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Two new species of cascudinhos of the genus *Otothyropsis* (Siluriformes: Hypoptopomatinae) from the rio Paraná basin, Brazil

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Abstract

Otothyropsis polyodon, **sp. n.**, and *O. biamnicus*, **sp. n.**, two new species of loricariid catfishes are described from the rio Paraná basin. *Otothyropsis biamnicus* and *O. polyodon* differ from two other *Otothyropsis* by having a longer caudal peduncle, middle series of lateral plates complete and with higher number of plates, and the anterior margin of the mesethmoid not covered by median rostral plate ventrally. The new species differ from each other in that *O. polyodon* have a longer pectoral-fin spine and a greater number of premaxillary and dentary teeth. *Otothyropsis polyodon* was collected in the rio Verde, tributary to the upper rio Paraná basin, and *O. biamnicus* is found in both the rio Iguaçu and rio Tibagi basins. A key for the species of *Otothyropsis* is presented and their relationships and geographical distributions are discussed.

Key words: Neotropical, Catfish, Systematics, Biogeography, *Hisonotus*, Genetype

Resumo

Otothyropsis biamnicus, **sp. n.**, e *O. polyodon*, **sp. n.**, duas novas espécies de cascudinhos são descritos da bacia do rio Paraná. *Otothyropsis biamnicus* e *O. polyodon* diferem dos outros *Otothyropsis* por ter maior comprimento do pedúnculo caudal, série média de placas laterais completa e com maior número de placas e a margem anterior do mesetmóide não coberta pela placa rostral ventralmente. As novas espécies diferem entre si por *O. polyodon* possuir o espinho da nadadeira peitoral mais longo e maior número de dentes na pré-maxila e dentário. *Otothyropsis polyodon* foi coletado no rio Verde tributário da bacia do rio Paraná superior e *O. biamnicus* é encontrado nas bacias do rio Iguaçu e do rio Tibagi. Uma chave para as espécies do gênero *Otothyropsis* é apresentada e suas relações e distribuição geográfica são discutidas.

Palavras-chave: Neotropical, Catfish, Sistemática, Biogeografia, *Hisonotus*, Genetipo

Introduction

Otothyropsis is a genus of the Hypoptopomatinae recently described by Ribeiro *et al.* 2005, who also included the species in the phylogenetic scheme of Schaefer (1998) and recovered *Otothyropsis* as the sister-group to the clade *Pseudotothyris* plus *Otothyris*. In a recent paper describing a second species of *Otothyropsis*, Calegari *et al.* 2011 conducted a re-analyses of its phylogenetic relationships and rediagnosed the genus. Presently, *Otothyropsis* is diagnosed among the Hypoptopomatinae by having the following non-exclusive synapomorphies: elongated posterior extension of the compound pterotic, which forms the dorsal margin of an augmented lateral opening of the swimbladder capsule, reduced upper pharyngeal tooth plate, and the mid-dorsal series of lateral plates truncated before the caudal fin (Calegari *et al.* 2011). However, relationships of *Otothyropsis* with the remaining Hypoptopomatinae are not clear yet. Furthermore, *Hisonotus* is the genus most similar morphologically to *Otothyropsis*, despite its limits are not well defined. Many studies in the last few years (Lehmann 2006; Cramer *et*

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al. 2011; Calegari 2010; and Martins 2012) support the hypothesis that *Hisonotus* is paraphyletic and show that many species presently allocated in *Hisonotus* have some of the diagnostic features of *Otothyropsis.* For this reason, it is necessary a thorough revisionary study of *Hisonotus*.

Currently, two species are recognized as valid in *Otothyropsis*: *O. marapoama* from headwater streams of the middle stretch of the rio Tietê, rio Paraná basin, and *O. piribebuy* from tributaries to the rio Paraguay basin. In the present paper, we describe two additional new species. The first was previously treated as *Otothyropsis* sp. 3 by Calegari *et al*. 2011 and is known from the rio Verde, tributary to the upper rio Paraná, while the second was treated by the same authors as *Otothyropsis* sp. 1 and sp. 2, respectively from the upper Iguaçu and the rio Tibagi basin, both tributaries to rio Paraná drainage.

Material and methods

Measurements were obtained to the nearest 0.1 mm with digital calipers under a stereomicroscope on the left side of specimens. Counts of plates, rays and dentary and premaxillary teeth were also performed under the scope. Dermal plate counts followed the schemes of serial homology and terminology proposed by Schaefer (1997), and the morphometric measurements are those described by Pereira *et al.* 2007 with the addition of prepelvic length (measured from the snout tip to the pelvic-fin origin), dorsal-fin base length (measured from the dorsal-fin origin to the end of the dorsal-fin base), pectoral-pelvic distance (measured from the pectoral-fin origin to pelvic-fin origin), pelvic-anal distance (measured from the pelvic-fin origin to anal-fin origin), internareal distance (measured transversely between the inner posterior margins of the nares), and prenasal length (measured from the snout tip to the anterior margin of the naris). Morphometric measures were treated as percents of standard length (SL), except for subunits of the cephalic region, treated as percents of head length (HL). Vertebral counts consider all vertebral centra, including the five centra modified into the Weberian apparatus and the caudal complex centrum (PU1 + U1) being counted as a single element. The osteological examination was conducted in specimens cleared and stained (c&s) according to the technique proposed by Taylor and Van Dyke (1985). The comparative material of *O. marapoama* and *O. piribebuy* used in this study is the same listed in Calegari *et al*. 2011. Institutional abbreviations of specimens examined are listed at http://researcharchive.calacademy.org/research/Ichthyology/catalog/collections.asp.

Principal Component Analysis (PCA) and Canonical Component Analysis (CCA) were employed to assess the variation in 21 morphometric variables from 75 type-specimens representing all species of *Otothyropsis*. The characters related to sexual dimorphism were eliminated from the analyses because their sexual variation was larger than the interspecific variation. To reduce the correlation between variance and specimen size and fit in a normal curve the morphometric characters were log-transformed. The analyses were performed with the software *Statistica* ver. 8.0 (Statsoft, Inc.- www.statsoft.com).

We designated paragenetypes for both new species following the suggestion of Chakrabarty (2010), by sequencing the Cytochrome c Oxidase I gene (COI). Total genomic DNA was extracted from ethanol-preserved tissue using the DNeasy blood & tissue kit (Qiagen). PCR were carried out in 25 µl reactions. Primers used were LCO1490 (forward) and HCO2198 (reverse; Folmer *et al.* 1994) to amplified a 614 bp fragment using the following PCR protocol. An initial denaturation step of 3 min at 95°C followed by 35 cycles of denaturation at 95°C for 60 s, annealing at four temperatures, 48°C, 45°C, 42°C and 40°C for 20 s each, and extension at 72°C for 2 min. This was followed by a final extension of 5 min at 72°C, and storage for 5 min at 4°C. Sequencing was performed by Macrogen Inc. Chromatograms was visualized and edited using Geneious ® 6.0.5 (Biomatters Ltd. 2005–2012).

Results

Statistical morphometric analyses. The Principal Component Analysis (PCA) of the four species showed two species clearly separated (*Otothyropsis polyodon*, *O. biamnicus*) and two other (*O. marapoama*, *O. piribebuy*) somewhat overlapped (Fig. 1). To test whether the populations in the rio Tibagi and rio Canoinhas are conspecific, they were treated with different symbols in this analysis. This analysis has not evidenced segregation between rio

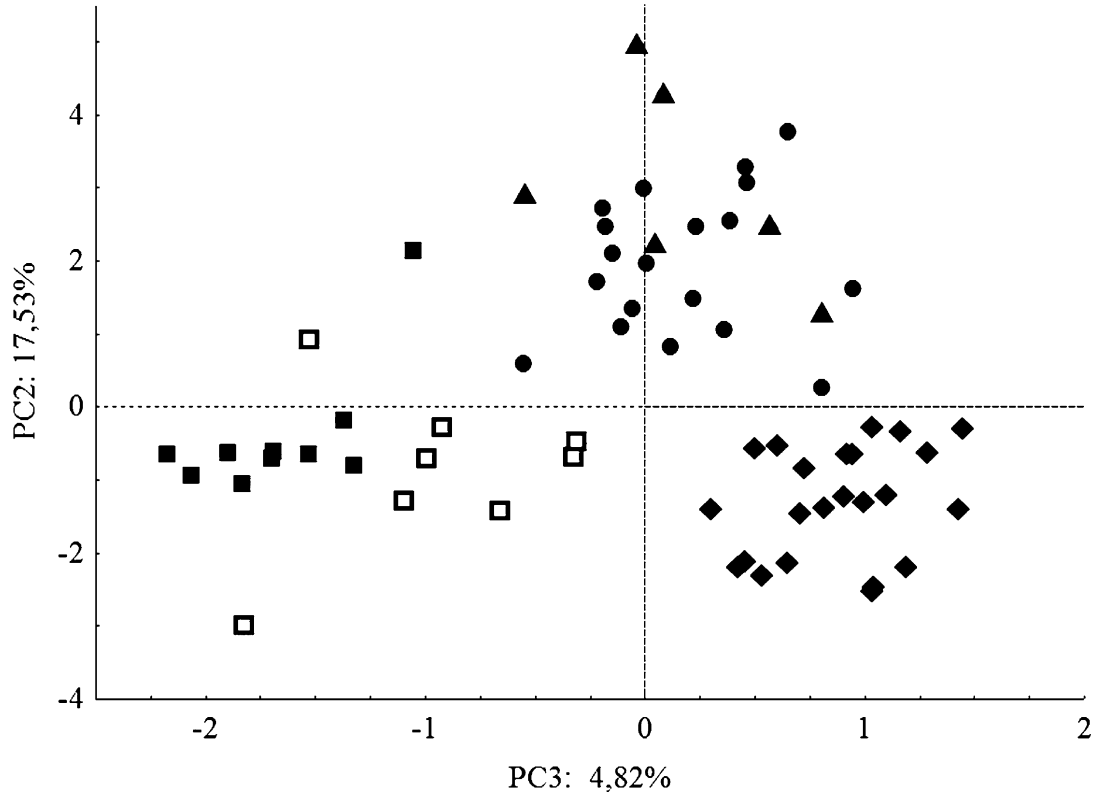

FIGURE 1. Biplot of the Principal Components Analysis comparing *Otothyropsis piribebuy* (circles), *O. biamnicus* from rio Tibagi basin (black squares), *O. biamnicus* from rio Iguaçu basin (white squares), *O. marapoama* (triangles), and *O. polyodon* (diamond).

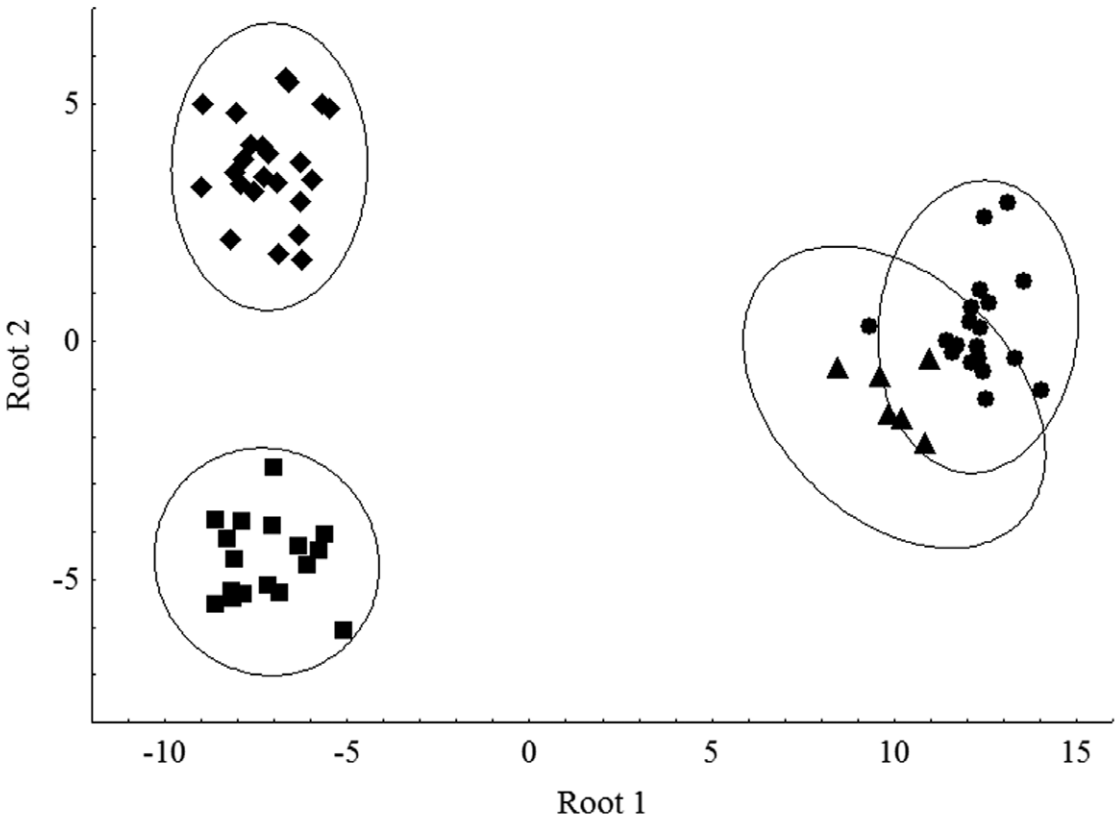

FIGURE 2. Biplot of the Canonical Variates Analysis comparing *Otothyropsis piribebuy* (circles), *O. biamnicus* (squares), *O. marapoama* (triangles), and *O. polyodon* (diamond).

Tibagi and rio Canoinhas populations. Two variables had stronger contribution to discriminate both new species from the two other species: the length and depth caudal peduncle, both new species having a longer and lower caudal peduncle.

The Canonical Component Analysis (CCA) summarized the overall morphological variation between the four species (Fig. 2). The analysis of the canonical variables formed separate groups for each species, with some overlap of the confidence ellipses (>95%) observed among *O. marapoama* and *O. piribebuy.* The first Canonical function separated *O. polyodon* and *O. biamnicus* from *O. marapoama* and *O. piribebuy.* The second Canonical function separated both new species.

***Otothyropsis polyodon*, sp. n.**
(Figure 3; Tables 1–2)

Otothyropsis sp. 3.—Calegari *et al*. 2011: 255, 259–260 (phylogenetic analysis).

Type material: Holotype. MCP 47139, female, 34.7 mm SL, Brazil, Mato Grosso do Sul State, Água Clara, ribeirão Tamanduá, tributary to rio Verde, near São Domingos Hydroeletric Plant, upper rio Paraná basin, 20°04'03"S 53°11'21"W, R. Reis, B. Calegari & P. Lehmann, 16 June 2012. **Paratypes.** All from Brazil, upper rio Paraná basin, Mato Grosso do Sul State. MCP 47076, 12, 29.6–37.3 mm SL, collected with the holotype. MCP 47038, 8 (1 c&s, 1 tissue voucher), 29.0–32.7 mm SL, AMNH 257002, 3, 28.4–28.5 mm SL, MNRJ 40112, 3, 27.6–32.7 mm SL, MZUSP 112206, 2, 28.1–35.2 mm SL, Água Clara, stream tributary to rio Verde on road between Mutum and the São Domingos Hydroeletric Plant, 20°22'33"S 53°11'31"W, R. Reis, B. Calegari & P. Lehmann, 16 June 2012. MCP 45756, 5 (1 c&s), 26.9–31.5 mm SL, mouth of ribeirão Tamanduá into rio Verde, 20°10'00"S 53°20'49"W, U. Schultz, 11 July 2009. **Paragenetype COI.** Genbank accession nb. KC417376 from tissue voucher on lot MCP 47038.

Diagnosis. *Otothyropsis polyodon* differs from all congeners by having a greater number of premaxillary teeth (19–31 *vs.* 10–20), greater number of dentary teeth (18–27 *vs.* 11–19), lower caudal peduncle 6.2–7.6% (*vs*. 7.6–11.5% SL), dorsal-fin spinelet rectangular in shape (*vs*. triangular or quadrangular), suture in the posteromesial portion of the paired basipterygium long—same size of the basipterygium medial cartilage (*vs.* suture smaller—one to two third of the basipterygium medial cartilage).

The new species further differs from *O. marapoama* and *O. piribebuy* by having the middle series of lateral plates complete (*vs.* middle series of lateral plates truncated at least two plates before the caudal fin), anterior margin of the mesethmoid not covered by the median rostral plate ventrally (*vs.* anterior margin of the mesethmoid covered by the median rostral plate in ventral view), shorter preanal length (54.9–60.2% *vs*. 60.9–67.4% SL), shorter prepelvic length (35.8–39.5% *vs*. 40.6–46.3% SL), narrower cleithrum (19.2–21.9% *vs*. 22.5–26.7% SL), shorter pectoral-pelvic distance (12.2–16.1% *vs*. 16.6–21.2% SL), shorter dorsal-fin spine (18.2–22% *vs*. 24.2–29.8% SL), longer caudal peduncle (40.0–45.1% *vs*. 28.1–35.9% SL), lower body at dorsal-fin origin (12.3–14.7% *vs*. 15.0–19.2% SL), shorter prenasal length (15.2–24.2% *vs*. 28.9–36.4% HL), and middle series of lateral plates with 23–25 plates (*vs.* 19–22 plates). *Otothyropsis polyodon* further differs from *O. piribebuy* by having a raised crest of enlarged odontodes on the supraoccipital in adults (*vs.* lack of such crest), narrower caudal peduncle (4.0–5.3% *vs*. 5.9–7.4% SL), and narrower interorbital (32.4–38.4% *vs*. 38.4–45.8% HL). It also differs from *O. biamnicus* by the longer pectoral-fin spine (21.4–26.9% *vs.* 18.6–21.3% SL).

Description. Morphometrics in Table 1 and meristics in Table 2. Dorsal body profile slightly arched on head surface, and concave along dorsal-fin length, straight from end of dorsal-fin base to caudal-fin origin. Ventral body profile relatively straight from head to tail. Greatest body width at operculum and cleithrum, gradually narrowing towards caudal-fin. Greatest body depth at dorsal-fin origin. Caudal peduncle vertically oval to squarish in cross section. Head slightly convex from nasal plate to middle of supraoccipital, more depressed at rostral plate. Eye dorsolaterally positioned. Iris operculum present and large, occupying most of pupil.

Posterior extension of supraoccipital with large crest of odontodes. Ventral and dorsal portion of snout tip with hypertrophied odontodes turned backward. Lips rounded, covered with minute papillae, maxillary barbel small. Lower lip reaching to vertical line passing through posterior margin of canal cheek plate. Teeth bifid and slender, with blade-like larger medial cusp and smaller lateral cusp.

TABLE 1. Morphometric data for *Otothyropsis polyodon*, holotype (Hol.) and 22 paratypes; range includes holotype. SD = standard deviation.

	Otothyropsis polyodon								
	Males (n= 13)				Females (n= 10)				
Character	Low	High	Mean	SD	Hol.	Low	High	Mean	SD
Standard length (mm)	27.0	34.9	30.6	-	34.7	32.7	37.3	34.9	-
Percents of Standard Length									
Head length	33.4	38.3	35.7	1.3	35.9	34.4	37.0	35.5	0.8
Predorsal length	43.6	47.7	45.9	1.3	45.7	44.8	48.7	46.2	1.3
Postdorsal length	41.9	45.6	44.6	0.9	45.1	40.6	47.2	44.9	2.0
Preanal length	54.9	59.5	57.3	1.2	57.7	56.3	60.2	57.5	1.1
Prepelvic length	36.2	39.5	37.9	1.2	37.4	35.8	38.5	37.4	0.8
Cleithral width	19.3	21.8	20.5	0.7	21.3	19.2	21.9	20.6	0.9
Pectoral-pelvic distance	12.9	15.5	13.9	0.8	14.9	12.2	16.1	14.5	1.1
Pelvic-pectoral distance	18.9	21.1	20.2	0.7	20.1	19.5	22.3	20.6	0.7
Dorsal-fin spine length	18.2	22.0	20.8	1.1	19.4	18.6	20.9	19.6	0.8
Dorsal-fin base length	10.7	12.4	11.4	0.5	11.5	10.8	12.2	11.5	0.4
Pectoral-fin spine length	21.4	26.9	23.9	1.8	23.2	21.5	24.9	23.0	1.1
Pelvic-fin spine ray length	15.8	20.3	18.1	1.2	15.0	14.4	16.4	15.4	0.6
Anal-fin spine ray length	14.1	16.9	15.9	0.7	14.5	13.7	15.7	14.8	0.7
Caudal-peduncle length	40.5	45.1	42.9	1.4	42.6	40.0	45.0	42.5	1.2
Caudal-peduncle depth	6.6	7.6	7.1	0.3	6.8	6.2	7.1	6.6	0.3
Caudal-peduncle width	4.1	5.3	4.7	0.3	4.5	4.0	4.7	4.3	0.2
Body depth at dorsal-fin origin	12.3	14.7	13.7	0.7	13.4	12.4	14.7	13.4	0.5
Body width at dorsal-fin origin	15.4	17.2	16.4	0.5	18.9	15.8	18.9	17.3	1.0
Percents of Head Length									
Head depth	36.7	42.7	39.7	1.9	36.9	36.0	41.6	39.2	1.6
Snout length	47.0	50.0	48.9	0.8	49.3	47.4	51.9	49.4	1.2
Orbital diameter	13.9	16.4	15.4	0.7	14.6	13.3	15.6	14.5	0.6
Interorbital width	33.9	38.4	36.0	1.5	36.0	32.4	38.1	35.3	1.8
Internareal width	9.4	10.9	10.2	0.5	12.3	11.3	12.9	12.1	0.6
Nares diameter	13.0	15.6	14.2	0.8	11.6	10.9	12.1	11.5	0.4
Prenasal length	15.2	20.0	18.3	1.6	22.1	20.1	24.2	21.7	1.3
Barbel length	4.3	9.4	5.9	1.3	5.6	4.5	6.9	5.5	0.7

Body entirely covered by plates, except for ventral surface in front of anus to exposed first pterygiophore of anal-fin, anterior portion of abdomen, and from posterior margin of median rostral plates to nares. Anterior abdomen generally with three small lateral abdominal plates and few platelets between pelvic fins. Abdomen with small odontodes embedded in skin. Pectoral girdle almost entirely exposed and supporting odontodes, except for arrector fossae at central portion of coracoids covered by skin.

Mid-dorsal series of lateral plates truncated posteriorly; median series complete with continuous perforated plates. Mid-ventral series truncated posteriorly, reaching approximately to same level of mid-dorsal series. Two or three transverse rows of predorsal plates not including nuchal plate.

Pectoral-fin I,6. Pectoral-fin axillary slit present in adults (juveniles not available). Pectoral-fin spine homogeneously slender. Odontodes on pectoral-fin spine distributed mostly on lateral surface and increasing in size gradually toward tip. Pelvic fin i,5, unbranched ray thickened, covered with few odontodes; those on ventral surface oriented mesially. Dorsal fin II,7 (rarely II,8); its origin slightly anterior to vertical through pelvic-fin

origin. Dorsal-fin spinelet rectangular in shape and dorsal-fin locking mechanism non-functional. Anal-fin I,5, first anal-fin pterygiophore exposed anterior to anal-fin spine. Caudal-fin i,14,i (one specimens with i,12,i rays and two specimens with i,13,i rays). Total vertebrae 29 (in two c&s specimens).

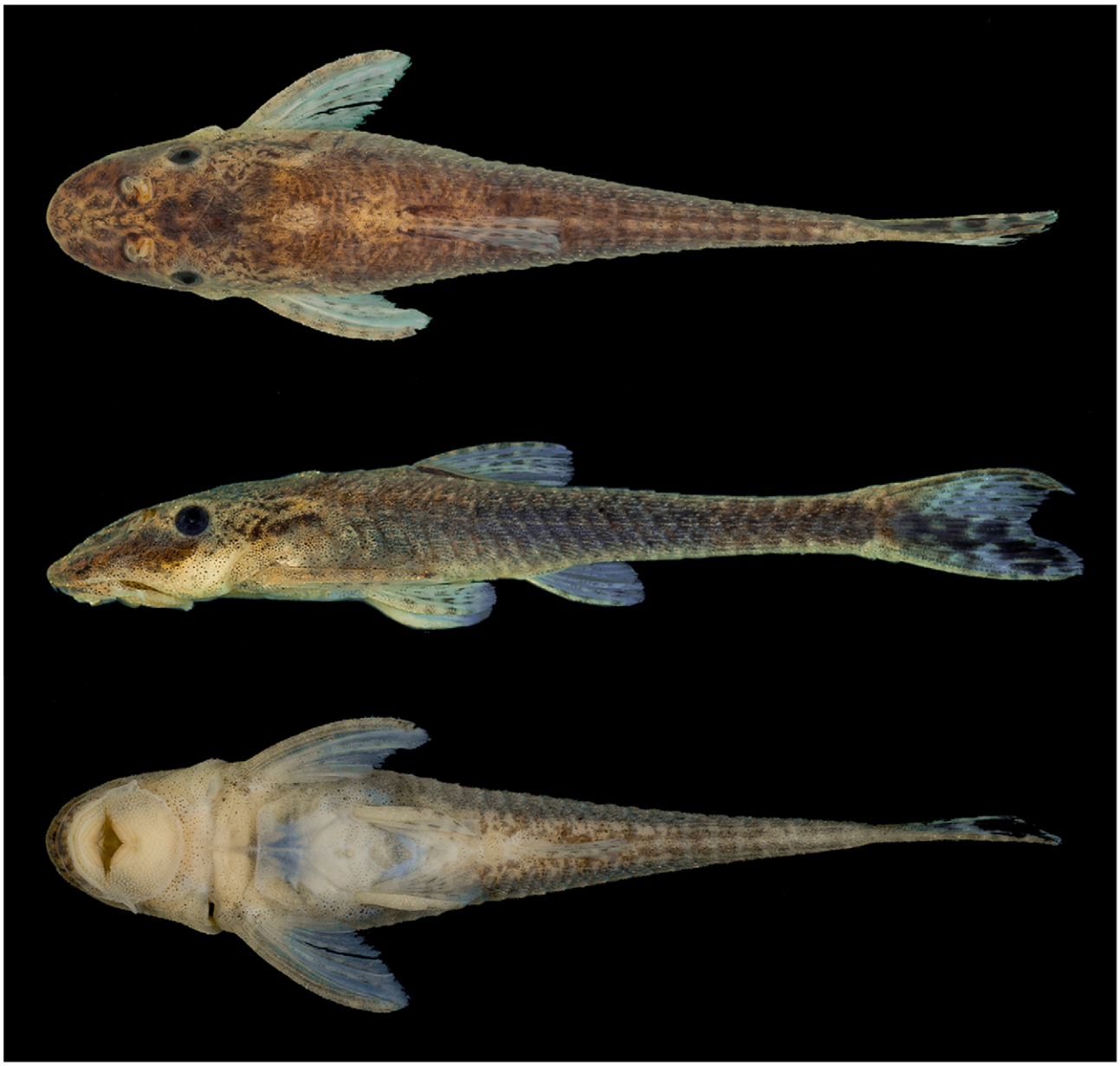

FIGURE 3. *Otothyropsis polyodon*, holotype, MCP 47139, female, 34.7 mm SL, Brazil, tributary to rio Verde, upper rio Paraná drainage.

Color in alcohol. Ground color of dorsal surface of head, except for posterior process of supraoccipital, median brown with many tiny dark dots, mostly in compound pterotic and prenasal region. Posterior process of supraoccipital and dorsal surface of trunk light brown with dark chromatophores uniformly distributed. Longitudinal dark stripe from snout, crossing between middle of orbit and opercle, and continuing to lower lobe of caudal fin. Fin membranes mostly hyaline, with series of small dark dots arranged in irregular transverse bands. Base and lower lobe of caudal fin with both rays and membrane mostly dark brown. Lower portion of lower lobe with roundish to rectangular hyaline area, always with small dark dots inside hyaline area (Fig. 4A, B). Ventral surface mostly pale yellow, with heavier concentration of dark chromatophores on snout and caudal peduncle.

Sexual dimorphism. Sexual dimorphism characterized by the presence of a conical urogenital papilla immediately posterior to the anus opening in males, which also posses a fleshy flap along the dorsal margin of the pelvic-fin spine. In addition, males have a longer pelvic-fin spine (15.8–20.3% SL, mean 18.1%), *vs.* short pelvic-

fin spine (14.4–16.4% SL, mean 15.4%) in females. Furthermore, the new species exhibits a remarkable secondary sexual dimorphism associated with the much larger olfactory organ of males: males have a shorter internareal distance (9.4–10.9 *vs.* 11.3–12.9% HL in females); males have wider nares diameter (13–15.6 *vs*. 10.9–12.1% HL in females); and males have a shorter prenasal length (15.2–20.0 *vs.* 20.1–24.2% HL in females).

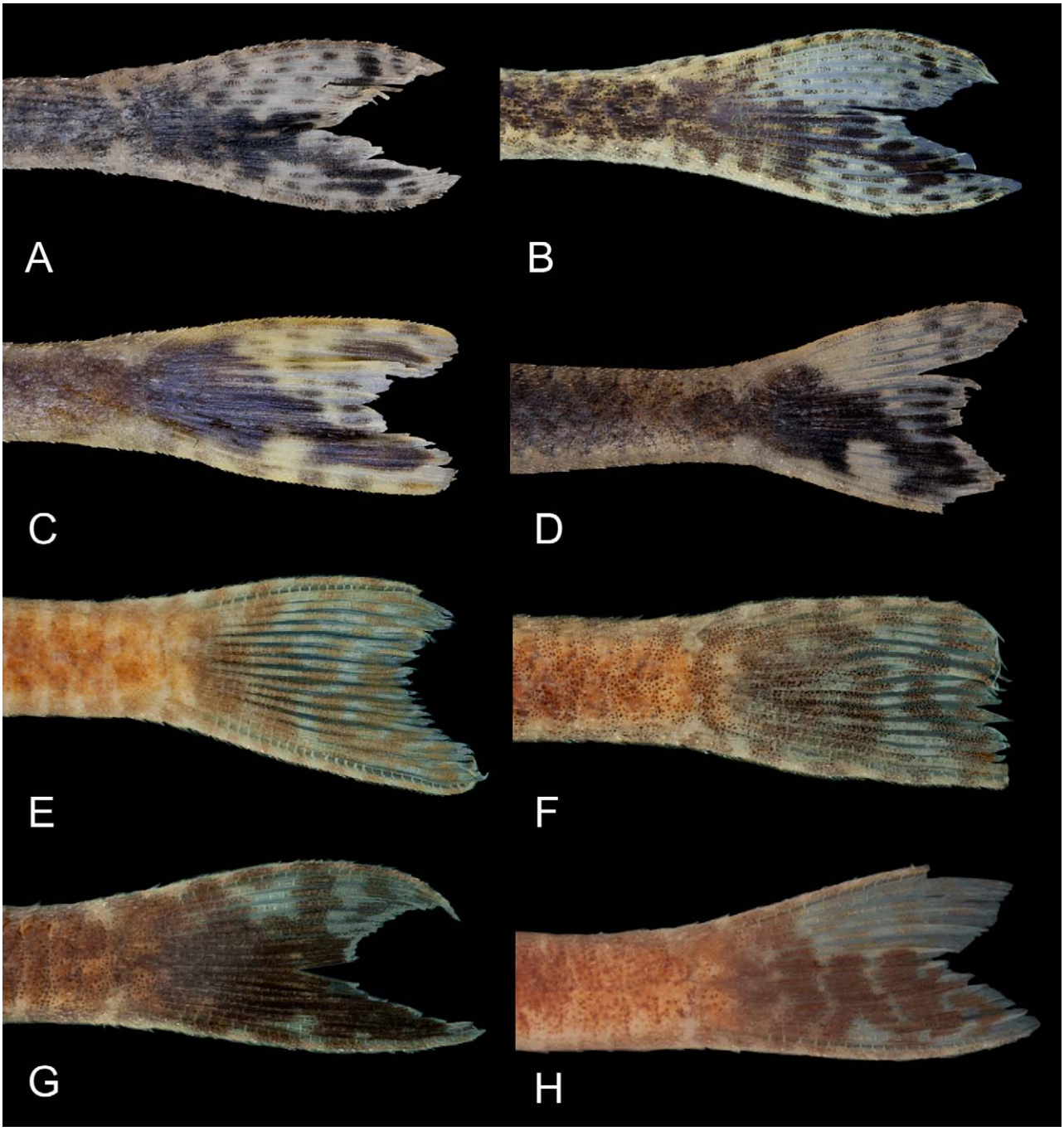

FIGURE 4. Color pattern of caudal fin in *Otothyropsis* species. *Otothyropsis polyodon*, MCP 47076, (A) 37.3 mm SL, (B) 35.1 mm SL; *O. biamnicus*, MCP 11498, (C) 34.5 mm SL, MCP 47289, (D) 30.7 mm SL; *O. marapoama*, LIRP 4621, (E) 32.6 mm SL, (F) 26.6 mm SL; *O. piribebuy*, MCP 44394, (G) 23.9 mm SL, (H) 23.3 mm SL.

Distribution. *Otothyropsis polyodon* is known from tributaries to the rio Verde a tributary to the upper rio Paraná basin in Mato Grosso do Sul, Brazil (Fig. 5).

Etymology. From the Greek *polys*, meaning many, and *odon*, meaning tooth, in allusion to its higher number of teeth compared to the other species. A noun in apposition.

Remarks. Specimens of *Otothyropsis* from three additional tributaries to the right margin of the rio Paraná south of the rio Verde were examined (rio Laranjaí, rio Guiraí, and some unnamed streams tributaries to the rio

Ivinhema basin; lots listed in Additional Comparative Material). Despite very similar to *O. polyodon*, those specimens were not included as paratypes because of small differences such as slightly lower dentary and premaxillary teeth counts, and deeper caudal-peduncle.

TABLE 2. Frequency of distribution of meristic data for *Otothyropsis polyodon*. Holotype values are marked with an asterisk. Meristic marked with double asterisks was counted in c&s specimens only. N = number of specimens.

Character	N	Range	Distribution Frequency
Teeth in left premaxilla	23	19–31	19(1), 21(1), 22(5), 23(5), 24(1), 25(3), 26(2) 27(2), 28(2), 31(1)*
Teeth in right premaxilla	23	20–28	20(2), 21(1), 22(5), 23(5), 24(1), 26(5)*, 27(3) 28(1)
Teeth in left dentary	23	16–26	16(1), 18(1), 19(2), 20(3), 21(9), 22(1)*, 23(2) 25(3), 26(1)
Teeth in right dentary	23	18–27	18(3), 19(1), 20(6)*, 21(2), 22(2), 23(5), 24(1) 25(2)*, 27(1)
Plates in median lateral series	23	24–25	24(4), 25(18)*
Plates in mid-dorsal series	23	17–21	17(1), 18(8), 19(10), 20(3)*, 21(1)
Plates in dorsal series	23	19–21	19(4), 20(7)*, 21(12)
Plates in mid-ventral series	23	18–20	18(8), 19(14)*, 20(1)
Plates in ventral series	23	19–21	19(3), 20(13), 21(7)*
Plates between anal and caudal fin	23	11–13	11(8), 12(14)*, 13(1)
Plates at dorsal-fin base	23	5–6	5(18)*, 6(5)
Plates at anal-fin base	23	2–4	2(2), 3(19)*, 4(2)
Predorsal plates	23	2–3	2(1), 3(22)*
Total vertebrae**	2	29	29

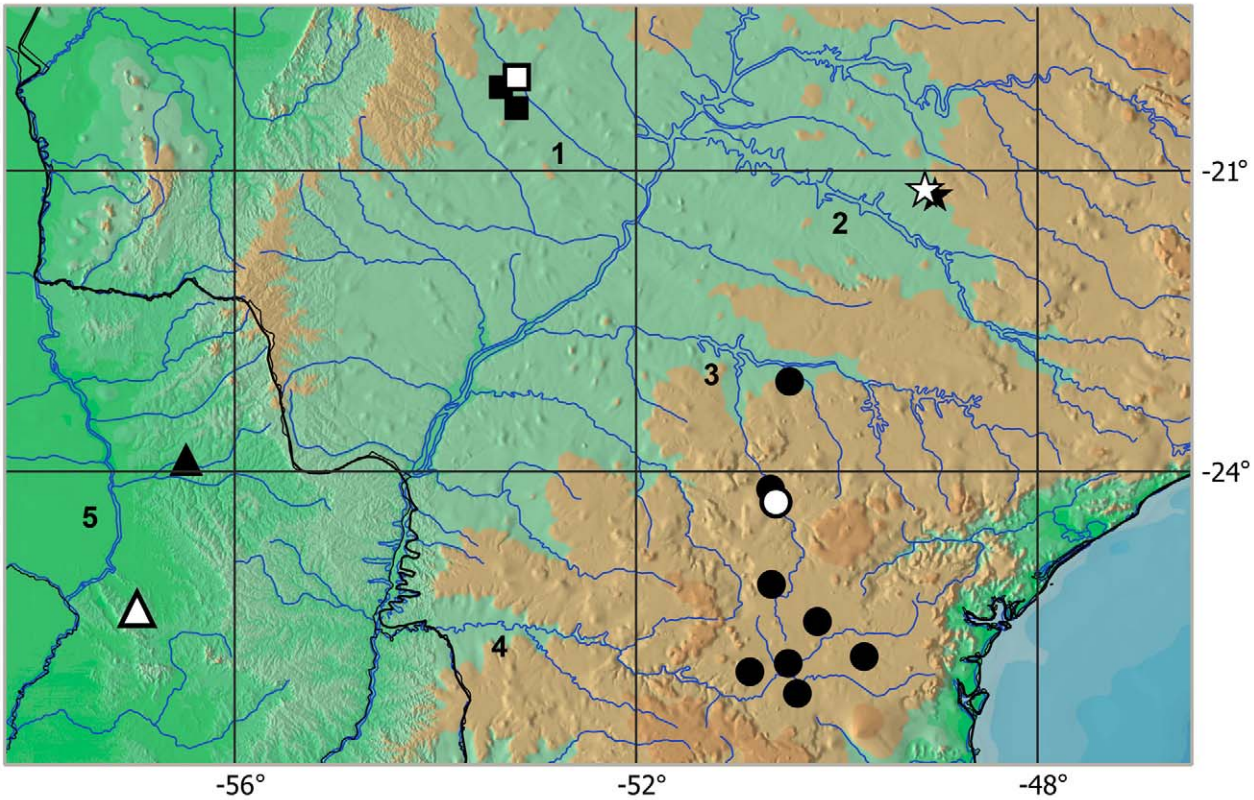

FIGURE 5. Geographic distribution of *Otothyropsis marapoama* (star), *O. polyodon* (square), *O. biamnicus* (dot), and *O. piribebuy* (triangle). Open symbols for type-localities. Some symbols represent more than one lot or locality. 1—rio Verde; 2—rio Tietê; 3—rio Paranapanema; 4—rio Iguaçu; 5—rio Paraguay.

***Otothyropsis biamnicus*, sp. n.**
(Figure 6; Tables 3–4)

Otothyropsis sp. 1.—Calegari *et al*. 2011: 255, 259–260 (phylogenetic analysis)
Otothyropsis sp. 2.—Calegari *et al*. 2011: 255, 259–260 (phylogenetic analysis)

Type material: Holotype. MCP 47288, female, 38.0 mm SL, Brazil, Paraná State, Telêmaco Borba, ribeirão Harmonia, tributary to rio Tibagi basin, rio Paraná drainage, 24°18'19"S 50°36'23"W, A. Costa and D. Garcia, 26 March 2012. **Paratypes.** All from Brazil, rio Paraná basin. MCP 47289, 4, 21.0–33.8 mm SL, and MZUEL 6122, 7, 24.5–34.1 mm SL, collected with holotype. MCP 39531, 5 (2 c&s), 21.5–27.8 mm SL, Santa Catarina State, Canoinhas, rio Água Verde, tributary to rio Canoinhas, affluent to rio Negro, rio Iguaçu drainage, 26°12'44"S 50°23'35"W, L. Duboc, V. Abilhoa & R. A. Torres, 3 July 2004. MCP 22602, 3, 31.8–34.0 mm SL, Paraná State, Paulo Frontin, arroio Barra Grande at road BR-153, 25°59'42"S 50°52'00"W, C. Lucena, J. Pezzi & V. Bertaco, 5 December 1998. MCP 37164, 5 (1 c&s), 25.1–38.7 mm SL, Paraná State, Lapa, rio dos Patos at road PR-427 between Lapa and Campo do Tenente, 25°50'37"S 49°43'39"W, E. Pereira, L. Duboc, V. Abilhoa & F. Torres, 29 October 2004. UFRGS 11498, 16 (2 c&s), 23.1–38.6 mm SL, Santa Catarina State, Monte Castelo, creek at BR-116 highway, tributary to rio Negro, rio Iguaçu drainage, 23°06'03"S 50°28'15"W, L. Malabarba, V. Bertaco, L. Artioli, and J. Wingert, 17 October 2009. MCP 45755, 1, 37.5 mm SL, Paraná State, Telêmaco Borba, creek tributary to rio Tibagi, 24°10'29"S 50°39'38"W, M. Volcan, 26 July 2009. UFRGS 11495, 7 (1 c&s), 32.0–39.9 mm SL, Paraná State, Ponta Grossa, rio Tibagi at Uvaia, approx. 100 meters from highway BR-373, 25°07'33"S 50°39'04"W, L. Malabarba and others, 17 October 2009. UFRGS 11434, 1, 34.9 mm SL, Paraná State, Porto Amazonas, rio Lageado in Porto Amazonas, tributary to rio Iguaçu, 25°54'39"S 50°29'04"W, V. Bertaco, L. Artioli, and J. Wingert, 15 October 2009. UFRGS 11464, 4, 23.2–36.9 mm SL, Paraná State, Ponta Grossa, arroio Sutil at road PR-151, tributary to rio Tibagi basin, 25°29'44"S 50°11'36"W, L. Malabarba and others, 17 October 2009. **Paragenetype COI.** Genbank accession nb. KC417375 from tissue voucher number 1589 on lot UFRGS 12879, Paraná State, Porto Amazonas, rio Lageado in Porto Amazonas, tributary to rio Iguaçu, 25°54'39"S 50°29'04"W, V. Bertaco, L. Artioli, and J. Wingert, 15 October 2009.

Diagnosis. *Otothyropsis biamnicus* is distinguished from its congeners by having shorter pectoral-fin spine (18.6–21.3 *vs*. 21.4–30.4% SL in remaining species). It also has a lower caudal peduncle (7.6–9.0 *vs*. 9.3–11.0 in *O. marapoama* and 9.7–11.5% SL in *O. piribebuy*), deeper caudal peduncle (7.6–9.0 *vs*. 6.2–7.6% SL in *O. polyodon*); and dorsal-fin spinelet triangular in shape (*vs*. spinelet rectangular or quadrangular).

Otothyropsis biamnicus is also distinguished from *O. marapoama* and *O. piribebuy* by having shorter preanal length (55.5–59.1 *vs.* 60.9–67.4% SL); shorter prepelvic length (36.7–39.3% *vs.* 40.6–46.3% SL), shorter pectoral-pelvic distance (13.3–15.9 *vs*. 16.6–21.2% SL); shorter dorsal-fin spine (19.4–22.9 *vs.* 24.2–29.8% SL), longer caudal peduncle (41.3–45.1 *vs.* 28.1–35.9% SL), shorter prenasal length (17.6–24.4 *vs.* 28.9–36.4% HL), higher number of middle series lateral plates (24–26 *vs.* 19–22 plates), middle series of lateral plates complete (*vs.* middle series of lateral plates truncated at least two plates before the caudal fin); and anterior margin of the mesethmoid not covered by median rostral plate ventrally (*vs.* anterior margin of the mesethmoid covered by the median rostral plate in ventral view). *Otothyropsis biamnicus* also differs from *O. marapoama* by having a narrower cleithrum (20.6–23.1 *vs.* 23.8–25.8% SL); shorter snout (44.1–47.9 *vs.* 48.0–50.5% HL); and larger orbital diameter (14.5–18.3 *vs.* 11.3–13.8% HL). The new species also differs from *O. piribebuy* by having a raised crest of enlarged odontodes on the supraoccipital (*vs.* crest absent), shorter predorsal length (41.7–46.7 *vs.* 46.5–50.5% SL); longer postdorsal length (42.6–47.6 *vs.* 38.8–42.5% SL); shorter dorsal-fin base (9.2–12.2 *vs.* 12.2–14.7% SL); and narrower caudal peduncle (3.5–5.9 *vs.* 5.9–7.4% SL). Finally, the new species further differs from *O. polyodon* by having lower number of premaxillary teeth (13–20 *vs.* 19–31 teeth), lower number of dentary teeth (11–19 *vs.* 18–27 teeth), and longer anal-fin spine length (16.9–19.5 *vs.* 13.7–16.9% SL).

Description. Morphometrics in Table 3 and meristics in Table 4. Dorsal body profile slightly concave along dorsal-fin length, straight from end of dorsal-fin base to caudal-fin origin. Ventral profile almost straight, slightly concave at anal region. Greatest body width at operculum and area corresponding to lateral opening of swimbladder capsule. Body gradually tapering towards caudal-fin. Greatest body depth at dorsal-fin origin and sometimes middle of suproccipital.

TABLE 3. Morphometric data for *Otothyropsis biamnicus*, holotype (Hol.) and 17 paratypes; range includes holotype. SD = standard deviation.

	***Otothyropsis biamnicus* (rio Iguaçu basin)**								***Otothyropsis biamnicus* (rio Tibagi basin)**								
	Males (n= 5)				**Females (n= 3)**				**Males (n= 4)**					**Females (n= 6)**			
Character	**Low**	**High**	**Mean**	**SD**	**Low**	**High**	**Mean**	**SD**	**Low**	**High**	**Mean**	**SD**	**Hol.**	**Low**	**High**	**Mean**	**SD**
Standard length (mm)	28.4	38.6	32.4	-	32.7	34.3	33.6	-	30.5	31.0	30.8	-	38.0	32.6	38.0	34.3	-
Percents of Standard Length																	
Head length	31.0	36.0	34.5	2.1	34.2	36.5	35.4	1.1	33.3	34.4	33.9	0.4	33.9	33.1	34.1	33.6	0.4
Predorsal length	41.7	45.8	44.4	1.6	45.0	46.7	46.0	0.9	44.9	45.1	45.0	0.0	45.7	42.5	45.7	44.3	1.0
Postdorsal length	43.8	47.4	46.4	1.4	42.6	46.2	44.6	1.8	44.4	47.3	45.6	1.3	44.3	44.3	47.6	46.5	1.2
Preanal length	55.5	58.0	56.8	0.9	55.8	59.1	57.9	1.8	58.2	58.4	58.3	0.0	58.6	57.2	58.6	57.9	0.5
Prepelvic length	36.9	39.3	38.0	1.0	36.7	38.3	37.6	0.8	37.4	37.9	37.6	0.2	38.0	36.8	38.2	37.5	0.5
Cleithral width	21.0	22.5	21.6	0.5	21.2	23.1	22.2	0.9	20.9	21.3	21.1	0.1	21.9	20.6	21.9	21.2	0.5
Pectoral-pelvic distance	14.2	15.9	15.0	0.6	13.3	14.8	13.9	0.7	14.2	15.3	14.6	0.5	14.2	13.9	15.1	14.6	0.4
Pelvic-anal distance	19.2	21.0	20.2	0.7	19.7	21.1	20.7	0.8	21.1	22.2	21.5	0.5	21.3	20.7	21.9	21.2	0.4
Dorsal-fin spine length	19.4	22.6	20.8	1.4	20.7	21.4	21.1	0.4	21.6	22.9	22.4	0.6	21.8	20.0	22.1	21.1	0.7
Dorsal-fin base length	9.2	11.2	10.4	0.8	11.6	12.2	12.0	0.3	10.2	11.2	10.8	0.4	12.0	9.5	12.0	10.7	0.8
Pectoral-fin spine length	19.8	21.2	20.5	0.5	20.6	21.0	20.8	0.1	18.8	20.4	19.7	0.6	19.5	18.6	21.3	20.0	1.0
Pelvic-fin spine ray length	16.9	19.3	17.6	0.9	15.0	16.2	15.6	0.6	19.0	19.6	19.3	0.2	15.3	14.1	16.2	15.3	0.7
Anal-fin spine ray length	16.9	18.8	17.6	0.8	16.9	17.7	17.2	0.4	18.4	19.5	19.1	0.5	17.6	17.4	18.5	17.8	0.4
Caudal-peduncle length	41.3	44.8	43.4	1.2	42.5	45.1	43.4	1.4	41.5	43.6	42.6	0.9	42.0	42.0	43.5	42.7	0.5
Caudal-peduncle depth	7.7	8.5	8.0	0.3	7.6	8.4	7.9	0.4	8.8	9.0	8.9	0.1	8.4	8.2	8.8	8.4	0.2
Caudal-peduncle width	3.5	4.4	4.1	0.4	3.8	5.1	4.6	0.6	4.2	5.4	4.8	0.4	5.9	4.2	5.9	4.6	0.6
Body depth at dorsal-fin origin	13.7	15.3	14.7	0.6	13.6	15.1	14.5	0.7	13.6	14.0	13.8	0.1	15.9	13.0	15.9	13.8	1.0
Body width at dorsal-fin origin	14.9	17.7	16.1	1.0	15.9	17.0	16.5	0.5	15.1	16.0	15.4	0.4	19.5	14.7	19.5	15.8	1.8
Percents of Head Length																	
Head depth	40.6	47.3	43.2	2.4	39.3	42.2	41.1	1.5	39.1	42.0	40.6	1.2	42.6	37.5	42.6	39.3	1.7
Snout length	45.4	47.8	46.8	0.9	45.5	47.5	46.4	1.0	44.1	47.9	46.4	1.6	47.6	45.7	47.8	47.0	0.8
Orbital diameter	15.4	18.3	16.6	1.2	14.5	15.7	14.9	0.6	15.7	16.3	15.9	0.2	14.7	14.7	15.9	15.1	0.5
Interorbital width	34.9	41.5	37.1	2.6	34.5	36.5	35.4	0.9	37.4	39.9	38.4	1.1	39.9	37.3	39.9	38.5	0.9
Internareal width	10.9	12.2	11.3	0.5	11.3	12.6	11.8	0.7	10.2	12.2	11.5	0.9	12.4	12.0	13.2	12.5	0.4
Nares diameter	13.1	15.0	13.9	0.7	10.9	11.5	11.2	0.3	13.1	13.7	13.3	0.2	9.2	9.2	11.0	10.1	0.8
Prenasal length	18.4	19.5	18.9	0.4	23.2	24.1	23.6	0.4	17.6	20.1	18.8	1.0	22.0	22.0	24.4	23.7	0.8
Barbel length	5.6	8.7	7.0	1.2	5.0	7.8	6.6	1.4	6.1	6.9	6.6	0.3	5.3	5.3	7.9	6.5	1.0

TABLE 4. Frequency of distribution of meristic data for *Otothyropsis biamnicus*. Holotype values are marked with an asterisk. Meristic marked with double asterisks was counted in c&s specimens only. N = number of specimens.

			Otothyropsis biamnicus (rio Iguaçu basin)			*Otothyropsis biamnicus* (rio Tibagi basin)
Character	N	Range	Distribution Frequency	N	Range	Distribution Frequency
Teeth in left premaxilla	8	13–17	13(1), 14(1), 15(3), 16(1), 17(2)	10	14–19	14(1), 16(2), 17(4)*, 18(2), 19(1)
Teeth in right premaxilla	8	13–18	13(1), 14(1), 15(2), 16(2), 17(1), 18(1)*	10	14–20	14(1), 16(1), 17(2), 18(3), 19(1), 20(2)*
Teeth in left dentary	8	12–16	12(1), 13(3), 14(2), 15(1), 16(1)*	10	14–19	14(2), 15(1), 16(2), 17(2)*, 18(2), 19(1)
Teeth in right dentary	8	11–16	11(1), 13(2), 14(3)*, 15(1), 16(1)	10	13–18	13(1), 15(1), 16(3)*, 17(4), 18(1)
Plates in median lateral series	8	24–25	24(3), 25(5)*	10	24–26	24(1), 25(8)*, 26(1)
Plates in mid–dorsal series	8	18–19	18(3), 19(5)*	10	19–21	19(1), 20(7)*, 21(2)
Plates in dorsal series	8	19–22	20(5)*, 21(1), 22(2)	10	20–22	20(1), 21(2)*, 22(7)
Plates in mid–ventral series	8	18–21	18(1), 19(4)*, 20(2), 21(1)	10	19–20	19(4), 20(6)*
Plates in ventral series	8	18–20	18(1), 19(3), 20(4)*	10	19–22	19(4), 20(4), 21(1), 22(1)*
Plates between anal and caudal fin	8	10–11	10(1), 11(7)*	10	11–12	11(5)*, 12(5)
Plates at dorsal-fin base	8	4–5	4(1)*, 5(7)	10	5	5(10)*
Plates at anal-fin base	8	3–5	3(5)*, 4(2), 5(1)	10	3–4	3(6)*, 4(4)
Predorsal plates	8	3	3(8)*	10	2–3	2(1), 3(9)*
Total vertebrae**	2	28	28	2	28	28

Head wide and rounded. Snout extremely short and very depressed at nares, forming bulge in prenasal area. Portion from rostral plates to posterior margin of orbital very sloping. Nares very large, its width occupying 9.2–15.0% of HL. Dorsal margin of orbit somewhat elevated. Iris operculum present. Libs rounded and papillose, with barbel very short and laterally positioned. Odontodes at snout tip larger than those on body. Posterior margin of supraoccipital with hypertrophied odontodes in juvenile and adults.

Body entirely covered by plates, except for region of nares, lateral opening of swimbladder capsule, and central portion of abdomen. One to four small irregular lateral abdominal plates in anterior portion of abdomen. Posterior portion of abdomen with one to three small plates restricted to central area, or when more plates present, always small and distributed in single or paired rows. Abdomen rarely completely devoid of plates.

Mid-dorsal series of lateral plates truncated posteriorly; median series complete with continuous perforated plates. Mid-ventral series truncated posteriorly, reaching to same point of mid-dorsal series. Two or three transverse rows of predorsal plates not including nuchal plate.

Pectoral-fin I,6–7. Pectoral-fin axillary slit present in juvenile and adult specimens. Pectoral-fin spine slender, with odontodes distributed mostly in lateral portion and increasing gradually in size toward spine tip. Pectoral girdle exposed, except for arrector fossae covered by skin. Pelvic-fin I,5, spine thickened with larger odontodes ventrolaterally turned mesially. Dorsal-fin II,7 (three specimens with II,6 rays), its origin slightly anterior to vertical through middle of pelvic-fin length. Dorsal-fin spinelet triangular in shape and dorsal-fin locking mechanism non-functional. Anal-fin I,5, first anal-fin pterygiophore exposed anterior to anal-fin spine origin. Caudal-fin i,14,i. Total vertebrae 28 (in four c&s specimens).

Color in alcohol. Ground color of dorsal surface of head median brown with many tiny dark dots, snout lighter with dark brown spots. Posterior process of supraoccipital and dorsal surface of trunk light brown with dark chromatophores uniformly distributed. Four darker saddles usually visible between origin of dorsal fin and end of caudal peduncle. Longitudinal dark stripe from snout, crossing between middle of orbit and opercle, and continuing to lower lobe of caudal fin. All fins with series of small dark dots arranged in irregular transverse bands. Fin membranes mostly hyaline. Base and lower lobe of caudal fin with both rays and membrane mostly pigmented

with dark brown. Lower portion of lower lobe with roundish to rectangular hyaline area, never with small dark dots inside (Fig. 4C, D). Ventral surface mostly pale yellow, with heavier concentration of dark chromatophores on snout and caudal peduncle.

FIGURE 6. *Otothyropsis biamnicus*, holotype, MCP 47288, female, 38.0 mm SL, Brazil, ribeirão Harmonia, tributary to rio Tibagi basin, rio Paraná dranaige.

Sexual dimorphism. Sexual dimorphism characterized by the presence of urogenital papilla immediately posterior to anal opening in males. Adult males also possess a fleshy flap along the dorsal margin of the pelvic-fin spine. Males have larger pelvic-fin spine (16.9–19.6% SL), *vs*. short pelvic-fin spine (14.1–16.2% SL) in females. Furthermore, the new species, exhibits a remarkable secondary sexual dimorphism associated with the much larger olfactory organ of males: males have wider nares diameter (13.1–15.0% *vs*. 9.2–11.5% HL in females); and males have shorter prenasal length (Fig. 7; 17.6–20.1% *vs*. 22.0–24.4% in HL females).

Distribution. *Otothyropsis biamnicus* is known from tributaries to rio Iguaçu, in Santa Catarina and Paraná States, and to the rio Tibagi, Paraná State, both in rio Paraná basin, Brazil (Fig. 5).

Ecology comments. Several specimens of *Otothyropsis biamnicus* from the rio Paranapanema have midge larvae (Diptera: Chironomidae) fixed on the operculum and more rarely on the cleithrum posterior process (Fig. 7). This ecological interaction was already reported for other catfishes of the families Astroblepidae (*Astrobleplus*) and Loricariidae (*Chaetostoma*, *Hemiancistrus*, *Hypostomus*, and *Ancistrus*) and classified as commensalism by Freihofer and Neil (1967). According to those authors, the commensalism between invertebrates and fish is extremely rare. Freihofer and Neil reported on commensalism for those species based on the examination of 1,100

specimens of 10 different families of South American catfishes. The current experience, however, suggests that this interaction is not rare, as it has been also observed for other species as *Pareioraphis hypsilurus* (E. H. L. Pereira, pers. commun.), *Microlepidogaster dimorpha*, *Hisonotus leucofrenatus*, and *H. depressicauda* (F. O. Martins, pers. commun.).

FIGURE 7. *Otothyropsis biamnicus*, male, paratype, MZUEL 6122, 30.5 mm SL, showing the Chironomidae larva. Scale bar = 5 mm.

The areas that chironomids usually attach themselves to loricariids are mostly the everted cheek plates, secondarily the fins (including the adipose fin), and less frequently the posterior nares (Freihofer and Neil 1967). However, in *Otothyropsis biamnicus* the larvae were found attached to the gill opening or, more rarely, to the posterior process of the cleithrum, both cases not previously reported. All specimens, both males and females, were carrying the larvae along one or both sides of the body, although one single individual on each side. In some cases we found only the pupal exuviae. The fact that some loricariids have a sedentary life and the chironomids also have sedentary habits, as well as both feed on detritus, algae and organic matter, allows for this specific interaction. Freihofer and Neil (1967) suggested that the larvae are probably benefited by feeding on the detritus expelled though the gill openings.

Etymology. From the Latin *bi*, meaning two, and *amnicus*, meaning inhabitant of a river, in allusion to the fact that the species is distributed in both the Iguaçu and Tibagi basins. A noun in apposition.

Key to species of *Otothyropsis*

1a. Middle series of lateral plates truncated at least two plates before the caudal fin; plates in middle lateral series 19–22 2
1b. Middle series of lateral plates reaching to the caudal-fin origin; plates in middle lateral series 24–26 3
2a. Mid-dorsal series of lateral plates discontinuous with 10–11 total plates with an intermediate gap of 4–5 plates; abdominal region entirely covered by platelets . . . . . *Otothyropsis marapoama*
2b. Mid-dorsal series of lateral plates continuous with 17–18 plates; abdominal region with extensive naked areas . . . . . *Otothyropsis piribebuy*
3a. Premaxillary and dentary teeth 19–31; pectoral-fin spine 21.4–26.9% SL; hyaline spot on lower lobe of caudal fin always with small dark dots (Fig. 4A, B); odontodes on caudal peduncle conspicuously arranged in lines . . . . . *Otothyropsis polyodon*
3b. Premaxillary and dentary teeth 13–20; pectoral-fin spine 18.6–21.3% SL; hyaline spot on lower lobe of caudal fin completely devoid of dark dots (Fig. 4C, D); odontodes on caudal peduncle not arranged in lines . . . . . *Otothyropsis biamnicus*

Discussion

The understanding of hypoptopomatine diversity and relationships is still growing steadily as almost half of its genera have been described in the last two decades (Reis *et al*. 2012). *Otothyropsis* represents one of those genera and was described a few years ago by Ribeiro *et al*. 2005 as a monotypic genus. That status, however, was not maintained for very long as Calegari *et al*. 2011 recently described a second species, *O. piribebuy*, from the rio Paraguay basin. In the present paper we describe two additional *Otothyropsis*, raising to four the number of recognized species. Our analyses of similar hypoptopomatine species, however, suggest that the diversity of *Otothyropsis* can still be higher than what is presently known. Additional undescribed species are likely to be found as more material is collected from peripheral areas to the presently known distribution. In addition to that, morphological similarity of *Otothyropsis* to *Hisonotus* is substantial and some species presently assigned to *Hisonotus*, like *H. francirochai* and perhaps *H. depressicauda* and *H. depressinotus*, can prove to be *Otothyropsis* species upon study. We have not investigated that possibility in detail because it represents the subject of the ongoing Ph.D. dissertation of Fernanda Martins.

Despite the significant similarity between *Hisonotus* and *Otothyropsis*, the latter can be diagnosed based on the following (Calegari *et al.* 2011): (1) elongated posterior extension of the compound pterotic, which forms de dorsal margin of an augmented lateral opening of the swimbladder capsule (*vs*. extension absent in *Hisonotus*); and (2) the mid-dorsal series of lateral plates truncated between the dorsal and the caudal fins (*vs*. mid-dorsal series of plates truncated before or at the dorsal-fin base in *Hisonotus*). In addition to those features, *Otothyropsis* can be differentiated from *Hisonotus* by having: (3) the suture between contiguous neural spines extending almost up to the spine distal margins (Calegari *et al*. 2011; *vs*. suture between neural spines up to last third of neural spines – but see exception in *O. biamnicus*); (4) the *levator* crest on hyomandibula developed (*vs*. *levator* crest absent or very low in *Hisonotus*); and (5) the supraoccipital forming a small, mesial portion of the dorsal wall of swimbladder capsule (*vs*. supraoccipital not forming a portion of the swimbladder capsule in *Hisonotus*). Another character used by Calegari *et al*. 2011 to diagnose *Otothyropsis*, a reduced upper pharyngeal tooth plate, is not sustained as a synapomorphy. A detailed reanalysis of a larger diversity within the genus showed that the variation in size of the upper pharyngeal tooth plate is similar in *Otothyropsis* to other related genera.

The species *Otothyropsis biamnicus* described above is distributed in both the upper rio Iguaçu and the rio Tibagi, itself a tributary to the rio Paranapanema, rio Paraná basin. Both populations were formerly treated as two separate species by Calegari *et al.* 2011, but additional material examined for the present study showed continuous variation. The few specimens of *O. biamnicus* from the rio Canoinhas examined by Calegari *et al*. 2011 were not fully grown and some characters were not completely developed. In the present study both populations are being considered conspecific as morphological, meristic, and morphometric traits completely overlap. Complementarily, its distribution in both the upper rio Iguaçu and rio Tibagi basins is not surprising, as this pattern is already known to some other bottom-dwellers as *Corydoras ehrhaldti*, *C. paleatus*, *Scleromyxtax barbatus* (Callichthyidae), and *Trichomycterus davisi* (Trichomycteridae, M. de Pinna, pers. commun.).

Additional comparative material. *Otothyropsis* cf. *polyodon*. MCP 45944, 13 (2 c&s), 24.9–35.1 mm SL, Angélica, creek on dirt road between Angélica and Ipezal, tributary to rio Ivinhema, M. Rocha and T. Carvalho, 17 December 2010. UFRGS 14068, 6, 28.5–35.4 mm SL, Naviraí, tributary to rio Laranjaí, 22°52'20"S 54°04'34"W, Y. Suarez, 23 June 2008. UFRGS 11174, 3, 26.2–33.7 mm SL, Naviraí, tributary to rio Guiraí, 22°36'45"S 54°02'09"W, Y. Suarez, 22 July 2008.

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