

A new catfish species of the *Trichomycterus hasemani* group (Siluriformes: Trichomycteridae), from the Branco river basin, northern Brazil

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Abstract

Trichomycterus wapixana is described from the Branco river basin, Roraima State, northern Brazil. It belongs to the *T. hasemani* group, composed of *T. hasemani*, *T. johnsoni* and *T. anhangá* and defined by the presence of a single wide cranial fontanel delimited by the frontal and supraoccipital, absence of the pores i1 and i3, absence of branchiostegal rays on the posterior ceratohyal and the by the presence of a large and distally expanded process on the palatine. It differs from the other species of that assemblage by having a unique combination of character states, including number of vertebrae, relative position of anal fin, relative position of pelvic and dorsal fin, presence of pelvic fin and pelvic girdle, number of dorsal and ventral procurrent rays in the caudal fin, anal-fin rays, pectoral-fin rays, branchiostegal rays, pleural ribs, morphology of palatine, presence of parasphenoid and relative position of urogenital pore.

Key words

Trichomycterus hasemani group, taxonomy, Trichomycteridae, miniaturization.

Introduction

Trichomycteridae is a family of catfishes comprising 278 valid species (ESCHMEYER & FONG, 2014) distributed from Costa Rica to Patagonia, in both cis- and trans- Andean drainages (DE PINNA, 1998). Trichomycterinae is the only one of the eight recognized subfamilies which monophyly has not been supported in phylogenetic studies (BASKIN, 1973; DE PINNA 1989; COSTA & BOCKMANN, 1993). *Trichomycterus* VALENCIENNES is the most species-rich genus of the family, comprising over 140 species (FERNANDEZ & VARI, 2009; KATZ *et al.*, 2013). Its extensive geographical range, high number of described species and lack of synapomorphies make *Trichomycterus* a huge taxonomic problem within the Trichomycteridae (BARBOSA & COSTA, 2003). This condition is illustrated by the description of *Ituglanis* COSTA & BOCKMANN 1993, in which this new genus was described based on nine species that were pre-

viously placed in *Trichomycterus* (COSTA & BOCKMANN, 1993).

Despite ARRATIA (1990) and DATOVO & BOCKMANN (2010) tried to establish derived character states for the Trichomycterinae, these works did not include *Trichomycterus hasemani* (EIGENMANN, 1914) and *T. johnsoni* (FOWLER, 1932). According to de PINNA (1989), *T. hasemani* and *T. johnsoni* are each other closest relatives and *T. hasemani* is related to the Tridentinae due to their expanded cranial fontanel, considering all these taxa derived from a single miniaturization event. Recently, DUTRA *et al.* (2012) described *T. anhangá* DUTRA, WOSIACKI & DE PINNA 2012 as being closely related to *T. hasemani* and *T. johnsoni*, naming the “*T. hasemani* group” for this species assemblage. The “*T. hasemani* group” is monophyletic and possibly related to non-Trichomycterinae

taxa (DE PINNA, 1989, DUTRA *et al.*, 2012). The geographical distribution of this group contrasts with the distribution of other species placed in *Trichomycterus*, by occurring in lowlands of the Amazon rainforest and Pantanal, instead of being endemic to mountain river drainages of southeastern and southern Brazil (BARBOSA & COSTA, 2010), Andes (ARRATIA, 1998) and those draining the Guyana Shield (EIGENMANN, 1909; EIGENMANN, 1912; LASSO & PROVENZANO, 2002). The new species herein described was collected in the Branco river basin.

Material and Methods

Measurements follow DUTRA *et al.* (2012) with the addition of pre-pelvic length (from the middle of the pelvic-fin base to the snout tip). Measurements are presented as percentages of standard length (SL), except for subunits of the head, which are presented as percentages of head length (HL). Counts, following BARBOSA & COSTA (2003), were made only in cleared and stained specimens (c&s) prepared following TAYLOR & VAN DYKE (1985). Scale bars = 1 mm. Nomenclature for the latero-sensory system is according to ARRATIA & HUAQUIN (1995). Specimens were euthanized submerging them in a buffered solution of Ethyl 3-aminobenzoate methanesulfonate (MS-222) at a concentration of 250mg/l, for a period of 10 min, following the guidelines of the Journal of the American Veterinary Medical Association (AVMA Guidelines), and European Commission DGXI consensus for fish euthanasia. Material is deposited in the ichthyological collection of the Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro (UFRJ), Field Museum of Natural History (FMNH) and in the Academy of Natural Sciences of Philadelphia (ANSP). The method for species delimitation follows the Population Aggregation Analysis (DAVIS & NIXON, 1992), in which one or more populations are recognized as a species by a unique combination of character states.

Trichomycterus wapixana new species

Fig. 1a – b; Fig. 2

Holotype. UFRJ 10251, 14.0 mm SL; Brazil: Estado de Roraima: Município de Bonfim: flooded areas in the Tacutu river drainage, tributary of the Branco river drainage, Amazonas river basin, 03° 24' 07" N 59° 56' 23" W, altitude about 110 m; collected by E. Henschel, F. P. Ottoni, P. Bragança; 10 September 2012.

Paratypes. UFRJ 8946, 7 ex., 12.5–14.5 mm SL; UFRJ 9006, 3 ex., 13.5–13.8 mm SL; UFRJ 9369, 3 ex. (c&s), 12.9–13.8 mm SL; all collected with holotype. UFRJ 8945, 3 ex., 13.9–15.5 mm SL; UFRJ 9004, 3 ex., 14.3–15.7 mm SL; UFRJ 9457, 1 ex. (c&s), 14.1 mm SL; Brazil: Estado de Roraima: Município de Bonfim: grove with buriti palms 65km after the bridge over Branco river, Branco river basin, 03° 09' 30" N 60° 14' 48", altitude about 120 m;

same collectors as the holotype; 10 september 2012. UFRJ 8951, 3 ex., 13.3–13.5 mm SL; UFRJ 9455, 1 ex. (c&s), 13.3 mm SL; Brazil: Estado de Roraima: Município de Bonfim: igarapé 29km after the bridge over rio Branco, rio Branco basin, 02° 56' 14.0" N 60° 27' 39.6" W, altitude 94 m; same collectors as the holotype; 10 september 2012. UFRJ 8952, 3 ex., 12.1–13.9 mm SL; UFRJ 9460, 1 ex. (c&s), 12.8 mm SL; Brazil: Estado de Roraima: Município de Cantá: Quitauá river, Branco river basin, 02° 34' 02.0" N 60° 38' 08.4" W, altitude 82 m; same collectors as the holotype; 13 september 2012. UFRJ 8965, 1 ex., 13.5 mm SL; UFRJ 9461, 1 ex. (c&s), 13.3 mm SL; Brazil: Estado de Roraima: Município de Caracará: igarapé in rio Anauá drainage, rio Branco basin, 01° 27' 56.0" N 60° 47' 04.4" W, altitude 75 m; same collectors as the holotype; 18 september 2012. UFRJ 8950, 7 ex., 13.2–15.1 mm SL; UFRJ 9005, 4 ex., 13.3–13.9 mm SL; UFRJ 9370, 2 ex. (c&s), 13.4–4.9 mm SL; Brazil: Estado de Roraima: Município de Caracará: riacho in Anauá river drainage, Branco river basin, 01° 12' 06.0" N 60° 18' 38.6" W, altitude 97 m; same collectors as the holotype; 16 september 2012.

Additional material (non-types). UFRJ 8957, 8 ex., 13.2–14.6 mm SL; UFRJ 9007, 5 ex., 12.9–13.8 mm SL; UFRJ 9462, 3 ex. (c&s), 14.3–15.0 mm SL; Brazil: Estado de Roraima: Município de Rorainópolis: igarapé in Jauaperi river drainage, Negro river basin, 00° 43' 54.7" N 60° 27' 27.4" W, altitude 82 m; collected by E. Henschel, F. P. Ottoni, P. Bragança; 14 september 2012.

Comparative material. *Trichomycterus hasemani*: FMNH 56424, holotype, 10.0 mm SL; Brazil: Estado do Pará: Santarém (only photographs and X-ray). UFRJ 9465, 3 ex., 15.7–17.8 mm SL; UFRJ 9653, 3 ex. (c&s), 16.7–17.3 mm SL; Brazil: Estado do Pará: Santarém: Lago do Maicá. *Trichomycterus johnsoni*: ANSP 53873, holotype, 16.0 mm SL; Brazil: Estado do Mato Grosso: Descalvados (only photographs). UFRJ 3823, 22 ex., 12.6–14.6 mm SL; UFRJ 9061, 1 ex. (c&s), 14.0 mm SL; UFRJ 9368, 4 ex. (c&s), 12.3–12.9 mm SL; Brazil: Estado do Mato Grosso: Cáceres: Paraguai river basin.

Diagnosis. *T. wapixana* is distinguished from all other species of the *T. hasemani* group by the presence of 34 to 36 vertebrae (vs. 32 in *T. hasemani* and *T. johnsoni*, 29 to 32 in *T. anhangá*); the origin of the anal fin in a vertical through the base of the 20th, 21st or 22nd vertebra (vs. 18th in *T. hasemani*, 17th in *T. johnsoni* and 16th in *T. anhangá*). It is distinguished from *T. hasemani* and *T. johnsoni* by having the origin of the pelvic fin in a vertical between the base of 15th and 17th vertebrae (vs. 14th in *T. hasemani* and 13th in *T. johnsoni*) and by the presence of a dark spot on the middle of the lower lip (vs. absence). *Trichomycterus wapixana* differs from *T. anhangá* by the presence of pelvic fins and girdle (vs. absence); the presence of 10 to 11 dorsal procurent rays in the caudal fin (vs. 6 to 8); the presence of 9 to 12 ventral procurent rays in the caudal fin (vs. 6 to 7); the presence of seven (ii + 5 or iii + 4) anal fin rays (vs. ii + 4); the presence of five (i + 4 or ii + 3) pectoral fin rays (vs. i + 2); the origin of the dorsal fin at vertical through the base of the 20th, 21st or 22nd vertebra (vs. 16th or 17th); the presence of six branchiostegal rays (vs. four or five); the presence of two pairs of pleural ribs on first two vertebrae posterior to Weberian Complex (vs. single pair); the presence of a series of dark brown spots in the lateral midline of the body (vs. absence); the broad palatine (Fig. 4) (vs. narrow, comma-shaped palatine) (DUTRA *et al.*, 2012; fig. 2a) and by the presence of the parasphenoid (vs. absence). It differs further from *T. johnsoni* by the origin of the urogenital pore in

Table 1. Morphometric data of *Trichomycterus wapixana*.

	H	Range	Mean	Standard deviation
Standard length (mm)	14.0	12.1–15.5	13.6	—
Percentage of standard length				
Total length	120.0	117.9–124.8	121.9	1.6
Body depth	17.1	14.8–18.5	16.7	1.0
Peduncle length	9.3	8.7–14.31	10.4	1.0
Predorsal length	69.3	65.2–74.4	71.6	1.7
Preanal length	69.3	65.9–76.0	71.4	2.0
Prepelvic length	57.1	54.5–62.6	59.1	1.9
Dorsal fin base length	7.9	6.2–12.6	8.9	1.3
Anal fin base length	10.0	6.2–10.1	8.2	1.1
Head length	13.6	13.5–18.1	15.5	1.3
Percentage of head length				
Head width	126.3	88.5–127.8	108.2	9.2
Head depth	78.9	53.8–70.0	62.8	4.6
Interorbital	31.6	25.0–36.0	29.3	3.0
Snout length	52.6	33.3–52.6	41.1	5.0
Nasal barbel length	63.2	35.0–68.4	52.0	8.2
Maxillary barbel length	100.0	63.2–119.0	85.5	12.0
Rictal barbel length	78.9	47.4–90.5	69.4	10.5
Mouth width	42.1	15.8–44.4	36.0	5.2
Eye diameter	15.8	9.5–16.7	13.2	2.0


Fig. 1. *Trichomycterus wapixana*: UFRJ 10251, 14.0 mm SL (holotype): Tacutu river drainage. (A) lateral view; and (B) dorsal view. Photos by: Axel Katz.

a vertical between the base of the 17th and 19th vertebrae (vs. 15th).

Description. Morphometric data for holotype and paratypes given in Table I. Body elongate, subcylindrical on anterior portion, gradually compressed until caudal peduncle. Dorsal profile slightly convex between snout and pectoral-fin origin, straight from that point to caudal peduncle. Ventral profile straight between tip of the snout and insertion of the pectoral fin, gently convex from that point to pelvic-fin origin and straight to end of caudal

peduncle. Greatest body depth in vertical immediately in front of pelvic-fin origin. Dorsal and anal fins approximately triangular. Dorsal-fin origin in vertical through base of 20th, 21st or 22nd vertebra. Anal-fin origin in vertical through base of 20th, 21st or 22nd vertebra. Pelvic-fin origin in vertical through base of 15th, 16th or 17th vertebra. Pectoral fin about triangular. First pectoral-fin ray terminating in long filament, about 30–40% pectoral-fin length. Pelvic fin not covering urogenital pore, bases separated by interspace; insertion in vertical through base of 15th, 16th or 17th vertebra. Caudal fin truncate. Dorsal-fin



Fig. 2. Live specimen of *Trichomycterus wapixana*: UFRJ 8957; about 13.2 mm SL. Photo by: Pedro Bragança.

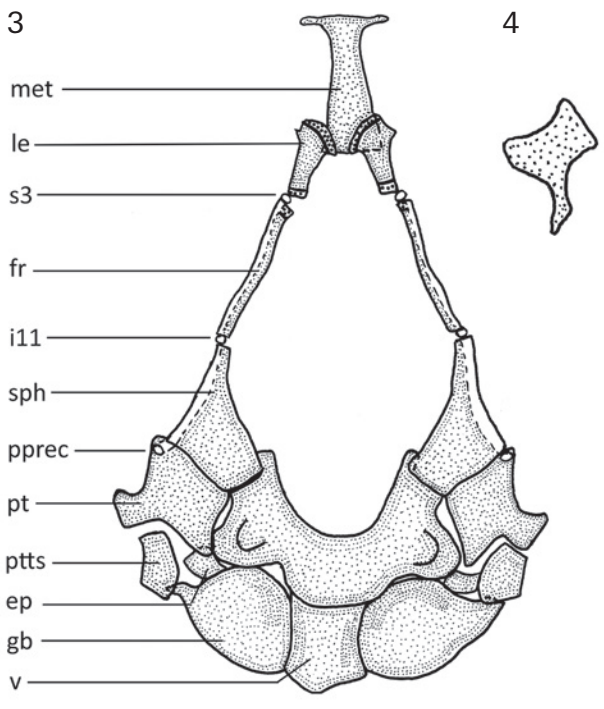
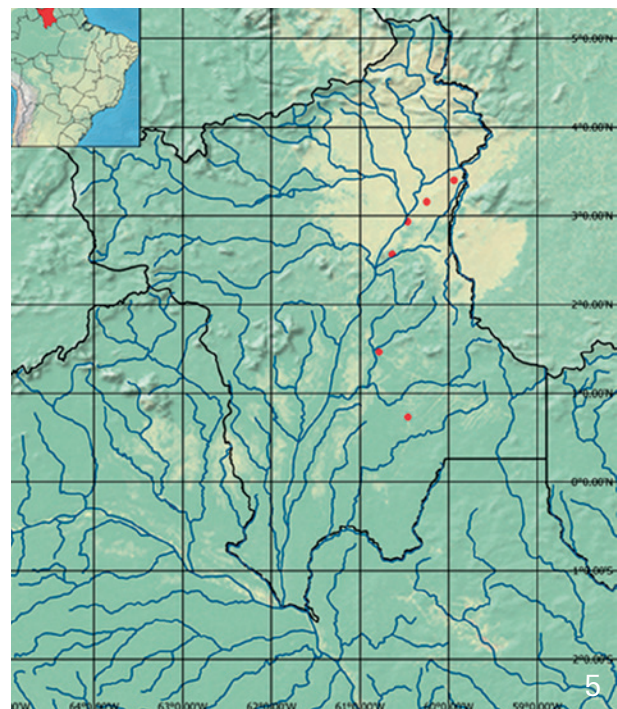


Fig. 3. Dorsal view of neurocranium of *Trichomycterus wapixana*: UFRJ 9461, 13.3 mm SL (paratype). ep = epiotic; fr = frontal; gb = gasbladder capsule; i11 = infraorbital 11 pore; le = lateral ethmoid; met = mesethmoid; pprec = preopercular pore; pt = pterotic; ptts = posttemporosupracleithrum; s3 = supraorbital 3 pore; sph = sphenotic; v = first vertebra. Scale bar = 1.0 mm.

Fig. 4. Palatine of *Trichomycterus wapixana*: UFRJ 9461 (paratype). Scale bar = 1.0 mm.

Fig. 5. Distribution of *Trichomycterus wapixana*.



rays 7–8 (iii + 4, ii + 5 or iii + 4, iii + 5); anal-fin rays 7 (iii + 4, ii + 5); pectoral-fin rays 5 (ii + 3, i + 4); pelvic-fin rays 4 (ii + 2); caudal-fin principal rays 12 (ii + 8 + ii, i + 9 + ii), dorsal procurrent rays 10 to 11, ventral procurrent rays 9 to 12. Total vertebrae 34 to 36; pleural ribs on first two vertebrae posterior to Weberian Complex.

Head trapezoidal in dorsal view. Mouth subterminal. Teeth conical. Tip of nasal barbel reaching posterior tip of interopercular patch of odontodes. Tip of maxillary barbel reaching middle of interopercular patch of odontodes. Tip of rictal barbel reaching posterior tip of interopercular patch of odontodes. Six branchiostegal rays. Odontodes conical. Interopercular odontodes 6 to 11, opercular

odontodes 9 to 14. Lateral line with two pores, LL1 and LL2. Cephalic portion of latero-sensory canal system restricted to s3, i11 and a praeopercular pore, S4.

Colouration in preserved specimens (Fig. 1a and b). Ground colour cream. Head with dark brown spot extending from anterior surface of eye to anterior margin of upper lip. Dorsal region of neurocranium with light brown spot. Dark brown spot on basis of opercular patch of odontodes and on basis of interopercular patch of odontodes. Ventral surface of head with small dark spots on upper lip and dark spot on lower lip. Nasal, maxillary and rictal barbels with small dark spots concentrated at basis.

Dorsal and lateral surfaces of body with chromatophores distributed between head and caudal peduncle. Ventral surface of body with chromatophores concentrated on head and between pelvic and anal fins. Lateral surface with series of dark brown spots.

Dorsal and anal fin hyaline with dark brown blotch on basis of rays. Caudal fin with small dark brown chromatophores. Caudal fin with light brown bar on basis of rays and with small dark brown spot on middle of basis of rays. Pectoral fin hyaline with small dark spot on basis of filament. Pelvic fin hyaline with dark small spot on basis of fin.

Etymology. The wapixana is a native tribe from the Serra da Lua region in western Roraima state, northern Brazil. These natives have occupied this region for, at least, three centuries. The villages of Cantá and Bonfim, where *Trichomycterus wapixana* was mainly collected, are situated in this area. The Wapixana tribe was oppressed by other native tribes and by colonisers, fact that contributed for a huge cultural loss.

Distribution. Known from the Branco and Negro river drainages, Amazonas river basin (Fig. 5).

Discussion

The “*Trichomycterus hasemani* group” has been considered as an *incertae sedis* group among trichomycterids. The first approach concerning the relationships between *T. hasemani* and *T. johnsoni* was made by DE PINNA (1989), where these species were proposed to constitute a clade more related to the Tridentinae than to the Trichomycterinae. This hypothesis was based on the presence of an expanded cranial fontanel delimited by the frontal and supraoccipital in the two taxa. Later, DE PINNA (1998), in a cladogram with information combined from several authors, listed the following synapomorphies to support the clade comprising the Vandelliinae, Stegophilinae and Tridentinae: 1 – absence of lacrimal; 2 – lateral opening of Weberian capsule at the end of a neck like constriction; 3 – jaw teeth S-shaped; 4 – mesethmoid cornu with ventral process. The *T. hasemani* group shares with this clade only the second condition, which makes the hypothesis of sister group relationships between the *T. hasemani* group and the Tridentinae doubtful.

DUTRA *et al.* (2012) established the following character states to diagnose the *T. hasemani* group: 1 – a wide fontanel that occupies most of the skull roof and is delimited by the frontal and supraoccipital (Fig. 3); 2 – absence of the anterior portion of the infraorbital canal (pores i1 and i3); 3 – first pectoral-fin ray much longer than other rays; 4 – absence of branchiostegal rays on the posterior ceratohyal; and 5 – a large posterior process of the palatine, partly forked and expanded distally (Fig. 4). The species herein described shares all these five char-

acter states with *T. hasemani* and *T. johnsoni*. However, the palatine condition (Fig. 4) is quite different from the other species of the group in *T. anhangá*, since the partly forked posterior process of the palatine is entirely absent in this species (DUTRA *et al.*, 2012; fig. 2a).

COSTA & BOCKMANN (1994) stated that a sister-group relationship between Sarcoglanidinae and Glanapteryginae would be supported by the reduced dorsal portion of the quadrate, the presence of a large anteriorly directed process in the hyomandibula, vomer rudimentary and miniaturization. *Trichomycterus wapixana*, *T. hasemani* and *T. johnsoni* share with these two subfamilies the last three character states. These authors also established a clade comprising Sarcoglanidinae, Glanapteryginae, Tridentinae, Vandelliinae and Stegophilinae, the so-called TSVSG clade, on the basis of an interopercular patch of odontodes reduced in length and with 15 or fewer odontodes, a reduction in number of the pleural ribs (1–8), a short posterior portion of the parasphenoid, its tip not reaching the basioccipital or extending only to its anterior part, and metapterygoid reduced or absent. *Trichomycterus wapixana*, *T. hasemani* and *T. johnsoni* also have all these character states. Since these character states are unique within the Trichomycteridae, they indicate that possibly the *T. hasemani* group is closely related to the TSVSG clade. However, the position of the group within the family cannot be exactly established, which depends on an inclusive phylogenetic analysis, which is beyond the scope of this study. These species thus remain allocated in *Trichomycterus* until a proper phylogenetic analysis is developed.

Other miniature Amazonian species-groups also have a problematic taxonomy. In the case of the *Scoloplax* BAILEY & BASKIN, 1976, 110 years have passed since the specimens collection in Thayer Expedition in 1866 and the formal description of the genus. This genus was originally described as a member of the Loricariidae, being placed in a new monotypic family (Scoloplacidae) by ISBRÜCKER (1980). According to SCHAEFER *et al.* (1989) the small size of these catfishes was the main problem to describe them, along with other factors such as lack of collecting effort, absence of any distinctive anatomy and their cryptic habitat. These authors also stated that the reductive characters derived from the miniaturization process represent synapomorphies at some phylogenetic level in *Scoloplax*. The same occurred with species of the genus *Fluviphylax* WHITLEY, 1965: specimens were collected in Thayer Expedition but remained undescribed until 1955 (MYERS, 1955). Previously, GARMAN (1895) improperly identified these fishes as undetermined species of *Rivulus* POEY, 1860 (COSTA & LE BAIL, 1999). These authors also stated that the miniaturization in *Fluviphylax* is parsimoniously interpreted as a single event. WEITZMAN & VARI (1988) published a study focusing on the miniaturization in the several groups of the Neotropical region and the consequences of this process to the phylogeny of those taxa. In the characiform genus *Nannostomus* GÜNTHER, 1872, the small size of three miniaturized species is probably derived, but attempts to eluci-

date the relationships within the genus were not feasible, and in the catfish genus *Corydoras* LACEPÈDE, 1803, a very specious genus, the relationships within four miniaturized species are unresolved, but possibly involving a single miniaturization event (WEITZMAN & VARI, 1988). The species herein described belongs to a miniaturized group, but the relationships within the *T. hasemani* group cannot be established since its phylogenetic relationships are still unknown.

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References

- ARRATIA, G. (1990): The South American Trichomycterinae (Teleostei: Siluriformes), a problematic group. In: *Vertebrates in the Tropics* (Eds. Peters, G. & R. Hutterer): 395–403. Museum Alexander Koenig, Bonn.
- ARRATIA, G. (1998): *Silvinichthys*, a new genus of trichomycterid catfishes from the Argentinean Andes, with redescription of *Trichomycterus nigricans*. – *Ichthyological Exploration of Freshwaters*, **9**: 347–370.
- ARRATIA, G. & HUAQUIN, L. (1995): Morphology of the lateral line system and of the skin of diplomystid and certain primitive loricarioid catfishes and systematic and ecological considerations. – *Bonner Zoologische Monographien*, **36**: 1–110.
- BARBOSA, M.A. & COSTA, W.J.E.M. (2003): *Trichomycterus potschi* (Siluriformes: Loricarioidei): a new trichomycterid catfish from coastal streams of southeastern Brazil. – *Ichthyological Exploration of Freshwaters*, **14** (3): 281–287.
- BARBOSA, M.A. & COSTA, W.J.E.M. (2003): Validade, relações filogenéticas e redescrção de *Eremophilus candidus* (Ribeiro, 1949) (Siluriformes: Trichomycteridae). – *Arquivos do Museu Nacional*, **61**: 179–188.
- BARBOSA, M.A. & COSTA, W.J.E.M. (2010): Seven new species of the catfish genus *Trichomycterus* (Teleostei: Siluriformes: Trichomycteridae) from Southeastern Brazil and redescription of *T. brasiliensis*. – *Ichthyological Exploration of Freshwaters*, **21** (2): 97–122.
- BASKIN, J.N. (1973): Structure and relationships of the Trichomycteridae. Unpublished Ph.D. Dissertation, City University of New York, New York: 389p.
- COSTA, W.J.E.M. (1992): Description de huit nouvelles espèces du genre *Trichomycterus* (Siluriformes: Trichomycteridae), du Brésil oriental. – *Revue française d'Aquariologie et Herpetologie*, **18**: 101–110.
- COSTA, W.J.E.M. (1994): A new genus and species of Sarcoglanidinae (Siluriformes: Trichomycteridae) from the Araguaia basin, central Brazil, with notes on subfamilial phylogeny. – *Ichthyological Exploration of Freshwaters*, **5**(3): 207–216.
- COSTA, W.J.E.M. (1996): Relationships, monophyly and three new species of the Neotropical miniature poeciliid genus *Fluviphylax* (Cyprinodontiformes: Cyprinodontoidae). – *Ichthyological Exploration of Freshwaters*, **7**: 11–30.
- COSTA, W.J.E.M. & BOCKMANN, F.A. (1993): Um nouveau genre néotropical de la famille des Trichomycteridae (Siluriformes: Loricarioidei). – *Revue française d'Aquariologie et Herpetologie*, **20**: 43–46.
- COSTA, W.J.E.M. & BOCKMANN, F.A. (1994): A new genus and species of Sarcoglanidinae (Siluriformes: Trichomycteridae) from southeastern Brazil, with a re-examination of subfamilial phylogeny. – *Journal of Natural History*, **28**: 715–730.
- COSTA, W. J. E. M. & LE BAIL, P.-Y. (1999): *Fluviphylax palikur*: A New Poeciliid from the Rio Oiapoque Basin, Northern Brazil (Cyprinodontiformes: Cyprinodontoidae), with Comments on Miniaturization in Fluviphylax and Other Neotropical Freshwater Fishes. – *Copeia*, **1999** (4): 1027–1034.
- DATOVO, A. & BOCKMANN, F.A. (2010): Dorsolateral head muscles of the catfish families Nematogenyidae and Trichomycteridae (Siluriformes: Loricarioidei): comparative anatomy and phylogenetic analysis. – *Neotropical Ichthyology*, **8**: 193–46.
- DAVIS, J.I., & NIXON, K.C. (1992): Populations, genetic variation, and the delimitation of phylogenetic species. – *Systematic Biology*, **41**: 421–435.
- DE PINNA, M.C.C. (1989): A new sarcoglanidine catfish, phylogeny of its subfamily, and an appraisal of the phyletic status of the Trichomycterinae (Teleostei, Trichomycteridae). – *American Museum Novitates*, **2950**: 1–39.
- DE PINNA, M.C.C. (1998): Phylogenetic relationships of neotropical Siluriformes (Teleostei: Ostariophysi): historical overview and synthesis of hypotheses. In: *Phylogeny and classification of neotropical fishes* (Eds. L.R. Malabarba, R.E. Reis, R.P. Vari, Z.M.S. Lucena & C.A.S. Lucena): 279–330. Editora da Pontifícia Universidade Católica do Rio Grande do Sul (ED-IPUCRS), Porto Alegre.
- DE PINNA, M.C.C. & KEITH, P. (2003): A new species of the catfish genus *Ituglanis* from French Guyana (Osteichthyes: Siluriformes: Trichomycteridae). – *Proceedings of the Biological Society of Washington*, **116** (4): 873–882.
- DUTRA, G.M., WOSIACKI, W.B. & DE PINNA, M.C.C. (2012): *Trichomycterus anhangá*, a new species of miniature catfish related to *T. hasemani* and *T. johnsoni* (Siluriformes: Trichomycteridae) from the Amazon basin, Brazil. – *Neotropical Ichthyology*, **61**(1): 225–231.
- EIGENMANN, C.H. (1909): Reports on the Expedition to British Guiana of the Indiana University and the Carnegie Museum, Report N° I. Some new genera and species of fishes from British Guiana. – *Annals of the Carnegie Museum*, **6**: 4–54.
- EIGENMANN, C.H. (1912): The freshwater fishes of British Guiana, including a study of the ecological grouping of species and the relation of the fauna of the Plateau to that of the lowlands. – *Memoirs of the Carnegie Museum*, **12**: 1–578.
- EIGENMANN, C.H. (1914): Some results from studies of South American fishes. IV. New genera and species of South American fishes. – *Indiana University Studies*, **20**: 44–48.

- EIGENMANN, C.H. (1918): The Pygidiidae, a family of South American catfishes. – *Memoirs of the Carnegie Museum*, **7**: 259–398.
- ESCHMEYER, W.N. & FONG, J.D. (2014): Species of Fishes by family/subfamily. <http://research.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp>. On-line version dated 10 March 2014.
- FERNANDEZ, L. & VARI, R.P. (2009): New Species of *Trichomycterus* from the Andean Cordillera of Argentina (Siluriformes: Trichomycteridae). – *Copeia*, **2009**: 195–202.
- FOWLER, H.W. (1932): Zoological results of the Mato Grosso Expedition to Brazil in 1931. I. Fresh water fishes. – *Proceedings Academy Natural Sciences*, **84**: 343–377.
- ISBRÜCKER, I.J.H. (1980): Classification and catalogue of the mailed Loricariidae (Pisces, Siluriformes). – *Verslagen en Technische Gegevens, Instituut voor Taxonomische Zoologie*, **22**: 1–181.
- KATZ, A.M., BARBOSA, M.A. & COSTA, W.J.E.M. (2013): Two new species of the catfish genus *Trichomycterus* from the Paraná river basin, southeastern Brazil (Siluriformes: Trichomycteridae). – *Ichthyological Exploration of Freshwaters*, **23**(4): 359–366.
- LASSO, C.A. & PROVENZANO, F. (2002): Dos nuevas especies de bagres del género *Trichomycterus* (Siluriformes: Trichomycteridae) de la Gran Sabana, Escudo de las Guayanas, Venezuela. – *Revista de Biología Tropical*, **50**(3/4): 1139–1149.
- LIMA, S.M.Q., LAZZAROTTO, H. & COSTA, W.J.E.M. (2008): A new species of *Trichomycterus* (Siluriformes: Trichomycteridae) from lagoa Feia drainage, southeastern Brazil. – *Neotropical Ichthyology*, **6**(3): 315–322.
- MATTOS, J.L.O. & LIMA, S.M.Q. (2010): *Microcambeva draco*, a new species from northeastern Brazil (Siluriformes: Trichomycteridae). – *Ichthyological Exploration of Freshwaters*, **21**(3): 233–238.
- MYERS, G.S. (1955): Notes on the classifications and names of cyprinodont fishes. – *Tropical Fish Magazine*, **4**: 7.
- SCHAEFER, S.A., WEITZMAN, S.H. & BRITSKI, H.A. (1989): Review of the Neotropical Catfish Genus *Scoloplax* (Pisces: Loricarioidea: Scoloplacidae) with Comments on Reductive Characters in Phylogenetic Analysis. – *Proceedings of the Academy of Natural Sciences of Philadelphia*, **141**: 181–211.
- TAYLOR, W.R. & VAN DYKE, G.C. (1985): Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. – *Cybio*, **9**: 107–109.
- WEITZMAN, S.H. & VARI, R.P. (1988): Miniaturization in South American freshwater fishes: an overview and discussion. – *Proceedings of the Biological Society of Washington*, **101**: 444–465.

