

Description and relationships of *Otothyropsis marapoama*, a new genus and species of Hypoptopomatine catfish (Siluriformes: Loricariidae) from rio Tietê basin, southeastern Brazil

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Otothyropsis marapoama, a new genus and species, is described based on specimens recently collected in a headwater stream of the middle stretch of the rio Tietê, a river from the upper rio Paraná basin in southeastern Brazil. The new taxon belongs to a clade also encompassing the genera *Schizolecis*, *Otothyris* and *Pseudotothyris*. *Otothyropsis marapoama* is hypothesized to be the sister-group of *Pseudotothyris* and *Otothyris* based mainly on the presence of several derived characters of the swimbladder capsule and associated bones. Several paedomorphic characters shared by *Pseudotothyris* and *Otothyris* and their significance for the phylogenetic position of the new genus are discussed.

Otothyropsis marapoama, novo gênero e espécie, é descrito baseado em espécimes recentemente coletados em um riacho de cabeceira da porção média do rio Tietê, um rio da bacia do alto rio Paraná no sudeste do Brasil. O novo táxon pertence a um clado que inclui também os gêneros *Schizolecis*, *Otothyris* e *Pseudotothyris*. *Otothyropsis marapoama* é considerado o grupo-irmão de *Pseudotothyris* e *Otothyris* baseado principalmente na presença de vários caracteres derivados da cápsula da bexiga natatória e ossos associados. Vários caracteres pedomórficos compartilhados por *Pseudotothyris* e *Otothyris* e seu significado filogenético para a posição deste novo gênero são discutidos.

Key words: Otothyridae, Systematics, Paedomorphic characters.

Introduction

The South American subfamily Hypoptopomatinae is a monophyletic unit of the Loricariidae arranged in two tribes, the Otothyridae and Hypoptopomatini, encompassing up to 70 species in 16 genera (Schaefer, 2003). The most comprehensive phylogenetic scheme available for Hypoptopomatinae is that proposed by Schaefer (1998), in which each tribe was considered monophyletic. Within the Otothyridae, one of the stronger clades includes the genera *Schizolecis* Britski & Garavello, 1984, *Pseudotothyris* Britski & Garavello, 1984 and *Otothyris* Myers, 1927, which share unique specializations of the cranium associated with an enlarged swimbladder capsule. The degree of development of the swimbladder capsule in these genera was not found in any other member of the Otothyridae (Schaefer, 1998).

Recent collecting efforts in headwater streams of the middle stretch of the rio Tietê, a tributary of the upper Paraná basin, led to the discovery of an undescribed species of the tribe Otothyridae, which also shares a highly developed swimbladder capsule. The inclusion of this new taxon in Schaefer's (1998) phylogenetic scheme led us to include it in the clade containing the genera *Schizolecis*, *Pseudotothyris* and *Otothyris*. A more detailed analysis reveals a close relationship of the new taxon with the clade that includes *Otothyris* and *Pseudotothyris*.

In this paper, describe this recently discovered catfish and place it into a new genus. We also provide the foundation for this taxonomic decision based on the inclusion of the new taxon in the phylogenetic framework of the subfamily Hypoptopomatinae proposed by Schaefer (1998).

The discovery of this new taxon exemplifies the paucity of

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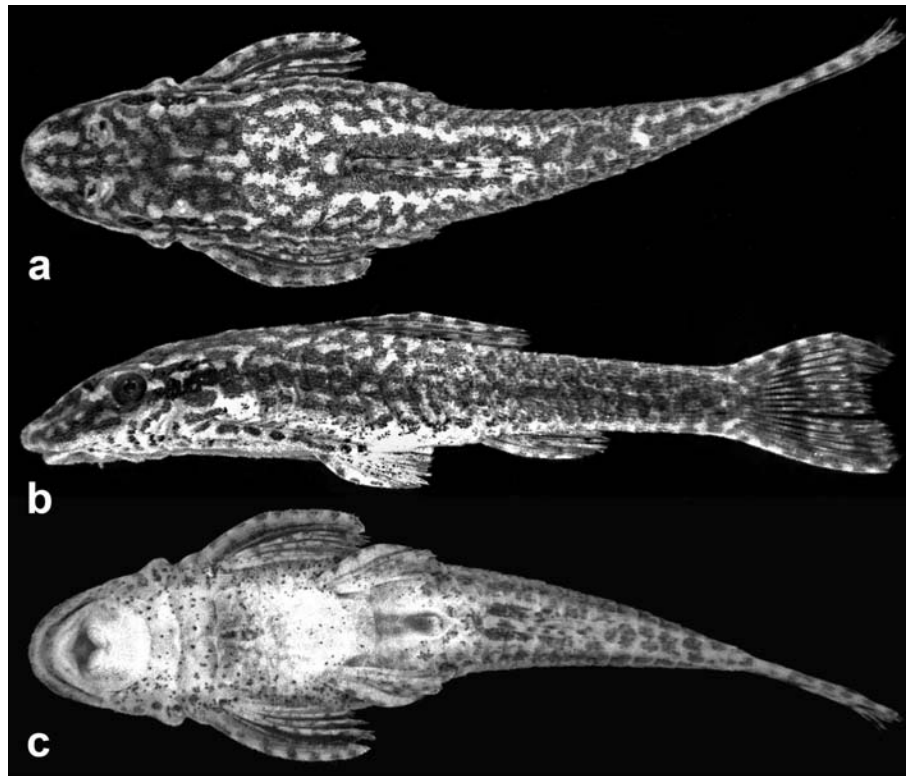


Fig. 1. *Otothyropsis marapoama*, holotype, LIRP 5640, 38.5 mm SL. Brazil, São Paulo, rio Tietê basin, Município de Marapoama, ribeirão Cubatão, off the road between Marapoara and Elisiário (21°11'35"S 49°07'22"W). Dorsal (a), lateral (b), and ventral (c) views.

knowledge of alpha diversity in the neotropics, especially on groups of small-sized fishes such as those of the Hypoptopomatinae. It also illustrates the risk of extinction of taxa that have not yet been described. In fact, the region where this new species was sampled is one of the most heavily impacted by anthropogenic activities in Brazil, and the lack of previous records of such a distinctive fish suggests a high degree of endemism and, consequently, a high degree of vulnerability.

Material and Methods

Morphological measurements were made point-to-point, to the nearest 0.1 mm with digital calipers. Methodology and terminology for measurements follow Boeseman (1968: 26-27, fig. 5) with modifications suggested by Armbruster & Page (1996). Two additional measurements were included: preanal length (taken from snout tip to the anal-fin origin) and maxillary barbel length (taken from barbel tip to its insertion on oral disk). Plate counts and nomenclature follow the schemes of serial homology proposed by Schaefer (1997). Counts follow Bockmann & Ribeiro (2003), but the following additional count was included: lateral abdominal plates (number of abdominal plates in the lateral abdominal series between the scapular bridge and pelvic-fin origin) (Britski & Garavello, 1984). Vertebral counts included all vertebrae (including the first five vertebrae modified into Weberian apparatus), with the compound caudal centrum (PU1+U1) (Lundberg & Baskin,

1969) counted as one element. All morphometric and meristic data, including premaxillary and dentary tooth counts, were taken from the left side of the specimens.

Morphometric data were expressed as percent of standard length (SL), except subunits of the cephalic region which were expressed in percent of head length. Anal width was also expressed as percent of cleithral width.

Plate counts were performed on 8 specimens stained in alizarin red solution (Taylor & Van Dyke, 1985) because limits of plates are difficult to identify in unprepared material. Osteological examination was made on specimens cleared and double-stained according to the procedure of Taylor & Van Dyke (1985).

Materials examined are from LIRP (Laboratório de Ictiologia de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, Brazil), MZUSP (Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil), MNRJ (Museu Nacional do Rio de Janeiro, Rio de Janeiro, Brazil), MCP (Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil), and DZSJRP (Coleção de Peixes do Departamento de Zoologia e Botânica do Instituto de Biociências, Letras e Ciências Exatas, Universidade Estadual Paulista, São José do Rio Preto, Brazil).

Phylogenetic analyses were performed using the character matrix published by Schaefer (1998), including outgroup data provided in that study, with the addition of the new species. The analysis was performed using PAUP version 3.1.1 (Swofford, 1993). We used the stepwise addition option

of the heuristic search algorithm, with a random addition sequence and 10 replications. The optimization criterion was ACCTRAN.

Abbreviations of bones in Figs. 3-9 are: AA = compound anguloarticular; AH = anterohyal; AP = abdominal plates; BB = basibranchial; BPT = basiptyergium; BR = branchiostegal; CB = ceratobranchial; CBF = ceratobranchial flange; CL = cleithrum; CO = coracoid; CP1-CP2 = subocular cheek plates 1 and 2; EB = epibranchial; EB4 = epibranchial 4; EBF = epibranchial flange; F = frontal; HB = hypobranchial; HH = hypohyal; HM = hyomandibula; IO1-IO5 = infraorbitals; LAP = lateral abdominal plates; LE = lateral ethmoid; LPT = lateropterygium; ME = mesethmoid; MPT = metapterygoid; MX = maxilla; N = nasal; OP = opercle; OS = orbitosphenoid; PAL = palatine; PB = infra-pharyngobranchial; PB3-PB4 = infra-pharyngobranchial 3 and 4; PF = prefrontal plate; PH = posterohyal; PMX = premaxilla; PN = pre-nasal plates; PO = prootic; PR1-PR4 postrostral plates; PS = parasphenoid; PTS = pterosphonoid; PT-SC = compound pterotic-supracleithrum-post-temporal; Q = quadrate; R = rostral plate; SOC = supraoccipital; SP = sphonotic; UH = urohyal; V = vomer.

Results

Otothyropsis, new genus

Type species: *Otothyropsis marapoama* by original designation.

Diagnosis. The clade that includes *Otothyropsis*, *Otothyris* and *Pseudotothyris* differs from the remaining genera of the Hypoptopomatinae by having an elongate posterior extension of the pterotic-supracleithrum which forms the dorsal margin of an enlarged lateral opening of the swimbladder capsule (vs. quadrangular in shape and not extending posteriorly to form the dorsal margin of swimbladder capsule), and by having the supraoccipital forming the dorsal wall of the swimbladder capsule (vs. supraoccipital does not contribute to dorsal wall of swimbladder capsule) (derived states of characters 8 and 12 of Schaefer, 1998). *Otothyropsis*, however, differs from *Pseudotothyris* and *Otothyris* by having enlarged odontodes on the dorsal and ventral margins of the snout (vs. enlarged odontodes only on the dorsal margin); by lacking conspicuous crests of enlarged odontodes on the tip of supraoccipital and pterotic-supracleithrum in adults (vs. adults with well-developed crests), and by having the abdomen completely plated in adults (vs. adults with abdominal platelets reduced, sometimes restricted to lateral abdominal plate series).

The following characters were considered autapomorphic in our reanalysis of Schaefer's (1998) phylogenetic framework of the Hypoptopomatinae, and phylogenetically diagnoses the new genus *Otothyropsis*: presence of a single median rostral plate; presence of enlarged odontodes in both dorsal and ventral snout margins (derived conditions of characters, 34 and 39 of Schaefer's, 1998 phylogeny); and presence of the ocular diverticulum (reversal of character 42 of

Schaefer's, 1998 phylogeny). None of these characters, however, are exclusive to *Otothyropsis*, being considered homoplasies according to the parsimony analysis.

Etymology. The first part of the name is from Greek (*otos* = ear and *thyris* = window) and is in reference to the Hypoptopomatinae genus *Otothyris*, to which the new taxon is closely related. The second part is from the Greek (*opsis* = relating to sight and appearance); hence, resembling a hypoptopomatine fish. Gender: feminine.

Otothyropsis marapoama, new species

Fig.1

Holotype: LIRP 5640, 38.5 mm SL, Brazil, São Paulo, rio Tietê basin, Município de Marapoama, ribeirão Cubatão, road between Marapoama and Elisiário (21°11'35"S 49°07'22"W) (Fig.2), 10 Feb 2003; A. L. A. Melo.

Paratypes: LIRP 4621, 3, 27.6-32.3 mm SL (1, 27.6 mm SL c&s), collected with holotype; MZUSP 87892, 1, 28.6 mm SL, collected at type locality, 14 Jul 2004, A. L. A. Melo, A. C. Ribeiro, M. Carvalho & A. K. Takako; LIRP 5641, 20, 18.0-29.0 mm SL (4, 19.8-29.0 mm SL c&s; 4 stained with alizarin red solution); MZUSP 87893, 10, 18.7-23.0 mm SL, MCP 38303, 10, 18.2-22.8 mm SL and DZSJRP 7887, 8, 19.3-21.9 mm SL, Brazil, São Paulo, rio Tietê basin, Município de Catanduva, Sítio Cubatão, córrego Cubatão (21°14'53.4"S 49°01'18.8"W), 14 Jul 2004, A. L. A. Melo, A. C. Ribeiro, M. Carvalho & A. K. Takako.

Diagnosis. As for genus.

Description. Morphometrics and meristics given in Tables 1 and 2 respectively. Dorsal profile of body gently arched from snout tip to dorsal-fin origin; slightly concave to straight at dorsal-fin base; straight from end of dorsal-fin base to cau-

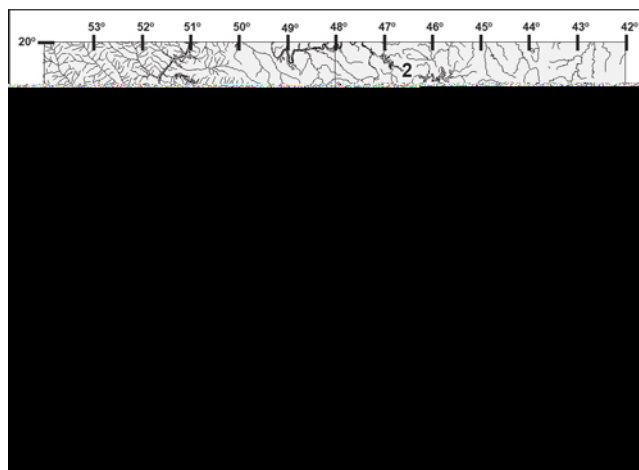


Fig. 2. Southeastern Brazil showing type-locality of *Otothyropsis marapoama* in the middle stretch of the rio Tietê basin (1: rio Tietê; 2: rio Grande; 3: rio Paraná; 4: rio Paranapanema; 5: rio Ribeira de Iguape; 6: rio Paraíba do Sul).

dal-fin origin. Ventral profile of body straight to slightly concave from snout tip to base of pectoral fin; straight from that point to anal-fin origin, slightly concave at anal-fin base, and then straight from end of anal-fin base to caudal-fin base. Greatest body depth at dorsal-fin origin. Least body depth at caudal peduncle. Greatest body width at opercular or cleithral regions. Trunk gradually tapering to caudal-fin base. Trunk and caudal peduncle rounded (smaller individuals) to slightly square (in the holotype, the larger specimen with 35.8 mm SL) in cross section, trunk slightly flattened at base of dorsal and pectoral fins and laterally compressed caudally. Body progressively narrowing caudally from cleithrum. Head wide and rounded anteriorly. Interorbital region flat to slightly convex, with latter margin slightly elevated. Snout straight at mid-line and concave in the region anterior to nares in both sides of

head. Eye laterally placed. Superior margin of orbit conspicuously elevated, forming a ridge around orbital margin. Region of pterotic-supracleithrum posterior to orbital margin slightly depressed. Lateral wall of pterotic pierced by enlarged fenestrae, which are visible externally (Fig. 3).

Body surface without well-developed crests. Body and abdomen entirely covered by plates, except for small ventral surface in front of anus, region overlying opening of swim bladder capsule, and around pectoral, pelvic, and anal-fin insertions. Rostral plates well-developed and projecting ventrally over the ventral margin of snout (Fig. 3b). Head and body plates covered with pointed odontodes, mostly uniform in size and distribution, not arranged in conspicuous rows. Odontodes from dorsal and ventral surface of snout slightly larger than remaining ones. Odontodes at tip of supraoccipital and com-

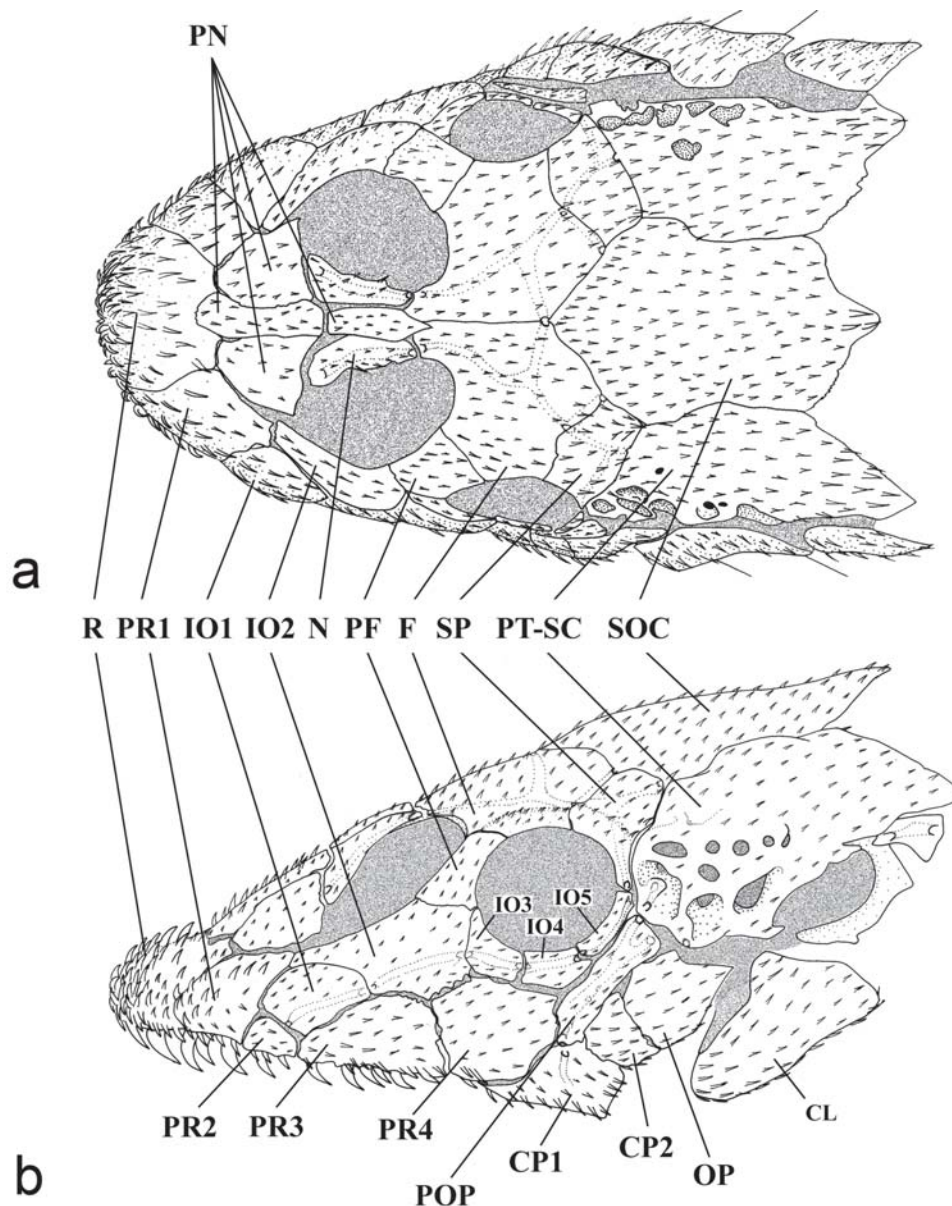


Fig. 3. Skull of *Otothyropsis marapoama*, paratype, LIRP 5641, 29.0 mm SL, a) dorsal view; b) lateral view.

Table 1. Descriptive morphometrics of *Otothyropsis marapoama*. Values are given for the holotype (separately) and 14 paratypes. Hol = Holotype; SD = Standard Deviation.

Character	Hol	Minimum	Maximum	Mean	SD
Standard length (mm)	38.5	19.6	38.5	25.6	5.2
Percents of standard length					
Predorsal length	46.0	44.4	50.3	46.8	1.9
Preanal length	61.8	58.4	64.1	61.6	1.8
Head length	32.4	30.2	38.2	35.5	2.3
Cleithral width	23.9	21.8	25.3	23.7	1.0
Dorsal-fin spine length	25.7	22.7	33.3	26.3	2.5
Folded dorsal-fin length	25.7	25.4	33.3	27.7	2.1
Base of dorsal-fin length	15.3	11.2	17.6	14.6	1.8
Thorax length	18.1	14.5	20.7	17.9	1.7
Pectoral-fin spine length	23.5	23.5	31.1	27.6	1.9
Abdomen length	14.1	10.4	14.9	13.4	1.2
Pelvic-fin spine length	12.8	12.8	19.0	16.2	1.8
Postanal length	34.5	32.3	40.3	35.8	2.3
Caudal-peduncle depth	9.2	9.0	11.0	9.8	0.5
Anal width	13.3	9.6	14.0	11.8	1.3
Snout-opercle length	23.5	21.9	26.6	24.1	1.2
Percents of head length					
Head width	72.8	6.7	12.5	9.1	1.6
Head depth	44.2	51.2	79.3	59.7	7.6
Snout length	50.3	40.0	54.8	44.5	3.5
Interorbital length	46.2	46.5	57.2	50.4	3.0
Orbital diameter	15.5	34.6	47.9	39.5	4.0
Barbel length	8.6	13.6	19.9	15.4	1.7
Percents of cleithral width					
Anal width	55.4	43.2	57.0	49.5	4.4

pound petrotic-supracleithrum-posttemporal slightly larger than remaining odontodes of head, but not forming conspicuous crests (Fig. 3). Pectoral girdle almost completely exposed, except for small median area covered by skin (Fig. 4a). Pelvic girdle with solid basipterygium anteriorly (Fig. 4b).

Tip of adpressed pectoral fin reaching to middle of pelvic fin, with posterior margin slightly rounded. Well-developed slit present posterodorsally to pectoral insertion. Tip of adpressed pelvic fin reaching anus. Pelvic-fin spine smaller than branched rays and supporting medially projected odontodes. Dorsal-fin origin at vertical behind end of pelvic-fin base. Dorsal-fin spinelet small, with dorsal-fin locking mechanism non-functional. Adipose fin absent. Ventral caudal-fin lobe slightly longer than dorsal lobe.

Lips roundish, papillose. Maxillary barbel present. Teeth slender, bifid, with larger medial cusp blade-like and slightly rounded, and smaller lateral cusp minute and pointed.

Color in alcohol. Background color of dorsal surface of head and body dark gray to brown. Body, in larger specimens, completely covered by white spots, ranging in shape from vermiculated to ovoid and often coalescing with each other. Smaller specimens more regular gray to brown overall color pattern. On head, dark pigmentation more concentrated between nares, and along lateral head margin. On body, dark pigmentation concentrated at lateral regions. Ventral surface of body mostly unpigmented, with small scattered spots, which are more concentrated around oral disk and pectoral-fin insertion.

Unbranched rays of dorsal, pectoral, pelvic and anal fins with five to seven, five to eight, two to five, and four to six dark transverse stripes, respectively. Branched rays of each of these fins with series of spots aligned in continuous transverse stripes. Caudal-fin coloration variable, with pattern ranging from striped along whole fin, to single large spot on fin base and scattered chromatophores distally. Ventral lobe of caudal fin usually more heavily pigmented than dorsal lobe.

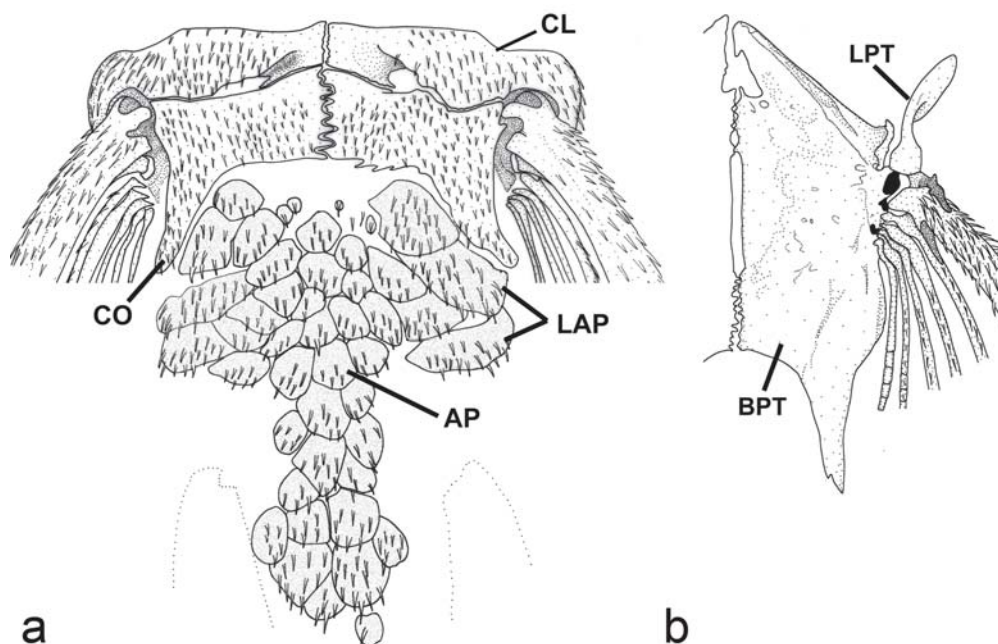


Fig. 4. *Otothyropsis marapoama*, paratype, LIRP 5641, 29.0 mm SL, a) pectoral girdle and abdominal platelets in ventral view, anterior to top; b) basipterygium in dorsal view, anterior to top.

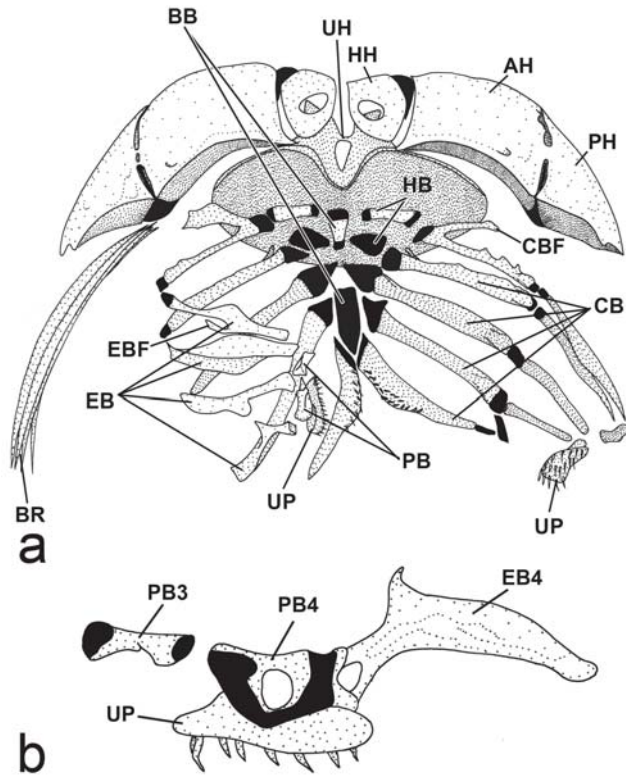


Fig. 5. *Otothyropsis marapoama*, a) branchial skeleton in dorsal view, except for upper elements of right side in ventral view, anterior to top, paratype, LIRP 5641, 24.2 mm SL; b) Upper pharyngeal toothplate in lateral view, showing its reduced condition relative to fourth infra-pharyngobranchial, Anterior to left paratype LIRP 4621, 27.6 mm SL (see Schaefer, 1991, fig. 5 a, b and c for comparisons).

Distribution. Known from two nearby localities in the same stream along the middle stretch of the rio Tietê, a tributary of the rio Paraná of southeastern Brazil (Fig. 2).

Etymology. The specific epithet *marapoama* is in reference to the county of the city in which the new species was collected. It is treated as a noun in apposition.

Discussion

In the phylogenetic scheme proposed by Schaefer (1998), *Pseudotothyris* and *Otothyris* form a clade which is the sister group of *Schizolecis*. The clade encompassing all three genera was supported by three synapomorphies, one of which is also present in the new species: upper pharyngeal tooth plate reduced (state 1 of character 23) (Fig. 5) (see Schaefer, 1991, figs. 5a, 5b and 5c for comparisons). The two other synapomorphies proposed by Schaefer (1998) [mesethmoid without pointed, arrow-shaped anterior margin (state 0 of character 3), and first dorsal-fin spinelet absent (state 2 of character 27)] were not considered synapomorphies after including *Otothyropsis* in our reanalysis. In *Otothyropsis*, the anterior margin of the mesethmoid is pointed with a ventral uncinat process (Fig. 6) (the plesiomorphic condition of character 3), and the dorsal-fin spinelet is reduced, but still present (state 1 of character 27). However, we found an additional synapomorphy for this clade including *Otothyropsis*. The enlarged pterotic fenestrae, typical of most hypoptopomatines, has a consistent pattern in *Schizolecis*, *Otothyropsis*, *Pseudotothyris* and *Otothyris*. In other Hypoptopomatinae with enlarged fenestrae, these are irregular in both size and shape, with the fenestrae expanded as large, cavernous grooves toward the ventral pterotic margin, while more dorsally located fenestrae have a more circular shape (Schaefer, 1998). The pterotic fenestrae in the clade (*Schizolecis*, (*Otothyropsis*, (*Pseudotothyris*, *Otothyris*))), however, are not irregularly arranged. We identified four enlarged fenestrae that are consistently found in all these genera (Fig. 7). Homologies are clearly identified based on the relative position of each fenestra in the pterotic and by landmarks, such as sensory canals. We defined and coded this character as state 1: presence of three distinct enlarged fenestrae at the ventral margin of pterotic (Fig. 7; fenestrae 1, 2 and

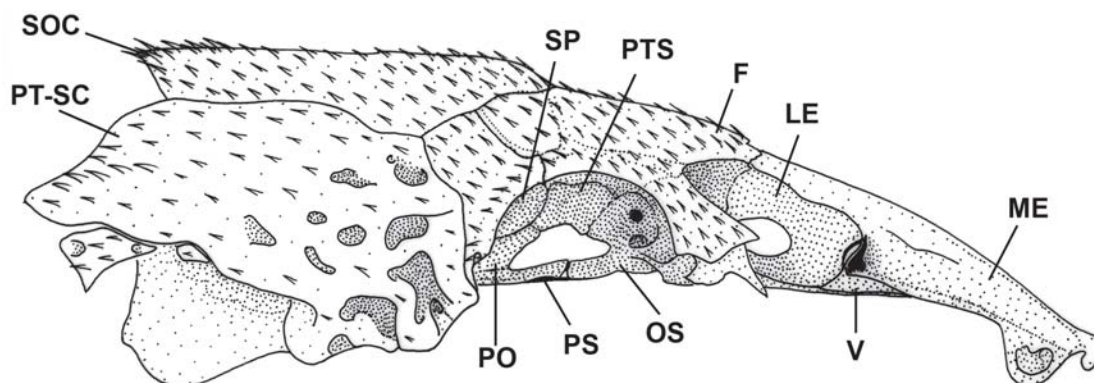


Fig. 6. Skull of *Otothyropsis marapoama*, paratype LIRP 5641, 29.0 mm SL, in lateral view. Dermal plates of the dorsal snout anterior to the frontals removed. Anterior to right.

Table 2. Frequency distribution and summary of meristics for *Otothyropsis marapoama*. Plate counts were made in 8 specimens stained with alizarin red solution. Holotype values are marked with an asterisk. Meristics marked with double asterisks were counted in c&s specimens only.

Character	Frequency Distribution	Range	Mode
Dorsal plates	19(3)*; 18(5)	18-19	18
Mid-dorsal plates	8(2); 10(2); 12(1)*; 13(1); 14(1); 16(1)	8-16	8
Median plates	17(2); 18(1)*; 19(3); 20(1); 21(1)	17-21	19
anterior field plates	3(3)*; 4(5)	3-4	4
gap field plates	3(1); 4(1); 5(1)*; 7(3); 9(2)	3-9	7
posterior field plates	4(2); 5(3); 7(1)*; 8(1) 9(1)	4-9	5
Mid-ventral plates	14(1); 15(6)*; 16(1)	14-16	15
Ventral plates	16(2); 17(3)*; 18(3)	16-18	18
Lateral abdominal plates	2(4); 3(4)*	2-3	2
Predorsal plates	3(8)	---	---
Dorsal plates below dorsal-fin base	5(3); 6(3)*; 7(2)	5-7	5
Dorsal plates between end of dorsal base and caudal-fin membrane	11(1); 12(3); 13(3)*; 14(1)	11-14	13
Dorsal median unpaired plates	---	---	---
Ventral plates above anal-fin base	3(8)	---	---
Ventral plates between end of anal base and caudal-fin membrane	9(6)*; 10(2)	9-10	9
Dorsal-fin branched rays	7 (all specimens)	---	---
Pectoral-fin branched rays	6 (all specimens)	---	---
Pelvic-fin branched rays	5 (all specimens)	---	---
Anal-fin branched rays	5 (all specimens)	---	---
Caudal-fin branched rays	14 (all specimens)	---	---
Dorsal procurent rays **	26(1); 27(1); 28(1)	26-28	---
Ventral procurent rays **	3(1); 4(2)	3-4	4
Total vertebrae **	3(3)	3-3	3
Premaxillary teeth	10(1); 12(1); 13(2); 14(1); 15(1); 16(1); 17(3); 18(4)*; 19(1)	10-19	18
Dentary teeth	10(1); 11(3); 12(2); 15(3); 16(4)*; 17(2)	10-17	16

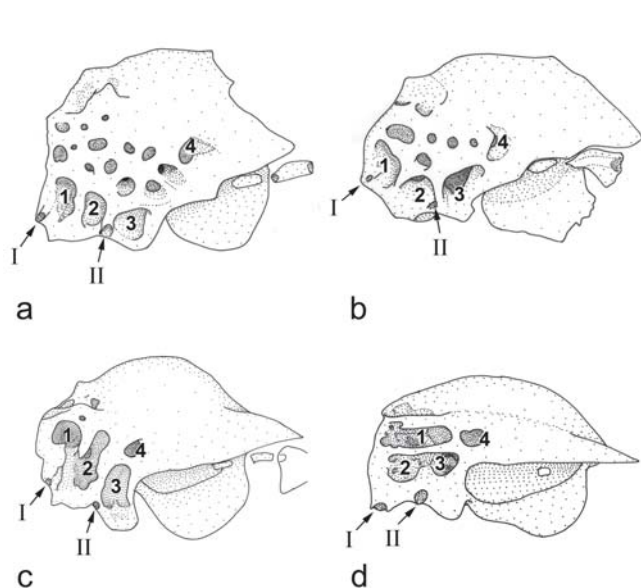


Fig. 7. Comparative morphology of the compound pterotic-supracleithrum-posttemporal, a) *Schizolecis guntheri*, LIRP 555, 38 mm SL; b) *Otothyropsis marapoama*, Paratype LIRP 5641, 29.0 mm SL, c) *Pseudotothyris obtusa*, LIRP 525, 27.4 mm SL, and d) *Otothyris lophophanes*, MZUSP 80205, 22 mm SL. Numbers 1 to 4 correspond to homologous fenestrae. Arrows indicate the homologous pores of the lateral line system. (I) opening of the preopercular latero-sensory canal and (II) opening of the posterolateral latero-sensory canal.

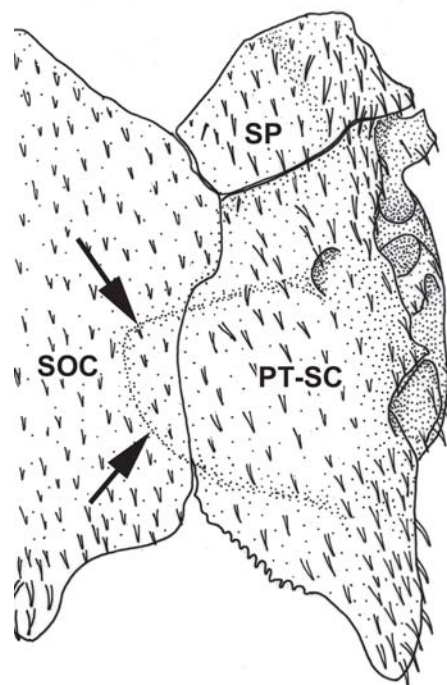


Fig. 8. Dorsal view of the posterolateral portions of the skull of *Otothyropsis marapoama*, Paratype, LIRP 5641, 29.0 mm SL. Arrows indicate the internal limits of the swimbladder capsule seen by transparency in c&s specimens. Note that supraoccipital contributes to dorsal wall of swimbladder capsule. Anterior at top.

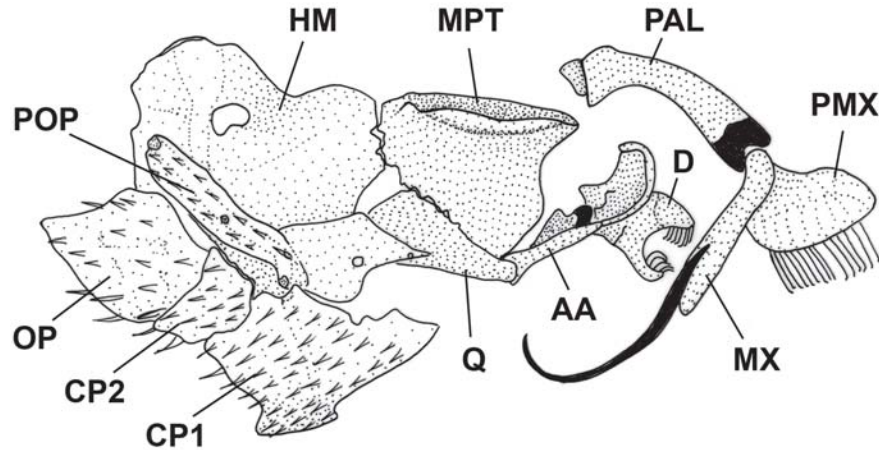


Fig. 9. Suspensorium of *Otothyropsis marapoama*. Paratype, LIRP 5641, 29.0 mm SL.

3) (present in *Schizolecis* and *Otothyropsis*), and state 2: the same fenestrae present, but continuous to each other in different degrees (present in *Pseudotothyris* and *Otothyris*). Other genera of Hypoptopomatinae have a larger number of fenestrae at the ventral pterotic margin compared with the clade (*Otothyropsis*, (*Pseudotothyris* (*Otothyris*))) (see Schaefer, 1991, fig. 2).

The monophyly of *Pseudotothyris* + *Otothyris* is supported by three synapomorphies, also present in our new

species: the presence of a pterotic posterolateral extension, which forms the dorsal margin of an enlarged lateral opening of the swimbladder capsule (Fig. 6); the supraoccipital forming the dorsal wall of the swimbladder capsule (Fig. 8); and presence of enlarged snout odontodes (Fig. 3). These characters correspond, respectively, to derived conditions of characters 8, 12, and 39 of Schaefer's (1998) phylogeny.

The inclusion of our new species in the phylogenetic framework of Schaefer (1998) and repeating the analysis with the original data set resulted in a single tree of 109 steps in length (CI = 0.51 and RI = 0.71) corroborating the inclusion of the new genus in the clade that included *Schizolecis*, *Pseudotothyris* and *Otothyris*. In this first analysis, however, the new taxon appears to be the sister-group of *Pseudotothyris* due to the absence in both genera of a subopercular plate between the opercle and the canal-bearing plate at the ventrolateral margin of the cheek (Figs. 3 and 9). According to Schaefer (1998), this character is derived among the Hypoptopomatinae (derived condition of character 17).

Schaefer's (1998) analysis, however, did not include a distinctive sculpturing of the supraoccipital bone, that bears enlarged odontodes forming three conspicuous ridges or crests, which was first noted by Garavito *et al.* (1998) as shared by *Otothyris* and *Pseudotothyris*. We also observed that *Otothyris* and *Pseudotothyris* share the presence of enlarged odontodes forming conspicuous crests in the pre-nasal plates. We included these characters in Schaefer's (1998) original database (numbered as Characters 48 and 49, respectively) along with the characteristic pterotic fenestrae mentioned above (included as character 47) and obtained a single tree with 114 steps in length (CI = 0.52 and RI = 0.71). In our reanalysis, therefore, *Otothyropsis* is the sister-group of *Otothyris* plus *Pseudotothyris*.

The presence of several pedomorphic characters suggests that *Pseudotothyris* and *Otothyris* are indeed more closely related to each other. Generally, immature individuals of Hypoptopomatinae exhibit salient crests of enlarged odontodes on the posterodorsal region of the supraoccipital

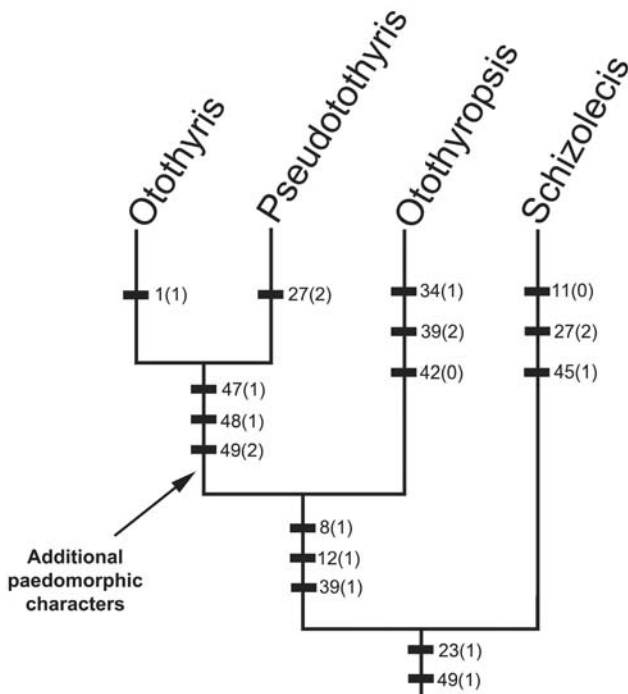


Fig. 10. Phylogenetic relationships of *Otothyropsis marapoama*. Characters states supporting nodes are unambiguous characters published by Schaefer (1998), except for characters 47, 48 and 49, included in our reanalysis. Pedomorphic characters commented in the text represent putative additional synapomorphies of *Otothyris* and *Pseudotothyris*.

Table 3. Character states of *Otothyropsis marapoama*, for 46 characters presented by Schaefer (1998) plus three additional characters included in the reanalysis (47, 48, and 49) (see text for explanation). Characters are listed from top to bottom, arranged in separate groups in columns.

Characters	1-10	11-20	21-30	31-40	41-49
Character states	0	1	0	1	0
	0	1	0	0	0
	1	2	1	0	?
	0	0	0	1	0
	1	0	0	0	?
	0	0	0	0	0
	0	1	1	1	1
	1	1	0	0	0
	0	0	0	2	0
	1	0	1	0	

and pterotic-supracleithum (Garavello *et al.*, 1998). In *Otothyris* and *Pseudotothyris* these odontode crests are retained in adults. In juveniles of *Otothyropsis* the crests are evident but disappear almost completely in larger specimens.

In *Otothyris* and *Pseudotothyris*, the dorsal portion of the swimbladder capsule, including both pterotic-supracleithrum and supraoccipital bones, are greatly arched forming a dome-like structure (Fig. 7c and d). In the new genus, this character is only present in juveniles, suggesting that retention of this shape in *Otothyris* and *Pseudotothyris* might be paedomorphic and derived.

We also observed that in juveniles of *Otothyropsis marapoama* the prenasal plates consist of several minor plates that become gradually fused in larger specimens. In *Otothyris* and *Pseudotothyris* prenasal plates remain separate. The presence of several prenasal plates in adults seems to be another derived paedomorphic character shared by *Otothyris* and *Pseudotothyris*.

Another character that is apparently derived and paedomorphic in *Otothyris* and *Pseudotothyris* is the pattern of abdominal plates. Commonly, young loriciariids have no platelets on the abdomen which becomes gradually plated during ontogeny. This is the case of *Otothyropsis*, in which juveniles possess naked abdomens that are almost completely plated in larger specimens (Fig. 4a). *Otothyris* and *Pseudotothyris*, however, possess abdomens with large naked areas and with only well-developed lateral plates. In *Otothyropsis*, lateral plates develop before the remaining abdominal plates. Other Hypoptopomatinae have different degrees of naked abdomens. However, because *Otothyropsis* has a completely plated abdomen, allied with the fact that the lateral abdominal plates develop earlier than the remaining abdominal plates, we suggest that the presence of solely lateral plates in the abdomen of *Otothyris* and *Pseudotothyris* might be paedomorphic.

The several reductive features shared by *Otothyris* and *Pseudotothyris*, despite of being homoplastic and widespread in the Hypoptopomatinae, are likely to correspond to additional synapomorphies of both genera. The relative small size of *Pseudotothyris* and *Otothyris* and the phylogenetic retention of several juvenile characters also found in juveniles of

Otothyropsis marapoama, their putative sister-group, suggest a paedomorphic evolutionary origin. The generalized juvenile shape of these genera is suggestive of progenesis.

According to the evidence mentioned above, we conclude that *Otothyropsis marapoama* is more closely related to *Pseudotothyris* and *Otothyris* (Fig. 10). A detailed ontogenetic description of *Otothyropsis* and *Schizolecis* can be crucial for understanding the degree of sensorial specialization acquired by this clade, as well for providing additional information on miniaturization within Ostariophysi, an important phenomenon, as mentioned by Weitzman & Vari (1988).

Comparative material. *Otothyris lophophanes*: MZUSP 80205, 7 (2 c&s), Brazil, Rio de Janeiro, Silva Jardim, tributary of Rio São João, (22°34'00"S 42°33'59"W). *Pseudotothyris janaeirensis*: MNRJ 4707, 20 (1 c&s), Paraty, Brazil, Rio de Janeiro, Município de Engenheiro Paulo de Frontin, rio dos Macacos, Represa Engenho da Serra, (approx. 22°33'S 43°40'W). *Pseudotothyris obtusa*: LIRP 525, 73 (2 c&s), Brazil, São Paulo, Município de Cananéia (24°56'S 47°58"W). *Schizolecis guntheri*: LIRP 555, 601 (2 c&s), Brazil, Rio de Janeiro, Município de Parati, Fazenda Muricana, rio Pedra Branca, (approx. 23°10'S 44°48'W). *Parotocinclus prata*: LIRP 1136, 38 (2 c&s), Paraty, Brazil, Minas Gerais, Município de Presidente Olegário, headwaters of rio da Prata, ribeirão Quiricó, near Galena, São Francisco Basin (approx. 18°19'S 46°03'W). *Hisonotus insperatus*: LIRP 383, 11 (2 c&s), Brazil, São Paulo, Município de Ribeirão Preto, rio Pardo, Paraná Basin, (approx. 21°10'S 47°48'W). *Hisonotus* sp.: LIRP 1580, 12 (2 c&s), Brazil, São Paulo, Município de Teodoro Sampaio, córrego São Carlos at Parque Estadual Morro do Diabo, Paraná Basin (22°35'28"S 52°14'38"W).

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Literature Cited

- Armbruster, J. W. & L. M. Page. 1996. Redescription of *Aphanotorulus* (Teleostei: Loricariidae) with description of one new species, *A. ammophilus*, from the Río Orinoco basin. *Copeia*, 1996 (2):379-389.
- Bockmann, F. A. & A. C. Ribeiro. 2003. Description of a new suckermouth armored catfish of the genus *Pareiorhina* (Siluriformes: Loricariidae), from southeastern Brazil. *Ichthyological Exploration of Freshwaters*, 14(3): 231-242.
- Boeseman, M. 1968. The genus *Hypostomus* Lacépède, 1803, and its Surinam representatives (Siluriformes, Loricariidae). *Zoologische Verhandelingen*, 99:1-89.
- Britski, H. A. & J. C. Garavello. 1984. Two new southeastern Brazilian genera of Hypoptopomatinae and a redescription of *Pseudotocinclus* Nichols, 1919 (Ostariophysi, Loricariidae). *Papéis Avulsos de Zoologia*, 35(21): 225-241.
- Garavello, J. C., H. A. Britski & S. A. Schaefer. 1998. Systematics of the genus *Otothyris* Myers 1927, with comments on geographic distribution (Siluriformes: Loricariidae: Hypoptopomatinae). *American Museum Novitates*, 3222: 1-19.
- Lundberg, J. G. & J. N. Baskin. 1969. The caudal skeleton of the catfishes, order Siluriformes. *American Museum Novitates*, 2398: 1-49.
- Myers, G. S. 1927. Descriptions of new South American freshwater fishes collected by Dr. Carl Ternetz. *Bulletin of the Museum of Comparative Zoology*, 68 (3): 107-135.
- Schaefer, S. A. 1991. Phylogenetic analysis of the loricariid subfamily Hypoptopomatinae (Pisces: Siluroidei: Loricariidae), with comments on generic diagnoses and geographic distribution. *Zoological Journal of the Linnean Society*, 102:1-41.
- Schaefer, S. A. 1997. The Neotropical Cascudinhos: Systematics and biogeography of the *Otocinclus* catfishes (Siluriformes: Loricariidae). *Proceedings of the Academy of Natural Sciences of Philadelphia*, 148:1-120.
- Schaefer, S. A. 1998. Conflict and resolution: Impact of new taxa on phylogenetic studies of the neotropical cascudinhos (Siluriformes: Loricariidae). Pp. 375-400 *In*: L. R. Malabarba, R. E. Reis, R. P. Vari, C. A. S. Lucena & Z. M. S. Lucena (Eds.). *Phylogeny and Classification of Neotropical Fishes*. Edipucrs, Porto Alegre. 603p.
- Schaefer, S. A. 2003. Loricariidae - Hypoptopomatinae (Armored catfishes). Pp. 321-329 *In*: R. E. Reis, S. O. Kullander & C. J. Ferraris, Jr. (Eds.) *Checklist of the Freshwater Fishes of South and Central America*. Edipucrs, Porto Alegre. 729p.
- Swofford, D. L. 1993. PAUP: Phylogenetic Analysis Using Parsimony, Version 3.1.1. Washington, D.C.: Smithsonian Institution.
- Taylor, W. R. & G. C. Van Dyke. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium*, 9(2): 107-119.
- Weitzman, S. H. & R. P. Vari. 1988. Miniaturization in South American freshwater fishes: and overview and discussion. *Proceedings of the Biological Society of Washington*, 101(2): 444-465.

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