line); and the laterodorsal and lateroventral regions of trunk devoid of dark pigmentation, forming unpigmented streaks (vs. laterodorsal and lateroventral regions of trunk with continuous dark pigmentation, except for the intervals between the squares).

**Description**

Morphometrics of holotype and paratypes in Table 2. See Figs. 12-14 for general body shape. Body relatively elongated, its cross-section round to vertically oval predorsally, becoming gradually more compressed caudally. Anterior dorsal profile of body gently convex, without noticeable hump at end of head. Dorsal profile of head gently convex, almost straight, continuous with dorsal profile of trunk. Dorsal profile of trunk posterior to dorsal-fin base approximately straight with slight elevation at origin of adipose fin. Ventral profile of head slightly convex and continuous with abdominal region, also slightly convex. Ventral trunk contour nearly straight from end of pelvic-fin base to caudal-fin base. Posterior body depth gradually decreasing caudally. Axillary pore minute, just dorsal to pectoral-fin base, and ventral to first pore of lateral line. Urogenital and anal openings adjacent to each other; anal opening approximately on vertical through middle of pelvic fin.

Head longer than broad, depressed, and subtriangular to trapezoidal in dorsal view (Figs. 12-15). Anterior and posterior cranial fontanels short, separated from each other by broad bridge, about two times longer than each fontanel (Fig. 16). Eye small, laterodorsally placed, approximately equidistant from snout tip and supraoccipital posterior end, and without free orbital rim except for shallow ventral invagination. Deep longitudinal facial ridge marking dorsal limit of adductor mandibulae muscle, extending from dorsal base of maxillary barbel to or just anterior of eye. Cheek distinctly swollen ventral to eye, forming groove to maxillary barbel. Anterior intranarial width and posterior intranarial width approximately equal. Anterior and posterior nares far apart from each other; with separation between them slightly greater than distance between each pair of nares. Anterior naris surrounded by fleshy tubular flap of integument, with anterior border slightly raised. Base of anterior nostril shallow, not sunk in conspicuous trench. Posterior naris wide, elliptical, with transversal axis longest. Posterior naris surrounded by low fleshy flap anteriorly, mesially

![Figure 12. *Cetopsorhamdia spilopleura*, MZUSP 121503, 47.9 mm SL, holotype; Brazil, Mato Grosso State, Comodoro: unnamed stream affluent of Rio Doze de Outubro, Rio Tapajós basin.](image-url)
and laterally; posterior border devoid of flap. Mouth distinctly subinferior; gape gently convex anteriorly, slightly downturned at corners. Skin of lips with fleshy rictal fold at corner of gape. Rictal fold ventrally subtended by submandibular groove that extends anteriorly to point approximately adjacent to third or fourth preoperculo-mandibular pores (pm3 and pm4, respectively).

Premaxilla with 5-7 and dentary with 3-4 irregular rows of small villiform teeth (Fig. 16C). Anteriormost tooth row of premaxilla with 14-16 teeth; anteriormost tooth row of dentary with 26-29 teeth. Palate and vomer edentulous.

Gular fold distinct, fleshy, and broadly V-shaped. Branchiostegal membranes well-developed, free, united to isthmus only at medial apex, and not connected to each other anteriorly (Fig. 15C). Branchiostegal rays 8 (9*), posteriormost two wider and more laminar than anterior ones (Fig. 17). Ceratobranchials 1-2, and 5 with rakers along lateral margin only; ceratobranchials 3-4 with rakers along both lateral and mesial margins (Fig. 18). Branchial rakers short and straight, 6/6 (2*), 6/7 (2), 7/7 (1), 7/8 (1), or 8/7 (2) on first ceratobranchial (including one on angle formed with epibranchial), and 0/0 (8*) on first epibranchial.

Barbels relatively short and depressed, and progressively tapering distally (Figs. 12-15). Tip of maxillary barbel almost reaching middle of opercle, usually to or short of posterior margin of bone, when adpressed against body. Tips of outer and inner mental barbels extending to or slightly surpassing outer border of branchiostegal membrane. Outer mental barbel longer than inner barbel. Inner and outer mental barbels inserted at approximately same line or origin of outer mental barbel slightly anterior to origin of inner mental barbel.

Dorsal fin approximately triangular in lateral profile, not reaching to adipose fin when adpressed (Figs. 12-14).
Dorsal fin with i,6 (9*) rays. First dorsal-fin ray (spinelet) absent. Second dorsal-fin ray unbranched, with basal third stiffened and distal two thirds flexible and segmented. Second dorsal-fin ray slightly shorter than third and fourth rays (first and second branched rays, respectively). Origin of dorsal fin at or slightly anterior to vertical through pelvic-fin origin. Dorsal fin with 7 (9*) basal radials. Anteriormost dorsal-fin basal radial on neural spines of vertebrae 11 (1) or 12 (8*). Posteriormost dorsal-fin basal radial on space between neural spines of vertebrae 14 and 15 (1) or between neural spines of vertebrae 15 and 16 (8*).

Pectoral fin with distal margin slightly convex, i,7 (8*) or i,8 (1) rays. First pectoral-fin ray with basal third rigid and unsegmented and distal two thirds flexible and segmented (Fig. 19). First pectoral-fin ray slightly shorter than second (first branched) and third (second branched) rays, whose tips project slightly beyond tip of first ray. Pectoral fin lying parallel to main body axis when expanded and slightly directed upwards when adpressed to body.

Pelvic fin wide, with distal border rounded (Figs. 12-14), i,5 (17*) rays. Origin of pelvic-fin base at or slightly posterior to vertical through dorsal-fin origin, on vertical through origin of first (unbranched) dorsal-fin ray (1), on vertical through space between origins of first (unbranched) and second (first branched) dorsal-fin rays (2*), on vertical through origin of second (first branched) dorsal-fin ray (4), or on vertical through space between origins of second (first branched) and third (second branched) dorsal-fin rays (2). Inner margins of pelvic-fin bases apart from each other. Tip of adpressed pelvic fin falling short of vertical through anal-fin origin.

Figure 15. Anterior portion of the body of Cetopsorhamdia spilopleura, MCP 41057, 30.5 mm SL, paratype, showing laterosensory canal system. (A) left lateral view; (B) dorsal view; (C) ventral view. Scale bar = 3 mm.
origin. Lateralmost ray unbranched, completely flexible, segmented, and with tip distinctly falling short of tips of second and third rays (first and second branched rays, respectively). Origin of pelvic fin on vertical through vertebral centrum 14 (3*) or on vertical through region between centra 14 and 15 (6).

Anal-fin deeper than adipose fin, with short base and posterior border slightly convex (Figs. 12-14), with 11 (1), 12 (6*), or 13 (2) total rays, including 7 (4) or 8 (5*) branched rays. Anal-fin rays with following branching pattern: iv, 7 (1), v, 7 (3), iv, 8 (3*), or v, 8 (2). Two or three anteriormost anal-fin rays vestigial, unsegmented, embedded into thick anterior fold. Origin of anal-fin base just anterior to vertical through adipose-fin origin. Anal-fin base terminus at or slightly posterior to vertical through middle of adipose-fin base. Anal-fin with 9 (4), 10 (3), or 11 (2*) basal radials. Anteriormost anal-fin basal radial on space between hemal spines of verte-

Figure 16. Neuroranium and associated structures of Cetopsorhamdia spilopleura, MZUSP 121503, 47.9 mm SL, holotype (CT reconstructions). (A) left lateral view; (B) dorsal view; (C) ventral view. Cartilage not represented. Scale bars = 2 mm.
brae 22 and 23 (5*) or on space between hemal spines of vertebrae 23 and 24 (4). Posteriormost anal-fin basal radial on space between hemal spines of vertebrae 27 and 28 (2*) or on space between hemal spines of vertebrae 28 and 29 (7).

Adipose fin deep and short, with deepest point on second third of fin (Figs. 12-14). Distance from dorsal-fin base to adipose fin approximately twice length of dorsal-fin base. Origin of adipose fin slightly posterior to vertical through anal-fin origin, on vertical through insertion of first branched anal-fin ray (8), or second branched anal-fin ray (1*). Posterior limit of adipose fin well-defined, with free, conspicuous rounded lobe. Vertical through terminus of adipose-fin base slightly anterior to tip of posteriormost anal-fin ray. Origin of adipose fin on vertical through vertebral centrum 25 (1), on vertical through region between centra 25 and 26 (1), on vertical through vertebral centrum 26 (4*), on vertical through region between centra 26 and 27 (2), or on vertical through vertebral centrum 27 (1). End of adipose-fin base on vertical through region between vertebral centra 33 and 34 (1), on vertical through vertebral centrum 34 (3*), on vertical through region between centra 34 and 35 (1), or on vertical through vertebral centrum 35 (4).

Caudal fin forked, with ventral lobe equal or slightly longer than dorsal lobe (Figs. 12-14). Dorsal lobe with 7 (9*) branched rays; ventral lobe with 8 (8*) branched rays. Total caudal fin-rays 39 (1), 41 (4*), 44 (1), or 45 (3), being with 19 (1), 20 (4*), or 22 (4) rays in dorsal lobe, and 20 (1), 21 (3), 22 (2*), or 23 (3) rays in ventral lobe. Dorsal caudal plate (uro neural and hypurals 3, 4, and 5) with 8 (9*) rays, arranged as follows: 5 rays on hypural 3+4 and 3 rays on hypural 5 (2*) or 6 rays on hypural 3+4 and 2 rays on hypural 5 (7). Ventral caudal plate (parhypural plus hypurals 1 and 2) with 9 (7*), less commonly 8 (2) rays, arranged as follows: 3 rays on parhypural and 6 rays on hypural 1+2 (5*), 2 rays on parhypural and 7 rays on hypural 1+2 (2), or 2 rays on parhypural and 6 rays on hypural 1+2 (2).

Number of vertebrae 39 (3*) or 40 (6); first completely formed hemal spine on centrum 16 (7*) or 17 (2); and pleural ribs 7/7 (3*), 7/8 (1), 8/7 (1), or 8/8 (4). Last precaudal vertebra (1), or last three (2), four (3*), five (1), or six (2) precaudal vertebrae with discrete neural processes. Last precaudal vertebra (6*), or last two (2), five (1) precaudal vertebrae with very discrete, almost imperceptible, neural processes.
Laterosensory system

Head laterosensory canals with simple (non-dendritic) tubes ending in single pores (Fig. 15). Supraorbital laterosensory canal continuous and connected to optic and infraorbital laterosensory canals posteriorly. Supraorbital laterosensory canal with 5 branches: s1, s2, s3, s6 (epiphyseal branch), and s8 (parietal branch). Contralateral epiphyseal branches (s6) fused to each other, bearing single symphysial pore (s6+s6) (Fig. 15B). S4, s5, and s7 (postorbital) branches and pores absent. Supraorbital and infraorbital laterosensory canals anteriorly connected to each other through s2 and i2 branches (forming complex s2+i2 pore) (Fig. 15B). Otic laterosensory canal short, without pores, and continuous with posterior limits of supra- and infraorbital laterosensory canals, anteriorly, and with anterior limit of postotic laterosensory canal, posteriorly. Postotic (or temporal) laterosensory canal extends from posterior limit of otic laterosensory canal to anterior limit of lateral line, with 3 branches and pores (po1, po2, and po3) (Fig. 15A-B). Infraorbital laterosensory canal with 6 branches and pores, with s2 fused to i2 (see above). Preoperculomandibular laterosensory canal with 11 branches and pores (Fig. 15A-C); anteriormost preoperculomandibular laterosensory branch (pm1) independent from its symmetrical; posteriormost preoperculomandibular laterosensory branch (pm11) fused to po1 branch forming complex po1+pm11 branch and pore (Fig. 15A-B). Lateral line sensory canal continuous with postotic laterosensory canal anteriorly and interrupted posteriorly (Fig. 15A-B). Lateral line laterosensory canal long, with posterior limit extending to vertical through anterior half of caudal plate. First segment of lateral line long, with terminus at vertical through origin of anal fin to vertical through end of adipose-fin base, followed by 3-6 patches with 2-5 pores each. First lateral line pore ventral to level of adjacent pores of lateral line. One pair of short, anteriorly convergent, lines of neuromasts, with two neuromasts each, between anterior and posterior or nostrils. Two vertical, short lines of neuromasts on face, just ventral to eye. One short neuromast line, with single neuromast, just posterior to each parietal branch (s8).

Pigmentation in alcohol and in life

Background body coloration withish pale or yellow. Body pigmented with brown melanophores dorsally and laterally, except for regions described below; lateroventral and ventral regions mostly unpigmented except for few scattered melanophores, slightly more concentrated dorsal to anal fin (Figs. 12-14). Head mostly dark-brown dorsally; lateral and ventral portions of head unpigmented. Anterior border of snout, anterior to each anterior nare, uniformly dark, lacking unpigmented area. Midportion of snout, between anterior and posterior nares, with two small, adjacent unpigmented areas in juveniles (30.5 mm SL or smaller) (Fig. 14). Region between corner of mouth and cheek unpigmented, with milky hue. Maxillary barbel dorsally with light-brown melanophores, mental barbels yellow. Region along base of maxillary barbel to just posterior to eye with dark stripe. Elongate, roughly rectangular white or yellow band ventral to eye (Figs. 12-14), less evident in larger specimens. Dark mark on posterior portion of head, from postero-dorsal region of opercle to posterior limit of branchiostegal membrane, extending ventrally along branchiostegal membrane, reaching level of pectoral-fin base in larger specimens; such dark stripe fused with dark mark dorsal to pectoral-fin base (Figs. 12-14). Posterior border of supraoccipital with unpigmented (of milky hue), broad, M-shaped streak, extending laterally towards posterior or extremity of opercle (Figs. 12-14). Trunk background bright yellow, with dark-brown to black marks in life and brownish in alcohol (Figs. 12-14). Dorsum mostly covered by dark-brown, marbled pigmentation (Figs. 12-14). Flanks with 18-22 irregular, vertical, dark bars, sometimes resembling inverted ‘v’, ‘y’, or ‘x’ (Figs. 12-14). Anterior border of pseudotympanum wall, dorsal to pectoral-fin base, with dark brown, vertical mark, fusing dorsally with dark stripe across posterior region of opercle and branchiostegal membrane (Figs. 12-14). Lateral wall of pseudotympanum darkly pigmented, without any unpigmented region (Figs. 12-14). Laterodorsal region of trunk with whitish stripe (formed by absence of melanophores), extending posteriorly from level of pectoral-fin base up to approximately level of anal-fin origin (sometimes interrupting vertical bars), demarking midlateral, broad dark band (Figs. 12-14). Middorsal region of trunk with two unpigmented, milky blotches (Figs. 12-14); one predorsal, rounded, small mark (equal or slightly larger than eye size) just anterior to dorsal fin and around base of its first ray; and one diffuse, postdorsal unpigmented mark, just posterior to dorsal-fin base; pependipose, post-adipose, and precaudal white marks absent. Fin rays brown, fading distally, in larger individuals (40.2 mm SL or larger specimens) (Figs. 12-13), and with dark pigmentation restricted to their proximal thirds or almost absent, with few dark chromatophores, in smaller specimens (Fig. 14); interradial membranes mostly hyaline. Muscular base of pectoral, dorsal, and anal fins dark brown (Figs. 12-14). Adipose fin with ventral ½ light-brown and dorsal ½ translucent (Figs. 12-14). Caudal peduncle with dark-brown, blackened, vertical mark, extending posteriorly to limit of skin on base of caudal-fin rays and most evident at base of principal rays (Figs. 12-14); peduncular mark more conspicuous in smaller individuals. Base of caudal fin lobes with large, oval or rounded unpigmented spots, with milky appearance (Figs. 12-14), especially notable in life (Fig. 13).

Etymology

*Cetopsorhamdia spilopleura*, from the Greek “spilos”, spot, stain, and “pleura”, side, in allusion to the spotted pattern of the flanks. A noun in apposition.

Geographic distribution and habitat

*Cetopsorhamdia spilopleura* is only known from the Rio Doze de Outubro, a tributary of the upper Rio Juruena,
in the upper Rio Tapajós system, in Mato Grosso State, Brazil (Fig. 10). Ohara & Loeb (2016) found *C. spilopleura* (identified as *Cetopsorhamdia* sp. 3) in two collection sites, one in the Igarapé Mutum located near highway BR-364 (13°05'08"S, 59°53'32"W) (MZUSP 115478), described as 3-6 m wide and 0.5-2.5 m deep, with preserved riparian vegetation, swift current, and sand, pebbles, and dead leaves on the bottom (Ohara & Loeb, 2016: fig. 2a); and one in an unnamed stream affluent of Rio Doze de Outubro, also located near highway BR-364 (12°57'50"S, 60°01'40"W) (where the holotype, LIRP 13992, and MZUSP 115498 were caught), characterized as having 1-2 m wide and 0.5-1.7 m deep, with preserved riparian vegetation, swift current, subaquatic vegetation, and sand on the bottom (Ohara & Loeb, 2016: fig. 2c) (Fig. 20). Three other paratypes (MCP 35993, MCP 41057) were collected in a stretch of Rio Doze de Outubro where the river was small, with water clear and current moderate, sandy bottom and rich submersed and marginal vegetation.

**Conservation assessment**

The extinction risk of *Cetopsorhamdia spilopleura* is preliminarily assessed as low. The species is known from three localities very close together, in the headwaters of the Rio Doze de Outubro, a tributary to the Rio Juruena of the Rio Tapajós drainage. The three localities are very close and preclude the estimation of Extension of Occurrence. Instead, the Area of Occupation was estimated as eight square kilometers by the superposition of a 2 x 2 km grid. The three known collecting sites are located on the highway BR-364, and despite the area west of the road being heavily impacted by deforestation and agriculture, most of the Rio Doze de Outubro basin is located east of the road and is protected by the Nambikwara Indigenous Territory. As no specific threats to the species were detected and based on the inferred more widespread presence in the Rio Doze de Outubro basin, *C. spilopleura* is tentatively categorized as Least Concern (LC) according to the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN Standards and Petitions Sub-Committee, 2019). Additional fish inventories should be conducted in the region in order reveal the real geographic distribution of this species.

**DISCUSSION**

**Monophyly of Cetopsorhamdia**

The genus *Cetopsorhamdia* is morphologically diagnosed by four synapomorphies (Bockmann, 1998:

---

Figure 20. Unnamed stream affluent of Rio Doze de Outubro, Rio Tapajós basin, about 25 km from Vilhena, on highway BR-174, at Chapada dos Parecis (12°57'50"S, 60°01'40"W), Comodoro, Mato Grosso State, Brazil, type locality of *Cetopsorhamdia spilopleura*. Photograph by W.M. Ohara.
clade 118): (1) presence of a medial ossification over the median portion of the skull, covering the epiphyseal bar and leaving reduced anterior and posterior fontanels; (2) orbital (= optic) foramen small; (3) mouth ventral; and (4) snout conical. The first character is notably present in both *Cetopsorhamdia clathrata* (Fig. 6B) and *C. spilopleura* (Fig. 16B). Plesiomorphically, the cranium of most catfishes has a dorsal fontanel divided into two by a narrow epiphyseal bridge. The anterior fontanel is delimited anteriorly by the mesethmoid and postero-laterally by the frontals, while the posterior fontanel is framed anteriorly and laterally by the frontals and postero-laterally by the supraoccipital. Among heptapterids, this generalized configuration has been illustrated for species of *Gladioglanis* Ferraris-Jr. & Mago-Leccia, 1989 (cf. Ferraris-Jr. & Mago-Leccia, 1989: fig. 5; Lundberg et al., 1991: fig. 1), *Mastiglanis* Bockmann, 1994 (Bockmann, 1994: fig. 4), *Pimelodella* Eigenmann & Eigenmann, 1888 (Bockmann & Miquelarena, 2008: fig. 21; Slobodian & Pastana, 2018: fig. 3), *Rhamdella* Eigenmann & Eigenmann, 1888 (Miquelarena & Menni, 1999: fig. 7; Bockmann & Miquelarena, 2008: fig. 7), and *Rhamdiopsis* Haseman, 1911 (Bockmann & Castro, 2010: fig. 4A). We have found that all species of *Cetopsorhamdia* share the frontals with superficial outgrowths along their inner margins so as to obliterate the epiphyseal bar, the posterior half of anterior fontanel, and the anterior half of posterior fontanel. This condition has been noticed by Eigenmann (1916, 1922) for *C. nasus*, described as “a small frontal fontanel, far removed from the long parietal fontanel”, and by Eigenmann (1922) for *C. boquillae*, described as “frontal fontanel and occipital fontanel […] shorter than the roofed space between them”. Although we have not examined in detail the skeleton of *C. nasus* (only a radiograph of the holotype was available), the type species of the genus, that feature was illustrated for this species by Ortega-Lara (2012: fig. 6). Ruiz-C. & Román-Valencia (2006: fig. 4a) illustrated this condition for *C. boquillae*, but they were unaware about the presence of the epiphyseal bar, ignoring that it was indeed covered by the superficial ossifications along the medi-al margins of frontals. These authors also described and illustrated the anterior fontanel of a heptapterid identified as *C. nasus* as being wide and bifurcated (Ruiz-C. & Román-Valencia, 2006: fig. 4b). It is not clear what the authors mean by bifurcated, but their observation of a broad fontanel is probably owed to their inability in determining the correct limits of anterior fontanel in a poorly-calcified cleared and stained specimen (cf. Ruiz-C. & Román-Valencia, 2006: 129, fig. 4b). The weak calcification of that specimen is also indicated by the broadly cartilaginous composition of the anterior portion of the palatine, which was mistakenly recognized as a diagnostic characteristic for *C. nasus* by Ruiz-C. & Román-Valencia (2006). On the other hand, the limits of the posterior fontanel are well defined, and its shape represents the plesiomorphic configuration. This character, in addition to the presence of relatively large eyes, long maxillary barbel, fins with convex distal profile, long adipose-fin base, dor-sal caudal-fin lobe longer than the ventral lobe, and total number of vertebrae indicate that the correct identification of *C. nasus* by Ruiz-C. & Román-Valencia (2006: fig. 2) is *Imparfinis usmai* Ortega-Lara, Milani, DoNascimento, Villa-Navarro & Maldonado-Ocampo (cf. Ortega-Lara et al., 2011). Among heptapterids, a state like that exhibited by *Cetopsorhamdia* is also present in *Taunayia* Miranda-Ribeiro, 1918, a condition thought to be homoplastic, considering that these genera are distantly related to each other (cf. Bockmann, 1998; Silva et al., 2021). In members of *Brachyglanis* Eigenmann, 1912, *Brachyrhamdia* Myers, 1927, *Leptoheramdia* Eigenmann, 1918, and *Myoglanis* Eigenmann, 1912, and in *Rhamdella aymarae* Miquelarena & Menni, 1999, *Rhamdia enur-nada* Bichuette & Trajano, 2005, *Rhamdia guasaorenis* DoNascimento, Provenzano & Lundberg, 2004, and *Rhamdia quelen* (Quoy & Gaimard, 1824), the posterior cranial fontanel is totally or partially closed (cf. Lundberg & McDade, 1986; Bockmann, 1998; Silfvergrip, 1996; Miquelarena & Menni, 1999; DoNascimento et al., 2004; Bichuette & Trajano, 2005; Slobodian & Bockmann, 2013) but due to a non-homologous configuration. In those taxa the closure of the posterior fontanel is produced by the approximation of the internal borders of the posteri-or portion of the frontals and the anterior portion of the supraoccipital, at the region corresponding to the mid-portion of posterior fontanel.

Regarding the second character, the foramen for the optic nerve in *C. clathrata* (Figs. 6A, C) and *C. spilopleura* (Figs. 16A, C) is undoubtedly smaller than in those of most heptapterids (cf. Bockmann, 1998; Bockmann & Miquelarena, 2008), having approximately half the length of the trigeminofacial foramen. A further reduction in the foramen for the optic nerve to 1/4 or less the length of the trigeminofacial foramen is observed in *C. boquillae*, *C. iheringii*, *C. insidiosa*, and *C. picklei*. Ortega-Lara (2012) did not describe or illustrate the foramen for the optic nerve in *C. nasus*, so that its state for this trait cannot be accessed.

The third and fourth synapomorphies proposed for *Cetopsorhamdia* by Bockmann (1998), i.e., the ventral mouth and conical snout, are not derived characters for the genus. Instead, they are likely synapomorphies for a more restricted group of species within the genus (see below). A ventral mouth, with its anterior border forming a wide arch, sometimes being almost straight in ventral view, is clearly present in *C. iheringii* (cf. Schubart & Gomes, 1959: fig. 1), *C. insidiosa* (cf. Steindachner, 1915: pl. 12, fig. 7), *C. nasus* (cf. Eigenmann, 1922: pl. 4, fig. 1; Ortega-Lara, 2012: figs. 1-2, 4, 19), and *C. picklei* (cf. Schultz, 1944: p. 2, fig. D). In both *C. clathrata* (Figs. 1-3, 5A) and *C. spilopleura* (Figs. 12-14, 15A), the mouth also has a ventral position, but not at the extent of the species above mentioned, nor does it have an almost straight edge. The mouth of *C. boquillae*, on the other hand, has the widespread heptapterid configuration, being subterminal and bearing a contour markedly arched (cf. Eigenmann, 1922: pl. 1, fig. 3; Ruiz-C. & Román-Valencia, 2006: fig. 1). Likewise, the snouts of *C. iheringii* (cf. Schubart & Gomes, 1959: fig. 1), *C. insidiosa* (cf. Steindachner, 1915: pl. 12, fig. 7), *C. nasus* (cf. Eigenmann, 1922: pl. 4, fig. 1; Ortega-Lara, 2012: figs. 1-2, 4, 19), and *C. picklei* (cf. Schultz, 1944:
pl. 2, fig. D) are distinctly conical, almost triangular, when viewed dorsally. The snout of *C. clathrata* (Figs. 1, 4, 5B) and *C. spilopleura* (Figs. 12, 14, 15B), although also conical, is much more attenuated, bearing ellipsoid contour in dorsal view. *Cetopsorhamdia boquillae*, in turn, exhibits a snout with an anterior contour characteristically rounded in dorsal view, which is the typical plesiomorphic morphology among heptapterids (*cf.* Bockmann, 1998). These last two characters should, therefore, be excluded from the list of *Cetopsorhamdia* synapomorphies.

Figure 21. Left suspensorium and opercular series of *Cetopsorhamdia clathrata*, MCP 36064, 50.8 mm SL, holotype (CT reconstructions). (A) lateral view; (B) medial view. Cartilage not represented. Arrow points to the anterior process of the hyomandibula. Scale bars = 1 mm.
On the other hand, our study allowed us to hypothesise other two putative synapomorphies for the genus Cetopsorhamdia. One of them, the presence of a vertical, dark band at caudal peduncle, on the region of insertion of caudal-fin rays, had already been mentioned by Eigenmann (1916) in the original description of the genus. Eigenmann (1916) described it as “a dark band at base of caudal”, considering it characteristic of C. nasus.

This condition was explicitly mentioned and illustrated for C. iheringi, C. insidiosa, and C. picklei in their original descriptions (cf. Steindachner, 1915; Schultz, 1944; Schubart & Gomes, 1959). Although this mark cannot be verified in the types of C. boquillae because they are strongly faded, the examination of a photograph of a live specimen provided by Armando Ortega leaves no doubt about its presence in the species. Ruiz-C. & Román-Valencia (2006) also reported this caudal mark for C. boquillae. Cetopsorhamdia clathrata (Figs. 1-3) and C. spilopleura (Figs. 12-14) exhibit a state different from the remaining species of Cetopsorhamdia, in which the mark is smaller, being mostly restricted to the central portion of the caudal peduncle. In C. boquillae, C. iheringi, C. insidiosa, C. nasus, and C. picklei the caudal mark is larger, W-shaped, distinctly extending towards the dorsal and ventral borders of the caudal peduncle.

In the course of this investigation we identified another character in the hyomandibular bone that also seems to corroborate the monophyly of Cetopsorhamdia. All species of the genus, including C. clathrata (Fig. 21A) and C. spilopleura (Fig. 22A), have an oblique keel (HK) at the posterodorsal region of the lateral surface of the hyomandibula. In spite of Ortega-Lara (2012) had not described such a structure in the hyomandibula of C. nasus, it is possible to identify it, albeit faintly, in his photograph of a c&s specimen (cf. Ortega-Lara, 2012: fig. 10).

**Putatively informative features to resolve Cetopsorhamdia’s internal relationships**

Cetopsorhamdia clathrata and C. spilopleura share with C. iheringi, C. insidiosa, C. nasus, and C. picklei two putatively apomorphic characteristics that are absent in C. boquillae. One is the presence of a conspicuous pointed process on the anterior border of the hyomandibula (Figs. 21-22, see arrows), as illustrated and described for C. nasus by Ortega-Lara (2012: fig. 10). On the other hand, C. boquillae has the generalized heptapterid hyomandibula, lacking a pointed process at its anterior margin.

In addition, in all Cetopsorhamdia species other than C. boquillae the ventral lobe of the caudal fin is longer than the dorsal lobe (cf. Eigenmann, 1916, 1922: pl. 4, fig. 1; Steindachner, 1915: pl. 12, fig. 7; Schultz, 1944: pl. 2, fig. d; Schubart & Gomes, 1959: fig. 1; Ortega-Lara, 2012: fig. 19). Such a condition, presumably derived, is exhibited by C. clathrata (Figs. 1-3) and C. spilopleura (Figs. 12-14), although the condition is more discrete in the latter species. Eigenmann (1922) imprecisely characterized the condition of ventral caudal-fin lobe of C. boquillae as “probably somewhat the longer” (likely due to the poor state of conservation of its type series). Indeed, the tips of the caudal-fin rays of the holotype and paratypes of C. boquillae are heavily damaged so that it is not possible to ascertain its state. However, the examination of a photograph of a live specimen of C. boquillae by Armando Ortega allowed us to determine the state of its caudal fin as having a dorsal lobe with the same length of the ventral lobe, or slightly longer. The caudal-fin lobes of approximately the same length or the dorsal lobe slightly longer than the ventral one is plesiomorphic for catfishes (Bockmann & Miquelarena, 2008). A long ventral caudal-fin lobe also occurs homoplastically in the genus Phenacorhamdia (cf. Britski, 1993; Bockmann, 1998; DoNascimento & Milani, 2008).

Despite the striking morphological differences distinguishing Cetopsorhamdia clathrata from C. spilopleura, they share at least seven presumable apomorphies observed in the hyomandibula, in the dorsal and pectoral fins, and in the body coloration, which are suggestive of a sister group relationship between them.

As above commented, Cetopsorhamdia clathrata (Fig. 21, see arrow) and C. spilopleura (Fig. 22, see arrow) share with most of species of Cetopsorhamdia the presence of a conspicuous pointed process on the anterior border of hyomandibula. These two new species exhibit a further elongation in this process that reaches the metapterygoid so that these bones, together with quadrate, forming a large, rounded fenestra in the suspensorium (Figs. 21-22).

In Cetopsorhamdia clathrata and C. spilopleura the degree of ossification of the first (unbranched) dorsal- and pectoral-fin rays is quite distinct from the remaining Cetopsorhamdia species. In these species the first rays of the dorsal and pectoral fins are weakly ossified and stiffened only at their basal portions at most. In C. clathrata (Fig. 9) the range of variation of the length of the rigid part of the first dorsal-fin ray is 4.0-6.9% SL (x = 5.7, SD = 0.7) and of the first pectoral-fin ray is 3.4-6.2% SL (x = 4.6, SD = 0.7) (Table 1), while in C. spilopleura (Fig. 19) is 5.3-6.4% SL (x = 5.8, SD = 0.4) and 4.1-5.1% SL (x = 4.4, SD = 0.3) (Table 2). In opposition, the basal portion of first, undivided dorsal- and pectoral-fin rays of C. boquillae, C. iheringi (Fig. 23A), C. insidiosa (Fig. 23B), C. nasus, and C. picklei is densely ossified in comparison to its distal segment, forming a somewhat rigid strut of about ⅓ and ½ size of the total length of those elements, respectively. This condition exhibited by most species of Cetopsorhamdia is closer to that present in several successive basal lineages of the family Heptapteridae in which more than half of the proximal portion of the first ray of the dorsal and the pectoral fins is heavily ossified and stiffened, sometimes forming a spine (cf. Bockmann, 1998). Among these last-mentioned species of Cetopsorhamdia, the proportions of the rigid part of the first dorsal-fin ray in SL are 8.2-12.9% SL whereas the proportions of the rigid part of the first pectoral-fin ray are 10.4-13.5% SL. No material of C. nasus was available to be measured, but examination of the photographs and radiographs of its holotype and data provided by Ortega-Lara (2012) indicates that the first rays of the dorsal and pectoral fins are
unquestionably rigid, at least for their $\frac{1}{3}$ and $\frac{1}{2}$ proximal parts, respectively, resembling the conditions exhibited by *C. boquillae*, *C. iheringi*, *C. insidiosa*, and *C. picklei*.

At last, most putative synapomorphies clustering together *C. clathrata* and *C. spilopleura* into a clade are observed in their color patterns, namely: (1) a dark stripe across the base of maxillary barbel to the region just posterior to the eye (Figs. 1-4, 12-14); (2) a roughly rectangular unpigmented region just ventral to the eye (Figs. 1-4, 12-14); (3) a dark, vertical bar at the pos-

**Figure 22.** Left suspensorium and opercular series of *Cetopsorhamdia spilopleura*, MZUSP 121503, 47.9 mm SL, holotype (CT reconstructions). (A) lateral view; (B) medial view. Cartilage not represented. Arrow points to the anterior process of the hyomandibula. Scale bars = 1 mm.
terior portion of opercle and branchiostegal membrane (Figs. 1-4, 12-14); (4) a dark, vertical bar at the anterior portion of the trunk, dorsal to the pectoral fin (Figs. 1-4, 12-14); and (5) each lobe of caudal fin with one ovoid, unpigmented area, of milky-looking in life, immediately posterior to the dark mark (Figs. 1-3, 12-14). None of the other species of *Cetopsorhamdia* has any of these characteristics, alternatively possessing a mostly uniform dark coloration in the referred regions, without bands or unpigmented areas.

Four putative autapomorphies have been identified for *Cetopsorhamdia clathrata*: (1) unpigmented area in the postero dorsal part of the head, dorsally at the end of the opercular cleft (Figs. 1-4); (2) trunk flanks with 10-12 quadrangular marks, separated by unpigmented vertical lines or bars (Figs. 1-4); (3) midlateral region of the trunk, along the lateral line, devoid of pigmentation, forming a white stripe (Figs. 1-3); and (4) trunk with scattered unpigmented, rounded spots, mostly concentrated on its dorsal half (Figs. 1, 3-4).

For *Cetopsorhamdia spilopleura*, in turn, three putative autapomorphies have been recognized: (1) anterodorsal region of the quadrate, outlining part of the suspensorium fenestra, expanded and turned backwards, broadly articulating with the ventral part of the anterior process of the hyomandibula (Fig. 22); (2) trunk flanks with 18-22 irregular, vertical brown bars, sometimes resembling inverted “v”, “y” or “x” (Figs. 12-14); and (3) trunk with laterodorsal unpigmented stripe, demarcating a broad midlateral dark band along the lateral line (Figs. 12-14).

**Distribution and fish endemism at Chapada dos Parecis**

Both species described in this paper inhabit headwater creeks of the Chapada dos Parecis, an elevated geomorphological formation with altitudes between 400 and 700 m, drained by tributaries of the Madeira and Tapajós rivers. This region constitutes what Dagosta & de Pinna (2019) called an extreme shield, an area with an extremely high level of endemism where coexisting closely related lineages are rare, the diversity is low, and few taxa broadly distributed in the remaining Amazon basin occur. Further on the two new *Cetopsorhamdia* species herein described, the following taxa are endemic to the headwaters of the rivers draining the Chapada dos Parecis: *Bryconops piracolina*, *Hasemania nambiquara* Bertaco & Malabarba, 2007, *Hemigrammus silimoni* Britski & Lima, 2008, *Hemigrammus skolioplatus* Bertaco & Carvalho, 2005b, *Hyphessobrycon hexastichos* Bertaco & Carvalho, 2005a, *Hyphessobrycon lucenorum*, *Hyphessobrycon petricolus* Ohara, Lima & Barros, 2017, *Hyphessobrycon melanostichos* Carvalho & Bertaco, 2006, *Hyphessobrycon notidanos* Carvalho & Bertaco, 2006, *Moenkhausia cosmops* Lima, Britski & Machado, 2007, and *Moenkhausia parecis* (Characidae), *Corydoras hephaestus* (Callichthyidae), *Ancistrus verecundus*, and the monotypic genus *Araichthys* Zawadzki, Bifi & Mariotto, 2016, with *A. loro* Zawadzki, Bifi & Mariotto, 2016 (Loricariidae) (cf. Bertaco & Carvalho, 2005a b; Fisch-Muller et al., 2005; Carvalho & Bertaco, 2006; Bertaco & Malabarba, 2007; Lima et al., 2007; Britski & Lima, 2008; Wingert & Malabarba, 2011; Ohara & Lima, 2015; Ohara & Marinho, 2016; Ohara et al., 2016, 2017; Zawadzki et al., 2016).
Cetopsorhamdia boquillae: FMNH 55212 [ex CM 3923], 71.5 mm SL in ethyl alcohol (ms and xr), holotype, Colombia, Boquilla [Boquía, affluent of Rio Cauca, Rio Magdalena basin – cf. Miles, 1943; Ruiz-C. & Román-Valencia, 2006], coll. C.H. Eigenmann, 18-19 Feb 2012; CAS 63607 [ex IU 15004], 4 ex. in ethyl alcohol (42.4-59.1 mm SL, all ms and xr), 1 ex. c&s (52.9 mm SL), paratypes, Colombia, Río Quindio, in Boquilla [Río Quindio, in Boquía, affluent of Río Cauca, Río Magdalena basin – cf. Miles, 1943; Ruiz-C. & Román-Valencia, 2006], coll. C.H. Eigenmann, 18-19 Feb 1912.

Cetopsorhamdia iheringi: Rio São Francisco basin, Rio das Velhas drainage (Brazil): MZUSP 37158, 61 ex. in ethyl alcohol (26.2-67.6 mm SL), 3 ex. c&s (56.8-57.9 mm SL), State of Minas Gerais, Pereira, W.G. Saul, 12 Jul 1993; MCP 16640, 1 ex. in ethyl alcohol (47.9 mm SL, ms and xr), State of Minas Gerais, Abaeté, Río Marmelada, on road between Pompeu and Frei Orlando, 19°02'59"N, 45°12'00"W, coll. R.E. Reis, J.F.P. da Silva, E.H.L. Pereira, W.G. Saul, 12 Jul 1993; MCP 16640, 1 ex. in ethyl alcohol (42.7 mm SL, ms and xr), State of Minas Gerais, Distrito de Montalvânia, São Sebastião dos Poções, Río Quindio, affluent of Río Cauca, Río Magdalena basin, ca. 11 km S of Montalvânia, 14°32'00"S, 44°24'00"W, coll. R.E. Reis, J.F.P. da Silva, E.H.L. Pereira, 16 Jul 1993. Upper Paraná basin, Rio Grande drainage (Brazil): MZUSP 23768, 7 ex. in ethyl alcohol (35.8-61.0 mm SL), State of Minas Gerais, Ribeirão da Prata, on road São João del Rei/Itutinga, 21°07'5", 44°15'W, coll. H.A. Britski, J.C. Garavello, 10 Nov 1969; MZUSP 42294, 1 ex. c&s (57.0 mm SL), same data as MZUSP 23768; AMNH 9090, 1 ex. in ethyl alcohol (28.3 mm SL, xr), State of São Paulo, Franca, Río Grande basin [possibly at Ribeirão dos Bagres, affluent of Río Sapucaí, 20°33'23"S, 47°25'10"W], coll. E. Garbe, 1900, LIRP 3512, 17 ex. in ethyl alcohol (15.8-67.8 mm SL, all ms and xr), State of São Paulo, Guará, Córrego São José or Córrego Bocaina (Río Sapucaí basin), 20°29'20"S, 47°45'47"W, coll. BIOTA Team, 30 Mar 2002; UFRJ 689, 2 ex. c&s (33.9-52.7 mm SL), State of São Paulo, Río Pardo, near Caconde, 21°33'38"S, 43°58'55"W, coll. C.R.S.F. Bierzell, 13 Nov 1991; LIRP 5671, 1 ex. in ethyl alcohol (39.7 mm SL, ms and xr), State of São Paulo, Pirassununga, Ribeirão Quebra-Cua or Ribeirão do Sertãozinho (affluent of right margin of Río Mogi-Guaçu, affluent of Río Pardo), 21°51'34"S, 47°19'30"W, coll. H.F. Santos, M. Carvalho, M.R. Cavallaro, A. Takako, A. Datovo, 4 Oct 2005; LIRP 5681, 2 ex. in ethyl alcohol (35.5-72.0 mm SL, all ms and xr), State of São Paulo, Leme, Córrego do Sapezal (affluent of right margin of Ribeirão do Meio, affluent of left margin of Río Mogi-Guaçu, affluent of Río Pardo), 22°05'48"S, 47°18'39"W, coll. H.F. Santos, M. Carvalho, M.R. Cavallaro, A. Takako, A. Datovo, 4 Oct 2005. Upper Paraná basin, Río Tietê drainage (Brazil): LIRP 2804, 19 ex. in ethyl alcohol (24.2-76.1 mm SL, 10 ex. xr, 46.4-76.1 mm SL), State of São Paulo, São Pedro, Ribeirão da Ponta do Meio (Rio Piracica-Bapivari-Jundiaí basin), at Fazenda Santa Maria da Ponta do Meio farm, 22°33’27”S, 47°57’08”W, coll. BIOTA Team, 29 May 2001; MZUSP 47950, 45 ex. in ethyl alcohol (23.5-75.4 mm SL), 3 ex. c&s (46.2-65.4 mm CP), State of São Paulo, Botucatu, Río da Indiana (affluent of left margin of Río Capivara, affluent of left margin of Río Tietê), at Fazenda Indiana farm, in the region of Depressão Periférica, 22°54’14”S, 48°23’25”W, altitude 590 m, coll. M.G. Bueno, 16 Jul 1993. Upper Paraná basin, Río Aguaipé drainage (Brazil): LIRP 2812, 5 ex. in ethyl alcohol (44.9-54.3 mm SL, all ms and xr), State of São Paulo, Lins, Córrego da Figueira, 21°51’06”S, 49°50’20”W, coll. BIOTA Team, 30 Mar 2001. Upper Paraná basin, Río do Peixe drainage (Brazil): LIRP 2806, 5 ex. in ethyl alcohol (62.5-91.9 mm SL, all ms and xr), State of São Paulo, Rancharia, Córrego Tupi, 22°04’55”S, 50°54’33”W, altitude 385 m, coll. BIOTA team, 21 May 2000. Upper Paraná basin, Río Paranapanema drainage (Brazil): LIRP 2807, 5 ex. in ethyl alcohol (43.2-73.4 mm SL, all ms and xr), State of São Paulo, Euclides da Cunha, Río do Piau, at Fazenda Santa Maria farm, 22°33’04”S, 52°44’36”W, coll. BIOTA team, 5 Aug 2000; LIRP 2805, 46 ex. in ethyl alcohol (28.9-71.6 mm SL, 12 ex (45.1-68.1 mm SL)), State of Paraná, Andirá, Córrego Águas das Antas, at Fazenda das Antas farm, 23°02’56”S, 50°11’51”W, coll. BIOTA team, 4 Nov 2000; NUP 3357, 4 ex. in ethyl alcohol (53.5-73.5 mm SL, all ms and xr), State of Paraná, Maringá, Córrego Miosótis, affluent of Ribeirão Maringá (Río Pirapó basin), 23°21’59.3”S, 51°57’35.6”W, coll. A.M. Cunico, v.2004; CZUEL 1142, 2 ex. in ethyl alcohol (86.2-87.6 mm SL, all ms and xr), State of Paraná, Londrina, Ribeirão Três Bocas (Río Tibagi basin), 23°26’S, 51°10’W, coll. ECPUEL, 16.xii.1992.

Cetopsorhamdia insidiosa: Rio Branco-Negro basin: NMW 46094:1, 56.9 mm SL in ethyl alcohol, syntype of Imparfinis insidiosus, Río Surumú, einem Nebenflusse des Rio Miang, der selbst ein sekundärer Nebenfluss des Río Branco, Serra do Mello [Brazil, State of Roraima, Pacaraima, Río Surumú, affluent of left bank of the Río Tacutu], coll. J.D. Haseman, 1913; NMW 46094:2, 59.7 mm SL in ethyl alcohol, syntype of Imparfinis insidiosus, same data as NMW 46094:1; NMW 46094:3, 63.1 mm SL in ethyl alcohol (ms), syntype of Imparfinis insidiosus, same data as NMW 46094:1; NMW 46094:4, 60.0 mm SL in ethyl alcohol (ms), syntype of Imparfinis insidiosus, same data as NMW 46094:1; NMW 46095:1, 76.8 mm SL in ethyl alcohol (ms and xr), syntype of Imparfinis insidiosus, Rio Branco bei Bem Querer [Brazil, State of Roraima, Caracaráí, Río Branco, near Cachoeira do Bem Querer, 01°51’40.7”S, 61°04’03.5”W], coll. J.D. Haseman, 1913; NMW 46095:2, 25.3 mm SL in ethyl alcohol (ms), syntype of Imparfinis insidiosus, same data as NMW 46095:1; ANSP 179707, 1 ex. in ethyl alcohol (31.1 mm SL, ms and xr), Guyana, Rupununi [Region 9], Moco-Moco River (affluent of Río Takutu, affluent of Río Branco), at Moco-Moco Hydro Power, below dam, 18.8 km SE of Lethem, 03°17’48”N, 59°38’41”W, coll. M.H. Sabaj Pérez, J.W. Armbruster, M.R. Thomas, D.C.
We refer to the new species of *C. clathrata* and *C. spilopleura* which were added to this study, and provided photographs of collecting sites and freshly collected specimens of both species and information on localities. We thank Armando Ortega for providing a photograph of a live specimen of *C. boquillae* in the aquarium. Sandra Raredon kindly took radiographs of several specimens at USNM. We sincerely thank Daniel C. Cavallari (Center for Biodiversity Documentation, University of São Paulo, Brazil) for skillfully preparing the material and generating the CT scans. We thank Bárbara Calegari for preparing the base map of Fig. 10 and André L.H. Esguiciero for taking the photographs in Fig. 12. Pedro Rizzato supported us in the segmentation of 3D reconstructions of tomographies and generation of images. We thank Carlos J.E. Lamas and Murilo Pastana for competently guiding us through the publishing process of this journal. Authors are also grateful for the careful reading of the manuscript by two anonymous referees. We would also like to acknowledge all the support given by Mário C.C. de Pinna throughout the development of this work. Specimens used to describe these new species were captured under IBAMA collecting permit 053/2004. An earlier version of this work was presented at the “2011 Joint Meeting of Ichthyologists and Herpetologists”, Minneapolis, Minnesota, under support of São Paulo Research Foundation (FAPESP), Government of the State of São Paulo, Brazil (2011/06213-0). Infrastructure for research at Laboratório de Ictiologia de Ribeirão Preto is supported by funding from FAPESP (2009/54931-0). The fieldwork and part of the research associated with this paper were supported by the “All Catfish Species Inventory”, funded by the National Science Foundation (NSF), Federal Government of the United States (DEB 0315963). This is a contribution of the project “Composição taxonômica da ictiofauna do alto Rio Paraguai e do alto Rio Juruena, e suas relações biogeográficas” [PROTAX; National Council for Scientific and Technological Development (CNPq), Brazilian Government, 440621/2015-1; FAPESP, 2016/50375-9] and part of the project “Core-facility for the conservation of scientific documentation: biological collections and high technology research in comparative morphology” (CT-INFRA 01/2013), financed by the Funding Authority for Studies and Projects (FINEP), Ministry of Science, Technology, Innovation and Communication, Brazilian Federal Government. Authors are supported by CNpq (F.A.B., 312687/2018-4, and R.E.R., 306455/2014-5 and 400166/2016-0).
REFERENCES

Arratia, G. & Huéquín, L. 1995. Morphology of the lateral line system and of the skin of diplomyctid and certain primitive loricarioid catfishes and systematic and ecological considerations. Bonner Zoologische Monographien, 36: 1-110. https://www.biodiversitylibrary.org/item/159032#page/147/mode/1up

Bertaco, V.A. & Carvalho, T.P. 2005a. A new characid fish, Hypsobrycon hexastichos (Characiformes: Characidae) from Chapada dos Parecis, Mato Grosso, Brazil. Neotropical ichthyology, 3(3): 439-443. DOI

Bertaco, V.A. & Carvalho, T.P. 2005b. A new characid fish, Hemigrammus skuliplatus (Characiformes: Characidae) from upper rio Tapajos drainage, Central Brazil. Comunicações do Museu de Ciências e Tecnologia PUCRS, Série Zootologia, 18(2): 141-150.

Bertaco, V.A. & Malabarba, L.R. 2007. A new species of Hasemania from the Upper Rio Tapajos drainage, Brazil (Teleostei: Characiformes: Characidae). Copeia, 2007(2): 350-354. DOI

Bichuette, M.E. & Trajano, E. 2005. A new cave species of Rhambia (Siluriformes: Heptapteridae) from Serra do Ramalho, northeastern Brazil, with notes on ecology and behavior. Neotropical ichthyology, 3(4): 587-595. DOI

Bockmann, F.A. 1994. Description of Mastiglanis asopus, a new pimelodid catfish from northern Brazil, with comments on phylogenetic relationship inside the subfamily Rhamdiinae (Siluriformes: Pimelodidae). Proceedings of the Biological Society of Washington, 107(4): 760-777.

Bockmann, F.A. 1998. Análise filogenética da família Heptapteridae (Teleostei, Ostariophysi, Siluriformes) e redefinição de seus gêneros. Doctoral Thesis. Universidade de São Paulo, São Paulo.

Bockmann, F.A. & Castro, R.M.C. 2010. The blind catfish from the caves of Chapada Diamantina, Bahia, Brazil (Siluriformes: Heptapteridae): description, anatomy, phylogenetic relationships, natural history, and biogeography. Neotropical ichthyology, 8(4): 673-706. DOI

Bockmann, F.A. & Ferraris-Jr., C.J. 2005. Systematics of the Neotropical catfish genera Nemuroglanis Eigenmann and Eigenmann 1889, Imparales Schultz 1944, and Medemichthys Dahl 1961 (Siluriformes: Heptapteridae). Copeia, 2005(1): 124-137. DOI

Bockmann, F.A. & Guazzelli, G.M. 2003. Family Heptapteridae (Heptapterids). In: Reis, R.E.; Kullander, S.O. & Ferraris-Jr., C.J. (Eds.). Check list of the freshwater fishes of South America. Porto Alegre, Edipucrs. p. 406-431.

Bockmann, F.A. & Miguilarena, A.M. 2008. Anatomy and phylogenetic relationships of a new catfish species from northeastern Argentina with comments on the phylogenetic relationships of the genus Rhamdia Eigenmann and Eigenmann 1888 (Siluriformes, Heptapteridae). Zootaxa, 1780(1): 1-54. DOI

Bockmann, F.A. & de Pinna, M.C.C. 2004. Heptapterus colletti Steindachner, 1881: a member of the Asian bagrid genus Olyra erroneously assigned to the neotropical fauna. Copeia, 2004(3): 665-675. DOI

Bockmann, F.A. & Reis, R.E. 2011. Two new, beautifully-colored species of the Neotropical catfish Cetoposorhamdia Eigenmann and Fishes, 1916 (Siluriformes, Heptapteridae) from western Brazil, with a cladistic analysis of the genus. In: Abstracts for the 2011 Joint Meeting of Ichthyologists and Herpetologists, Minneapolis, Minnesota, 6-11 July 2011. Minneapolis, AES, ASIH, HL, NIA, SSAR, unnumb. p. [CD-ROM]

Bockmann, F.A. & Slobodian, V. 2013. Heptapteridae. In: Queiroz, L.J.; Torrente-Vilara, G.; Ohara, W.M.; Silva, T.H.P.; Zuanon, J. & Doria, C.R.C. (Eds.). Peixes do Rio Madeira. São Paulo, Dialeto. v. 3, p. 14-77.

Bockmann, F.A. & Slobodian, V. 2018. Heptapteridae. In: van der Steen, P. & Albert, J.S. (Eds.). Field guide to the fishes of the Amazon, Orinoco, and Guianas. New Jersey, Princeton University Press. p. 233-252.

Britski, H.A. 1993. Uma nova espécie de Phencorhamdia da bacia do Alto Paraná (Pisces, Siluriformes). Comunicações do Museu de Ciências da Pontifícia Universidade Católica do Rio Grande do Sul, série zoologia, 6: 41-50.

Britski, H.A. & Lima, F.C.T. 2008. A new species of Hemigrammus from the Upper Rio Tapajós Basin in Brazil (Teleostei: Characiformes: Characidae). Copeia, 2008(3): 565-569. DOI

Carvalho, T.P. & Bertaco, V.A. 2006. Two new species of Hypsobrycon (Teleostei: Characidae) from upper rio Tapajós basin on Chapada dos Parecis, central Brazil. Neotropical ichthyology, 4(3): 301-308. DOI

Dagosta, F.C.P. & de Pinna, M. 2019. The fishes of the Amazon: distribution and biogeographical patterns, with a comprehensive list of species. Bulletin of the American Museum of Natural History, 431: 1-163. http://digitallibrary.amnh.org/handle/2246/6940

DoNascimento, C. & Melani, N. 2008. The Venezuelan species of Phencorhamdia (Siluriformes: Heptapteridae), with the description of two new species and a remarkable new tooth morphology for siluriforms. Proceedings of the Academy of Natural Sciences of Philadelphia, 157(1): 163-180. DOI

DoNascimento, C.; Provenzano, F. & Lundberg, J.G. 2004. Rhambdia guasarensis (Siluriformes: Heptapteridae), a new species of cave catfish from the Sierra Perijá, northerwestern Venezuela. Proceedings of the Biological Society of Washington, 117(4): 564-574.

Dubois, A. 2010. Zoological nomenclature in the century of extinctions: priority vs. usage. Organisms Diversity & Evolution, 10(3): 259-274. DOI

Eigenehn, C. 1916. Vi. New and rare fishes from South American rivers. Annals of the Carnegie Museum, 10(1-2): 77-86, pl. 13-16. http://biostor.org/reference/20454.

Eigenehn, C.H. 1919. Peces Colombianos de las cordilleras y de los llanos al oriente de Bogotá. Boletin de la Sociedad Colombiana de Ciencias Naturales, 7(62-65): 126-136.

Eigenehn, C.H. 1922. The fishes of western South America, Part I. The fresh-water fishes of northwestern South America, including Colombia, Panama, and the Pacific slopes of Ecuador and Peru, together with an appendix upon the fishes of the Rio Meta in Colombia. Memoirs of the Carnegie Museum, 9(1): 1-350, pl. 1-138. https://www.biodiversitylibrary.org/item/217382#page/9/mode/1up

Ferraris-Jr., C.J. & Mago-Leccia, F. 1989. A new genus and species of pimelodid catfish from the Rio Negro and Rio Orinoco drainages of Venezuela (Siluriformes: Pimelodidae). Copeia, 1989(1): 166-171. DOI

Fisch-Muller, S.; Cardoso, A.R.; Silva, J.F.P. & Bertaco, V.A. 2005. Two new Amazonian species of armored catfishes (Siluriformes: Loricariidae): Ancistrus verecundus and Ancistrus parecis. Neotropical Ichthyology, 3(4): 525-532. DOI

Fowler, H.W. 1945. Description of seven new freshwater fishes from Peru. Natura Borealis (Philadelphia), 159: 1-11.

Fricke, R.; Eschmeyer, W.N. & Fong, J.D. 2021. Species by family/subfamily. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.aspx. Access: 02/05/2021.

Gosline, W.A. 1941. Synopsis of the genera of pimelodid catfishes without a free orbital rim. Stanford Ichthyological Bulletin, 2(3): 83-88.

Haseman, J.D. 1911. Descriptions of some new species of fishes and miscellaneous notes on others obtained during the expedition of the Carnegie Museum to central South America. Annals of the Carnegie Museum, 7(3-4): 315-328, pl. 46-48 (fig. 1), 49-50 (fig. 1), 51-52.

Herrick, C.J. 1889. The cranial and first spinal nerves of Menidia. A contribution upon the nerve components of the bony fishes. Archives of Neurology and Psychopathology, 2: 1-299. DOI

Herrick, C.J. 1901. The cranial nerves and cutaneous sense organs of the North American siluroid catfishes. Journal of Comparative Neurology, 11(3): 177-249. DOI
staining-and-clearing-small-fishes-and-other-vertebrates-bone-and-cartilage-study

Villa-Navarro, F.A.; Zúñiga-Upegui, P.T.; Castro-Roa, D.; García-Melo, J.E.; García-Melo, L.J. & Herrada-Yara, M.E. 2006. Peces del alto Magdalena, cuenca del río Magdalena, Colombia. *Biota Colombiana*, 7(1): 3-22. http://revistas.humboldt.org.co/index.php/biota/article/view/162/161.

Wingert, J.M. & Malabarba, L.R. 2011. A new species of *Bryconops* (Teleostei: Characidae) from the rio Madeira basin, Northern Brazil. *Neotropical Ichthyology*, 9(3): 471-476. DOI

Zawadzki, C.H.; Bifi, A.G. & Mariotto, S. 2016. *Araichthys loro*, a new genus and species of suckermouth armored catfish from the upper rio Tapajós basin, Brazil (Siluriformes: Loricariidae). *Ichthyological Exploration of Freshwaters*, 27(4): 361-372. https://pfeil-verlag.de/wp-content/uploads/2017/04/ief27_4_10.pdf.

Zuanon, J.A.S.; Bockmann, F.A. & Sazima, I. 2006. A remarkable sand-dwelling fish assemblage from central Amazonia, with comments on the evolution of psammophily in South American freshwater fishes. *Neotropical Ichthyology*, 4(1): 107-118. DOI

**SUPPLEMENTARY INFORMATION**

CT-Scan information for *Cetopsorhamdia* species.

Abbreviations: CNC = computer numerical control; FDD = focus-detector distance; and FOD = focus-object distance.

|                       | *C. clathrata* sp. nov. | *C. spilopleura* sp. nov. |
|-----------------------|-------------------------|---------------------------|
| **MCP 36064**         |                         |                           |
| Standard length (mm)  | 50.8                    | 47.9                      |
| **MZUSP 121503**      |                         |                           |
| Geometry              |                         |                           |
| Magnification         | 11.338953               | 10.644004                 |
| Voxel size (μm)       | 17.688313               | 18.789923                 |
| FOD (mm)              | 71.354500               | 76.013252                 |
| FDD (mm)              | 809.085327              | 809.083327                |
| Acquisition           |                         |                           |
| Number of images      | 2000                    | 1000                      |
| Image width           | 990                     | 990                       |
| Image height (pixels) | 1000                    | 1000                      |
| Fast scan             | 0                       | 0                         |
| **Detector**          |                         |                           |
| Type (rt)             | dxr-250                 | dxr-250                   |
| Timing (ms)           | 333.091000              | 1000.071000               |
| Averaging             | 5                       | 4                         |
| Skip frames           | 1                       | 1                         |
| **X-Ray**             |                         |                           |
| Voltage (kV)          | 60                      | 60                        |
| Current (μA)          | 200                     | 200                       |
| Tube mode             | 0                       | 0                         |
| Filter                | Unknown                 | Unknown                   |
| **CNC**               |                         |                           |
| XS (mm)               | -0.078375               | -0.034312                 |
| YS (mm)               | -28.435750              | 1.249875                  |
| ZS (mm)               | 71.354500               | 76.013250                 |
| **Volume**            |                         |                           |
| Dimensions            | 990 x 990 x 1000        | 990 x 990 x 1000          |
| Voxel size (μm)       | 17.64 x 17.64 x 17.64   | 18.79 x 18.79 x 18.79     |
| Format                | 32 bit float            | 32 bit float              |
| Full size on disk     | 3738.78 MB              | 3738.78 MB                |

Published with the financial support of the “Programa de Apoio às Publicações Científicas Periódicas da USP”