

Research article

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Two new species of *Trichomycterus* (Siluriformes: Trichomycteridae) from the Rio Itabapoana Basin, south-eastern Brazil

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Abstract. Streams in the Atlantic Forest of Brazil are home to a great diversity of endemic freshwater fishes, but some fish groups are still poorly known. In the last 22 years, our field inventories have recorded some species of the mountain catfish genus *Trichomycterus* that are endemic to the Rio Itabapoana Basin, among which two were not still described. Herein, we provide formal descriptions for these two species. One of these species is a member of the NMM-clade of the subgenus *Cryptocambeva* and the other one belongs to the beta-clade of the subgenus *Psammocambeva*. Both species are diagnosed by an exclusive combination of character states of the external morphology and osteology. This study indicates that the number of endemic trichomycterine species in the Rio Itabapoana Basin, presently five, is larger than in any other small coastal river basin of the Atlantic Forest. A key for identification of species of *Trichomycterus* from this basin is provided. We discuss two factors that may be responsible for the relatively high concentration of trichomycterines in this basin: streams draining separate mountain ranges or possible past connections with two neighbouring larger basins, the Rio Doce and the Rio Paraíba do Sul basins.

Keywords. Atlantic Forest, *Cryptocambeva*, mountain biodiversity, *Psammocambeva*.

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Introduction

Several studies have shown the great diversity of endemic freshwater fish species in the coastal river basin drainage areas within the Atlantic Forest of Brazil (Weitzman *et al.* 1988; Menezes *et al.* 2007; Costa 2009; Abilhoa *et al.* 2011). This diversity is not surprising, since the Atlantic Forest is a well-known biodiversity hotspot, standing out among the five most biodiversity hotspots in the world (Myers

et al. 2000). However, some fish groups that occur in these river basins remain poorly known, especially those inhabiting areas not exhaustively sampled such as fast-flowing streams draining mountain regions of small, isolated river basins. Recent field inventories have revealed a considerable diversity of endemic trichomycterine catfishes (Trichomycteridae: Trichomycterinae) inhabiting these habitats (Costa *et al.* 2021a, 2021b, 2022a, 2023a), but data on this fish group from several coastal river basins are mostly incomplete, restricted to sporadic descriptions of single species (e.g., Costa 1992; Barbosa & Costa 2003, 2010; Alencar & Costa 2004; Lima & Costa 2004; Lima *et al.* 2008; Barbosa 2013). In south-eastern Brazil, the most diverse group of trichomycterine catfishes is *Trichomycterus* s. str., a well-supported clade including *Trichomycterus nigricans* Valenciennes, 1832, the type species of the genus, and over 80 other species, presently divided in six subgenera (Katz *et al.* 2018; Costa *et al.* 2020; Costa 2021; Vilaro *et al.* 2023).

Among the many small, isolated hydrogeographic coastal basins that drain the Atlantic Forest in south-eastern Brazil, the Rio Itabapoana Basin, with a drainage area of only 4875 km², stands out for having its source in the Serra do Caparaó, where is located the highest peak in the region, the Pico da Bandeira, with 2891 m a.s.l.. Historically, the course of the Rio Itabapoana has been used as a boundary between the provinces of Rio de Janeiro and Espírito Santo, presently states, since the colonial period. At the beginning of the 19th century, the time of the first expeditions of European naturalists to eastern Brazil, the interior of the basin was still occupied by dense forests inhabited by indigenous peoples not friendly to contact with Europeans, with naturalist expeditions mostly limited to the region close to the sea (Wied-Neuwied 1820; Saint-Hilaire 1833). Since then, much of the basin has lost its original vegetation, which has been largely replaced by pastures and plantations in low areas, with remaining forest environments restricted to some higher areas. A recent regional inventory of fish species shows that the Rio Itabapoana Basin has a diverse ichthyofauna (Sarmiento-Soares & Martins-Pinheiro 2014), but trichomycterines were rarely recorded for this basin, as below described.

The first two studies dealing with *Trichomycterus* in the Rio Itabapoana Basin comprised formal descriptions of two species, *Trichomycterus (Cryptocambeva) brunoi* Barbosa & Costa, 2010 and *Trichomycterus (Psammocambeva) caudofasciatus* Alencar & Costa, 2004 (Alencar & Costa 2004; Barbosa & Costa 2010). These species were collected in December 2002 by one of us (WJEMC), during an ichthyofaunal survey directed to trichomycterine habitats in the Serra do Caparaó, which is part of the northern nucleus of the Serra da Mantiqueira, in the upper reaches of the Rio Itabapoana Basin. Subsequently, one of us (MAB) in the company of students from the Laboratory of Systematics and Evolution of Teleost Fishes (IB-UFRJ: Institute of Biology, Federal University of Rio de Janeiro) made some collecting trips directed to trichomycterine habitats in the lower mountain areas nearer the coast of Espírito Santo state, in the Serra do Mar. In 2007, they found two undescribed species in springs of a tributary at the middle course of the Rio Itabapoana, in the Rio Muqui do Sul drainage, of which one, *Trichomycterus (Psammocambeva) mimosensis* Barbosa, 2013, was described (Barbosa 2013). The other species, still undescribed, is a typical member of the subgenus *Cryptocambeva* Costa, 2021, which includes species with relatively small eyes, a dotted colour pattern and a series of apomorphic skeletal traits (Costa 2021). This species belongs to the northern Mantiqueira-Mar clade of *Cryptocambeva* (NMM-clade; Costa *et al.* 2022b), which is endemic to the northern nucleus of the Serra da Mantiqueira and the adjacent areas of the Serra do Mar. This clade may be diagnosed by the presence of a distinctive posterior extension on the middle of the posterior margin of the metapterygoid (Barbosa & Costa 2010). Recently, a molecular analysis indicated that this new species, below described, is sister to *Trichomycterus argos* Lezama, Triques & Santos, 2012 (Vilaro *et al.* 2023), a species endemic to the Rio Doce Basin (Lezama *et al.* 2012). Other species belonging to the NMM-clade are *T. brunoi* from the upper Rio Itabapoana Basin and *Trichomycterus fuliginosus* Barbosa & Costa, 2010 from the Rio Paraíba do Sul Basin.

The region of the upper Rio Preto drainage, lower Rio Itabapoana Basin, at the Serra das Torres, which is part of the Serra do Mar was inventoried by a team of students from the Laboratory of Amphibians (IB-UFRJ), which in 2010 found another trichomycterine species that remains undescribed. There is no material suitable for DNA analysis, but the presence of a combination of a shallow anterior outgrowth of the hyomandibula (Costa & Katz 2022) and a long interopercle, about 90% of the hyomandibula longitudinal length, support it as a member of the *Psammocambeva* beta-clade (Costa *et al.* 2024), containing six species endemic to the Rio Doce Basin, *Trichomycterus barrocos* Reis & de Pinna, 2022, *Trichomycterus brucutu* Reis & de Pinna, 2022, *Trichomycterus illuvies* Reis & de Pinna, 2022, *Trichomycterus ipatinga* Reis & de Pinna, 2022, *Trichomycterus melanopygius* Reis, dos Santos, Britto, Volpi & de Pinna, 2020, and *Trichomycterus tantalus* Reis, Vieira & de Pinna, 2022, and one to the Rio Paraíba do Sul Basin, *Trichomycterus largoperculatus* Costa & Katz, 2022 (Reis & de Pinna 2022; Vilaro *et al.* 2023; Costa *et al.* 2024). Here, we provide formal descriptions for the two species from the Rio Itabapoana Basin that had not yet been included in previous taxonomic studies, besides a key for identification of species of *Trichomycterus* occurring in the Rio Itabapoana Basin.

Material and methods

Morphological terminology, methods to take and describe morphometric and meristic data, selection and sequence pattern of morphological attributes used in species descriptions are according to our most recent taxonomic studies on *Trichomycterus* (e.g., Costa *et al.* 2023a), which follow Taylor & Van Dyke (1985) for osteological preparations, Costa (1992), Costa *et al.* (2020), and Bockmann & Sazima (2004) for taking morphometric and meristic data, Costa (2021) and Kubicek (2022) for osteological nomenclature, and Arratia & Huaquin (1995) and Bockmann & Sazima (2004) for latero-sensory pore nomenclature.

This paper is based on specimens collected a long time ago, deposited in the ichthyological collection of the Laboratory of Systematics and Evolution of Teleost Fishes, Institute of Biology, Federal University of Rio de Janeiro (UFRJ), with some specimens recently transferred to the ichthyological collection of the Center of Agrarian and Environmental Sciences, Federal University of Maranhão, Chapadinha, Brazil (CICCAA). A few specimens of one of the new species were collected more recently with permission given by ICMBio (Instituto Chico Mendes de Conservação da Biodiversidade; permit number: 38553-13) and following ethical protocols as described in our recent papers on trichomycterines (e.g., Costa *et al.* 2022a), approved by CEUA-CCS-UFRJ (Ethics Committee for Animal Use of the Federal University of Rio de Janeiro; permit number: 065/18). In lists of specimens, the abbreviation C&S indicates cleared and stained specimens for osteological analyses. Geographical names follow Portuguese terms used in the region. Comparative material is listed in Costa *et al.* (2022a, 2023a).

Institutional abbreviations

CICCAA = Ichthyological collection of the Center of Agrarian and Environmental Sciences, Federal University of Maranhão, Chapadinha, Brazil
UFRJ = Ichthyological collection of the Institute of Biology of the Federal University of Rio de Janeiro, Rio de Janeiro City, Brazil

Abbreviations for morphological terms

C&S = cleared and stained specimens
SL = standard length

Results

Taxonomy

Phylum Chordata Haeckel, 1874
Class Actinopterygii Klein, 1885
Order Siluriformes Cuvier, 1817
Family Trichomycteridae Bleeker, 1858
Genus *Trichomycterus* Valenciennes, 1832
Subgenus *Cryptocambeva* Costa, 2021

Trichomycterus (Cryptocambeva) berthaltutzae sp. nov.
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Figs 1, 2A–C, 3, Table 1

Trichomycterus sp. – Vilardo *et al.* 2023: fig. 3 (phylogenetic relationships).

Diagnosis

Trichomycterus (Cryptocambeva) berthaltutzae sp. nov. is distinguished from all other species of the NMM-clade of *Cryptocambeva* by having a shorter nasal barbel, its tip not reaching the opercular patch of odontodes (vs reaching or surpassing it), and a sinuous medial margin of the autopalatine (Fig. 2A, vs about straight or slightly concave). *Trichomycterus (Cryptocambeva) berthaltutzae* is also distinguished from *T. brunoi* and *T. fuliginosus* by having a minute pectoral-fin filament, its length about 10% or less of the pectoral-fin length (vs about 20–25%), more dorsal procurrent caudal-fin rays (20 or 21, vs 16–19), flank with sparse dark brown dots that are separated among themselves by large interspaces (vs dots highly overlapped), the presence of a lateral expansion on the sesamoid supraorbital (Fig. 2A; vs absence), and absence of an elongate expansion on the posteroventral margin of the metapterygoid (Fig. 2B, vs presence, Barbosa & Costa 2010: figs 1, 4); and from *T. argos* by having fewer opercular odontodes (12–15 vs 16–22) and the absence of a vertical zone of dark chromatophores on the caudal-fin base, forming a distinctive bar (vs presence).

Etymology

The specific epithet ‘*berthaltutzae*’ honours the Brazilian herpetologist Bertha Maria Júlia Lutz (1894–1976), professor emeritus at Federal University of Rio de Janeiro, who between 1919 and 1964 worked at the National Museum of that institution, describing several species of anurans from the mountains of the Atlantic Forest and other locations. She was also an important feminist activist, being the main actor in guaranteeing women’s right to vote during the United Nations Conference in San Francisco, 1945.

Type material

Holotype

BRAZIL • 78.1 mm SL; Espírito Santo State, Mimoso do Sul Municipality, Rio Alto Pratinha, tributary of the Rio Muqui do Sul, Rio Itabapoana Basin; 21°03’51” S, 41°18’13” W; ca 205 m a.s.l.; 27 Feb. 2007; M.A. Barbosa, J.L.O. Mattos and E.M. Ribeiro leg; UFRJ 12930.

Paratypes

BRAZIL • 3 ex., 19.0–35.6 mm SL; same data as for holotype; UFRJ 7546 • 3 ex., 32.0–96.1 mm SL; same data as for holotype; CICCAA 07749 • 2 ex. (C&S), 31.2–44.5 mm SL; same data as for holotype; UFRJ 12932. • 9 ex., 21.1–46.2 mm SL; same data as for holotype; 19 Sep. 2022; A.M. Katz and P.J. Vilardo leg; UFRJ 13252 • 1 ex. (C&S), 45.8 mm SL; same data as for preceding; UFRJ 13650.

Description

GENERAL MORPHOLOGY. Morphometric data see Table 1. Body moderately slender, head and trunk with dorsal and ventral profiles slightly convex, dorsal and ventral profiles of caudal peduncle nearly straight, greatest body depth at vertical just anterior to pelvic-fin base. Trunk subcylindrical anteriorly, compressed posteriorly. Anus and urogenital papilla at vertical just posterior to dorsal-fin origin. Head subtrapezoidal in dorsal view, snout profile rounded. Eye relatively small, dorsally positioned in head. Posterior nostril located nearer anterior nostril than orbital rim. Tip of maxillary and rictal barbels reaching between anterior and posterior regions of interopercular patch of odontodes, tip of nasal barbel reaching about midway between orbit and opercle or slightly before. Mouth subterminal. Jaw teeth pointed, slightly curved, arranged in irregular rows. Premaxillary teeth 47–60, dentary teeth 40–43. Odontodes conical. Opercular odontodes 12–15, interopercular odontodes 34–42. Branchiostegal rays 8.

FINS. Dorsal and anal fins subtriangular, anterior and posterior margins slightly convex; longest ray longer than fin base. Total dorsal-fin rays 10–11 (ii + II + 6–7), total anal-fin rays 9 (ii + II + 5); anal-



Fig. 1. *Trichomycterus (Cryptocambeva) berthallutzae* sp. nov., holotype (UFRJ 12930), 78.1 mm SL. **A.** Left lateral view. **B.** Dorsal view. **C.** Ventral view.

fin origin at vertical shortly posterior to middle of dorsal-fin base, through base of 4th branched ray. Dorsal-fin origin at vertical through centrum of 20th vertebra; anal-fin origin at vertical between centrum of 22nd or 23rd vertebra. Pectoral fin subtriangular in dorsal view, posterior margin slightly convex, first pectoral-fin ray terminating in filament, its length about 10% or less of pectoral-fin length without filament. Total pectoral-fin rays 7 (I + 6). Pelvic fin rounded, its posterior extremity covering urogenital papilla, at vertical through anterior half of dorsal-fin base. Pelvic-fin bases medially separated by minute interspace. Total pelvic-fin rays 5 (I + 4). Caudal fin slightly rounded, dorso-ventrally symmetrical. Total principal caudal-fin rays 13 (I + 11 + I), total dorsal procurent rays 20 or 21 (xix–xx + I), total ventral procurent rays 14 or 15 (xiii–xiv + I).

LATERO-SENSORY SYSTEM. Supraorbital canal, posterior section of infraorbital canal and postorbital canal continuous. Supraorbital sensory canal with 3 paired pores: s1, adjacent to medial margin of anterior nostril; s3, adjacent and just posterior to medial margin of posterior nostril, and s6, at transverse line through posterior half of orbit; s6 pore nearer to its symmetrical homologous s6 pore than to orbit, sometimes at close proximity. Infraorbital sensory canal with 2 segments. Anterior infraorbital canal with 2 pores: i1, at transverse line through anterior nostril, and i3, at transverse line just anterior to posterior nostril. Posterior infraorbital canal with two pores: i10, adjacent to ventral margin of orbit, and i11, posterior to orbit. Postorbital canal with 2 pores: po1, at vertical line above posterior portion of interopercular patch of odontodes, and po2, at vertical line above posterior portion of opercular patch of odontodes. Lateral line of trunk with 2 pores just posterior to head.

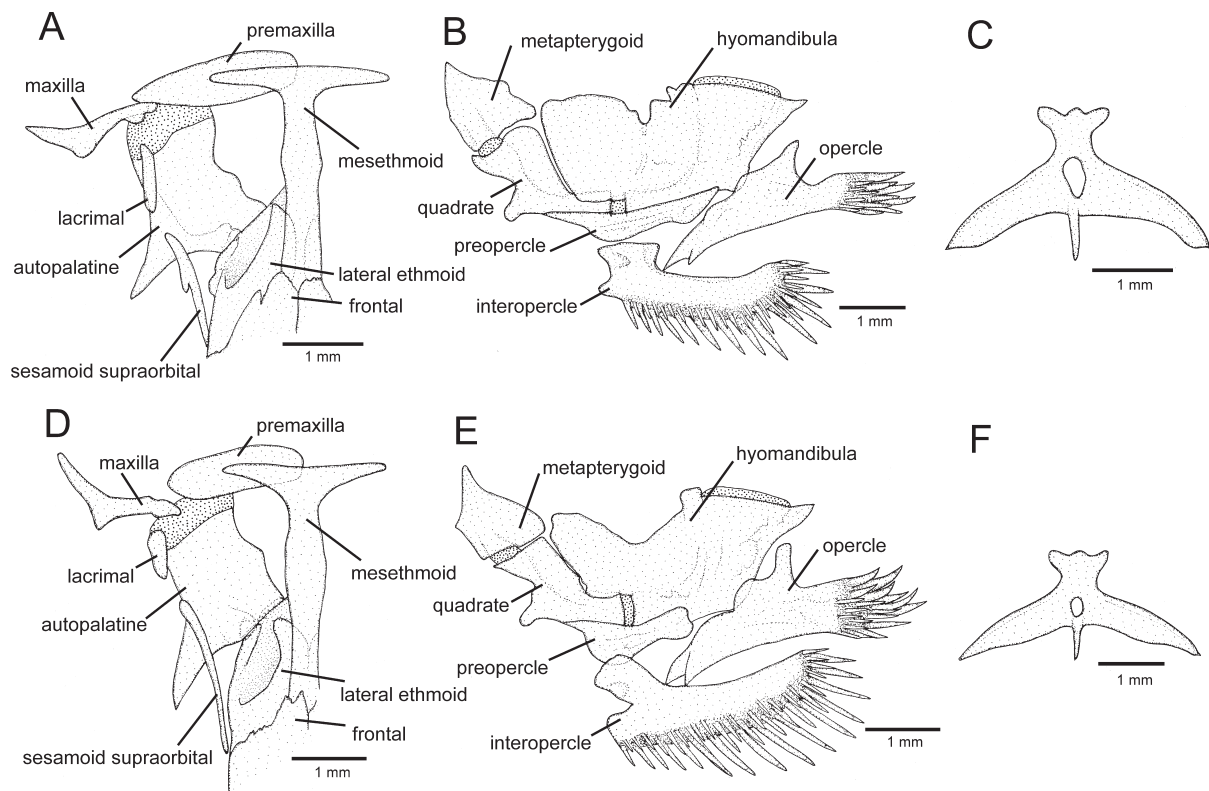


Fig. 2. Osteological structures. **A–C.** *Trichomycterus (Cryptocambeva) berthaltutzae* sp. nov. (UFRJ 13252). **D–F.** *Trichomycterus (Psammocambeva) fabioheppi* sp. nov. (UFRJ 12933). **A, D.** Mesethmoidal region and adjacent structures, left and middle portions, dorsal view. **B, E.** Left jaw suspensorium and opercular series, lateral view. **C, F.** Parurohyal, ventral view. Larger stippling represents cartilaginous areas.

Table 1. Morphometric data of *Trichomycterus (Cryptocambeva) berthallutzae* sp. nov.

	Holotype	Paratypes (n = 7)
standard length (SL)	78.1	40.9–96.1
percentage of standard length		
body depth	14.8	14.6–15.8
caudal peduncle depth	14.3	13.8–15.3
body width	12.3	10.4–13.4
caudal peduncle width	4.9	3.1–5.1
pre-dorsal length	62.1	61.3–67.0
pre-pelvic length	58.4	55.5–60.1
dorsal-fin base length	11.0	11.5–13.5
anal-fin base length	9.2	10.2–11.6
caudal-fin length	16.5	14.9–18.1
pectoral-fin length	11.6	11.5–14.6
pelvic-fin length	9.5	9.4–11.6
head length	20.2	20.4–22.5
percentage of head length		
head depth	50.3	43.6–51.9
head width	90.9	82.9–92.5
snout length	43.7	40.9–46.3
interorbital width	30.5	23.6–27.6
preorbital length	13.2	9.8–15.5
eye diameter	9.4	8.7–14.9

OSTEOLOGY (Fig. 2A–C). Anterior margin of mesethmoid nearly straight to slightly convex, mesethmoid cornu narrow. Lacrimal narrow and flat, its largest length about $\frac{3}{5}$ of sesamoid supraorbital largest length. Sesamoid supraorbital flat, its largest length smaller than largest maxilla length, with distinctive lateral projection. Premaxilla sub-rectangular in dorsal view, slightly tapering laterally. Maxilla boomerang-shaped, slender, shorter than premaxilla, with minute posterior process. Autopalatine sub-rectangular in dorsal view when excluding posterolateral process, lateral margin about straight, medial margin sinuous. Shortest autopalatine width about half autopalatine length. Latero-posterior process of autopalatine subtriangular, its length about equal shortest autopalatine width. Metapterygoid subtriangular, deeper than long, with distinctive postero-dorsal projection. Quadrate robust, dorsoposterior outgrowth in close proximity to hyomandibular outgrowth. Hyomandibula long, anterior outgrow deep, with small concavity on dorsal margin. Opercle slender, depth of opercular odontode patch about half dorsal articular facet of hyomandibula, dorsal process of opercle short, subtriangular. Interopercle long, about three fourths of hyomandibula length. Preopercle compact, slender, with small ventral expansion. Parurohyal robust, lateral process relatively elongate, pointed, slightly curved. Parurohyal head well-developed, with prominent anterolateral paired process. Middle parurohyal foramen oval, its largest length about equal to posterior parurohyal process. Posterior parurohyal process about half distance between anterior margin of parurohyal and anterior insertion of posterior process. Vertebrae 37. Ribs 13 or 14. Two dorsal hypural plates, corresponding to hypurals 4 + 5 and 3, respectively; single ventral hypural plate corresponding to hypurals 1 and 2 and parhypural.

COLOURATION IN ALCOHOL. Flank, dorsum and head side light yellowish grey with minute dark brown dots, slightly larger and sometimes horizontally coalesced on anterior lateral midline, more concentrated on dorsum. In juveniles below about 25 mm SL, head and trunk light yellowish grey with longitudinal row of dark brown spots on flank midline, and similar row between flank midline and venter. Barbels light grey, with brown pigmentation concentration on dorsal surface of basal portion. Fins hyaline, with minute brown dots on basal portion.

Distribution

Presently known only from the type locality, Rio Alto Pratinha, tributary of the Rio Muqui do Sul, Rio Itabapoana Basin, Serra do Mar (Fig. 3).

Subgenus *Psammocambeva* Costa, 2021

Trichomycterus (Psammocambeva) fabioheppi sp. nov.

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Figs 2D–F, 3–4, 5A, Table 2

Diagnosis

Trichomycterus (Psammocambeva) fabioheppi sp. nov. is distinguished from all other species of *Trichomycterus* s. str. by having a unique morphology of the caudal fin, which is dorso-ventrally asymmetrical, with the dorsal portion longer than the ventral one, consequently making the ventral-most principal caudal-fin rays about half the length of dorsal-most ones (Fig. 5A; vs caudal fin dorso-ventrally symmetrical as in all other species of *Psammocambeva*, Fig. 5C–E, or dorsal portion just slightly longer than ventral one in larger specimens of *Trichomycterus (Cryptocambeva) maracaya* Bockmann & Sazima,

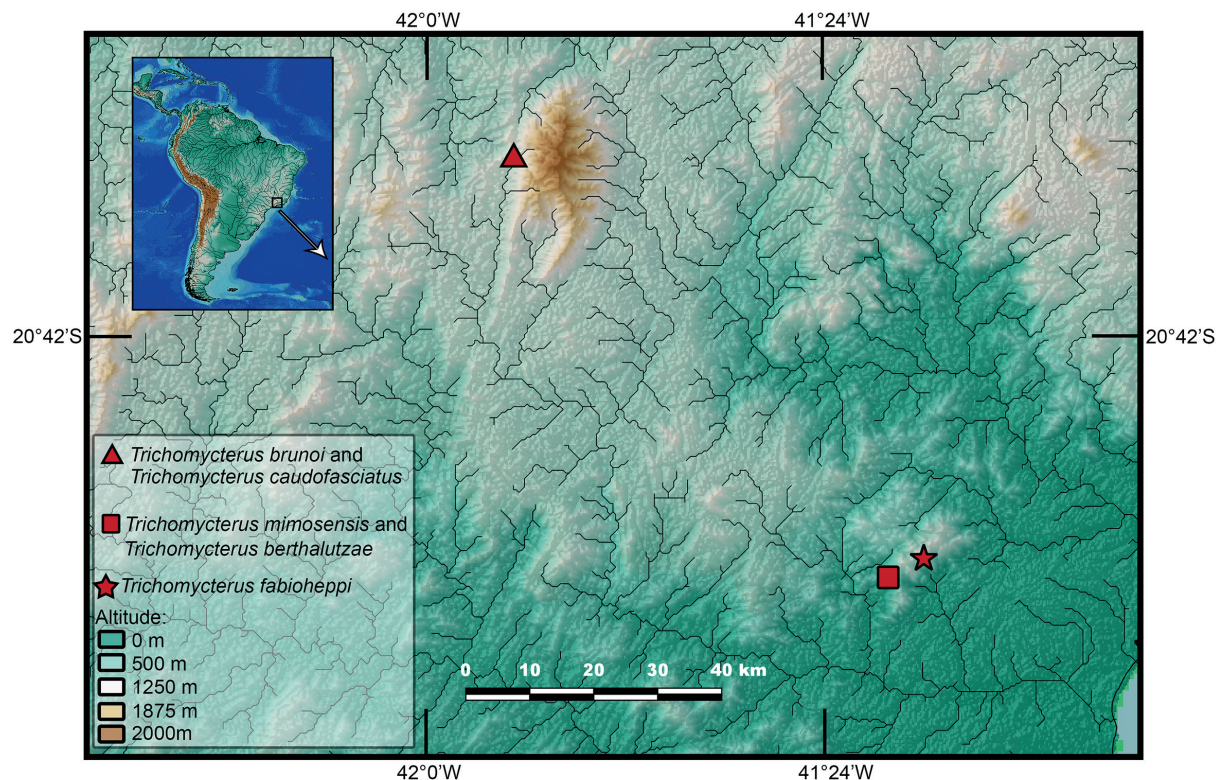


Fig. 3. Geographical distribution of trichomycterine catfishes in the Rio Itabapoana Basin.

2004, with dorsal-most and ventral-most principal caudal-fin rays about same length, Bockmann & Sazima, 2004: fig. 1). *Trichomycterus* (*Psammocambeva*) *fabioheppi* differs from all congeners, except species of the *Psammocambeva* beta-clade, by combining a shallow anterior outgrowth of the hyomandibula (Fig. 2E; vs never so shallow, e.g., Costa *et al.* 2022: fig. 4) and a long interopercle, about 90% of the hyomandibula longitudinal length (Fig. 2E; vs about 75% or less). *Trichomycterus* (*Psammocambeva*) *fabioheppi* is also distinguished from all species of the *Psammocambeva* beta-clade by having a rounded caudal fin (vs subtruncate or emarginate). *Trichomycterus* (*Psammocambeva*) *fabioheppi* differs from all other congeners of the *Psammocambeva* beta-clade, except *T. largoperculatus* and *T. tantalus*, by having a relatively short preopercle with a distinctive ventral expansion (Fig. 2E; vs a relatively longer, without distinctive ventral expansion). *Trichomycterus* (*Psammocambeva*) *fabioheppi* is also distinguished from *T. largoperculatus* and *T. tantalus* by possessing eight pectoral-fin rays (vs nine) and a broad dark brown stripe along lateral mid-line (vs no dark brown stripe).



Fig. 4. *Trichomycterus* (*Psammocambeva*) *fabioheppi* sp. nov., holotype (UFRJ 12931), 68.1 mm SL. A. Left lateral view. B. Dorsal view. C. Ventral view.

Etymology

The specific epithet '*fabioheppi*' honours the Brazilian herpetologist Fábio Hepp, researcher at the Institute of Biology, Federal University of Rio de Janeiro, who collected the type series of this species.

Type material

Holotype

BRAZIL • 68.1 mm SL; Espírito Santo State, Mimoso do Sul Municipality, Serra das Torres, stream tributary to Rio Preto, Rio Itabapoana Basin; 21°02'06" S, 41°15'01" W; ca 450 m a.s.l.; 6 Sep. 2010; F. Hepp, G.R. Silva, C.L. Dias and V. Sedano; UFRJ 12931.

Paratypes

BRAZIL • 8 ex., 27.4–49.7 mm SL; same data as for holotype; UFRJ 7939 • 3 ex. (C&S), 35.2–53.7 mm SL; same data as for holotype; UFRJ 12933 • 4 ex., 26.5–47.9 mm SL; same data as for holotype; CICCAA 07750.

Description

GENERAL MORPHOLOGY. Morphometric data are in Table 2. General morphology of trunk and head as described for *T. (Cryptocambeva) berthaltutzae* sp. nov. Anus and urogenital papilla at vertical just anterior to middle dorsal-fin base. Eye moderately large, slightly smaller than exposed area of opercular patch of odontodes, dorsally positioned in head. Posterior nostril located at about $\frac{1}{3}$ of distance between anterior nostril than orbital rim. Tip of maxillary and rictal barbels reaching between anterior and posterior regions of interopercular patch of odontodes, tip of nasal barbel reaching about midway between orbit and opercle or slightly before. Mouth subterminal. Jaw teeth pointed, slightly curved, arranged in irregular rows. Premaxillary teeth 41–83, dentary teeth 58–85. Odontodes conical. Opercular odontodes 17–19; interopercular odontodes 36–40. Branchiostegal rays 8.

FINS. Dorsal and anal fins subtriangular, anterior and posterior margins slightly convex; longest ray shorter than fin base. Total dorsal-fin rays 12 (iii + II + 7), total anal-fin rays 10 (iii + II + 5); anal-fin origin at vertical just anterior to dorsal-fin base end, through base of 5th branched ray. Dorsal-fin origin at vertical through centrum of 18th or 19th vertebra; anal-fin origin at vertical between centrum of 22nd or 23rd vertebra. Pectoral fin subtriangular in dorsal view, posterior margin slightly convex, first pectoral-fin ray terminating in filament, its length about 20–25% of pectoral-fin length without filament. Total pectoral-fin rays 8 (I + 7). Pelvic fin subtruncate, its posterior extremity not reaching urogenital papilla, at vertical through middle of dorsal-fin base. Pelvic-fin bases medially separated by interspace about $\frac{1}{3}$ or less pelvic-fin base width. Total pelvic-fin rays 5 (I + 4). Caudal fin rounded, dorso-ventrally asymmetrical, dorsal portion longer than ventral one. Total principal caudal-fin rays 13 (I + 11 + I), total dorsal procurrent rays 17–20 (xvi–xix + I), total ventral procurrent rays 13–16 (xii–xv + I).

LATERO-SENSORY SYSTEM. As described for *T. (Cryptocambeva) berthaltutzae* sp. nov.

OSTEOLOGY (Fig. 2D–F). Anterior margin of mesethmoid gently concave, mesethmoid cornu subtriangular in dorsal view, tip rounded. Lacrimal oval, its largest length about $\frac{1}{3}$ of sesamoid supraorbital length. Sesamoid supraorbital narrow, rod-like, longer than premaxilla largest length. Premaxilla sub-rectangular in dorsal view. Maxilla boomerang-shaped, slender, about so long as premaxilla, with minute posterior process. Autopalatine sub-rectangular in dorsal view when excluding posterolateral process, its shortest width about half autopalatine length, lateral margin about straight, medial margin sinuous. Latero-posterior process of autopalatine subtriangular, its length about $\frac{2}{3}$ of autopalatine length. Metapterygoid subtrapezoidal, deeper than long, with distinctive projection on anterior margin. Quadrate robust, dorsoposterior outgrowth in close proximity to hyomandibular outgrowth. Hyomandibula long, anterior outgrow shallow, with pronounced concavity on dorsal margin. Opercle moderately elongate,

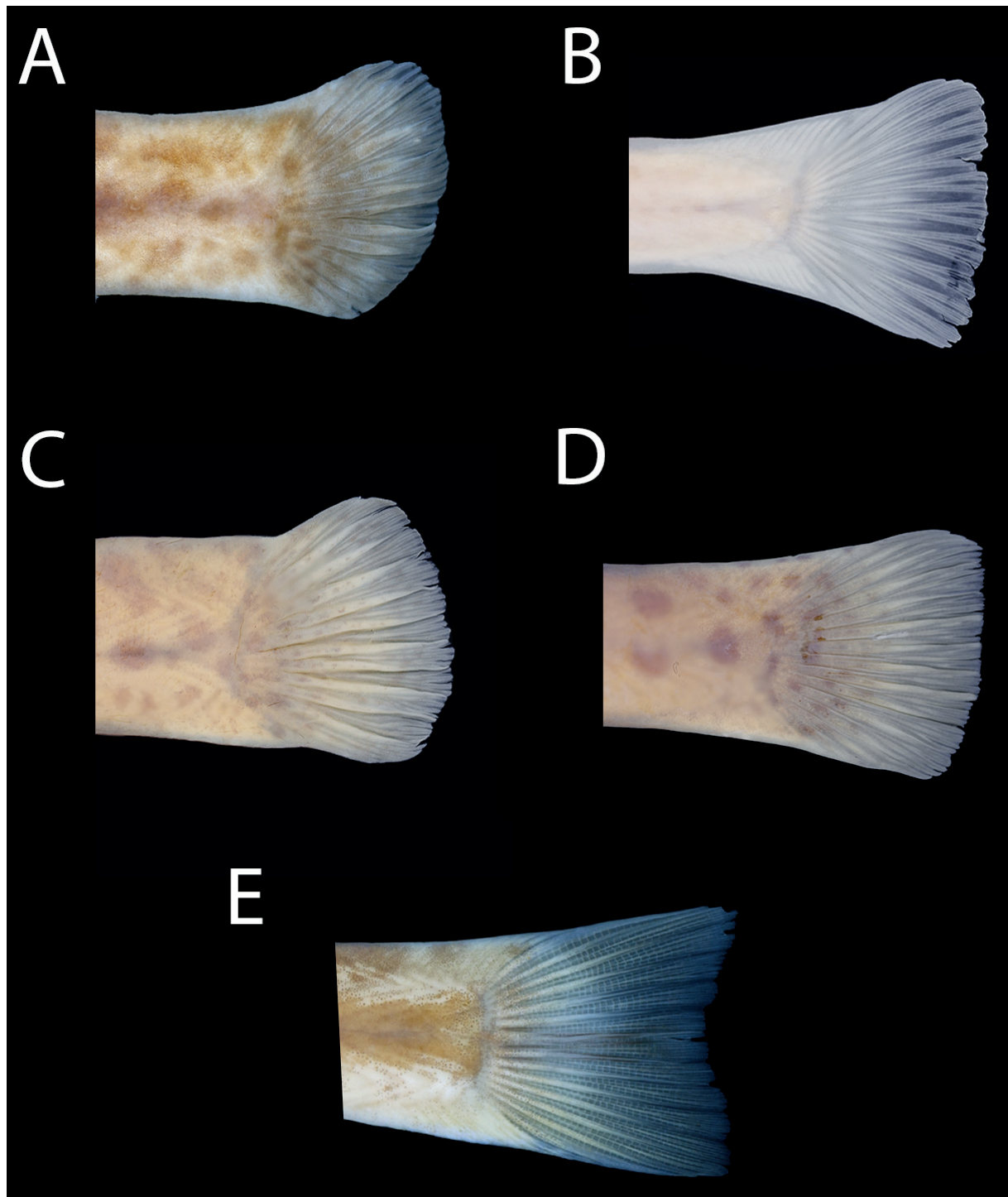


Fig. 5. Caudal fin morphology in species of *Psammocambeva* Costa, 2021, left lateral view. **A.** *Trichomycterus (Psammocambeva) fabioheppi* sp. nov., holotype (UFRJ 12931), 68.1 mm SL. **B.** *Trichomycterus longibarbatu*s Costa, 1992, topotype (UFRJ 3368), 52.9 mm SL. **C.** *Trichomycterus travassosi* (Miranda Ribeiro, 1949) (UFRJ 5190), 57.2 mm SL. **D.** *Trichomycterus puriventris* Barbosa & Costa, 2012 (UFRJ 5398), paratype, 76.9 mm SL. **E.** *Trichomycterus largoperculatus* Costa & Katz, 2022, holotype (UFRJ 6987), 77.8 mm SL.

Table 2. Morphometric data of *Trichomycterus (Psammocambeva) fabioheppi* sp. nov.

	Holotype	Paratypes (n = 6)
standard length (SL)	68.1	42.3–53.7
percentage of standard length		
body depth	15.5	16.8–20.4
caudal peduncle depth	13.0	11.6–13.9
body width	13.4	10.6–14.1
caudal peduncle width	4.7	3.5–4.6
pre-dorsal length	63.4	63.5–67.7
pre-pelvic length	61.9	61.6–65.6
dorsal-fin base length	11.3	11.7–13.3
anal-fin base length	9.4	9.5–11.4
caudal-fin length	13.3	13.9–16.4
pectoral-fin length	12.8	11.5–13.3
pelvic-fin length	9.6	9.0–10.7
head length	22.1	21.7–24.5
percentage of head length		
head depth	45.2	47.8–55.2
head width	84.4	86.7–93.5
snout length	44.3	39.1–42.7
interorbital width	25.3	25.6–31.6
preorbital length	13.7	10.1–13.8
eye diameter	10.2	11.8–14.5

depth of opercular odontode patch about $\frac{3}{5}$ of dorsal articular facet of hyomandibula, dorsal process of opercle short and blunt. Interopercle long, its longitudinal length nearly equal to hyomandibula longitudinal length. Preopercle compact, with pronounced ventral expansion. Parurohyal robust, lateral process relatively elongate, pointed, slightly curved. Parurohyal head well-developed, with prominent anterolateral paired process. Middle parurohyal foramen oval, its largest length smaller than parurohyal posterior process. Posterior parurohyal process short, about half distance between anterior margin of parurohyal and anterior insertion of posterior process. Vertebrae 35 or 36. Ribs 12–14. Two dorsal hypural plates, corresponding to hypurals 4 + 5 and 3, respectively; single ventral hypural plate corresponding to hypurals 1 and 2 and parhypural.

COLOURATION IN ALCOHOL. Flank light yellowish grey with broad dark brown stripe along lateral mid-line interrupted on its posterior-most portion, longitudinal row of dark brown spots on dorsal portion, and small brown dots irregularly arranged on ventral portion. Dorsum light yellowish grey with middorsal row of small brown spots between nape and dorsal-fin origin. Dorsal and lateral portions of head brown, with light yellowish grey infraorbital zone. Ventral surface of head and trunk yellowish white. Jaws and nasal barbel brownish grey, maxillary and rictal barbels light grey. Fins hyaline, with faint brown spots on basal portion of unpaired and pectoral fins.

Distribution

Trichomycterus (Psammocambeva) fabioheppi is presently only known from the type locality, a small stream tributary to the Rio Preto, Rio Itabapoana Basin, at Serra das Torres, which is part of the Serra do Mar (Fig. 3).

Key to the identification of trichomycterine catfishes from the Rio Itabapoana Basin

1. Flank with minute dark brown dots on its entire surface, never forming large spots or broad stripes; seven pectoral-fin rays 2
– Flank with large spots or broad stripes; eight pectoral-fin rays 3
2. Nasal barbel posteriorly area anterior to opercular patch of odontodes; pectoral-fin filament about 10% of pectoral-fin length or less; dorsal procurent caudal-fin rays 20 or 21; flank with sparse dark brown dots that are separated among themselves by large interspaces *T. (Cryptocambeva) berthallutzae* sp. nov.
– Nasal barbel posteriorly reaching opercular patch of odontodes; pectoral-fin filament about 20–25% of pectoral-fin length; dorsal procurent caudal-fin rays 17–19; flank with highly overlapped dots *T. (Cryptocambeva) brunoi* Barbosa & Costa, 2010
3. Flank with broad longitudinal dark brown stripe on midline; caudal fin rounded, asymmetrical, with dorsal portion longer than ventral portion; paired s6 pore *T. (Psammocambeva) fabioheppi* sp. nov.
– Flank with longitudinal rows of dark brown blotches; caudal fin subtruncate, symmetrical; single median s6 pore 4
4. Maxillary barbel reaching between interopercle and pectoral-fin base; pectoral-fin filament about 40–50% of pectoral-fin length; premaxillary teeth 30–34, dentary teeth 38–41
..... *T. (Psammocambeva) caudofasciatus* Alencar & Costa, 2004
– Maxillary barbel reaching interopercle; pectoral-fin filament about 10–20% of pectoral-fin length; premaxillary teeth 43–46, dentary teeth 51–54 .. *T. (Psammocambeva) mimosensis* Barbosa, 2013

Discussion

Field inventories directed to fast-flowing rivers of small coastal basins of the Brazilian Atlantic Forest have demonstrated the occurrence of several endemic species of Trichomycterinae. In subtropical areas of southern Brazil, a total of ten species of the trichomycterine genus *Cambeva* Katz, Barbosa, Mattos & Costa, 2018 have been recently described from small coastal basins (Wosiacki 2005; Costa *et al.* 2023b and references therein). The number of endemic species in each of these basins ranges from one to three. In tropical areas of south-eastern Brazil, a total of 12 species of *Trichomycterus* has been recorded (Costa *et al.* 2022a and references therein). However, with the exception of the Rio Itabapoana Basin, each of these basins harbours only one or two endemic species. Thus, it is possible to verify that the Rio Itabapoana Basin, with five endemic species registered until now, has a diversity of species that exceeds that of any other small coastal basin inventoried so far.

Among the factors possibly responsible for the comparatively higher concentration of species of *Trichomycterus* in the Rio Itabapoana Basin is the fact that the basin drains different mountain ranges separated by small orographic discontinuities, with species being geographically restricted to small areas, which may be considered as distinct areas of endemism. *Trichomycterus brunoi* and *T. caudofasciatus* are known only from the region of the basin that drains the Serra do Caparaó, in the upper course of the Itabapoana River (Alencar & Costa 2005), whereas *T. (Cryptocambeva) berthallutzae* sp. nov., *T. (Cryptocambeva) fabioheppi* sp. nov. and *T. mimosensis* are found in streams draining the Serra do Mar (Fig. 3). This geographical pattern is according to our previous studies reporting different areas of endemism restricted to mountain streams of the same river basin (Costa *et al.* 2021b, 2022a, 2022b).

Another factor that should be considered relevant is the fact that each trichomycterine species endemic to the Rio Itabapoana Basin is more closely related to species from the larger neighbouring basins, Rio Doce and Rio Paraíba do Sul basins (Vilardo *et al.* 2023), than to other congeners of the same basin, which suggests a complex past biogeographic scenario. For example, a recent molecular phylogeny by Vilardo *et al.* (2023) supports *T. (Cryptocambeva) berthaltutzae* sp. nov., here described from the middle Rio Itabapoana Basin, as sister to *T. argos*, a species endemic to the Rio Doce Basin (Lezama *et al.* 2012), a hypothesis morphologically corroborated by the unique presence of a lateral expansion on the sesamoid supraorbital (Fig. 2A) in these two species; as well as the presence of a short preopercle with a pronounced ventral expansion suggests possible close relationships between *T. (Psammocambeva) fabioheppi* sp. nov., here described, with species of the *Psammocambeva* beta-clade endemic to the Rio Doce and Rio Paraíba do Sul basins (Costa *et al.* 2023b, 2024). These relationships indicate the possible existence of past connections between segments of the Rio Itabapoana Basin with neighbouring larger basins, the Rio Doce and the Rio Paraíba do Sul basins, which harbour a rich diversity of trichomycterine catfishes (Costa *et al.* 2022a, 2023a).

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