



A new catfish species of *Microcambeva* Costa & Bockmann 1994 (Siluriformes: Trichomycteridae) from a coastal basin in Rio de Janeiro State, southeastern Brazil

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Abstract

Microcambeva bendego, a small psammophilous catfish species, is described from the rio Guapi-Macacu basin at Guanabara Bay in Rio de Janeiro State, an Atlantic Forest remnant. This coastal drainage has been explored by several naturalists and fish researchers since the 19th century. It is a drainage with remarkably high endemism and species richness, and some recently-described and threatened species. The new species is distinguished from all congeners by two distinctive characters: long finger-like projections in the branchial isthmus and a large opercular patch of odontodes with 19 odontodes. Due to the paucity of specimens (n=3) osteological features of the new species were accessed by CT-Scan images of the holotype. *Microcambeva bendego* shares putative synapomorphies with two congeners, *M. ribeirae* and *M. filamentosa*, such as the fusion of supraorbital pore s6, the absence of ossification in the anterior autopalatine cartilage, the presence of an elongated and wide posterior process of the autopalatine, and a concavity on the dorsal process of the opercle. Those characters suggest that *M. bendego* is more closely related to those two species from the rio Ribeira de Iguape basin than to other congeners. The biogeography and conservation status of *M. bendego* are also discussed.

Key words: Taxonomy, Microcambeviniae, Fluminense ecoregion, Atlantic Forest, Guanabara bay, CT-Scan

Resumo

Microcambeva bendego, é uma pequena espécie de bagre psamófilo descrita da bacia do rio Guapi-Macacu na Baía de Guanabara, no Estado do Rio de Janeiro, em um remanescente da Mata Atlântica. Essa bacia costeira tem sido explorada por vários naturalistas e pesquisadores de peixes desde o século 19 e possui alto endemismo e riqueza de espécies, com algumas espécies recentemente descritas e ameaçadas. A nova espécie se distingue de todos os congêneres por possuir um barbilhão digitiforme longo, na região do istmo branquial e por uma grande placa opercular de odontódeos com 19 odontódeos dispostos em cinco fileiras. Devido à escassez de espécimes (n = 3), as características osteológicas da nova espécie foram analisadas por tomografia computadorizada (CT-Scan). *Microcambeva bendego* compartilha várias sinapomorfias com dois congêneres, *M. ribeirae* e *M. filamentosa*, como a fusão do poro supraorbital s6, a ausência de ossificação na cartilagem anterior do autopalatino, um processo posterior alongado e amplo do autopalatino e uma concavidade no processo dorsal do opérculo, sugerindo uma relação mais próxima com espécies da bacia do rio Ribeira de Iguape que com outras espécies do gênero. A biogeografia e o estado de conservação de *M. bendego* também são discutidos.

Palavras chaves: Taxonomia, Microcambeviniae, Ecorregião Fluminense, Floresta Atlântica, Baía de Guanabara, CT-Scan

Introduction

Microcambeva Costa & Bockmann 1994 is a genus of small psammophilous translucent catfishes endemic to coastal streams of the Atlantic Forest (Costa & Bockmann 1994; Sarmiento-Soares *et al.* 2019; Costa *et al.* 2019a; 2020a; 2020b). The genus was originally assigned to the trichomycterid subfamily Sarcoglanidinae based on morphology (Costa & Bockmann 1994). However, recent proposals place *Microcambeva* as the sister group to *Listrura* de Pinna 1988 (formerly in Glanapteryginae), also from the eastern Atlantic basins, in a separate clade distinct from the other Amazonian taxa they convergently resemble (Costa *et al.* 2020a, Ochoa *et al.* 2020). As a consequence, Costa *et al.* (2020a) proposed a new subfamily, the Microcambevinae, to comprise the two genera.

Currently, *Microcambeva* includes six species distributed in three freshwater ecoregions (*sensu* Abell *et al.* 2008, Sarmiento-Soares *et al.* 2019). The type species of the genus is *M. barbata* Costa & Bockmann 1994 from rio São João basin, in Rio de Janeiro State, Fluminense ecoregion (Costa & Bockmann 1994). *Microcambeva ribeirae* Costa, Lima & Bizerril 2004 and *M. filamentosa* Costa, Katz & Vilaro 2020 were described from the rio Ribeira do Iguape basin and ecoregion, in São Paulo and Paraná states (Costa *et al.* 2004; 2020b). *Microcambeva draco* Mattos & Lima 2010 are recorded from rio Jucuruçu and rio Peruípe basins (Mattos & Lima 2010), *M. jucuensis* Costa, Katz, Mattos & Rangel-Pereira 2019 from rio Jucu basin, in Bahia State, and *M. mucuriensis*; Costa, Katz, Mattos & Rangel-Pereira 2019 from rio Mucuri basin, in Espírito Santo State (Costa *et al.* 2019b), all in the Northeastern Mata Atlantica ecoregion. Half of those species came to light in the last two years, indicating that knowledge on the genus is still incipient, a situation unfavorable for the conservation of these cryptic and easily overlooked catfishes. According to IUCN criteria, *M. barbata* and *M. ribeirae* are considered ‘near threatened’, *M. draco* is ‘endangered’, and the remaining species have not yet had their conservation status evaluated (ICMBio, 2018; Sarmiento-Soares *et al.* 2019).

During a taxonomic revision of *Microcambeva* conducted by the first author, three specimens of a single lot located in the Museu Nacional fish collection (MNRJ) proved to be a new species. Those small catfishes were collected in the rio Guapi-Macacu basin in Rio de Janeiro State in 2016, and constitute a remarkable discovery considering that the area has been extensively sampled since the 19th century (Bizerril & Primo 2001, Koerber & Reis 2020). The species is herein described and its putative phylogenetic relationships and conservation status are discussed.

Material and methods

Counts and measurements followed Costa (1992). Measurements were taken with digital calipers, calibrated to one-tenth millimeter precision under binocular stereomicroscope. Measurements are presented as percentages of standard length (SL), except for head measurements which are expressed as percentages of head length (HL).

Osteological structures were examined in the CT-scanning Laboratory of the Museu de Zoologia da Universidade de São Paulo (Phoenix v | tome | x M—General Electric Company), applying the following parameters, voxel size X= 0.2395892, number of images 4400 voltage 60Kv and current 220mA. Osteological nomenclature follows de Pinna (1989) and Adriaens *et al.* (2010). Bones of the orbital region, barbular and lachrymal-antorbital, follow de Pinna *et al.* (2020). Counts of procurrent caudal-fin rays, branchiostegal rays, ribs, precaudal and caudal vertebrae, opercular and interopercular odontodes, and premaxillary and dentary teeth were performed on the micro-tomographed holotype. Vertebrae involved in the Weberian apparatus and compound caudal centrum were not included in counts. Nomenclature of the latero-sensory canal system and pores followed Arratia & Huaquin (1995). Morphological, meristic and osteological data for *M. barbata*, *M. ribeirae*, *M. draco*, *M. filamentosa* and *M. jucuensis* were obtained from type and non-type specimens deposited in Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP); Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ); Coleção Ictiológica da Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS); and Universidade Estadual Paulista - Campus São José do Rio Preto Instituto de Biociências, Letras e Ciências Exatas, São José do Rio Preto (DZSJRP) (see Sarmiento-Soares *et al.* 2019). Data on *M. mucuriensis* were obtained from published sources (Costa *et al.* 2019a; Costa *et al.* 2020b).

***Microcambeva bendego* new species**

(Fig. 1, Table 1)

Holotype. MNRJ 52042, 28.1 mm SL; Brazil: Rio de Janeiro State, Guapimirim Municipality; rio Guapiaçu near Cachoeiras de Macacu, rio Guapi-Macacu basin, 22°35'33"S 42°53'20"W, P. A. Backup, D. F. Moraes-Jr and V. Brito, 31 Aug 2016.

Paratypes. MNRJ 48616, 1, 26.9 mm SL, collected with holotype. MZUSP 125789, 1, 27.8 mm SL, collected with holotype.

Diagnosis. *Microcambeva bendego* is distinguished from all congeners by the long finger-like projections, as long as orbital diameter (*vs.* projections absent in *M. filamentosa* and smaller than orbital diameter in the remaining congeners), and the more numerous opercular odontodes (19 *vs.* 6–7 in *M. barbata*, 9–12 in *M. mucuriensis*, 9–14 in *M. ribeirae*, 11–12 in *M. draco* and *M. filamentosa*, and 13–15 in *M. jucuiensis*). It is also distinguished from all congeners, except *M. ribeirae*, by the unmodified first pectoral-fin ray (*vs.* first pectoral-fin ray filamentous). It differs from all species of the genus, except *M. ribeirae* and *M. filamentosa*, by the absence of ossification in the anterior cartilage of the autopalatine (*vs.* presence), and by the supraorbital pores (s6) fused into a single median pore, positioned on the middle of head (*vs.* paired s6 pore). The new species differs further from *M. filamentosa* by having 8 interopercular odontodes (*vs.* 6) and 33 vertebrae (*vs.* 36), and from *M. ribeirae* by the rictal barbels reaching the anterior portion of the interopercular patch of odontodes (*vs.* reaching middle of orbit), and the three first rays of the dorsal-fin unbranched (*vs.* two).

Description. Morphometric data of holotype and two paratypes presented in Table 1. Body elongated, cylindrical immediately posterior to head to pelvic-fin origin, gradually compressed towards caudal peduncle (Fig. 1a). Dorsal profile gently convex from snout to dorsal-fin origin, and straight along caudal peduncle. Ventral profile convex from jaw to pelvic-fin insertion, straight from that point to terminus of caudal peduncle.



FIGURE 1. *Microcambeva bendego*, new species, holotype, MNRJ 52042, 28.1 mm SL. Rio Guapiaçu, near Cachoeiras de Macacu, rio Guapi-Macacu basin, Guapimirim Municipality, Rio de Janeiro State, southeastern Brazil. **a.** lateral view; **b.** dorsal view; **c.** ventral view. Scale: 10 mm.

TABLE 1. Morphometric data of holotype (MNRJ 52042, 28.1 mm SL) and two paratypes (MNRJ 48616, 26.94 mm SL and MZUSP 125789, 27.8 mm SL) of *Microcambeva bendego*.

	Holotype MNRJ 52042	Paratype MNRJ 48616	Paratype MZUSP 125789	Mean
Standard length—SL	28.1	26.9	27.8	27.5
Percentage of SL				
Body depth	3.7	3.2	3.5	3.5
Caudal peduncle depth	2.6	2.1	2.1	2.3
Body width	2.5	1.0	1.0	1.5
Caudal peduncle width	2.2	0.6	0.6	1.1
Caudal peduncle length	8.8	5.0	5.7	6.5
Dorsal-fin base length	3.3	2.8	2.6	2.9
Anal-fin base length	2.1	2.3	2.5	2.3
Pelvic-fin length	4.7	4.1	4.3	4.4
Distance between pelvic-fin bases	1.1	0.6	1.0	0.9
Pectoral-fin length	5.6	3.8	4.3	4.5
Predorsal length	17.0	13.9	14.8	15.2
Prepelvic length	14.9	12.5	12.3	13.2
Head length (HL)	6.0	5.1	5.8	5.7
Percentage of HL				
Head depth	3.0	2.3	2.4	2.6
Head width	4.9	4.1	4.3	4.4
Interorbital width	0.8	0.9	1.2	1.0
Preorbital length	2.7	2.4	2.6	2.6
Eye diameter	1.2	1.1	0.7	1.0
Mouth width	1.3	1.5	1.2	1.3
Internarial width	0.1	0.4	0.4	0.3

Head triangular in dorsal view, moderately depressed, longer than wide (Fig. 1b). Mouth subterminal. Snout rectangular, with slight lateral compression after origin of maxillary barbel. Nostrils circular, posterior ones larger than anterior ones. Anterior nostril surrounded by skin continuous with nasal barbel, posterior nostril with small half-moon skin fold, approximately as large as nasal opening. Posterior nostril closer to anterior nostril than to margin of eye, anterior nostril closer to upper lip than posterior nostril. Barbels tapering distally. Nasal barbel originating on median portion of anterior nostril, reaching posterior portion of posterior nostril. Maxillary barbel reaching posterior half of interopercular patch of odontodes. Rictal barbel reaching anterior half of interopercular patch of odontodes. Pair of finger-like projections approximately as long as eye diameter, inserted anterior to branchial isthmus (Fig. 2). Eyes round, positioned dorsally at middle distance between snout and posterior portion of opercular patch of odontodes.

Pectoral fin subtriangular, with seven rays (i+6). First unbranched ray not filamentous, approximately 60% as long as first branched ray, last branched ray shortest. Tips of rays extending beyond interradiial membrane. Adipose organ round, translucent, dorsal to pectoral fin. Dorsal fin semicircular, nine rays (iii+6), origin at vertical through 14th vertebrae. Pelvic fins subtriangular, with five rays (i+4) extending beyond interradiial membrane; pelvic-fin origin at vertical through 10th vertebrae, its tip not reaching urogenital papilla. Urogenital papilla conic. Anal fin with seven rays (iii+4) and semicircular distal margin, originating at vertical through 19th vertebrae. Caudal fin truncated, with 13 rays (i+11+i), six in dorsal plate (i+5) and seven in ventral plate (6+i). Six procurrent caudal-fin rays dorsally and ventrally. Vertebrae 33, 27 caudal and six precaudal. Five pleural ribs. Six branchiostegal rays.

Mesethmoid long, cornua short, straight and pointed; slight depression at anterior portion of the mesethmoid; main body of bone compressed at posterior portion, and pointed. Lateral margin straight along mid-length (Fig.3). Frontals slender; progressively more spaced from each other posteriorly. Two pores of supraorbital canal present, s3 pore opening at anterior portion of frontal, and median s6 pore at center of neurocranium, near anterior edge of

cranial fontanel. Cranial fontanel extending for approximately 75% of neurocranium length, with rounded anterior and posterior ends. Sphenotic+ pterosphenoic+ prootic trapezoid, prominent, with elongated and pointed lateral process at middle portion, bearing part of laterosensory canal, opening as single pore i11. Pterotic square-like, without lateral process, bearing preopercle pore i11. Epioccipital rectangular. Posttemporo-supracleithrum rectangular, with small lateral process near its proximal portion. Vomer long, arrow-shaped, with lateral constriction at anterior portion and forked anteriorly; thin lateral projections anterior to constriction. Lateral ethmoid rectangular, without lateral projections. Basioccipital fused with exoccipital anteriorly and with Weberian complex posteriorly.

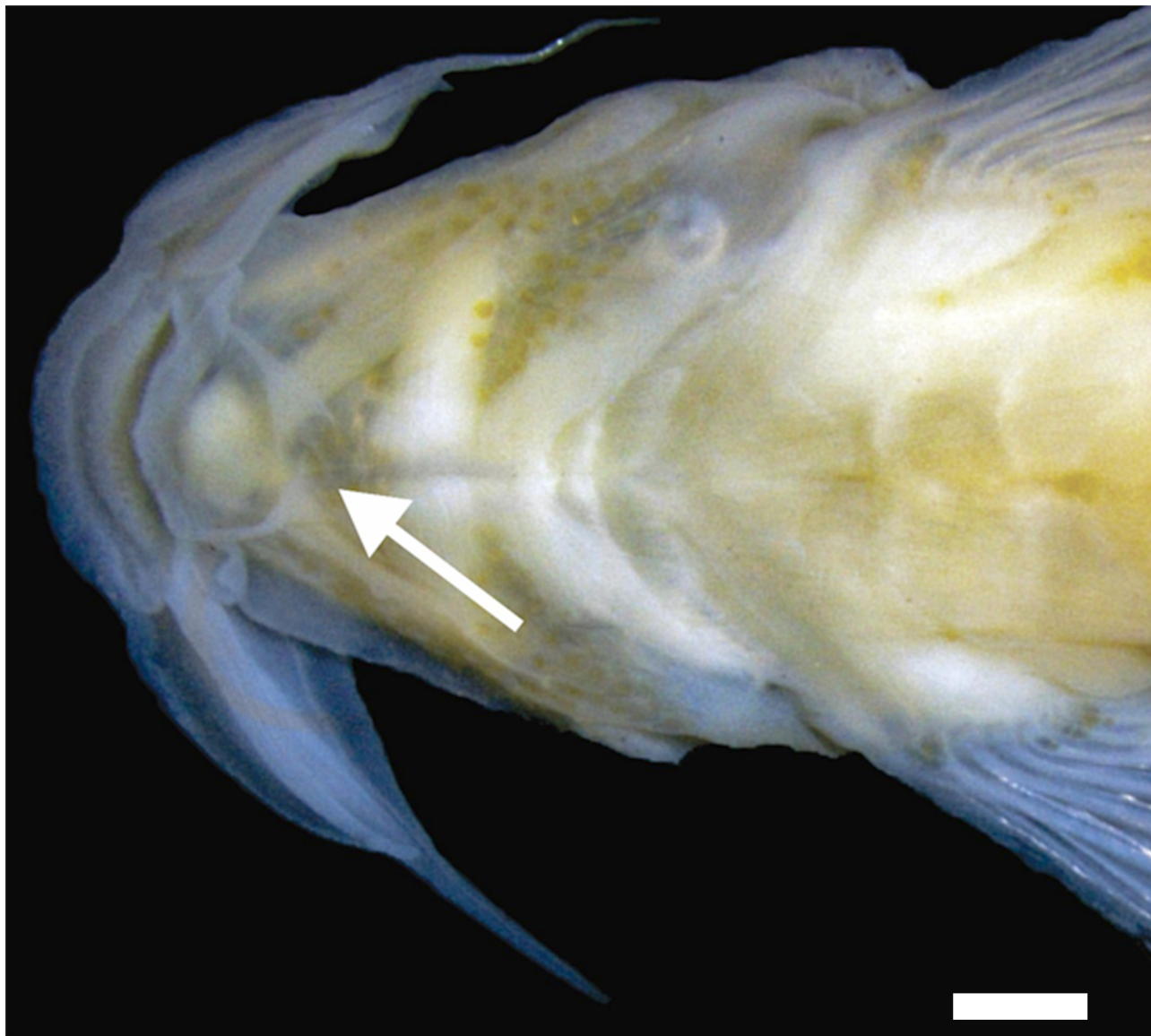


FIGURE 2. Ventral view of holotype of *Microcambeva benedego*, new species, holotype, MNRJ 52042, 28.1 mm SL, white arrow indicates the finger-like projections. Scale bar: 1.0mm.

Premaxilla with two tooth rows. Eight conical teeth in labial row and 12 in lingual; premaxillary dorsal protuberance present and expanded near palatine cartilage (Fig. 3). Maxilla long, 50% larger than premaxilla, its distal tip pointed and triangular expansion on its ventrolateral portion. Autopalatine long with moderately concave lateral margin, and straight mesial margin. Posterior process of autopalatine long and pointed. Lacrimal-antorbital elongated and cylindrical approximately 75% of barbular length. Barbular bone long and cylindrical; lacrimal-antorbital and barbular disposed in line, separated by gap approximately equivalent to length of lacrimal-antorbital.

Metapterygoid small and elliptical. Quadrate elongated and concave, with small dorsally-directed process forming distal synchondrosis with metapterygoid (Fig. 4). Quadrate-hyomandibula fenestra lacking defined shape. Hyomandibula narrow, long, with pointed anterior process with slightly ventrally-curved anteriorly. Ventroposterior

margin of hyomandibula with lateral condyle articulating with opercle. Preopercle narrow, pointed anteriorly and round posteriorly, its anteromedial region concave with lateral extension articulating with interopercle, its central portion with pointed process. Opercle narrow, with 19 conical, posteriorly-directed odontodes arranged obliquely in five irregular rows on posterior region. Opercle with pronounced dorsomedial concavity and small pointed process anteriorly. Opercle articulating dorsally with hyomandibula via small condyle on anterior medial process. Interopercle narrow with eight conical, posteriorly-oriented odontodes arranged in two oblique irregular rows on posterior region. Interopercle with deep concavity in dorsomedial region, with small pointed process on anterior portion. Odontodes progressively larger and more strongly curved posteriorly, on both opercle and interopercle. Dentary straight, with two rows of small conical teeth, seven teeth in inner row and nine in outer one. Prominent coronoid process and associated Meckel's cartilage.

Parurohyal with two long wings tapering gradually from base to tip, with slight concavity between them. Posterior median process straight and pointed, shorter than lateral wings. Hypobranchial foramen small and circular. Anterior portion of parurohyal with two small condyles articulating with ventral hypohyals (Fig. 3B). Ventral hypohyal triangular, with gentle concavity on dorsal portion and slightly depression on ventral portion, accommodating parurohyal condyles. Anterior ceratohyal cylindrical, with constriction at middle; its anterior margin nearly straight, its posterior margin concave dorsally and convex ventrally with both ends lined with cartilage. Posterior ceratohyal roughly triangular, with irregular margins. Six branchiostegal rays, cylindrical and pointed, three on posterior ceratohyal, one on interceratohyal cartilage and two on posterior ceratohyal.

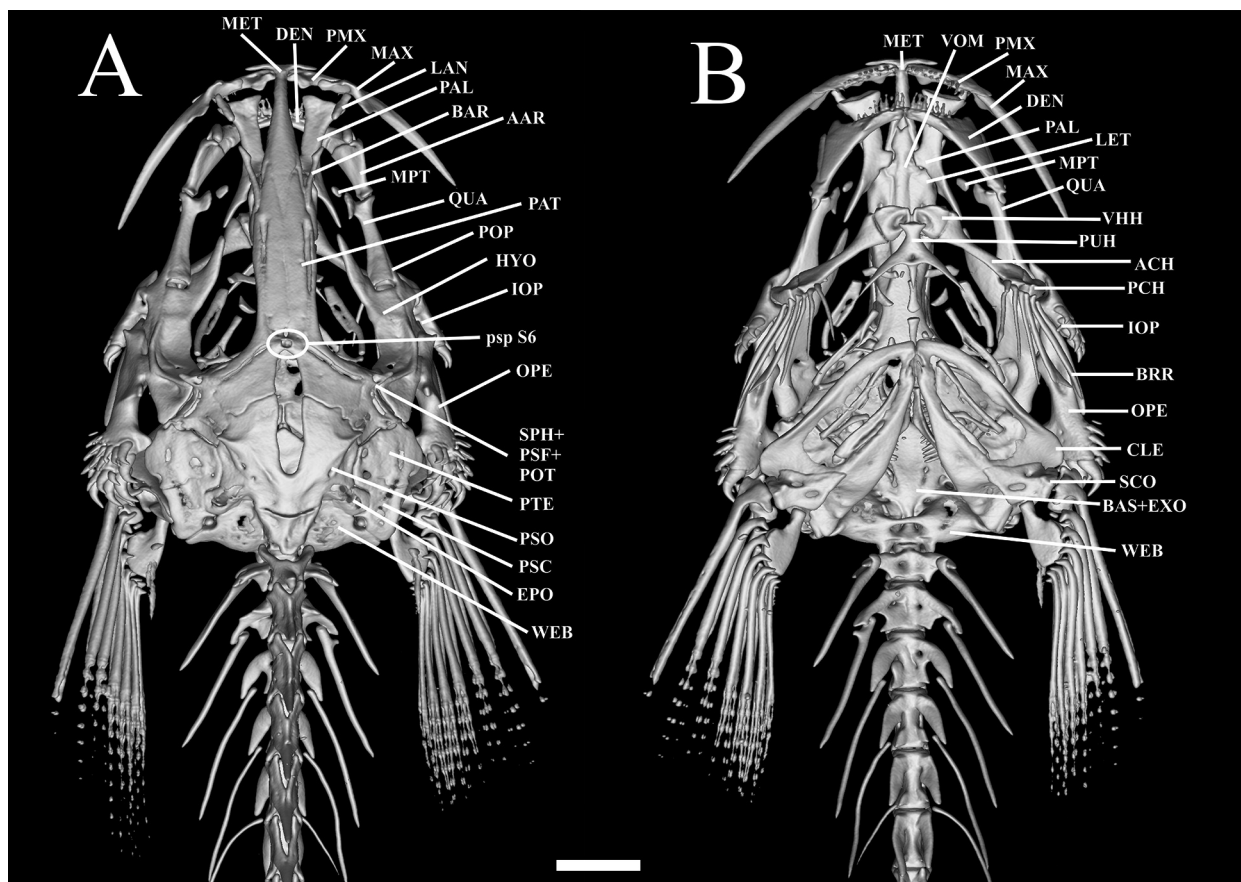


FIGURE 3. Skull, Hyoid Arch, Jaws, Opercular Apparatus, pectoral fin and girdle, Suspensorium, anterior vertebrae and Weberian complex of *Microcambeva bendego*, new species, holotype, MNRJ 52042, 28.1 mm SL. Dorsal view (A) and Ventral view (B). Abbreviations: AAR, Anguloarticular; ACH: Anterior ceratohyal; BAR: Barbular; BAS+EXO: Basioccipital-exoccipital bone; BRR: Branchiostegal rays; CLE: Cleithrum; DEN: Dentary; EPO: Epioccipital; HYO: Hyomandibula; IOP: Interopercle; LAN: Lacrimal-antorbital; LAT: Lateral ethmoid; MAX: Maxilla; MET: Mesethmoid; MPT: Metapterygoid; OPE: Opercle; ORB: Orbitosphenoid; PAT: Parietal; PAL: Autoplatine; PCH: Posterior ceratohyal; PMX: Premaxilla; POP, Preopercle; PSC: Posttemporo-supracleithrum; PSO: Parieto-supraoccipital; PTE: Pterotic; PUH: Parurohyal; QUA: Quadrate; SCO, Scapulocoracoid; SPH+POT+PSF: Sphenotic + Prootic + Pterosphonoid complex; VHH: Ventral hypohyal; VOM: Vomer; WEB: Capsule of Weberian apparatus; psp S6: Posterior supraorbital pore S6. Scale bar: 1.0mm.

Basibranchial 1 absent. Basibranchial 2–3 rod-like with anterior and posterior tips cartilaginous; basibranchial-4 fully cartilaginous, circular and flattened, with slight constriction at middle (Fig. 3B). Hypobranchial 1, rod-like, anterior and posterior ends with globose cartilages; hypobranchial 2–3 conical, with constriction at middle. Ceratobranchial 1–4 cylindrical, with irregular dorsal margins. Ceratobranchial 1–2 with small laminar expansion at ventromedial region; ceratobranchial 3 with small round process at ventromedial region; ceratobranchial 4 with pointed process near anterodorsal margin. Five conical pharyngeal teeth irregularly arranged on ceratobranchial-5. Epibranchial 1 Y-shaped, with pronounced concavity at distal portion. Epibranchial 2 rod-like, with two lateral expansions, a mid-dorsal one directed anteriorly, and an anteroventral one directed posteriorly. Epibranchial 3 laminar with expansion distally at anteroventral portion; epibranchial 4 rectangular. Pharyngobranchials 1–2 absent; pharyngobranchial 3 rod-like, with thin roundish cartilages at tips; pharyngobranchial 4 entirely cartilaginous, inserted at anterior portion of upper pharyngeal tooth plate. Tooth plate large, trapezoid in shape, with 12 conical teeth distributed in single row on ventral surface.

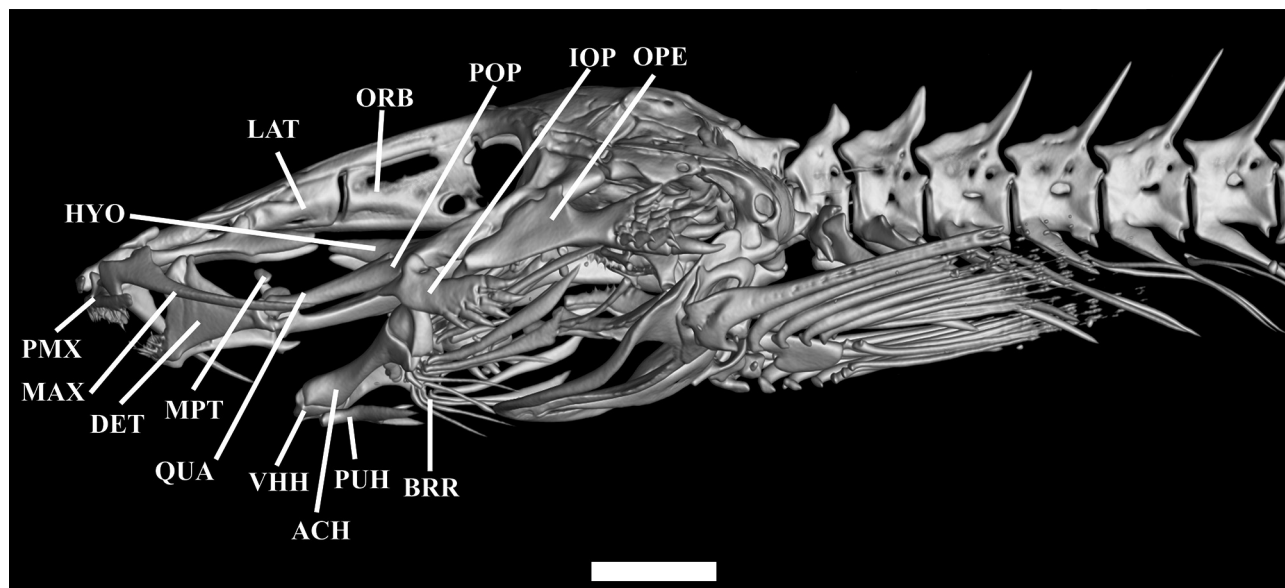


FIGURE 4. Suspensorium, opercular apparatus and jaws of *Microcambeva bendego*, new species, holotype, MNRJ 52042, 28.1 mm SL. Left lateral view. Abbreviations: ACH: Anterior ceratohyal; BRR: Branchiostegal rays; DEN: Dentary; HYO: Hyo-mandibula; IOP: Interopercle; LAT: Lateral ethmoid; MAX: Maxilla; MET: Mesethmoid; OPE: Opercle; ORB: Orbitosphenoid; PMX: Premaxilla; POP: Preopercle; PUH: Parurohyal; QUA: Quadrate; VHH: Ventral hypohyal. Scale bar: 1.0mm.

Cleithrum triangular and flat; scapulacoracoid ossified, roughly triangular. Basipterygium square, excluding anterior processes; internal and external processes long and slender with pointed tips; external process larger than internal; posterior process rudimentary; pelvic splint pointed and small. Hypural complex composed of two plates (Fig. 5). Lower plate rectangular, supposedly corresponding to fused parhypural plus hypurals 1–2, and upper plate corresponding to hypurals 3–5. Uroneural long and equal in size to adjacent neural spine, in contact with, but not fused to, upper hypural plate. Two procurent rays associated with uroneural. Neural spine long and pointed, reaching approximately half of upper hypural plate. Hemal spine larger than neural one, not contacting lower hypural plate, and reaching to distal portion of lower hypural plate; two procurent rays associated with hemal spine. Ventral procurent rays larger than dorsal ones (Fig. 5).

Color in alcohol. Dorsum, lateral and ventrum of body, almost yellowish pale. Four rows of large dark spots, two along sides, one middorsal and one midventral. Lower lateral row midlateral, with nine unevenly-spaced spots extending along longitudinal skeletogenous septum. First spot dorsoposteriorly to base of pectoral fin. Last spot of midlateral series largest, covering hypural plate and central portion of base of caudal fin. Upper lateral row extending along dorsal part of flanks, with three well-defined, bilaterally-aligned anterior spots (third one at transverse line through origin of dorsal fin), plus three or four poorly-defined and bilaterally misaligned ones. Middorsal series with three spots evenly spaced between occiput and origin of dorsal fin (with third one right at fin origin), plus fourth one at middle of dorsal-fin base. Anterior two middorsal spots intercalated with those of upper lateral row. Isolated final middorsal spot on terminus of edge of caudal peduncle. Midventral row with three spots, aligned respectively with distal portion of pelvic fins, middle of anal-fin base and middle of caudal peduncle. Faint files of dark chromato-

phores along limits of myotomes, more pronouncedly on epaxial series. Head with large dark field extending over middle of posterior part of neurocranium, from slightly anteriorly to eyes to limit of epaxial musculature, forming two dark arms at that limit. Cephalic color pattern poorly-defined. Eyes and iris black. Narrow dark field extending laterally between anterior and posterior nostrils. Remainder of dorsal surface of head with light uniform covering of dark chromatophores. Nostrils outlined in abrupt white, in stark contrast with remainder of dorsal surface of head. Dark concentration on opercular patch of odontodes. Ventral part of head entirely white. Maxillary and nasal barbels with dark chromatophores concentrated at base. Rictal barbel white. Dark concentrations on proximal third of pectoral fin. Remaining fins hyaline. Pale-gray vertical bar on caudal-fin base.

Etymology. The specific epithet is derived from the second-largest meteorite discovered in Brazil, the Bendegó. Found in 1794 in Northeastern Brazil, it was transported to the Museu Nacional in 1888, where it became part of its exhibit ever since. In 2018, a fire of huge proportions destroyed part of the Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ) including some of its bicentennial collections. Even though part of the building collapsed, the Bendegó remained intact at the main entrance of the museum, where it was seen by the crowd that gathered the day after the fire, becoming a symbol of the resistance of the institution. This is not only an homage to the MNRJ, its employees and students, but also an allusion to the resilience of the species herein described in Atlantic Forest basin severely impacted by anthropic actions. A noun in apposition.

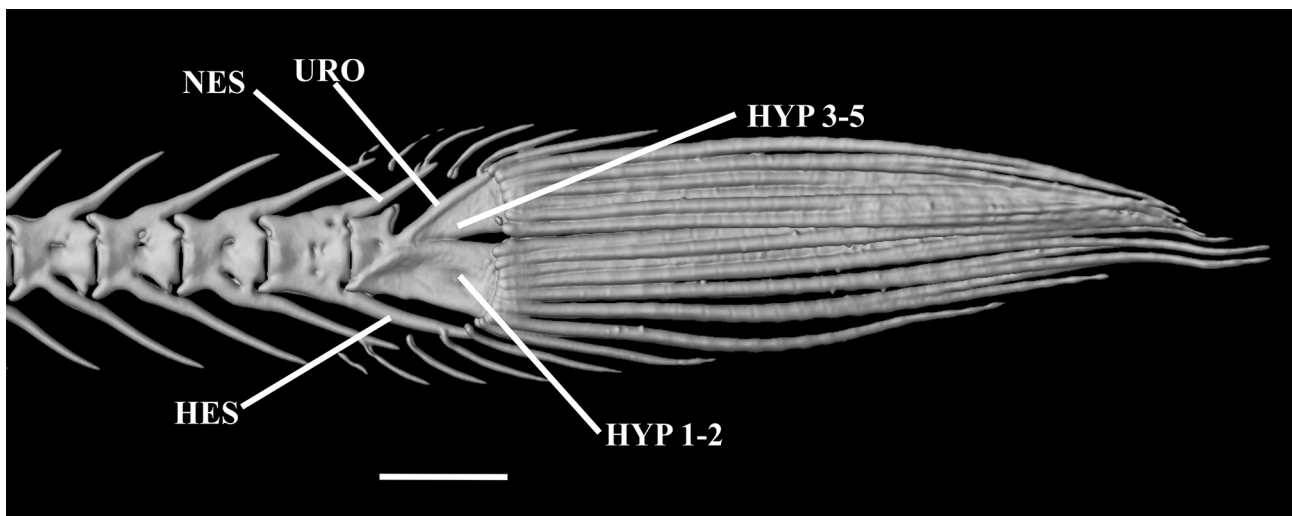


FIGURE 5. Caudal skeleton of *Microcambeva bendego*, new species, holotype, MNRJ 52042, 28.1 mm SL. Left lateral view. Abbreviations: HES: Hemal spine; HYP 1–2: Hypural plate 1–2 plus parhypural, fused; HYP 3–5: Hypural plate 3–5 fused; NES: Neural spine; URO: Uroneural. Scale bar: 1.0mm.

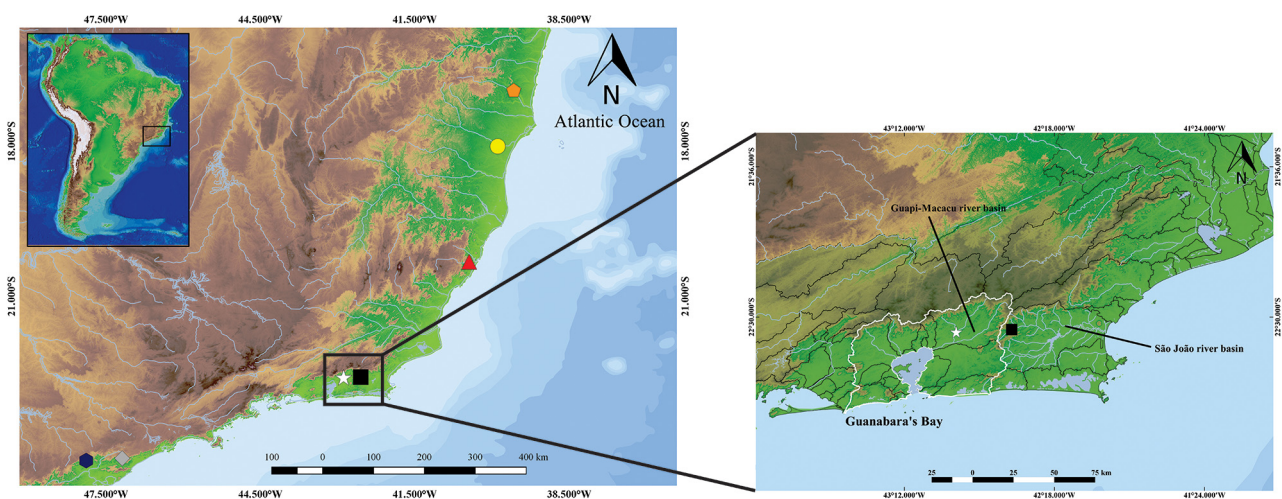


FIGURE 6. Geographic distribution *Microcambeva* catfishes in the Atlantic Forest coastal basins of southeastern Brazil. White star: type locality new species *M. bendego*; Black square: type locality of *M. barbata*; Blue hexagon: *M. filamentosa*; Gray diamond: *M. ribeirae*; Red triangle: *M. jucuiensis*; Yellow circle: *M. mucuriensis*; Pentagon orange: *M. draco*. White line: Guanabara Bay region; Black line: River basin limits.

Distribution. Known only from its type locality, in the middle section of the rio Guapiaçu, in the Guapi-Macacu system, a basin that drains directly into the northeastern portion of Guanabara Bay (Fig. 6).

Habitat and ecological notes. *Microcambeva bendego* was found in the middle course of rio Guapiaçu, in a stream approximately 10 m wide and 1 m deep, with sandy bottom and riparian vegetation composed mostly of grass-like Cyperaceae. The new species was collected along with *Hypostomus affinis* (Steindachner 1877), *Parotocinclus maculicauda* (Steindachner 1877) and *Rineloricaria* sp., plus two introduced aquarium species, the three-spot gourami *Trichopodus trichopterus* (Pallas 1770) and the jewel tetra *Hyphessobrycon eques* (Steindachner 1882). A recent visit to the type locality did not secure any *Microcambeva* specimens. According to local fishermen, the African catfish *Clarias gariepinus* (Burchell 1822) is also found in the stream.

Discussion. *Microcambeva bendego* has all four putative synapomorphies so far proposed for the genus, viz., a reduction in the quadrate process, a rectangular ventral hypural plate; and a reduced number of opercular and interopercular odontodes (Costa & Bockmann 1994; Costa *et al.* 2020a; 2020b), although polarity of those characters are debatable. The new species has the largest number of opercular odontodes (19) in the genus (6–7 in *M. barbata*, 9–14 in *M. mucuriensis*, *M. ribeirae*, *M. draco* and *M. filamentosa*, and 13–15 in *M. jucuensis*) (Costa & Bockmann 1994; Costa *et al.* 2004; 2019a; 2020b).

An additional putative synapomorphy of the genus is the presence of a distinct pair of finger-like projections, similar in position to a mentonian barbel. This barbel of unknown function occurs in all species of the genus, except *M. filamentosa* (Costa *et al.* 2020b), and at least five unrelated trichomycterid species, *Pseudostegophilus maculatus* (Steindachner 1879), *Malacoglanis gelatinosus* Myers & Weitzman 1966, *Stenolicmus sarmientoi* de Pinna & Starnes 1990, *Ammoglanis pulex* de Pinna & Winemiller 2000, and *A. obliquus* Henschel, Bragança, Rangel-Pereira & Costa 2019 (de Pinna & Winemiller, 2000; Henschel *et al.* 2020). The structure in *M. bendego* is the largest so far recorded for the genus, in stark contrast to the minute barbels seen in *M. draco*, *M. jucuensis*, and *M. mucuriensis* and the medium-sized ones in *M. barbata* and *M. ribeirae*.

Microcambeva ribeirae, *M. filamentosa* and *M. bendego* share three character-states not observed in other congeners: median fusion of the third pore (s6) of the supraorbital canal, absence of the anterior autopalatine ossification, and a deep concavity between the base of the ascending process of opercle and the patch of odontodes. Among *Microcambeva*, the new species additionally shares exclusively with *M. ribeirae* two distinct features: a non-filamentous first pectoral-fin ray and conspicuous series of dark spots along the body. In other congeners, the first pectoral-fin ray is modified as a filament, as the long filament in *M. filamentosa* (70–80% pectoral-fin length without filament), medium sized in *M. barbata* (40%) and *M. draco* (50%), and short in *M. jucuensis* and *M. mucuriensis* (5% to 10%). In the sarcoglanidines *Sarcoglanis simplex* Myers & Weitzman 1966 and *Malacoglanis gelatinosus*, the trichomycterine *Scleronema* Eigenmann 1917, and in the stegophiline *Ochmacanthus batrachostoma* (Miranda Ribeiro 1912) a small reduction in the size of the first pectoral filament is observed (Myers & Weitzman 1966; Neto & de Pinna 2016; Ferrer & Malabarba 2020); however this reduction is not comparable to that observed in *M. ribeirae* and *M. bendego*.

Several psammophilic species display a reduction in integumentary pigmentation, as observed in the sarcoglanidines *S. sarmientoi*, *Stauroglanis gouldingi* de Pinna 1989, *Microcambeva* and *Ammoglanis* Costa 1994 species. Species of *Scleronema*, have a yellowish background and patterns composed of rounded brown blotches (de Pinna, 1989; de Pinna & Winemiller 2000; Ferrer & Malabarba 2020). A unique pattern of color of the body, composed of a yellowish background with larger dark spaced spots is observed in *Stenolicmus ix* Wosiacki, Coutinho & Montang 2011, *M. ribeirae* and *M. bendego*, however in the Amazon species, the spots are distributed irregularly along the middle of the body, while in Atlantic forest species, the spots form a series along the middle of the body. These shared characteristics suggest that *M. bendego* is more closely related to *M. ribeirae* from the Ribeira de Iguape ecoregion than to species in its own Fluminense ecoregion.

The apparent sister-group relationship between *M. bendego* and *M. ribeirae* is surprising given that the new species is geographically closer to *M. barbata*, with the two type localities separated by mere 35 km in straight line. Geomorphological data, however, lend support to this biogeographic pattern. The Guapi-Macacu and São João drainages are separated by the Serra do Sembê, which extends from the Serra dos Órgãos Mountains to the Cabo Frio Magmatic Lineament (CFML) (Riccomini *et al.* 2005). These high and ancient rocky escarpments act as a geographical barrier, which has influenced the vicariant patterns and the high diversity of freshwater fish species in the Fluminense ecoregion (Lima *et al.* 2017). This is reflected in some taxa with different species on each side of this divide, such as the *Atlantirivulus* Costa 2008 rivulids, and *Parotocinclus* Eigenmann & Eigenmann 1889 loricari-

ids, and *Listrura* and *Homodiaetus* Eigenmann & Ward 1907 trichomycterids (Koch 2002; Villa-Verde *et al.* 2012; Roxo *et al.* 2017; Lima *et al.* 2017). In addition, Santos *et al.* (2009) and Pereira *et al.* (2013) also demonstrated that *Hoplias malabaricus* (Bloch 1794) lineages' from Guanabara Bay drainages are more closely related to those from the distant Paranaguá Bay, in Paraná State, than to the rio São João basin, corroborating the effectiveness of this barrier for the freshwater aquatic biota (Riccomini *et al.* 2005; Lima *et al.* 2017). Thus, the apparently geographically counter-intuitive relationships of *M. bendego* actually fits a broader biogeographical pattern.

It is not ideal to describe a species based on few specimens, because obviously there is not enough material to address such basic questions as ontogenetic or intraspecific variation (de Pinna *et al.* 2020). Still, some important recent discoveries on trichomycterid diversity were based on few individuals, e.g. *M. barbata* (n=4), *M. draco* (n=2), *Listrura boticario* de Pinna & Wosiacki 2002 (n=1), *L. depinnai* Villa-Verde, Ferrer & Malabarba 2014 (n=2), and *Trichogenes beagle* de Pinna, Reis & Britski 2020 (n=3) (Costa & Bockmann, 1994; de Pinna & Wosiacki 2002; Mattos & Lima 2010; Villa-Verde *et al.* 2014; de Pinna *et al.* 2020). The realities of this kind of research sometimes make it imperative to release new taxonomic knowledge on elements of biodiversity even with limited material. Species must be made available for phylogenetic, biogeographic, ecological and conservation strategies (Silva *et al.* 2019; de Pinna *et al.* 2020), especially for those occurring in highly impacted areas, such as the Guanabara Bay area in the present case.

Conservation status. The Guanabara Bay is composed of approximately 40 rivers and streams, and the region has been sampled by many naturalists since the 19th century. The type locality of the new species is near large urban conglomerates and rural properties concentrating approximately 70% of the metropolitan region of Rio de Janeiro State, including a major industrial center (Bizerril & Primo 2001). The rio Guapi-Macacu basin has an area of ca. 1.600 km², making it the largest drainage flowing into the Guanabara bay. Inserted in the inner portion of the basin, with its headwaters in the Serra dos Órgãos mountain range, it is considered as a biodiversity pocket of the Guanabara Bay region. It has been heavily impacted by unrestrained urban occupation, intensified in the mid-1930, deforestation of riparian forests, fires, diversion of river courses and water pollution (Bizerril & Primo 2001).

The intense degradation of the Guanabara's Bay aquatic environments is evidenced by its numerous threatened freshwater fish species, such as the 'endangered' *Brycon insignis* Steindachner 1877, *Hyphessobrycon flammeus* Myers 1924, and *Spintherobolus broccae* Myers 1925, and the 'critically endangered' *Characidium grajahuense* Travassos 1944, *Listrura nematopteryx* de Pinna 1988, *Kryptolebias brasiliensis* (Valenciennes 1821), *Leptolebias marmoratus* (Ladiges 1934), *Leptopanchax splendens* (Myers 1942), and *L. opalescens* (Myers, 1942) (ICMBio, 2018). While species previously considered extinct such as *L. splendens*, were later rediscovered in remnant natural areas of the Guanabara Bay region (Costa *et al.* 2019b), others like *Leptopanchax sanguineus* Costa 2019, may already be extinct (Costa 2019). Considering that *Microcambeva bendego* was only collected in a single locality consisting in a highly degraded habitat of well-sampled drainage, that recent efforts failed in the obtaining additional specimens, and its area is occupation of less than 20 km², the B2ab(iii) critically endangered category is recommended as an obvious preventive measure (IUCN 2012).

The coastal basins of Atlantic Forest harbor many endemic and restricted-range freshwater fish species. However, the habitat loss along five centuries of colonization has left its mark, with several of those species currently threatened (Abilhoa *et al.* 2011). To some of these 'endangered' species, the creation or expansion of conservation units encompassing small hydrographic basins and associated riparian zones in southeastern Brazil are important measures (Menezes *et al.* 2007). In the estuarine portion of rio Guapi-Macacu basin, there are two conservation units, the Guanabara Ecological Station (GES) between the municipalities of Itaboraí, Guapimirim, São Gonçalo and Magé, covering an area of 1,420km², and the Guapi-Mirim Environmental Protection Area (GMEPA), covering an area of 138.25 km². Outside the protected areas this region is severely impacted, with the riparian zone deforested, diversion of river courses to agriculture, and the introduction of exotic species (Bizerril & Primo 2001). Although the type locality of *M. bendego* is close to the buffer zone of the GES inside in GMEPA, its geographic distribution is limited to the middle section of the rio Guapiaçu. A measure that will contribute to the conservation, not only of the new species, but also of other aquatic species, is the expansion of the GES area to the middle portions of the rio Guapi-Macacu river basin to protect most freshwater habitats and their associated biota (Azevedo-Santos *et al.* 2019).

Comparative material. Rio de Janeiro: *Microcambeva barbata*: MZUSP 43678, 24.7 mm SL, holotype, rio São João. MZUSP 43679, 1, 18.7 mm SL, paratype. DZSJRP-Pisces 13861, 25.1 mm SL, affluent rio São João. MNRJ 49371, 22.7 mm SL, rio Aldeia Velha. MNRJ 47108, 19.6 mm SL, rio Aldeia Velha. MNRJ 37572, 26.3 mm

SL, rio São João. **São Paulo:** *Microcambeva ribeirae*: MZUSP 84301, 47.8 mm SL, holotype, rio São Lourençinho. MZUSP 79953, 7, 25.9–36.6 mm SL, paratypes, rio Espriado. MZUSP 74699, 10, 35.0–47.5 mm SL, paratypes, rio Faú. MNRJ14304, 3, 29.5–32.4 mm SL, paratypes, tributary of rio São Lourençinho. MNRJ 37165, 35.1 mm SL, rio Jacupiranga. **Paraná:** *Microcambeva ribeirae*: UFRGS 24759, 37.7 mm SL, tributary of rio Guaraqueçaba. **Bahia:** *Microcambeva draco*: MCP 17796, 2, 24.6–22.6 mm, holotype, rio Jucuruçu. *Microcambeva jucuiensis*: MZUSP 91641, 11, 19.5–24.6 mm SL, rio Formate.

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References

- Abell, R., Thieme, M.L., Revenga, C., Bryer, M., Kottelat, M., Bogutskaya, N., Coad, B., Mandrak, N., Balderas, S.C., Bussing, W., Stiassny, M.L.J., Skelton, P., Allen, G.R., Unmack, P., Naseka, A., Ng, R., Sindorf, N., Robertson, J., Armijo, E., Higgins, J.V., Heibel, T.J., Wikramanayake, E., Olson, D., López, H.L., Reis, R.E., Lundberg, J.G., Pérez, M.H.S. & Petry, P. (2008) Freshwater ecoregions of the world: a new map of biogeographic units for freshwater biodiversity conservation. *BioScience*, 58, 403–414.
<https://doi.org/10.1641/B580507>
- Abilhoa, V., Braga, R.R., Bornatowski, H. & Vitule, J.R.S. (2011). Fishes of the Atlantic Rain Forest Streams: Ecological Patterns and Conservation. In: Grillo, O. & Venora, G. (Eds.), *Changing Diversity in Changing Environment*. Intech, Rijeka, pp. 259–282.
<https://doi.org/10.5772/24540>
- Adriaens, D., Baskin, J.N. & Coppens, H. (2010) Evolutionary morphology of trichomycterid catfishes: about hanging on and digging in. In: *Origin and phylogenetic interrelationships of teleosts*. Friedrich Pfeil, München, pp. 337–362.
- Arratia, G. & Huaquín, L. (1995) Morphology of the lateral line system and of the skin of diplomystid and systematic and ecological considerations. *Bonner Zoologische Monographien*, 36, 110.
- Azevedo-Santos, V.M., Frederico, R.G., Fagundes, C.K., Pompeu, P.S., Pelicice, F.M., Padial, A.A., Nogueira, M.G., Fearnside, P.M., Lima, L.B., Daga, V.S., Oliveira, F.J., Vitule, J.R.S., Callisto, M., Agostinho, A.A., Esteves, F.A., Lima-Junior, D.P., Magalhães, A.L.B., Sabino, J., Mormul, R.P., Grasel, D., Zuanon, J., Vilella, F.S. & Henry, R. (2019) Protected areas: A focus on Brazilian freshwater biodiversity. *Diversity and Distributions*, 25, 442–448.
<https://doi.org/10.1111/ddi.12871>
- Bizerril, C.R.S.F. & Primo, P.B.S. (2001) *Peixes de Águas Interiores do Estado do Rio de Janeiro*. FEMAR—SEMADS, Rio de Janeiro, 417 pp.
- Costa, W.J.E.M. (1992) Description de huit nouvelles espèces du genre *Trichomycterus* (Siluriformes: Trichomycteridae), du Brésil oriental. *Revue française d'aquariologie*, 18, 101–110.
- Costa, W.J.E.M. (2019) Description of a new species of cynopoecilinae killifish (Cyprinodontiformes, Aplocheilidae), possibly extinct, from the Atlantic Forest of south-eastern Brazil. *ZooKeys*, 867, 73–85.
<https://doi.org/10.3897/zookeys.867.34034>
- Costa, W.J.E.M. & Bockmann, F.A. (1994) A new genus and species of Sarcoglanidinae (Siluriformes: Trichomycteridae) from southeastern Brazil, with a re-examination of subfamilial phylogeny. *Journal of Natural History*, 28, 715–730.
<https://doi.org/10.1080/00222939400770331>
- Costa, W.J.E.M., Lima, S.M.Q. & Bizerril, C.R.S.F. (2004) *Microcambeva ribeirae* sp. n. (Teleostei: Siluriformes: Trichomycteridae): a new sarcoglanidine catfish from the Rio Ribeira do Iguape basin, southeastern Brazil. *Zootaxa*, 563 (1), 1–10.
<https://doi.org/10.11646/zootaxa.563.1.1>
- Costa, W.J.E.M., Katz, A.M., Mattos, J.L.O. & Rangel-Pereira, F.S. (2019a) Two new species of miniature psammophilic sarcoglanidine catfishes of the genus *Microcambeva* from the Atlantic Forest of eastern Brazil (Siluriformes: Trichomycteridae). *Journal of Natural History*, 53, 1837–1851.
<https://doi.org/10.1080/00222933.2019.1669729>

- Costa, W.J.E.M., Mattos, J.L.O. & Amorim, P.F. (2019b) Rediscovery of *Leptopanchax splendens* (Cyprinodontiformes: Aplocheilidae): a seasonal killifish from the Atlantic Forest of south-eastern Brazil that was recently considered extinct. *Journal of Fish Biology*, 94, 345–347.
<https://doi.org/10.1111/jfb.13898>
- Costa, W.J.E.M., Henschel, E. & Katz, A.M. (2020a) Multigene phylogeny reveals convergent evolution in small interstitial catfishes from the Amazon and Atlantic forests (Siluriformes: Trichomycteridae). *Zoologica Scripta*, 49, 159–173.
<https://doi.org/10.1111/zsc.12403>
- Costa, W.J.E.M., Vilaro, P. & Katz, A.M. (2020b) Sympatric sister species with divergent morphological features of psammophilic catfishes of the south-eastern Brazilian genus *Microcambeva* (Siluriformes: Trichomycteridae). *Zoologischer Anzeiger*, 285, 12–17.
<https://doi.org/10.1016/j.jcz.2020.01.001>
- Ferrer, J. & Malabarba, L.R. (2020) Systematic revision of the Neotropical catfish genus *Scleronema* (Siluriformes: Trichomycteridae), with descriptions of six new species from Pampa grasslands. *Neotropical Ichthyology*, 18 (2). [published online]
<https://doi.org/10.1590/1982-0224-2019-0081>
- Henschel, E., Bragança, P.H.N., Rangel-Pereira, F. & Costa, W.J.E.M. (2020) A new psammophilic species of the catfish genus *Ammoglanis* (Siluriformes, Trichomycteridae) from the Amazon River basin, northern Brazil. *Zoosystematics and Evolution*, 96 (1), 67–72.
<https://doi.org/10.3897/zse.96.48952>
- Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) (2018). Livro Vermelho da Fauna Brasileira Ameaçada de Extinção. Vol. VI—Peixes. In: Instituto Chico Mendes de Conservação da Biodiversidade (Ed.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*. ICMBio, Brasília, pp. 1–1234.
- International Union for Conservation of Nature (IUCN) (2012) *Guidelines for application of IUCN red list criteria at regional and national levels: Version 4.0*. IUCN, Gland and Cambridge, 41 pp.
- Koch, W.R. (2002) Revisão taxonômica do gênero *Homodiaetus* (Teleostei, Siluriformes, Trichomycteridae). *Iheringia. Série Zoologia*, 92 (3), 33–46.
<https://doi.org/10.1590/S0073-47212002000300004>
- Koerber, S. & Reis, R.E. (2020) Evidence for the true type-locality of *Rhamdia quelen* (Siluriformes: Heptapteridae), and the geographical origin and invalid neotype designation of four of its synonyms. *Neotropical Ichthyology*, 18 (1), 1–12.
<https://doi.org/10.1590/1982-0224-2019-0117>
- Lima, S.M.Q., Berbel-Filho, W.M., Araújo, T.F., Lazzarotto, H., Tatarenkov, A. & Avise, J.C. (2017) Headwater capture evidenced by paleo-rivers reconstruction and population genetic structure of the armored catfish (*Pareiorhaphis garbei*) in the Serra do Mar mountains of southeastern Brazil. *Frontiers in genetics*, 8 (199), 1–8.
<https://doi.org/10.3389/fgene.2017.00199>
- Mattos, J.L. & Lima, S.M.Q. (2010) *Microcambeva draco*, a new species from north-eastern Brazil (Siluriformes: Trichomycteridae). *Ichthyological Exploration of Freshwaters*, 21, 233–238.
- Menezes, N.A., Weitzman, S.H., Oyakawa, O.T., Lima, F.C.T., Correa e Castro, R.M. & Weitzman, M.J. (2007) *Peixes de água doce da Mata Atlântica: lista preliminar das espécies e comentários sobre conservação de peixes de água doce neotropicais*. Museu de Zoologia da Universidade de São Paulo, São Paulo, 407 pp.
- Myers, G.S. & Weitzman, S. H. (1966) Two remarkable new trichomycterid catfishes from the Amazon basin in Brazil and Colombia. *Journal of Zoology*, 149 (3), 277–287.
<https://doi.org/10.1111/j.1469-7998.1966.tb04049.x>
- Neto, S.C. & de Pinna, M.C.C. (2016) Redescription of *Ochmacanthus batrachostoma* (Miranda-Ribeiro, 1912) (Siluriformes: Trichomycteridae): a possible case of incipient paedomorphism. *Neotropical Ichthyology*, 14 (1). [published online]
<https://doi.org/10.1590/1982-0224-20150030>
- Ochoa, L.E., Datovo, A., DoNascimento, C., Roxo, F.F., Sabaj, M.H., Chang, J., Melo, B.F., Silva, G.S.C., Foresti, F., Alfaro, M. & Oliveira, C. (2020) Phylogenomic analysis of trichomycterid catfishes (Teleostei: Siluriformes) inferred from ultra-conserved elements. *Scientific Reports*, 10 (2697), 1–15.
<https://doi.org/10.1038/s41598-020-59519-w>
- de Pinna, M.C.C. (1989) A new sarcoglanidine catfish, phylogeny of its subfamily, and an appraisal of the phyletic status of the Trichomycterinae (Teleostei, Trichomycteridae). *American Museum novitates*, 2950, 1–39.
- de Pinna, M.C.C. & Winemiller, K.O. (2000) A new species of *Ammoglanis* (Siluriformes: Trichomycteridae) from Venezuela. *Ichthyological Exploration of Freshwaters*, 11 (3), 255–264.
- de Pinna, M.C.C. & Wosiacki, W.B. (2002) A new interstitial catfish of the genus *Listrura* from southern Brazil (Siluriformes: Trichomycteridae: Glanapteryginae). *Proceedings of the Biological Society of Washington*, 115 (4), 720–726.
- de Pinna, M.C.C., Reis, V. & Britski, H. (2020) A new species of *Trichogenes* (Siluriformes, Trichomycteridae), with a discussion on the homologies of the anterior orbital bones in trichomycterids and other loricarioids. *American Museum Novitates*, 3951, 1–27.
<https://doi.org/10.1206/3951.1>
- Pereira, T.L., Santos, U., Schaefer, C.E., Souza, G.O., Paiva, S.R., Malabarba, L.R., Schmidt, E.E. & Dergam, J.A. (2013) Dispersal and vicariance of *Hoplias malabaricus* (Bloch, 1794) (Teleostei, Erythrinidae) populations of the Brazilian continental margin. *Journal of Biogeography*, 40, 905–914.

<https://doi.org/10.1111/jbi.12044>

- Riccomini, C., Velázquez, V.F. & Gomes, C.B. (2005) Tectonic controls of the Mesozoic and Cenozoic alkaline magmatism in central-southeastern Brazilian platform. *In*: Comin-Chiaramonti, P. & Gomes, C.B. (Eds.), *Mesozoic to Cenozoic Alkaline Magmatism in the Brazilian Platform*. Editora da Universidade de São Paulo, São Paulo, 707 pp.
- Roxo, F.F., Melo, B.F., Silva, G.S.C. & Oliveira, C. (2017) New species of *Parotocinclus* (Siluriformes: Loricariidae) from coastal drainages of Rio de Janeiro, southeastern Brazil. *Zootaxa*, 4232 (2), 260–270.
<https://doi.org/10.11646/zootaxa.4232.2.9>
- Santos, U., Völcker, C.M., Belei, F.A., Cioffi, M.B., Bertollo, L.A.C., Paiva, S.R. & Dergam, J.A. (2009) Molecular and karyotypic phylogeography in the Neotropical *Hoplias malabaricus* (Erythrinidae) fish in eastern Brazil. *Journal of Fish Biology*, 75, 2326–2343.
<https://doi.org/10.1111/j.1095-8649.2009.02489.x>
- Sarmiento-Soares, L.M., Pessali, T.C., Reis, V., Medeiros, L.S., Lima, S.M.Q., Silva, J.P., Martins-Pinheiro, R.F. & de Pinna, M.C.C. (2019) Distribution, morphological notes and conservation status of the psammophilus *Microcambeva* catfishes (Siluriformes: Trichomycteridae). *Zootaxa*, 4712 (4), 576–588.
<https://doi.org/10.11646/zootaxa.4712.4.6>
- Silva, P.C., Malabarba, M.C. & Malabarba, L.R. (2019) Integrative taxonomy: Morphology and ancient DNA barcoding reveals the true identity of *Astyanax taeniatus*, a tetra collected by Charles Darwin during the Beagle's voyage. *Zoologischer Anzeiger*, 278, 110–120.
<https://doi.org/10.1016/j.jcz.2018.12.007>
- Villa-Verde, L., Lazzarotto, H. & Lima, S.M.Q. (2012) A new glanapterygine catfish of the genus *Listrura* (Siluriformes: Trichomycteridae) from southeastern Brazil, corroborated by morphological and molecular data. *Neotropical Ichthyology*, 10, 527–538.
<https://doi.org/10.1590/S1679-62252012000300005>
- Villa-Verde, L., Ferrer, J. & Malabarba, L.R. (2014) A new species of *Listrura* from Laguna dos Patos System, Brazil: the southernmost record of the Glanapteryginae (Siluriformes: Trichomycteridae). *Copeia*, 2013 (4), 641–646.
<https://doi.org/10.1643/CI-13-027>