

Otocinclus tapirape: A New Hypoptopomatine Catfish from Central Brazil (Siluriformes: Loricariidae)

MARCELO R. BRITTO AND CRISTIANO R. MOREIRA

A new species of *Otocinclus*, *Otocinclus tapirape*, is described. The new taxon differs from other species of the genus by the following combination of characters: low number of trunk lateral plates; canal-bearing plates of trunk median plate series truncated, restricted to the anterior field; presence of iris diverticulum; expanded subnasal lamina on lateral ethmoid; and nuchal plate narrow. The phylogenetic relationships of the new species are ((*Otocinclus affinis*, *Otocinclus flexilis*)(*Otocinclus xakriaba* (*Otocinclus tapirape*, remaining *Otocinclus* species))).

Uma nova espécie de *Otocinclus*, *Otocinclus tapirape*, é descrita. O novo táxon é distinto das outras espécies do gênero pela seguinte combinação de caracteres: número pequeno de placas da série mediana do corpo; placas laterais com canais restritas ao campo anterior do corpo; presença de um divertículo na íris; uma lâmina subnasal expandida no etmóide lateral; e placa nuchal estreita. As relações filogenéticas da nova espécie são ((*Otocinclus affinis*, *Otocinclus flexilis*)(*Otocinclus xakriaba* (*Otocinclus tapirape*, demais espécies de *Otocinclus*))).

OTOCINCLUS is one of 14 genera that constitute the subfamily Hypoptopomatinae, an easily distinguishable and well-corroborated monophyletic subgroup of the family Loricariidae (Schaefer, 1987, 1991, 1997). Like most of the genera in the subfamily, *Otocinclus* is composed of small individuals not exceeding 50 mm SL. Representatives of the genus generally occur in small lowland tributaries of almost all main river basins in South America east of the Andes (Schaefer, 1997). They inhabit well-oxygenated, moderate- to slow-flowing environments, often near river banks, feeding on algae that grow on submerged leaves.

Schaefer (1987) proposed an explicitly phylogenetic hypothesis of relationships within the Loricariidae, providing the framework for subsequent phylogenetic analyses of the Hypoptopomatinae (Schaefer, 1991, 1998). Schaefer (1991) corroborated the monophyly of the Hypoptopomatinae, proposed a phylogenetic hypothesis of relationships within the subfamily, and indicated the paraphyletic condition of the genus *Otocinclus*. Schaefer (1998) reanalyzed the relationships in the Hypoptopomatinae, with the addition of new taxa, and stated the monophyly of the *Otocinclus* (sensu Schaefer, 1997) and indicated the basal most position of *Otocinclus* within the tribe Hypoptopomatini.

Schaefer (1997) revised the systematics of the genus *Otocinclus*, proposing a phylogenetic hypothesis among its species. The author also reexamined the genus relationships within the subfamily and formulated a set of hypotheses for its biogeographical history.

Herein, we describe a new species of *Otocinclus* from the rio Araguaia basin, Central Brazil, and reexamine the relationships within the genus, including *Otocinclus tapirape*.

MATERIALS AND METHODS

Morphometric and meristic data follow methods outlined in Schaefer (1997). Vertebral counts were taken from cleared-and-stained (cs) specimens prepared according to Taylor and Van Dyke (1985). Vertebral counts include the five vertebrae of the Weberian apparatus (Schaefer, 1990). The compound caudal centrum (preural 1 + ural 1) was counted as one. Plates were counted only in cleared-and-stained specimens. Counts in text are followed by their frequency in parentheses. Values for holotype are indicated by asterisk. Drawings were made with the aid of camera lucida from the left side of these specimens. Osteological nomenclature follows Schaefer (1987). Dermal plates terminology follows Schaefer (1997). Abbreviations for institutions according to Levinton et al. (1985), with the addition of UFRJ for Laboratório de Ictiologia Geral e Aplicada da Universidade Federal do Rio de Janeiro, Brazil.

The phylogenetic placement of the new species was determined by including it in the data matrix of Schaefer (1997; Table 1). The matrix was analyzed using the software PAUP* 4.0b10 (D. L. Swofford, Software and documentation, Washington, D.C., 2001), using branch-and-bound algorithm. Multistate characters 17 and 19 were treated as ordered or minimally con-

TABLE 1. DATA MATRIX OF *Otocinclus* SPECIES. Characters and their states according to Schaefer (1997). The first three taxa represent the outgroup.

	1-5	6-10	11-15	16-20	21-25	26-27
<i>Microlepidogaster perforatus</i>	00010	00000	01000	00000	00001	00
<i>Hisonotus notatus</i>	00000	00000	01000	00000	00000	00
<i>Hypoptopoma</i> sp.	00000	00001	00000	00000	00001	01
<i>Otocinclus affinis</i>	10100	11110	00000	12001	01000	10
<i>O. bororo</i>	11101	11011	10001	00100	01001	11
<i>O. caxarari</i>	11101	11011	10001	01010	01001	10
<i>O. flexilis</i>	10100	11110	00000	12000	10100	10
<i>O. hasemani</i>	11100	11011	10001	00000	01000	10
<i>O. hoppei</i>	11101	11011	10001	01000	01011	10
<i>O. huaroani</i>	11101	11011	10001	00000	01001	11
<i>O. macrospilosus</i>	11101	11011	10001	01000	01011	10
<i>O. mariae</i>	11100	11011	10001	00100	01001	11
<i>O. mura</i>	11101	11010	10000	00120	01001	11
<i>O. vestitus</i>	11101	11011	10101	02000	01001	10
<i>O. vittatus</i>	11101	11011	10001	01000	01001	10
<i>O. xakriaba</i>	11110	11021	01011	00021	10000	10
<i>O. tapirape</i>	11100	11011	10001	02000	00000	10

nected (Slowinski, 1993), according to a morphocline sequence of similarity among character states.

Otocinclus tapirape, n. sp.

Figure 1

Holotype.—MZUSP 73975, 22.4 mm SL; Brazil: Goiás, córrego Água Parada, tributary of Rio Pintado, 11 km west from Novo Planalto, rio Araguaia system, 13°17'S, 49°62'W; F. Autran, M. Britto, W. Costa, R. D'Arrigo and E. Vicente, 26 August 1993.

Paratypes.—All collected with holotype: AMNH 232393 (4: 21.6–22.0 mm SL, 2 ex. cs); MZUSP 73976 (11: 22.1–23.6 mm SL, 5 ex. cs); UFRJ 5420 (8: 18.9–20.5 mm SL); UFRJ 5421 (2 cs: 20.1, 20.4 mm SL).

Nontype material.—MNRJ 21309 (7: 14.2–24.1 mm SL); Brazil: Goiás, ribeirão Corgão (tributary of rio Piranhas), and small tributary valley, at GO-060 road (Km 309), west from município de Piranhas, rio Araguaia system, 16°26'11"S, 51°47'05"W; P. Buckup, F. Melo and M. Melo, 20 February 2000.

Diagnosis.—*Otocinclus tapirape* differs from its congeners, except *Otocinclus vestitus*, *Otocinclus flexilis*, and *Otocinclus affinis*, by canal-bearing plates of trunk median plate series truncated, restricted to the anterior field (vs presence of canal-bearing plates on posterior field). *Otocinclus tapirape* is distinguished from *O. vestitus* by

the presence of iris diverticulum (vs absence), and by the absence of paired W-shaped marks on caudal fin (vs presence). *Otocinclus tapirape* differs from *O. flexilis* and *O. affinis* lateral ethmoid with large subnasal lamina (vs subnasal lamina small), 20–22 total lateral plates (vs 24 or more), a narrow nuchal plate (vs. wide nuchal plate), and plates of median series not arranged in tandem repeat pattern (vs plates arranged in tandem repeat pattern).

Description.—Morphometric data of holotype and paratypes presented in Table 2. Dorsal profile of head from snout tip to anterior supraoccipital margin straight to slightly convex; supraoccipital straight to slightly concave. From supraoccipital posterior margin to dorsal fin origin straight to slightly convex. Dorsal fin base straight to slightly concave, posteroventrally inclined. From end of dorsal fin to origin of dorsal procurrent caudal fin rays profile nearly straight. Ventral profile from snout tip to pelvic fin origin straight, transversely flat. From that point to anal fin origin convex. Anal fin base concave. Anal fin posterior end to origin of ventral procurrent caudal fin rays straight to slightly concave. Greatest body depth at dorsal fin origin. Caudal peduncle rectangular in cross-section.

Tip of snout rounded. Eyes large, positioned midway between snout tip and posterior pterotic process. Distance between ventral orbit margin and ventral head surface about 0.7 of orbit length. Iris diverticulum present. Lateral ethmoid with large subnasal lamina (Fig. 2). Sub-



Fig. 1. *Otocinclus tapirape*, new species, holotype, MZUSP 73975, 22.4 mm SL, dorsal, lateral, and ventral views.

TABLE 2. MORPHOMETRIC DATA FOR *Otocinclus tapirape*, NEW SPECIES. Data based on the holotype (MZUSP 73975) and the 16 noncleared-and-stained paratypes ($n = 17$). SOC = supraoccipital posterior process.

	Holotype	Min.	Max.	Mean	SD
Standard length (mm)	22.4	18.9	23.6	21.2	
Percentage of SL					
Body depth	24.1	19.3	24.1	22.0	1.1
Trunk depth at anal origin	20.5	16.8	21.5	19.0	1.3
Caudal peduncle depth	12.2	9.8	12.2	10.6	0.7
SOC to dorsal origin	10.7	9.0	13.5	10.8	1.2
Cleithrum to pelvic origin	16.4	14.4	17.5	15.7	0.9
Pelvic to anal origin	20.8	18.0	22.5	20.5	1.2
Trunk length	43.6	38.9	43.6	41.3	1.3
Head length	37.5	35.3	40.2	37.9	1.6
Percentage of head length					
Snout width	32.3	29.3	33.2	31.4	1.3
Interorbit width	46.4	42.2	46.6	44.3	1.4
Internasal width	18.5	13.3	18.5	15.4	1.4
Nares diameter	11.5	9.2	13.6	11.8	1.2
Orbit length	20.3	18.4	22.1	19.9	0.9

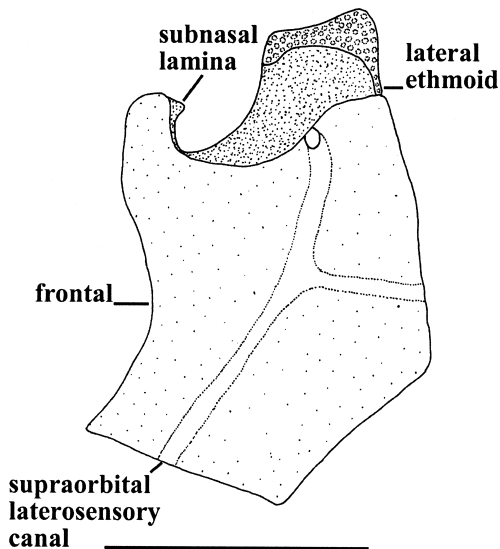


Fig. 2. Anterior part of neurocranium of *Otocinclus tapirape*, new species, paratype, MZUSP 73976. Dorsal view, left side. Odontodes not depicted. Scale bar = 1 mm.

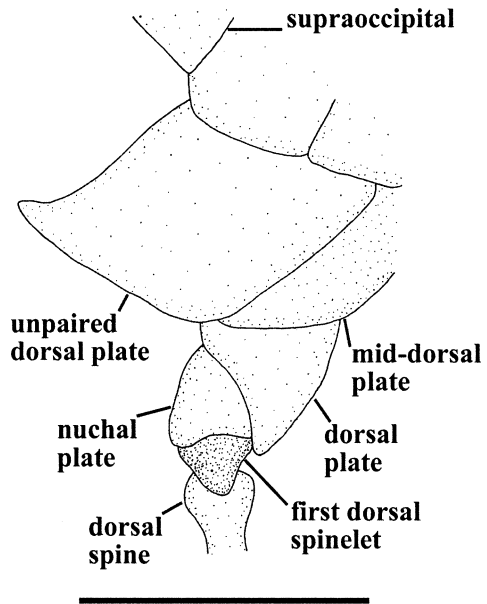


Fig. 3. Dorsal view of nuchal plate and plates anterior to dorsal spine of *Otocinclus tapirape*, new species, paratype, MZUSP 73976. Scale bar = 1 mm.

opercular plate present. Premaxillary teeth 12(8), 13(8), 14(5), 15*(2), 16(1). Mandibular teeth 11(3), 12(5), 13(12), 14*(4), 15(1). Oral disk ovoid, papillose. Maxillary barbels present.

Total plates in lateral series 20(2), 21(2), 22*(5). Lateral line short, incomplete; anterior plate field with 3(7), 4*(2) canal-bearing median series plates, remaining lateral plates bearing no pores or canals. Dorsal plates 18(7), 20(1); ventral plates 17(3), 18(3), 20(1); mid-dorsal plates 14(3), 15(3), 16(2); midventral plates 17(1), 18(5), 19(1), 20(1). Abdomen covered by plates, except in region immediately anterior to anus. Paired lateral abdominal plates 6(4), 7*(2), 8(1), arranged from pectoral fin origin to pelvic fin origin. Region between lateral abdominal series covered by several small irregular plates arranged in two to five rows, extending beyond lateral abdominal series, until anterior third of pelvic fin length. Posterior medial plates forming a triangular preanal shield with plates becoming larger posteriorly. Twenty-seven vertebrae.

Dorsal fin II, 7; origin approximately at vertical line through pelvic fin origin, extending beyond anal fin base, approximately at middle of anal fin length, when depressed against body. Nuchal plate narrow (Fig. 3). Anal fin i, 5. Pectoral fin I, 6; extending approximately to pelvic fin origin. Pelvic fin i, 5; extending through anal fin origin. Caudal fin i, 7/7, i, superior caudal fin

lobe slightly longer than inferior. Dorsal procurrent rays 3(2), ventral procurrent rays 3(2).

Odontodes distributed uniformly on head and body, concentrated on snout. Larger odontodes on snout margin, unbranched rays of all fins, procurrent rays, and edges of caudal peduncle. Males with odontodes more concentrated on ventrolateral caudal fin base, especially last ventral plate.

Color in alcohol.—Ground color light tan. Dark chromatophores scattered on dorsal portion of head and trunk, more concentrated between nares and eyes, and dorsal region between end of dorsal fin base and approximately two plates after tip of adpressed dorsal fin. Ventral surface with few dark chromatophores, except for some chromatophores concentrated on upper lip. Midlateral stripe from snout to caudal fin base, continuous with caudal spot. Stripe narrower than eye in snout, wider in trunk, composed both of superficial and deep-lying dark chromatophores; conspicuously pigmented on snout to posterior margin of compound pterotic-supracleithrum, posterior to that point becoming faint, with few dark chromatophores scattered in sides of abdominal region, similar to pigmentation of dorsal region. Midlateral trunk stripe conspicuous after vertical through posterior end of dorsal fin base.

Dorsal fin rays with dark chromatophores uniformly distributed, similar in concentration to

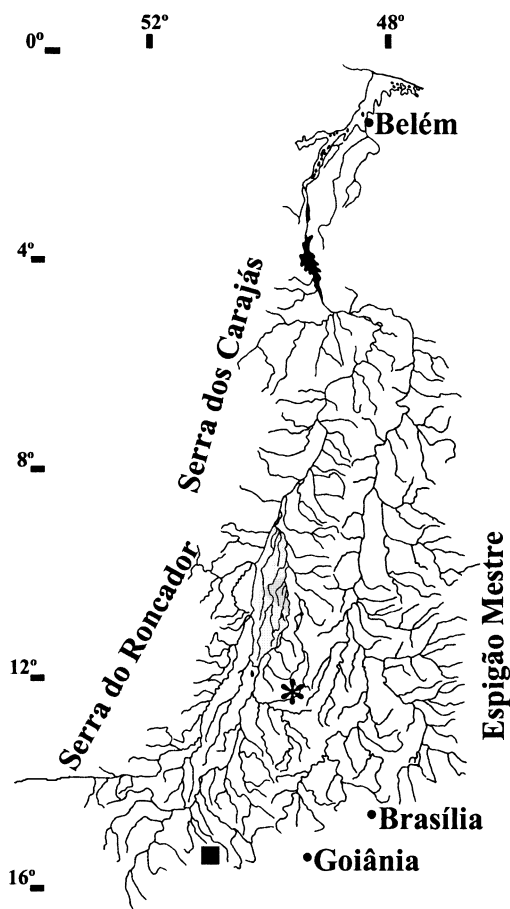


Fig. 4. Distribution of *Otocinclus tapirape*, new species. Type-locality indicated by an asterisk. The other known locality of the new species indicated by the square. Shaded area represents the Ilha do Bananal.

trunk dorsal region. Anal fin with few dark chromatophores on first unbranched ray, reaching in some specimens branched rays. Pectoral and pelvic fins with few dark chromatophores on spine. Caudal fin with scattered dark chromatophores on fin rays, more concentrated on unbranched and procurrent rays. Midlateral trunk stripe continuing along median caudal fin rays, forming narrow vertical band on anterior portion of fin, distinguishable only in some specimens. Caudal spot round, wider than midlateral stripe, extending posteriorly to tip of median caudal fin rays.

Distribution.—The new species is known from two localities from the upper and middle Rio Araguaia system (Fig. 4). The new species was found sympatrically with *O. vittatus* in the type locality.

Etymology.—The specific name *tapirape* is treated as a noun in apposition and is named for the indigenous tribe Tapirapé, which nowadays inhabit a restricted area between the rio Tapirapé and rio Araguaia. This tribe originally occupied an area between rio Tocantins and rio Xingú but migrated south, driven out by other tribes, such as the Karajás, occupying briefly the region of the Ilha do Bananal (Baldus, 1970). The population size of the Tapirapés decreased significantly by the early 20th century, when there were about 50 individuals. In the present, the population is restricted to a reserve, and there has been an increase in their number. However, the reserve suffers constant invasions of farmers, aiming the expansion of their land, thus, jeopardizing the future of the Tapirapés.

DISCUSSION

Schaefer (1997) proposed a phylogenetic hypothesis for the species of the genus *Otocinclus*, where *O. affinis* plus *O. flexilis* (what the author referred as the *affinis* clade) form the sister group to all other *Otocinclus* (what the author referred as the *vestitus* clade). Within the latter, *Otocinclus hasemani*, and *Otocinclus xakriaba* are the successive sister groups to the remaining species (what the author referred as the orbis clade: *Otocinclus bororo*; *Otocinclus mariae*; *Otocinclus mura*; *Otocinclus huaorani*; *Otocinclus vestitus*; *Otocinclus hoppei*; *Otocinclus macrospilus*; *Otocinclus caxarari*; *Otocinclus vittatus*). In the present re-analysis of Schaefer's data (Table 1; for the list and discussion of the character and its states refer to Schaefer, 1997:103–109), including the new species, resulted in two trees incongruent only in the relationships of the outgroup. Thus, the outgroups were collapsed to a polytomy at the base of the consensus tree. Concerning the relationships of *Otocinclus* species (ingroup) only one phylogenetic scheme was obtained. Where *O. tapirape* was the sister group of *O. hasemani* plus the orbis clade (Fig. 5). Two features corroborated the assemblage formed by *O. hasemani* plus the orbis clade: the reduction of the lateral margins of the nuchal plate and the presence of paired W-shaped marks on the caudal fin. *Otocinclus tapirape* has a reduced lateral margin of the nuchal plate (Fig. 3) but not the paired W-shaped marks on the caudal fin.

Although no autapomorphies were identified, the new species is readily distinguished from its congeners on the basis of a combination of several character states. As mentioned above, *O. tapirape* is placed as a member of the *vestitus* clade. Like the remaining species in this clade, *O. tapirape* has an expanded subnasal lamina on lat-

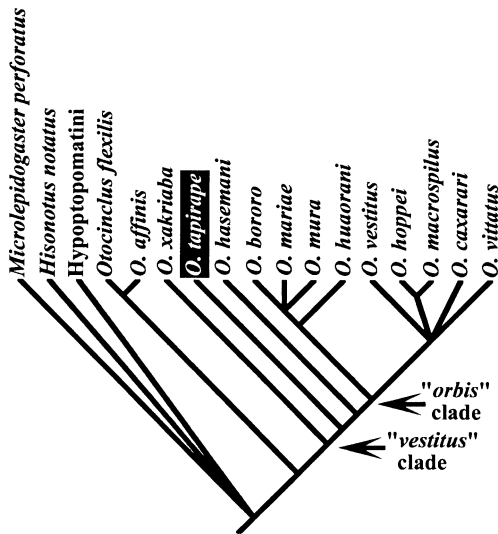


Fig. 5. Consensus tree showing relationships among species of *Otocinclus* (fundamental trees with length = 48, consistency index = 0.62, retention index = 0.76).

eral ethmoid (Fig. 2), a reduced number of vertebrae (27) and a reduced total number of lateral plates (20–22). Within that assemblage, *O. tapirape* is unique in having an iris diverticulum, combined with the absence of posterior canal-bearing plates. Within the *vestitus* clade, *O. xakriaba* and *O. hasemani* also have an iris diverticulum, but they possess eight to 10 posterior canal-bearing plates. Another representative of this clade, *O. vestitus*, also shows no posterior canal-bearing plates; however, it lacks an iris diverticulum. The new species has three to four perforated plates in the anterior field. Although an equal, or even a lower number of perforated anterior plates can be observed in other *Otocinclus* species, the mean number in *O. tapirape* (3.2) is the lowest among *Otocinclus* species (Schaefer, 1997:table 3).

Another feature observed in the new species, other Hypoptopomatinae, and some other Loricariidae examined is that which Schaefer (1997:29) described as hairlike pleural ribs. These ribs are peculiar structures, not present in any other nonloricariid catfishes. They are restricted to 10–12 vertebrae and are not directly articulated to the centra. Instead, the articulation is composed of a long connective tissue strand continuous with the rib (Fig. 6). In general appearance, these ribs are similar to intermuscular bones. However, they are associated with the peritoneal membrane rather than with the myoseptum, and thus, they are true ribs (Patterson and Johnson, 1995). Moreover, Silu-

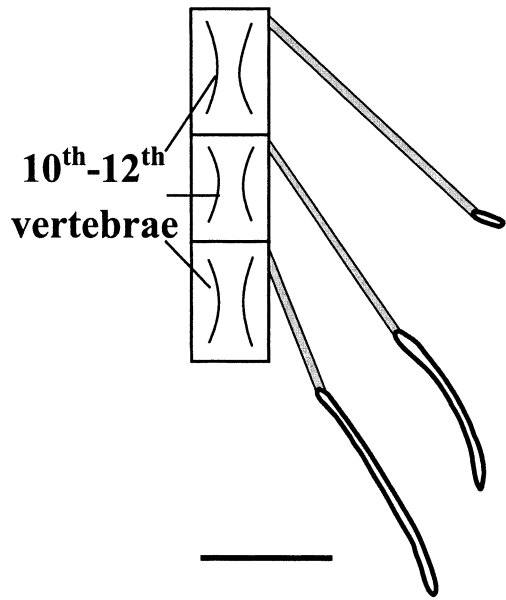


Fig. 6. Schematic illustration of vertebrae and ribs of *Otocinclus tapirape*, new species, paratype, MZUSP 73976. Gray areas represent ligaments. Scale bar = 1 mm.

riformes lack intermuscular bones (Roberts, 1973). Among non-*Otocinclus* hypoptopomatines examined, *Hypoptopoma* spp. has no ribs, except the well-developed rib on the sixth vertebra. However, this is a derived condition for a monophyletic group within the *Hypoptopoma*, the basal species possess the condition similar to the one described to *Otocinclus* (A. Aquino, pers. comm.). Armbruster (1997) assigned a character based on the thickness of the ribs other than the enlarged one on the sixth vertebra (character V17). However, the character states are concerned with absence or presence of the ribs and when ribs are present, whether the ribs are thin or thick. After a survey in some loricariids, we noted that the thin ribs (state 1) includes species with ribs contacting the vertebral centra, as well as species where this contact is absent, similar to the new species described herein. All hypoptopomatines examined have ribs as described for the new species (three to four pairs), except for *Hypoptopoma*, which has no ribs. A similar condition is observed in *Pariorhina rudolphi* (with ribs from vertebrae eight to 13) and *Hemipsilichthys mutuca* (with ribs from vertebrae eight to 16, with vertebrae 14 to 16 in contact with the centra). The reduction of the number of ribs may represent an additional synapomorphy for the Hypoptopomatinae, and the lack of contact between the ribs and the vertebral centra may represent a synapomorphy

for a more inclusive clade. A more detailed study of this character in a larger array of the Loricariidae should be made to verify its distribution and potential phylogenetic signal.

Comparative material examined.—*Otocinclus affinis* MZUSP 36562, 10 ex.; UFRJ 4660, 2 cs; *O. bororo* MZUSP 59908, 229 ex., 5 cs; *O. caxarari* MZUSP 51102, holotype; MZUSP 51602, paratypes, 9 ex.; *O. flexilis* MZUSP 51092, 2 cs; MZUSP 63811, 6 ex.; *O. hasemani* MZUSP 24195, 3 ex.; MZUSP 47854, 2 ex.; *O. hoppei* MZUSP 51097, 4 ex.; MZUSP 51098, 11 ex., 2 cs; UFRJ 4663, 2 cs; *O. macropilus* FMNH 101551, 45 ex., 1 cs; FMNH 101556, 14 ex., 2 cs; *O. mariae* MZUSP 37619, 1 cs; MZUSP 37644, 1 cs; MZUSP 51099, 43 ex., 3 cs; UFRJ 4762, 2 cs; *O. mura* MZUSP 51100, paratypes, 2 cs; MZUSP 52743, 4 ex.; UFRJ 4661, 2 ex.; *O. vestitus* MZUSP 54154, 8 ex.; UF 82035, 3 cs; UF 82450, 3 cs; *O. vittatus* MZUSP 54159, 30 ex.; UFRJ 4659, 2 cs; *O. xakriaba* MZUSP 39331, 2 cs; MZUSP 39352, 79 ex., 2 cs; *Hisonotus notatus* MZUSP 4665, 20 ex., 2 cs; *Hypoptopoma* sp.1 MZUSP 36195, 1 cs; *Hypoptopoma* sp.2 MZUSP 38144, 1 cs; *Hypoptopoma* sp.3 UFRJ 4664, 2 cs; *Oxyropsis* sp. MZUSP 38139, 2 cs; *Pseudotocinclus tietensis* MZUSP 63643, 1 cs; *Pseudotothyris obtusus* MZUSP 38138, 2 cs; *Ancistrus* sp. MZUSP 34176, 1 cs; *Ancistrus* sp. MZUSP 58680, 1 cs.; *Harttia loricariiformes* MNRJ 12153, 1 cs; *Hemipsilichthys mutuca* MZUSP 45883, 2 cs; *Hypostomus* sp. MZUSP 48126, 1 cs; *Neoplecostomus microps* MZUSP 51641, 4 cs; *Pareiorhina rudolphi* MZUSP 51630, 4 cs; *Pseudoloricaria punctulata* MZUSP 34542, 2 cs.

ACKNOWLEDGMENTS

We are grateful to H. Britski, M. I. Landim, F. Lima, M. de Pinna and J. Reid for suggestions that improved the manuscript, and to P. Souza and C. A. Figueiredo for the help in the preparation of Figure 1. We are also indebted to J. Albert, A. Aranda, P. Buckup, W. Costa, and M. A. Rogers for loan of material. Both authors were supported by FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo).

LITERATURE CITED

ARMBRUSTER, J. W. 1997. Phylogenetic relationships of the sucker-mouth armored catfishes (Loricariidae)

with particular emphasis on the Ancistrinae, Hypostominae, and Neoplecostominae. Unpubl. Ph.D. diss., University of Michigan, Ann Arbor.

- BALDUS, H. 1970. Tapirapé. Tribo tupi no Brasil Central. Editora da Universidade de São Paulo, São Paulo, Brazil.
- LEVINTON, A. E., R. H. GIBBS JR., E. HEAL AND C. E. DAWSON. 1985. Standards in herpetology and ichthyology. Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985:802–832.
- PATTERSON, C., AND G. D. JOHNSON. 1995. Intermuscular bones and ligaments of teleostean fishes. *Smiths. Contrib. Zool.* 559:1–85
- ROBERTS, T. S. 1973. Interrelationships of ostariophyans, p. 373–395. *In: Interrelationships of fishes.* P. H. Greenwood, R. S. Miles, and C. Patterson (eds.). Academic Press, London.
- SCHAEFER, S. A. 1987. Osteology of *Hypostomus plecostomus* (Linnaeus), with a phylogenetic analysis of the loricariid subfamilies (Pisces: Siluroidei). *Contr. Sci. Nat. Hist. Mus. Los Angeles Co.* 394:1–31.
- . 1990. Anatomy and relationships of the scoleoplacid catfishes. *Proc. Acad. Nat. Sci. Phila.* 142: 167–210.
- . 1991. Phylogenetic analysis of the loricariid subfamily Hypoptopomatinae (Pisces: Siluroidei: Loricariidae), with comments on generic diagnosis and geographic distribution. *Zool. J. Linn. Soc.* 102: 1–41.
- . 1997. The Neotropical cascudinhos: systematics and biogeography of the *Otocinclus* catfishes (Siluriformes: Loricariidae). *Proc. Acad. Nat. Sci. Phila.* 148:1–120.
- . 1998. Conflict and resolution: impact of new taxa on phylogenetic studies of the Neotropical cascudinhos (Siluroidei: Loricariidae), p. 375–400. *In: Phylogeny and classification of Neotropical fishes.* L. R. Malabarba, R. E. Reis, R. P. Vari, Z. M. S. Lucena, and C. A. S. Lucena (eds.). EDPUCRS, Porto Alegre, Brazil.
- SLOWINSKI, J. B. 1993. “Unordered” versus “ordered” characters. *Syst. Biol.* 42:155–165.
- TAYLOR, R., AND C. C. VAN DYKE. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybiurn* 9:107–119.
- MUSEU DE ZOOLOGIA DA UNIVERSIDADE DE SÃO PAULO, CX. POSTAL 42594, 04299–970 SÃO PAULO, SÃO PAULO, BRAZIL. E-mail: (MRB) mrbritto@ib.usp.br; and (CRM) cmoreira@ib.usp.br. Send reprint requests to MRB. Submitted: 13 Dec. 2001. Accepted: 7 June 2002. Section editor: S. A. Schaefer.