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Hypostomus macushi, a new species of the *Hypostomus cochliodon* group (Siluriformes: Loricariidae) from Guyana

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Abstract

Hypostomus macushi is described as a new species of the *H. cochliodon* group based on the presence of a light background with widely separated black spots. The only members of the *H. cochliodon* group with similar coloration are *H. cochliodon, H.ericae, H. ericius and H. paucipunctatus*. *Hypostomus macushi* can be separated from *H. cochliodon* by lacking a longitudinal ridge on the pterotic-supracleithrum and a lack of longitudinal dark stripes; from *H. ericius* by lacking keels formed from sharp odontodes on the lateral plates; from *H. ericae* and *H. paucipunctatus* by lacking a buccal papilla; from *H. ericae* by having spots in the distal dorsal and caudal fins not combining (vs. spots combining to form wavy lines); and from H. *paucipunctatus* by having medium to large spots (vs. very small spots). *Hypostomus macushi* is found in tributaries of the Essequibo and Negro Rivers of Guyana. The range of *H. taphorni* is additionally expanded to cover much of the Essequibo River basin in Guyana and a single locality in the Takutu River drainage. Addition of *H. macushi* and *H. sculpodon* to the phylogeny of the *Hypostomus cochliodon* group collapsed most of the clades found in a previous analysis. Only the *H. cochliodon* group, the wood-specializing species, and *H. ericius* + *H. oculeus* are supported as clades.

Hypostomus macushi é descrito como uma nova espécie do grupo *H. cochliodon* baseado no padrão de coloração do corpo claro com pontos esparços. Os únicos membros deste grupo com pigmentação similar são *H. cochliodon, H.ericae, H. ericius* e *H. paucipunctatus. H. macushi* difere de *H. cochliodon* pela ausência da crista do pterótico-supracleitro e pela ausência de listras largas; e difere de *H. ericius* pela presença de quilhas pouco desenvolvidas com odontóides arredondados; de *H. ericae* e *H. paucipunctatus* pela ausência de papila bucal; de *H. ericae* por apresentar máculas na porcão distal dorsal e nadadeira caudal organizados aleatóriamente (vs. máculas arranjadas formando linhas onduladas); e de *H. paucipunctatus* por porssuir máculas de tamanho médio a grande (vs. máculas diminutas). *H. macushi* é encontrado nos tributários dos Rios Essequibo e Negro, na Guiana. A distribuição de *H. taphorni* é expandida para a maior parte da bacia do Rio Essequibo e em uma localidade na drenagem do Rio Takutu. A adição de *H. macushi* e *H. sculpodon* na filogenia do grupo *H. cochliodon* colapsou a maioria dos clados encontrados em um estudo anterior.

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Somente o grupo *H. cochliodon*, que contém espécies especializadas em comer madeira, e o clado *H. ericius* + *H. oculeus* permaneceram suportados.

Key words: Hypostominae, South America, suckermouth armored catfishes, wood-eating

Introduction

On two recent expeditions to southern Guyana, a team from Auburn University, the Academy of Natural Sciences of Philadelphia, Iwokrama International Centre for Rain Forest Conservation and Development, and the University of Guyana Center for the Study of Biodiversity collected an undescribed species of the *Hypostomus cochliodon* group from streams draining into the Essequibo and Negro Rivers. The *Hypostomus cochliodon* group is one of two groups of loricariids whose members are known to consume wood as the major part of the diet (Schaefer and Stewart 1993; Nelson et al. 1999; Armbruster 2003). The *H. cochliodon* group consists of 16 currently described and accepted species (Armbruster 2003, Hollanda Carvalho & Weber 2004). Armbruster (2003) suggested that there were two new species in Guyana; however, one of these is actually *H. taphorni*. In this paper, the new species is described, and the range of *H. taphorni* is discussed. In addition, a cleared and stained specimen of *H. sculpodon* has been obtained, and the phylogeny of Armbruster (2003) is reviewed.

Methods

Methods and additional specimens examined from Armbruster (2003). Character data for *H. ericae*, *H. paucipunctatus*, *H. simios*, *H. soniae* and *H. waiampi* are from Hollanda Carvalho & Weber (2004). Institutional abbreviations are as in Leviton et al. (1985) with the addition of UG/CSBD for the University of Guyana, Center for the Study of Biological Diversity.

In the phylogenetic analysis, the outgroup consisted of specimens of *Hypostomus plecostomus*, a species that was found to be closely related to the *H. cochliodon* group (Armbruster 2004). All other species of *Hypostomus* examined had the same character states in this analysis as *H. plecostomus*, so no other outgroup was necessary. The ingroup consisted of all members of the *H. cochliodon* group except those recently described by Hollanda Carvalho and Weber (2004), which were not available for study, and internal skeletal characteristics were missing for *H. ericius* because no skeletons were available. A branch-and-bound search was performed in PAUP*, version 4.0b10, (Swofford 2002).

***Hypostomus macushi* New Species**
(Fig. 1)

Holotype: UG/CSBD 11047, Guyana, Rupununi (Region 9), 130.9 mm SL, Ireng River, 6.9 km WSW Karasabai, Takutu River - Negro River drainage, 04.01957°, -059.60170°, 1 November 2002, J.W. Armbruster, M.H. Sabaj, D.C. Werneke, C.L. Allison, M.R. Thomas, C.J. Chin, D. Arjoon, and L. Atkinson.

Paratypes: All collections Guyana, Rupununi (Region 9), Takutu River - Negro River drainage: ANSP 180211, 2 specimens, 37.2–99.2, AUM 35553, 3, 36.2–114.9, MCP 35157, 1, 67.3, and UG/CSBD 11048, 1, 86.9, same data as holotype; ANSP 180212, 2, 58.2–77.3, AUM 35540, 3, 50.5–94.5, MCP 35157, 1, 80.1, and UG/CSBD 11049, 2, 42.7–71.3, Yuora River, tributary of the Ireng River, 6.7 km NE Karasabai, 04.05399°, -059.45450°, 31 October 2002, J.W. Armbruster, M.H. Sabaj, C.L. Allison, M.R. Thomas, C.J. Chin, D. Arjoon, and L. Atkinson; ANSP 180213, 1, 38.9 and AUM 38884, 1, 34.4, Takutu River, 3.77 km SSW Lethem. 03.35500°, -059.83077°, 1 November 2003, J.W. Armbruster, M.H. Sabaj, M. Hardman, D. Arjoon, N.K. Lujan, and L.S. de Souza; and AUM 35544, 1, 34.4, Sauriwau River, 31.2 km NW village of Sand Creek, 03.11432°, -059.77544°, 4 November 2002, J.W. Armbruster, M.H. Sabaj, D.C. Werneke, C.L. Allison, M.R. Thomas, C.J. Chin, and D. Arjoon; AUM 35548, 1, 34.8.

Nontypes: All collections, Guyana, Essequibo River drainage: AUM 35510, 1, 141.5, Rupununi (Region 9), Simoni River, tributary of Rupununi River, 4 sites from 6.6 km SE to 3.2 km W Karanambo, 03.71917°, -059.26121°, 29 October 2002, J.W. Armbruster, M.H. Sabaj, C.L. Allison, M.R. Thomas, and R. Francis; AUM 35534, 1, 30.6, Rupununi (Region 9), Rupununi River, 4.6 km NW Massara, 03.92603°, -059.28037°, 26 October 2002, J.W. Armbruster, M.H. Sabaj, D.C. Werneke, C.L. Allison, M.R. Thomas, C.J. Chin, D. Arjoon, S.M. James, and S. Mario; AUM 35531, 3, 30.0–40.5, Rupununi (Region 9), Rupununi River at Karanambo, 03.75004°, -059.30835°, 29–30 October 2002, J.W. Armbruster, M.H. Sabaj, D.C. Werneke, C.L. Allison, M.R. Thomas, C.J. Chin, and D. Arjoon; and AUM 35548, 1, 34.8, Upper Demerara - Berbice (Region 10), Essequibo River at Kurukupari, east bank, 04.66149°, -058.67519°, 24 October 2002, J.W. Armbruster, M.H. Sabaj, D.C. Werneke, C.L. Allison, M.R. Thomas, C.J. Chin, D. Arjoon, and S.M. James.

Diagnosis: *Hypostomus macushi* can be separated from all other *Hypostomus* except the species of the *H. cochliodon* group based on the presence of large, spoon-shaped teeth (vs. viliform teeth and loss of the buccal papilla; and from all members of the *H. cochliodon* group except *H. cochliodon, H. ericae, H. ericius* and *H. paucipunctatus* by the presence of very widely spaced black spots on a light background. *Hypostomus macushi* can be separated from *H. cochliodon* by lacking a longitudinal ridge on the pterotic-supracleithrum and a lack of longitudinal dark stripes; from *H. ericius* by lacking keels formed from sharp odontodes on the lateral plates; from *H. ericae* and *H. paucipunctatus* by lacking a buccal papilla; from *H. ericae* by having spots in the distal dorsal and caudal fins not combining (vs. spots combining to form wavy lines); and from *H. paucipunctatus* by having

medium to large spots (vs. very small spots). *Hypostomus macushi* can additionally be separated from *H. cochliodon, H. ericius, H. oculeus, H. pyrineusi,* and *H. sculpodon* by having seven to eight adipose-caudal plates (vs. nine to 16); and from *H. hemicochliodon, H. hondae, H. pagei, H. plecostomoides, H. sculpodon, H. simios and H. soniae* by generally having no odontodes on the opercle (zero to 10), vs. having a patch of greater than 10 odontodes on the opercle.

Description: Morphometric data given in Table 1. Fairly small for *Hypostomus cochliodon* group, largest 141.5 mm SL. Body shape deep at origin of the dorsal fin then narrowing posteriorly causing body to appear humped. Body depth increases from snout to tip of supraoccipital at steep angle, angle of body depth increase decreases from tip of supraoccipital to dorsal-fin spinelet. Rounded ridge present from anterodorsal corner of orbit to posterior margin of nares; ridge widest and tallest posteriorly. Longitudinal ridge formed of raised bone and slightly larger odontodes absent on pterotic-supracleithrum beginning at postdorsal corner of orbit. Nuptial body odontodes present. Cheek plates generally support several stout odontodes slightly larger than surrounding odontodes.

TABLE 1. Morphometrics of *Hypostomus macushi*.

	Mean ± SD	Range
SL (mm)	65.4 ± 32.6	30.0 – 141.5
%SL		
Predorsal length	47.2 ± 2.7	43.9 – 54.3
Head length (HL)	39.5 ± 3	34.2 – 44.9
Snout-pectoral length	28.2 ± 2.4	23.9 – 32.4
Thorax length	25.7 ± 1.9	21.4 – 30.5
Pectoral-spine length	31.7 ± 2.8	26.4 – 35.3
Abdomen length	22.7 ± 1.7	19.8 – 25.6
Pelvic-spine length	24.4 ± 1.3	21.6 – 26.7
Postanal length	30.4 ± 1.7	26.9 – 33.6
Anal-fin length	12.9 ± 1.2	9.6 – 14.8
Caudal depth	10 ± 0.9	8.9 – 11.8
Adipose spine length	7.5 ± 1.7	0 – 10
Adipose-caudal length	15.9 ± 1.6	13.1 – 19.9
Interdorsal length	17.3 ± 1.4	14.9 – 20.3
Base of dorsal length	26.1 ± 2.9	20.8 – 31.1
Dorsal spine length	29.9 ± 4.2	19.1 – 36.0
Head depth	28.8 ± 1.3	26.1 – 30.9
Dorsal-pectoral length	31.7 ± 1.5	29.1 – 35.0

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TABLE 1 continued

	Mean ± SD	Range
Dorsal-pelvic length	22.4 ± 4.1	13.8 – 27.9
Pelvic-dorsal length	25.9 ± 3.4	15.8 – 30.2
Dorsal-anal length	15.4 ± 2	10.5 – 18.1
Adipose-anal length	18.8 ± 1.6	15.3 – 20.8
Anal-fin width	12.9 ± 1.2	9.6 – 14.8
Cleithral Width	30.4 ± 2.1	23.9 – 33.1
%HL		
Head-eye length	44.1 ± 2.1	39.2 – 47.1
Orbit length	19.2 ± 1.6	16.6 – 23.2
Snout length	62.5 ± 2.9	57.2 – 67.1
Eye-nare length	17.4 ± 2.8	11.9 – 22
Snout-nare length	40 ± 1.6	36.3 – 42.9
Internares width	17.1 ± 1.6	14.4 – 20.8
Interorbital width	49.6 ± 4.5	42 – 56.4
Eye height	25.2 ± 3.8	19.8 – 33.3
Head Width	75.8 ± 8.4	56 – 88.1
Mouth Width	40.7 ± 3	34.9 – 45.1
Mouth Length (ML)	45.1 ± 1.9	42.2 – 50.3
Dentary length	14.9 ± 1.7	11.7 – 20.5
%ML		
Mouth Width	90.4 ± 6.9	72.4 – 103.5

Rounded ridge present from posterodorsal corner of eye to end of pterotic-supracleithrum. Space between orbits concave such that dorsal rim of orbit raised above medial surface of head. Nares separated by flap of skin held erect in life. Dorsal, supramedian, median, and inframedian plate rows complete from head to caudal fin, ventral plate row begins at insertion of pelvic fin and continues to caudal fin. Lateral plates with very short median keels formed from ridge of bone and enlarged odontodes; keel odontodes not sharp; keels of first three plates of supramedian plate row angled dorsally, confluent with keel of dorsal plate row; keels on first three plates of dorsal row forming angle from tip of supraoccipital to posterolateral corner of nuchal plate, not confluent with keel on dorsal plate row beginning on fourth plate. Base of caudal fin covered in elongate, roughly triangular plates. Entire ventral surface of head and body (including space above pectoral- and pelvic-fin rays) of most adults covered in small platelets, platelets often extending onto base of pectoral- and pelvic-fin rays ventrally; some adults with broad, naked areas around insertions of pelvic-fin spines. Zero to few small platelets present in skin between dorsal

fin and lateral plates of adults. Platelets on abdomen and near fins increase in number with standard length. Head covered in small plates. Frontal, nasal, sphenotic, infraorbitals, pterotic-supracleithrum, suprapreopercle, and supraoccipital supporting odontodes. Opercle typically without odontodes, but one to 10 may be present in some individuals. Some odontodes present on posterior margin of preopercle. Platelets that cover anteroventral corner of opercle slightly separated from opercle allowing plates to be marginally everted (angle of eversion less than 30°).

Dorsal fin moderately long, usually just barely reaching preadipose plate when depressed, consisting of small, *V*-shaped spinelet, fairly strong spine, and seven rays. Caudal fin forked, lower lobe longer than upper. Pectoral-fin spine strong, reaches posterior to pelvic-fin rays when depressed ventral to pelvic fin; cleithrum with exposed process dorsal to pectoral-fin rays that tapers posteriorly to point; pectoral fin inserted on same plane as pelvic fin such that spine, when depressed parallel with body, lies on top of and in contact with pelvic fin. Pelvic-fin spine thin, flexible, reaches origin of anal fin when depressed. Anal fin with relatively strong, unbranched first ray that supports odontodes. Adipose fin consisting of single median, unpaired preadipose plate and a stout, strong, pointed spine; adipose-fin membrane not reaching procurrent caudal-fin spines. Dorsal fin II7; pectoral fin I6; pelvic fin I5, anal fin I4, caudal fin I14I. Jaws strongly angled, dentaries forming angle of less than 80°. Teeth few (six to nine in dentary, mode eight, and five to eight in premaxilla, mode six), spoon-shaped. Lateral line plates 26–29; dorsal plates seven to eight; interdorsal plates six to seven; adipose-caudal plates seven to eight.

Color light gray to tan when alive, becoming tan when preserved. Body covered with small- to medium-sized spots widely separated from one another, head spots just slightly smaller than body spots. Spots on all fins except anal fin generally larger than spots on body, centered on rays and spines; anal fin with one to two bands or mottled. Caudal fin generally with clear area at base and spots almost fading into a dark wash distally. Abdomen slightly lighter than sides, with fewer spots (spots absent on abdomen in juveniles. Spots relatively larger in juveniles. Juveniles with bands in the dorsal and paired fins, and caudal with a distal clear band that does not extend completely into the lower lobe, preceded by a dark band that extends to the tip of the lower lobe, preceded by a clear area. Juveniles with a dark bar at end of caudal peduncle

Range: Currently known from the middle and lower Rupununi River, the Essequibo River at Kurukupari, and the Takutu and Ireng Rivers (Negro River drainage) along the Guyana-Brazil border (Fig. 2).

Ecology: Found among submerged, dead wood in modest to swift flow. The Macushi people collected the holotype and several of the paratypes collected with it by spearing them in fairly deep (2m) water in the Ireng River.

Etymology: Named for the Macushi people of the northern Rupununi who provided us with a lot of help and hospitality on our journeys to Southern Guyana, and who collected most of the best specimens in the type series. Treated as a noun in apposition.

FIGURE 1. Dorsal, lateral, and ventral views of the holotype of *Hypostomus macushi*, UG/CSBD 11047, 130.9 mm SL. Photos by J.W. Armbruster.

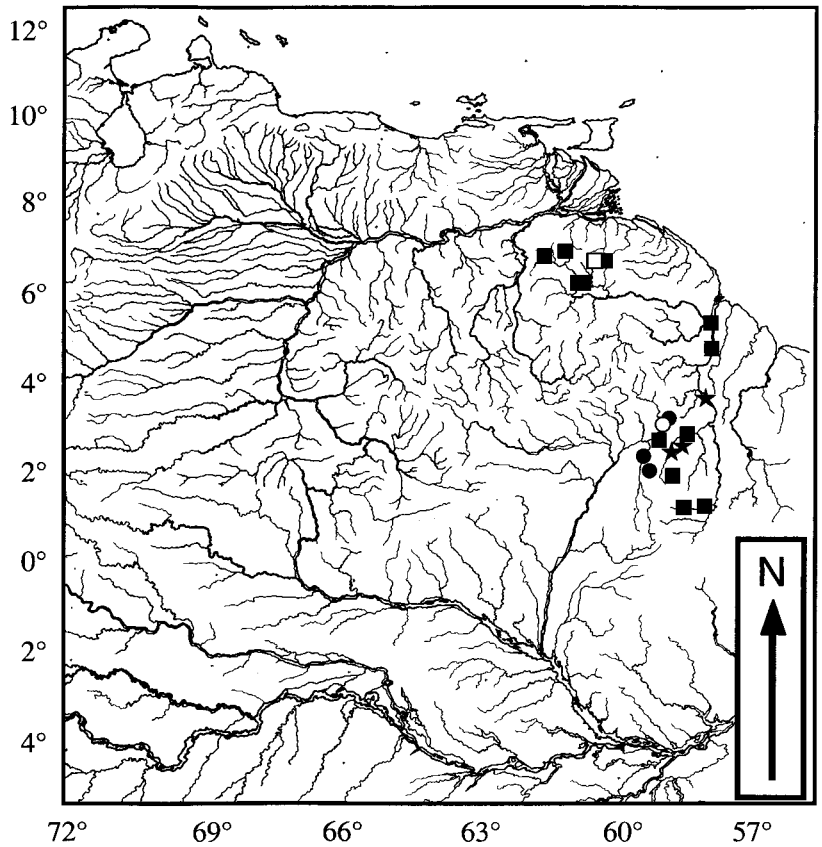

FIGURE 2. Range of *Hypostomus macushi* (dots) and *H. taphorni* (squares) or where both were collected (stars). Open symbols are type localities.

Phylogeny

The phylogenetic analysis of the *Hypostomus cochliodon* group (Armbruster, 2003) was based on few characters, two of which were incorrectly labeled (Character 6 should have referred to the deflection of the preoperculo-hyomandibular crest and not the presence of a notch between the hyomandibula and metapterygoid; and Character 9 should have had State 0 as absent and State 1 as present; text is corrected below). These errors did not alter the phylogeny presented in Armbruster (2003), and the remainder of the text is correct on the distribution of these characters. Character 11 is added below for the presence or absence of a notch between the hyomandibula and metapterygoid. Armbruster (2003) stated that a notch was not present in *H. hemicochliodon;* and he suggested that it was a synapomorphy for wood specializing members of the *H. cochliodon* group. However, no specimens of *H. sculpodon* were available at that time for skeletal analysis. A specimen of *H. sculpodon* is now available for skeletal analysis (AUM 39476), and it does lack the notch between the metapterygoid and hyomandibula as in the wood-specializing species.

Hypostomus sculpodon lacks the spoon-shaped teeth of wood-specializing species, suggesting that the notch was lost prior to the evolution of this group. Species recently described by Hollanda Carvalho and Weber (2004) were not available for analysis. Because of the problems with the character list of Armbruster (2003) and the addition of Character 11, the character list is updated below, and a new character state matrix is provided (Table 2).

Character 1: Teeth—0: elongate; 1: intermediate throughout life; 2: spoon-shaped at least in adults.

Character 2: Maxilla—0: straight to moderately curved; 1: greatly curved, almost forming right angle.

Character 3: Odontodes on opercle—0: 11+; 1: 0–10.

Character 4: Longitudinal ridge formed from bone and slightly enlarged odontodes on pterotic-supracleithrum—0: present; 1: absent.

Character 5: Nuptial body odontodes—0: absent; 1: present.

Character 6: Preoperculo-hyomandibular ridge deflected posterior to the main body of the hyomandibula—0: absent; 1: present.

Character 7: Buccal papilla—0: present; 1: absent or extremely small.

Character 8: Dentary angle—0: averaging greater than 90°; 1: averaging less than 80°.

Character 9: Sharp keel odontodes—0: absent; 1: present.

Character 10: Body shape deep and narrow with the head taller than wide—0: absent; 1: present.

Character 11: Notch between the hyomandibula and metapterygoid—0: present; 1: absent.

TABLE 2. Character state matrix for phylogenetic analysis.

	Character										
Species	1	2	3	4	5	6	7	8	9	10	11
H. plecostomus	0	0	0	0	0	0	0	0	0	0	0
H. cochliodon	2	1	0&1	0	1	1	1	1	0	1	1
H. ericius	2	?	1	1	1	?	1	1	1	1	1
H. hemicochliodon	1	0	0	0	0	0	0	1	0	1	0
H. hondae	2	1	0	1	0	1	1	1	0	1	1
H. levis	2	1	1	1	?	1	1	1	0	1	1
H. macushi	2	1	1	1	1	1	1	1	0	1	1
H. oculeus	2	1	1	1	1	1	1	1	1	1	1
H. pagei	2	1	0	1	0	1	1	1	0	1	1
H. plecostomoides	2	1	0	1	0	1	1	1	0	1	1
H. pyrineusi	2	1	1	1	1	1	1	1	0	1	1
H. sculpodon	1	0	0	0	0	1	0	1	0	1	1
H. taphorni	2	1	1	1	0	1	1	1	0	1	1

Phylogenetic analysis resulted in 12 trees of 14 steps, CI = 0.857 (Fig. 3). The additions of *Hypostomus macushi* and the skeletal characteristics of *H. sculpodon* collapsed nearly all of the clades reported in Armbruster (2003). The result is that the current evidence only supports the *H. cochliodon* group as monophyletic, the wood specializing species as monophyletic, and a sister group relationship of *H. ericius* and *H. oculeus*. Skeletal morphology is fairly conserved among the species of the *H. cochliodon* group, and additional types of characters (such as gene sequences) will be necessary to elucidate the relationships of the species.

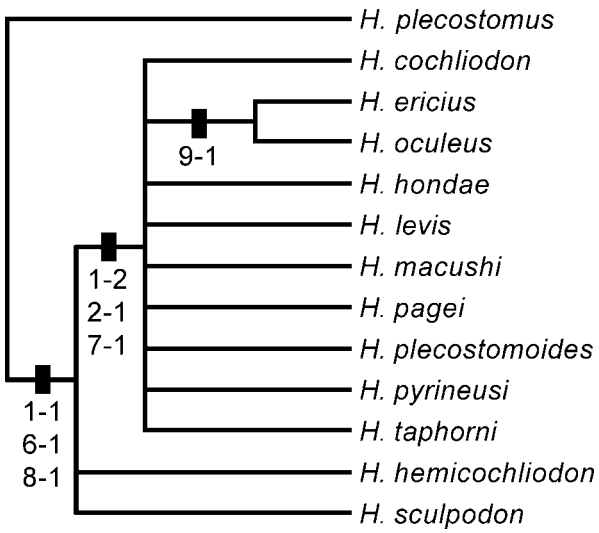

FIGURE 3. Strict consensus of 12 most parsimonious tree of 14 steps, CI = 0.857. A skeleton of *Hypostomus ericius* is not available, thus placement of skeletal characters for this species is based on speculation (see Armbruster 2003).

Discussion

In addition to *Hypostomus macushi*, *H. taphorni* was also collected in Guyana (Fig. 2). Interestingly, the only specimens of *H. taphorni* collected in the Takutu River drainage were collected in the Pirara River. The Pirara River is where the Rupununi River connects to the Takutu River during the rainy season (Lowe-McConnell 1964), and it is possible that *H. taphorni* has only recently invaded the Takutu River drainage.

Specimens of *Hypostomus taphorni* examined from Guyana: AUM 35509 and AUM 35522, Rupununi (Region 9), Simoni River, tributary of Rupununi River, 4 sites from 6.6 km SE to 3.2 km W Karanambo, 03.71917°, -059.26121°; AUM 35527, Pirara River, Rupununi (Region 9), tributary to Ireng - Takutu Rivers, 3.5 km NNW Pirara, 03.64870°, -

059.68897°; AUM 35528, Rupununi (Region 9), Rupununi River at Karanambo, 03.75004°, -059.30835°; AUM 35533, Rupununi (Region 9), Rupununi River, 4.6 km NW Massara, 03.92603°, -059.28037°; AUM 35543, Rupununi (Region 9), Stream, tributary of Rupununi River, 10.3 km NW Karanambo, 03.80758°, -059.38490°; AUM 35547, Upper Demerara - Berbice (Region 10), Essequibo River at Kurukupari, east bank, 04.66149°, -058.67519°; AUM 35552, Rupununi (Region 9), Hassar Pond and outlet, tributary of Ireng River, 5.4 km SSE Massara, 03.84436°, -059.28584°; AUM 38095, Rupununi (Region 9), Madkauwau Creek, tributary of Kuyuwini - Essequibo Rivers, between Kuyuwini Landing and Parabara, 155 km SSE Lethem, 02.09672°, -059.24346°; AUM 38931, Rupununi (Region 9), Backwater and mainstem of Kuyuwini River, Essequibo River drainage, 19.5 km W mouth of Kuyuwini River. 02.24098°, -058.50093°; AUM 38975, Rupununi (Region 9), Araquai Creek, tributary of Rupununi River, 77.3 km SSE Lethem, 02.76261°, -059.4660°.

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