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A new species of *Panaqolus* (Siluriformes: Loricariidae) from the rio Madeira basin with remarkable intraspecific color variation

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The rio Madeira is the largest white-water tributary of the Amazon, and is currently the river drainage with the highest fish species diversity in the world. A new species of *Panaqolus* was recognized from the middle Madeira and Mamoré rivers (Brazil) and from the Madre de Dios drainage (Peru) and it is described herein. This new species is readily distinguished from its congeners by the large number of white dots distributed all over the body and by its remarkable amplitude of color pattern variation, ranging from a pale, light brown, to dark brown and almost black background coloration. The new species closely resembles *P. albomaculatus* but has more and smaller dots on the body, a smaller orbital diameter (12.5-16.8% head length *vs.* 16.0-20.0%) and longer maxillary barbels (9.7-19.6% head length *vs.* 1.6-8.9%). The new species is the second of the genus *Panaqolus* described for a Brazilian location after nearly 80 years of the description of *P. purusiensis*.

O rio Madeira é o maior afluente de água branca do rio Amazonas e é atualmente o rio com o maior número de espécies do mundo. Uma nova espécie de *Panaqolus* foi reconhecida do médio rio Madeira, do rio Mamoré (ambos no Brasil) e da bacia do Río Madre de Dios (Peru) e é descrita aqui. Esta nova espécie se distingue de suas congêneres pela grande quantidade de pontos brancos espalhados pelo corpo e grande variabilidade na sua coloração, variando de um fundo branco a marrom claro até marrom escuro e quase preto. A espécie se assemelha a *P. albomaculatus* da qual se distingue por ter mais manchas de menor tamanho no corpo, olhos menores (12,5-16,8% do comprimento da cabeça *vs.* 16,0-20,0%) e barbilhões maxilares mais compridos (9,7-19,6% comprimento da cabeça *vs.* 1,6-8,9%). A nova espécie é a segunda de *Panaqolus* descrita para uma localidade no Brasil, aproximadamente 80 anos após a descrição de *P. purusiensis*.

Keywords: Amazon, Catfish, Key of identification, *Panaque, Peckoltia*.

Introduction

The rio Madeira is the largest tributary of the rio Amazonas with an average discharge of 31,200 m^3/s and a total drainage area of 1,370,000km^2 spanning three countries; Brazil, Bolivia and Peru. Suspended solids carried by the Madeira are responsible for 50% of the sediments in the rio Amazonas. The longest extension of the river is 3,600 km, including the Mamoré and the Río Grande rivers. The rio Madeira itself is 1,450 km long and is formed by the confluence of the Beni and Mamoré rivers (Goulding *et al*., 2003; Doria *et al*., 2011). An ongoing inventory in the rio Madeira has already identified more than 1,000 fish species (C. Doria, *pers. com*.; Queiroz *et al*., 2013), more than in any other river in the world (Doria *et al*., 2011). Despite this rich diversity of fishes, the rio Madeira is relatively poor in ancistrines (Siluriformes: Loricariidae) when compared with other Amazonian rivers, *e.g.* the rio Xingu with more than 40 species (Camargo *et al*., 2013), with only 28 species listed (C. Doria, *pers. com*.; Queiroz *et al*., 2013). Aquarists report one additional species of *Panaqolus* Isbrücker & Schraml, 2001 (Seidel, 2001) found in the rio Aripuanã, a tributary of middle-lower Madeira, but without any voucher specimens deposited in scientific collections.

Panaqolus is a recently described genus that includes small to medium-sized Ancistrini loricariids (Isbrücker *et al*., 2001). The genus comprises species formerly described as *Panaque* Eigenmann & Eigenmann, 1889 and it has been heavily criticized since it was erected (*e.g.* Chockley & Armbruster, 2002; Armbruster, 2004). However, after the description of several new species, its taxonomic position and limits have solidified and it is more widely accepted (for an overview see Cramer, 2014). The reasons for this are twofold. Firstly, molecular data show *Panaqolus* to be distinct from *Panaque,* being more closely related to *Peckoltia*, *Hypancistrus*, and *Scobinancistrus* (Cramer *et al*., 2011; Lujan *et al*., 2015). Secondly, the two most recent species descriptions utilized the genus *Panaqolus*. Therefore, *Panaqolus* comprises the following valid species: *P. dentex* (Günther, 1868), *P. purusiensis* (La Monte, 1935), *P. albomaculatus* (Kanazawa, 1958), *P. gnomus* (Schaefer & Stewart, 1993), *P. maccus* (Schaefer

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& Stewart, 1993), *P. nocturnus* (Schaefer & Stewart, 1993), *P. changae* (Chockley & Armbruster, 2002), *P. koko* Fisch-Muller & Covain, 2012 and *P. albivermis* Lujan, Steele and Velasquez, 2013. We note there are doubts about the correct generic assignment of *P. koko* as its body shape and dentition differ from those of other *Panaqolus* (Fisch-Muller *et al.*, 2012). In the last years, discovery of new species (most of them still undescribed) have widened the geographic distribution of the genus considerably since Schaefer & Stewart (1993). *Panaqolus* representatives are currently known from Brazil, Ecuador, French Guiana (only *P. koko*), Guyana (Miller, 2002), Colombia (Braitmayer, 2010), Peru and Venezuela. Despite the large number of different *Panaqolus* phenotypes and undescribed species known from Brazilian drainages (Evers & Seidel, 2005), the new species described herein is only the second described that occurs in Brazil, nearly 80 years after the description of *P. purusiensis*.

Material and Methods

Counts, measurements and terminology follow Armbruster (2003) and Lujan *et al.* (2010). All measurements were made to the nearest 0.1 mm with the use of digital calipers. The following abbreviations were used: SL, Standard Length; HL, Head Length; and DW, oral Disk Width. Institutional abbreviations are as listed in Ferraris (2007) with the addition of UFRO-I for Coleção Ictiológica of Universidade Federal de Rondônia, Porto Velho, Brazil.

Results

Panaqolus nix, new species

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(Figs. 1-5)

Fig. 1. Dorsal, lateral, and ventral views of *Panaqolus nix*, holotype, INPA 39606, male, 110.1 mm SL, Brazil, Rondônia, rio Madeira, cofferdam at construction site of Santo Antônio hydroelectric power plant (former Santo Antônio rapids) (Photos by B. S. F. Barros).

Panaque sp. 1: photo - Zawadzki & Chamon, 2013: p. 312.
Panaque sp. 2: UFRO-I 6384, Zawadzki & Chamon, 2013: p. 313 (see remarks for further explanation).

Holotype. INPA 39606, male, 110.1 mm SL, Brazil, Rondônia, rio Madeira, cofferdam at construction site of Santo Antônio hydroelectric power plant (former Santo Antônio rapids), 08°48'06"S 63°57'00"W, 14 Feb 2012, C. A. Cramer.

Paratypes. 48 specimens. Brazil: Rondônia State: INPA 39605, 3, 54.6-73.7 mm SL, Mamoré, near the São Lourenço community, trawl net fishing, 11°43'24.10"S 65°11'31.70"W, 30 May 2010, L. H. Rapp Py-Daniel. INPA 41148, 2, 95.3 and 96.8 mm SL, rio Karipunas near mouth, 09°11'46.6"S 64°37'20.7"W, 4 Oct 2010, Naturae Environmental Company technicians. INPA 41149, 1, 85.0 mm SL, rio Madeira, near mouth of rio Karipunas, 09°12'18.9"S 64°37'08.4"W, 30 Oct 2010, Naturae Environmental Company technicians. INPA 41150, 28, 32.8-112.2 mm SL, rio Madeira, cofferdam at the construction site of Jirau hydroelectric power plant (former Jirau rapids), 09°15'15.7"S 64°38'50.4"W, 11-13 Nov 2011, Naturae Environmental Company technicians. MZUSP 114009, 3, 68.5-76.2 mm SL;UFRO-I 6384, 5, 50.8-80.7 mm SL, same data as INPA 39605. UFRO-I 7968, 1, 81.4 mm SL, rio Madeira, near Ilha do Búfalo, trawl net fishing, 09°08'51.10"S 64°32'33.70"W, 23 Oct 2010, A. Ribeiro. UFRO-I 9974, 1, 53.6 mm SL, rio Madeira, below Santo Antônio rapids, trawl net fishing, 08°46'36.11"S 63°55'26.09"W, 23 Jul 2011, L. Nogueira. UFRO-I 10050, 1, 90.4 mm SL, same data as INPA 39605. UFRO-I 13039, 1, 49.5 mm SL, same locality as holotype, 1 Dec 2011, C. A. Cramer. UFRO-I 13040, 1, 57.7 mm SL, same data as UFRO-I 13039. UFRO-I 19646, 1, female, 97.3 mm SL, same data as holotype.

Non-types. 1 specimen. Peru: ROM 92440, 1, 117.0 mm SL, Río Tambopata, Madre de Dios drainage, approximately 12°48'S 69°17'W, 16 Aug 2010, K. Roach and A. Jackson.

Diagnosis. The presence of small white dots on the whole body and fins distinguish *Panaqolus nix* from all congeners except *P. albomaculatus*. These dots are frequently faded in preserved specimens (typically, at least the dorsal and caudal fins show some traces of dots). *Panaqolus nix* can be distinguished from *P. albomaculatus* by having more dots on the trunk (on nearly all plates having one dot each *vs.* one dot each on less than half of the plates), a longer head-eye length (35.1-41.5% HL [mean 37.8] *vs.* 31.9-37.2% HL [mean 34.4]), a smaller orbital diameter (12.5-16.8% HL [mean 14.3] *vs.* 16.0-19.9% HL [mean 17.7]), and longer rictal barbels (9.7-19.6% HL [mean 13.8] *vs.* 1.6-8.9% HL [mean 4.9]). Only two other *Panaqolus* species (*P. dentex* and *P. koko*) lack alternating dark and light bands on fins. *Panaqolus nix* can be distinguished from *P. dentex* by lacking lighter colored saddles (*vs.* three lighter colored saddles between dorsal-fin origin and caudal fin), by having a shorter head-pectoral length (22.4-28.2% SL [mean 25.5] *vs.* 27.2-38.1% SL [mean 29.2]), a lower caudal peduncle depth (9.3-11.4% SL [mean 10.5] *vs.* 11.0-13.3% SL [mean 12.2]), a smaller orbital diameter (12.5-16.8% HL [mean 14.3] *vs.* 16.4-22.8% HL [mean 17.8]), and a larger adult body size (more than 100 mm SL *vs.* less than 80 mm SL). *Panaqolus nix* differs from *P. koko* in the shape of the main tooth cusp (round and without or with very small lateral cusp *vs.* quadrangular and with strong lateral cusp), a smaller orbital diameter (12.5-16.8% HL *vs.* 18.9-20.8% HL [n=7]), and a larger interorbital width (34.3-39.3% HL *vs.* 29.4-33.2% HL). *Panaqolus albivermis* typically has alternating light bands and rows of light dots or short lines on its body. *Panaqolus nix* can be separated from this species by having a shorter dorsal spine (26.2-32.5% SL *vs.* 33.0-36.0% SL [n=4]), a shallower caudal peduncle (9.3-11.4% SL *vs.* 12.2-14.9% SL [n=4]), and a higher adipose-anal depth (17.9-22.2% SL *vs.* 15.8-17.9% SL [n=4]). *Panaqolus changae*, *P. gnomus*, *P. maccus*, *P. nocturnus*, and *P. purusiensis* have alternating dark and light bands on the body (except *P. nocturnus* and adult *P. purusiensis*) and fins (*vs.* never showing bands on body or fins in *P. nix*). Further, *P. nix* can be distinguished from *P. changae* by a narrower ventral cleithral width (29.0-33.8% SL [mean 31.0] *vs.* 33.4-37.4 [mean 34.8), a shorter head-pectoral length (22.4-28.2% SL [mean 25.5] *vs.* 28.0-31.1% SL [mean 29.9), a smaller orbital diameter (12.5-16.8% HL [mean 14.3] *vs.* 16.2-20.9% HL [mean 18.2]), and a larger adult body size (more than 100 mm SL *vs.* less than 90 mm SL). *Panaqolus nix* differs from *P. gnomus* by a lower dorsal-pectoral depth (26.9-30.3% SL [mean 28.6] *vs.* 30.3-36.8% SL [mean 32.9]), a smaller interorbital width (34.4-39.3% HL *vs.* 39.7-44.7% HL), and a larger adult body size (more than 100 mm SL *vs.* less than 80 mm SL). *Panaqolus nix* can be separated from *P. maccus* by a shorter predorsal length (40.1-44.5% SL [mean 42.3] *vs.* 44.3-49.2% SL [mean 46.0), a shorter head-pectoral length (22.4-28.2% SL [mean 25.5] *vs.* 27.2-44.1% SL [mean 30.8]), and a larger adult body size (more than 100 mm SL *vs.* less than 90 mm SL). *Panaqolus nix* can be distinguished from *P. nocturnus* by the angle of dentary tooth rows (less than 50° to nearly parallel *vs.* approximately 70°). *Panaqolus nix* differs from *P. purusiensis* by having a lower dorsal-pectoral depth (26.9-30.3% SL [mean 28.6] *vs.* 29.8-32.9% SL [mean 30.9;]), a lower caudal peduncle depth (9.3-11.4% SL [mean 10.6] *vs.* 10.9-14.0% SL [mean 12.1]), and a smaller mouth width (34.4-46.4% HL [mean 39.9] *vs.* 41.6-50.3% HL [mean 44.1]).

Description. Counts and proportional measurements in Table 1. Medium-sized loricariid with standard length of measured specimens up to 112.2 mm SL. Dorsal profile of head and snout strongly convex from snout tip to posterior tip of supraoccipital, straight and posteroventrally slanted between dorsal-fin origin and adipose-fin origin, gently concave through caudal peduncle to posterior tip of

procurrent caudal-fin ray. Dorsal orbit margin only slightly raised, forming gentle ridge, narrowing anteriorly, from anterior orbit margin to area lateral to nares. Dorsal surface of trunk transversely flattened from dorsal-fin origin to adipose-fin base. Ventral profile of head and body flat from oral disk to anal-fin origin. Caudal peduncle oval in cross-section. Greatest body depth at dorsal-fin origin. Pectoral-fin origin just posterior to orbit; pelvic-fin origin at vertical through origin of second dorsal-fin ray; anal-fin origin slightly posterior to vertical through origin of last dorsal-fin ray. Adipose fin with well-ossified leading spine bearing odontodes.

Head and body covered by odontodes of uniform size and distribution. Enlarged odontodes on anterodorsal border of pectoral-fin spine. Cheek odontodes hypertrophied with anteriorly curved hooks on the tips; longest odontode extending to posterior cleithrum margin. Interorbital space flat or slightly convex. Eye dorsolaterally placed; orbit diameter 12.5-16.8% HL. Iris operculum present. Nares small and ovoid, slightly longer than wide.

Table 1. Selected morphometrics of *Panaqolus nix*. Values are given as percents of standard length or head length. SD = standard deviation, n = number of specimens, H = holotype. Interlandmarks (ILM) are the two points between which measurements were taken (from Luj*an et al*., 2010).

ILM	Measurement	H	n	range	mean±SD
1-20	Standard length (mm)	110.1	47	32.84-112.2	82.44
		Percents of Standard Length			
1-10	Predorsal length	43.1	47	40.1-44.5	42.3±1.0
1-7	Head length	35.7	47	33.2-39.3	35.2±1.3
8-9	Cleithral width	31.5	47	30.8-34.3	32.3±0.9
8'-9'	Cleithral width ventral	29.5	47	29.0-33.8	31.0±1.2
1-12	Head-pectoral length	27.0	47	22.4-28.2	25.5±1.3
12-13	Thorax length	25.3	47	22.7-30.7	26.4±2.0
12-29	Pectoral-spine length	31.1	46	29.5-34.9	32.0±1.4
13-14	Abdominal length	23.8	47	20.5-24.3	22.4±0.9
13-30	Pelvic-spine length	27.8	46	25.7-31.2	28.1±1.1
13-13'	Pelvic girdle width	20.2	47	19.4-22.7	20.9±0.7
14-15	Postanal length	34.8	47	31.7-37.6	34.9±1.3
14-31	Anal-fin spine length	18.3	46	12.8-18.3	15.3±1.2
10-12	Dorsal-pectoral depth	29.7	47	26.9-30.3	28.6±1.0
10-11	Dorsal-spine length	27.5	39	26.2-32.5	29.5±1.5
10-16	Dorsal-fin base length	27.5	47	20.5-28.8	25.3±1.3
16-17	Dorsal-adipose distance	17.7	46	13.7-19.4	17.2±1.2
17-18	Adipose-spine length	5.7	47	5.7-10.0	8.2±0.7
17-19	Adipose-upper caudal distance	12.0	47	12.0-20.7	15.8±1.4
15-19	Caudal peduncle depth	10.8	47	9.3-11.4	10.6±0.4
20-32	Caudal peduncle-middle caudal ray	23.5	42	9.5-26.0	17.7±4.1
20-33	Caudal peduncle-dorsal caudal spine	47.0	17	33.7-81.7	51.8±13.0
15-17	Adipose-lower caudal depth	20.5	47	20.5-25.2	22.6±1.1
		Percents of Head Length			
5-7	Head-eye length	35.6	47	35.2-41.5	37.8±1.3
4-5	Orbit diameter	13.5	47	12.5-16.8	14.3±1.0
1-4	Snout length	61.0	47	49.7-63.7	59.5±2.2
2-3	Internares width	11.8	47	10.5-14.7	12.2±0.9
5-6	Interorbital width	51.8	46	46.5-54.6	49.6±1.6
5'-6'	Dorsal interorbital width	35.0	47	34.4-39.3	36.7±1.2
7-12	Head depth	70.3	47	61.7-75.4	69.3±2.2
1-24	Mouth length	46.2	46	36.2-50.5	42.7±3.7
21-22	Mouth width	42.0	46	34.4-46.4	39.9±3.2
22-23	Barbel length	13.6	46	9.7-19.6	13.8±2.5

Oral disk round, maxillary barbels of moderate length (10-20% HL). Lips papillate; small patch of elongate fleshy papillae behind each dentary tooth row (Fig. 2). Border of lips smooth, without papillae. Teeth spoon-shaped and unicuspidate or with very small lateral cusp. Premaxillary teeth 3-7 per ramus (mode 4), mandibular teeth 4-7 per ramus (mode 5). Premaxillary tooth rows angled at approximately 90°, dentary tooth rows acutely angled at approximately 50° or nearly parallel (Fig. 2).

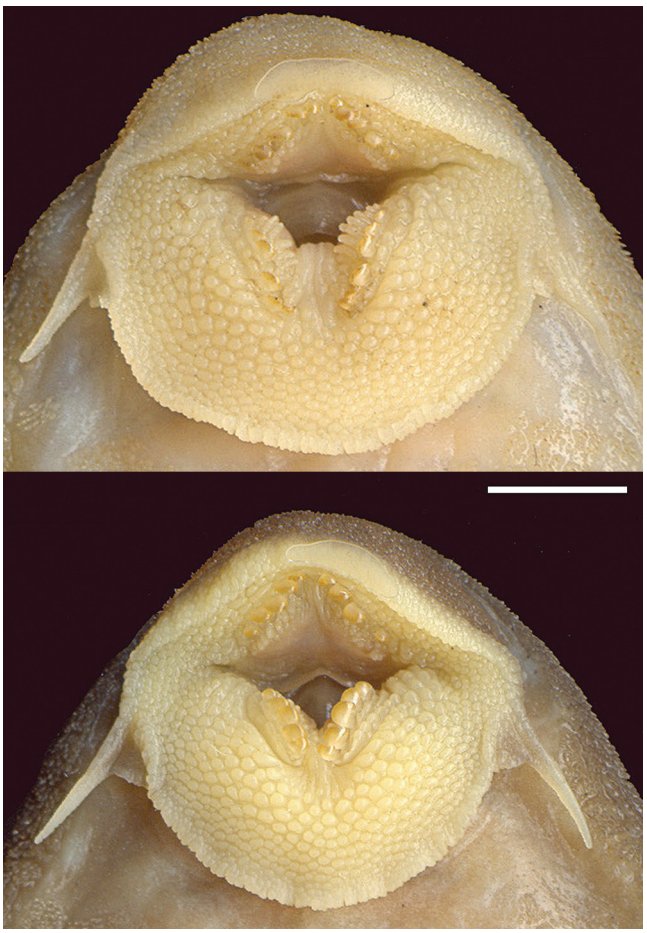

Fig. 2. Details of the mouth of *Panaqolus nix*: the dentary tooth rows are in an acute angle (below) or even nearly parallel (above) (MZUSP 114009, 68.8 mm + 76.2 mm SL). Scale bar = 5 mm.

Head and body plated dorsally, except for small naked area around dorsal-fin base; some specimens with naked area at tip of snout. Supraoccipital bordered posteriorly by 2-3 (mode 3) plates on each side. Abdomen of adults ranging from incompletely plated (plates only in pectoral girdle, along sides, and posterior to pelvic fin) to nearly completely covered by small irregularly arranged platelets, with a small naked area around pelvic-fin origin and the urogenital orifice. Abdomen of juveniles of 70 mm SL or less naked or with only very few plates on the border with inframedian plates. Large naked area dorsally to pelvic-fin base, below ventral margin of inframedian plate row; sometimes showing 1-3 small plates. Body with pronounced lateral ridge extending from cleithrum to posterior margin of fifth or sixth plate of the inframedian plate row, decreasing in prominence posteriorly. Trunk without elevated ridges. 7-8 plates on dorsal-fin base (mode 7), 5-7 plates between dorsal and adipose fin (mode 6), usually 1 azygous preadipose plate, 6-8 plates between adipose and caudal fin (mode 7), 2 plates on anal-fin base, 11-12 scutes between anal and caudal fin (mode 11), and 24-25 lateral plates (mode 25).

Dorsal fin II,7-8 (holotype II,7), pectoral fin I,6, pelvic fin i,5, anal fin i,4, caudal fin i,13-14,i (holotype i,14,i). Spinelet triangular, dorsal-fin spine lock functional, posterior fin margin straight, margin of last two rays rounded. Dorsal-fin origin closer to vertical line passing through pelvic-fin origin than to vertical line passing through pectoral-fin origin; not reaching adipose fin when adpressed. Last dorsal-fin ray without prolonged membrane. Adipose fin triangular; adipose-fin spine slanted posteroventrally, tip straight to curved ventrally, pointed; posterior margin of adipose-fin membrane concave to nearly vertical. Pectoral-fin spine robust, membrane between spine and first ray without fleshy extension, distal fin margin straight. Pectoral fin, when depressed reaching 1/3 of pelvic fin. Pelvic-fin spine robust, distal margin slightly rounded, when adpressed reaching mid-length of anal fin. Caudal fin strongly forked; caudal-fin spines usually tipped with filaments of the length of the longest branched caudal-fin rays.

Color in alcohol. Coloration of head, body and fins without bands or saddles. Base coloration varying from uniformly yellowish-white over light brown to dark brown or nearly black in different specimens. Small white dots (about 1/3 of the eye diameter) present on whole body and all fins; approximately one dot per plate; dots smaller on head. Dots faded to absent in preserved specimens, especially on trunk, but usually visible on fins. Caudal fin showing distinct dots or diffuse lighter markings.

Color in life. Color of head, body and fins without bands or saddles. Base coloration varying from uniformly yellowish-white over pale brown (Fig. 3) to dark brown or nearly black in different specimens. In an aquarium, with clear water, light colored fish become dark in few days (Fig. 4). Live specimens with small white dots (more or less 1/3 of the eye diameter) on whole body and all fins; approximately one dot per plate. Dots smaller on head. Caudal fin showing distinct dots or diffuse lighter markings.

Sexual dimorphism. Mature males have longer odontodes on the pectoral-fin spine and on the caudal peduncle (Fig. 5). The illustrated specimen was dissected and its gender was confirmed based on gonads examination. A large female (UFRO-I 19646) that was kept in an aquarium did not develop any conspicuously elongated odontodes over time. Some eggs were released during the process of preservation shortly after she died in captivity.

Fig. 3. Variation in the color of *Panaqolus nix*: a) nearly white specimen (UFRO-I 10050, 90.4 mm SL) b), intermediately colored specimen (UFRO-I 7968, 81.4 mm SL) (Photos by B. S. F. Barros).

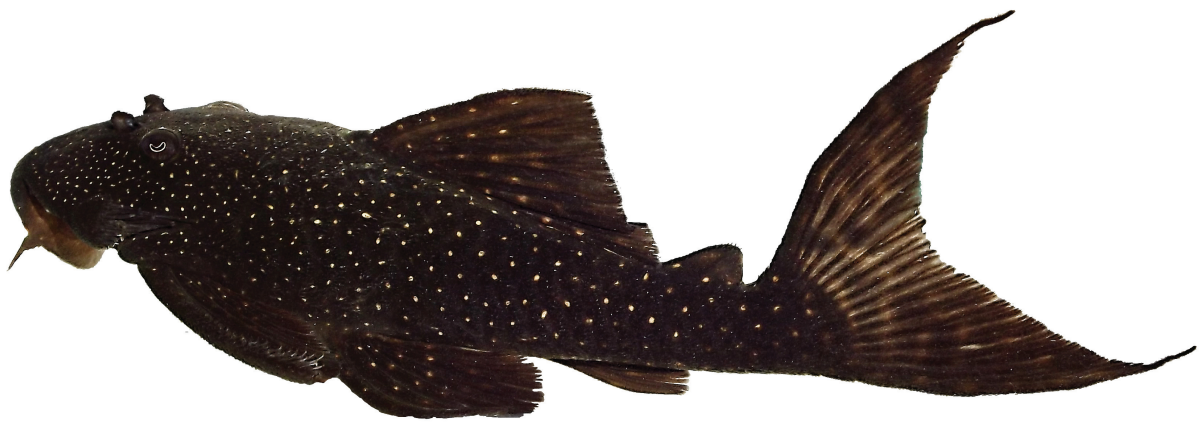

Fig. 4. Live photo of the holotype of *Panaqolus nix* (INPA 39606; 110.1 mm SL).

Distribution and Habitat. The known distribution of this species is the Madeira basin, including the Madeira, Mamoré, and Tambopata (Madre de Dios drainage) rivers (Fig. 6). Most of the specimens have been collected in cofferdams at the construction sites of the hydroelectric power plants of Santo Antônio and Jirau (former Santo Antônio and Jirau rapids), on the rio Madeira, by several technicians and ichthyologists hired by the two Consulting Environmental Companies responsible for the biological inventories in the area. Most of the remaining specimens have been caught in depths of 3.1 to 11 m (UFRO-I 6384, INPA 39605, MZUSP 114009) and 4.1 to 8.5 m (UFRO-I 6384) using trawl nets. This indicates that this species prefers deep-water habitats with strong current, which might help to explain its relative rarity in scientific collections.

Etymology. From the Latin *nix* meaning snow, alluding to the color: in dark individuals the dots look like falling snowflakes, while pale individuals look like they have the whole body covered by snow; treated as a noun in apposition.

Fig. 5. Sexual dimorphic male of *Panaqolus nix* (INPA 41150 (#29859); 105.1 mm SL) with elongated odontodes on pectoral spine, caudal peduncle and caudal fin.

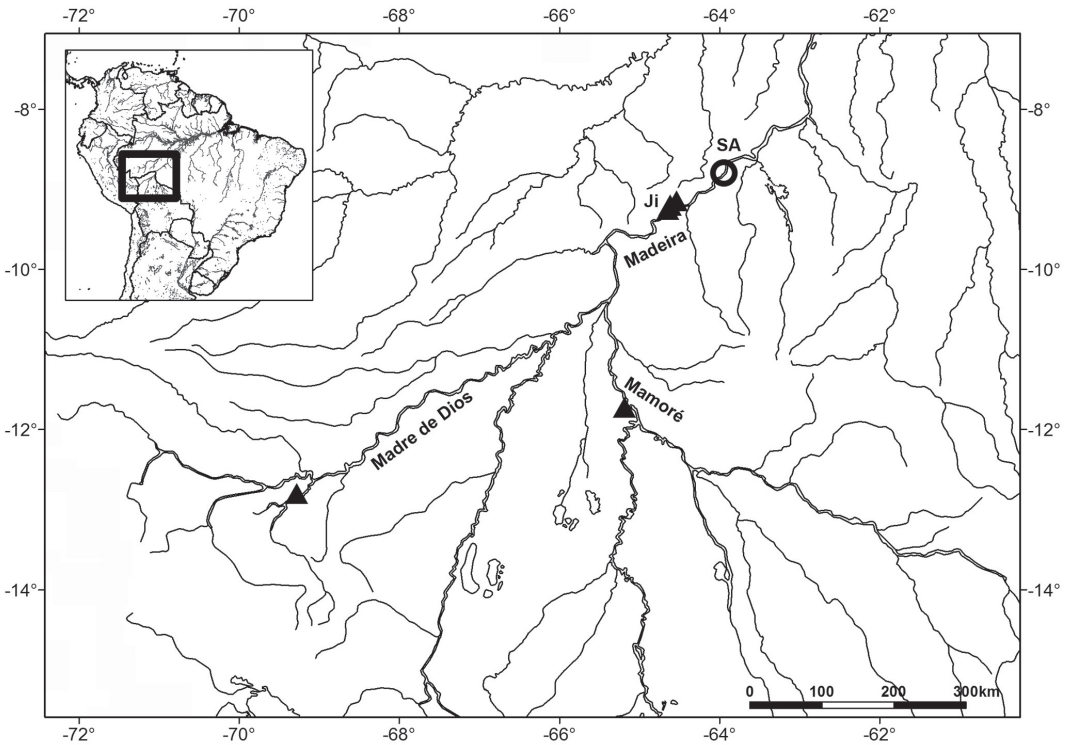

Fig. 6. Distribution of *Panaqolus nix*. Open symbol: type locality. Symbols may represent more than one locality or lot. Ji = former Jirau rapids, SA = former Santo Antônio rapids.

Remarks. ROM 92440 is not being considered in the type material as it is a dried specimen that disintegrated into several pieces. Zawadzki & Chamon (2013), in their list of Hypostominae of the rio Madeira, illustrated *Panaque* sp. 1 in page 312, and cited the lot UFRO-I 6384 as *Panaque* sp. 2, in page 315. In fact, there was a mistake in assigning the lots to the images. The illustration of *Panaque* sp. 1 shows in fact a specimen of *Panaqolus nix* and the correct number of this lot is UFRO-I 6384. The second illustration, *Panaque* sp. 2, is a different species and the correct numbers of the lots for this species are UFRO-I 6383 and UFRO-I 13109. So, *Panaqolus nix* was already known, but not named, as part of the ichthyofauna of the rio Madeira.

Conservation status. The species seems to be widely distributed along rio Madeira, Mamoré and Tambopata as well. Despite the fact that part of its distribution includes two hydroelectric power dams, Jirau and Santo Antônio, the area of occurrence of *Panaqolus nix* goes well beyond the dams. Thus, considering that important threats to the species were not detected yet, *P. nix* should be classified as Least Concern (LC) according to the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN Standards and Petitions Subcommittee, 2014). In the last years parts of the known habitats have been severely altered by the construction of these hydroelectric power plants, destroying the former Santo Antônio and Jirau rapids and transforming more than 200 km of the rio Madeira, enlarging the riverbed and reducing the current. Additional collecting efforts should be conducted in that region in order to better understand the impacts of these constructions on the population of *Panaqolus nix* and to be able to adjust (if necessary) the evaluation of the conservation status of the species.

Discussion

Panaqolus nix shows a remarkable plasticity in coloration: the base coloration can be uniformly yellowish-white, pale brown, or dark brown to nearly black. Specimens that showed a light coloration when collected, changed to a nearly black coloration when in an aquarium. *Panaqolus nix* showed a color pattern very different from most of its congeners that present a color pattern with bands or saddles. The other *Panaqolus* species with uniform coloration are *P. nocturnus*, from Peru, Río Marañon basin, and large *P. purusiensis*, from upper rio Purus. *Panaqolus nix* is the first species of the genus reported to be caught using trawl nets and also the first that seems to have a preference for deeper habitats. Besides, *P. nix* is the species in the genus with the smallest eyes what might be related to its capacity to explore deeper benthonic habitats. The other *Panaqolus* species with small orbits is *P. purusiensis*. However, *P. nix* has a more elongate body and shallower caudal peduncle depth, whereas *P. purusiensis* present a more robust and truncate body form. Schaefer & Stewart (1993) called attention for the reduced number of vertebrae in the holotype of *P. purusiensis* (26 *vs.* 28 in all other species of *Panaqolus*) and that the holotype showed some sort of teratology. However, the authors also remark that morphometric proportions related to caudal peduncle length did not differ between the holotype and the topotype. Young and subadult *P. purusiensis* are also reported as presenting bands on body and fins, differently from *P. nix*. *Panaqolus nocturnus* is also close to *P. nix* but it differs from the latter by the larger orbit and completely lack of clear dots along body and fns.

Coloration, presence of caudal-fin filaments and the angle between the dentary tooth rows suggest that *P. nix* is closely related with *P. albomaculatus* and *P. albivermis*. However, *P. albomaculatus* has a larger orbit, fewer teeth and shorter barbels than *P. nix*, whereas *P. albivermis* shows a quite conspicuous and peculiar color pattern with thin light transversal lines on body and fins. In the aquarium hobby, *P. nix* has been introduced as *Panaqolus* sp. L395, having been found in the Madre de Dios basin in Peru (Evers, 2005).

Key to the *Panaqolus* species (modified from Cramer, 2014)

1 Head, body and fins without alternating dark and light bands 2
1' Head, body and/or fins (in *P. nocturnus* and adult *P. purusiensis* only on fins [at least anal and pelvic fins]) with alternating dark and light bands 5
2 Dentary tooth rows in an angle of nearly 70°, forming a V. Normally dentaries meet in the middle; body and fins not covered with small light dots 3
2' Dentary tooth rows in a very acute angle (50° or less) or nearly parallel, often not meeting in the middle, forming a \ /; body and fins covered with small white or yellowish dots (if faded on body, traces are present at least on dorsal and caudal fins) 4
3 Body uniformly grayish black; teeth quadrate with strong lateral cusp (upper Maroni River basin, French Guiana) ..... *P. koko*
3' Body dark with three lighter saddles between dorsal and caudal fins; teeth rounded without or with tiny lateral cusps (upper Río Amazonas, Río Ucayali, Río Napo, and Río Marañón drainages)..... *P. dentex*
4 Maxillary barbels elongate (9.7-19.6% HL), small eyes with orbital diameter 12.5-16.8% HL, white dots on nearly all plates (rio Madeira, rio Marmoré, Río Madre de Dios drainages)..... *P. nix*
4' Maxillary barbels short (1.6-8.9% HL), orbital diameter 16-20% HL, white dots on less than half of the plates (upper Río Amazonas, Río Ucayali, Río Napo, and Río Marañón rainages)..... *P. albomaculatus*
5 Dark body with diffuse lighter markings; never showing bands or stripes on body or head, only on fins (upper Río Amazonas, Río Ucayali, Río Napo, and Río Marañón drainages) ..... *P. nocturnus*
5' Body with alternating light and dark bands, at least in individuals < 90 mm SL..... 6

6 Bands on trunk angled in an anterodorsal to posteroventral direction (upper Río Amazonas, Río Ucayali, Río Napo and Río Marañón drainages)..... *P. gnomus*

6' Bands on trunk angled in a posterodorsal to anteroventral direction..... 7

7 Dark bands on trunk and dorsal fin as wide as or thinner than light interspaces; trunk with 6-12 (mode=8) dark bands; adipose with 1-2 (usually 2) dark bands (Río Nanay and Río Itaya drainages)..... *P. changae*

7' Dark bands on trunk and dorsal fin much wider than light interspaces in specimens larger than 25 mm SL (specimens larger than 85 mm SL may not show clear bands on the trunk); trunk with 3-9 dark bars 8

8 Dentary tooth rows parallel; body base color black (Río San Alejandro, Ucayali drainage)..... *P. albivermis*

8' Dentary tooth rows acutely angled; body base color brown or olivaceous..... 9

9 Small adult size (max. 87 mm SL, usually smaller); trunk with 3-7 (mode=4) dark bars; dorsal-pelvic depth 19-23% (mean=21%) of SL (Río Orinoco drainage) ..... *P. maccus*

9' Large adult size (max. 130.4 mm SL); trunk with 5-9 (mode=7) dark bars in specimens larger than 25 mm SL (smaller specimens with 4 bars; specimens larger than 85 mm SL may not show clear bands on the trunk); dorsal-pelvic depth 22-32% (mean 27%) of SL (rio Purus drainage)..... *P. purusiensis*

Comparative Material Examined. *Panaque albomaculatus*: **Ecuador:** USNM 167909, holotype, 91.1 mm SL, Río Pucuno, tributary of Suno (altitude 350-400 m). USNM 167910, paratype, 81.7 mm SL, Río Cotapino, tributary of Río Pucuno. USNM 167908, paratypes, 4, 48.5-78.5 mm SL, Pastaza, Río Bobonaza, Pastaza drainage. **Peru:** Amazonas: AUM 45502, 5, 39.6-103.7 mm SL, Río Marañón, log riffle, 1.57 km ENE of Juan Valesco (Sta Maria de Nieva). AUM 45507, 5, 79.1-114.8 mm SL, Río Marañón, log riffle, 1.57 km ENE of Juan Valesco (Sta Maria de Nieva). LACM 36357-33, 72.3 mm SL, Río Cenepa, vicinity of Huampami. LACM 42001-9, 2, 91.4-113.3 mm SL, 100 m downstream from Caterpiza. LACM 41740-18, 99.8 mm SL, Río Marañón at confluence with Río Nieva at Sta. Maria de Nieva. LACM 36330-5, 120.2 mm SL, Caterpiza, quebrada. LACM 42005-10, 94.6 mm SL, 1 km upstream from Caterpiza. LACM 36313-3, 2, 84.9-96.1 mm SL, Peru, Amazonas, Río La Poza. LACM 42115-6, 54.8 mm SL, Caterpiza. UFRO-I 17825, 77.5 mm SL, aquarium specimen. *Panaqolus changae*: **Peru:** Loreto: MUSM 17107, holotype, 58.8 mm SL, Río Itaya, 11km SSW center of Iquitos at bearing 39°. SIU 29928, paratype, 45.2 mm SL, Río Itaya, 11km SSW center of Iquitos at bearing 39°. INHS 42419, paratypes, 2, 38.5-83.0 mm SL, Río Itaya, 11km SSW center of Iquitos at bearing 39°. AUM 28908, 5, 53.0-84.5 mm SL, Río Momon, ca. 8 hours by boat from Iquitos. *Panaqolus dentex*: **Peru:** Loreto: BMNH 1867.6.13.37, holotype, 58.8 mm SL, Río Xeberos, Huallaga drainage. Amazonas: FMNH 96952, 73.8 mm SL, Peru, Amazonas, Caterpiza. LACM 39892-1, 3, 46.9-67.7 mm SL, Shaime, village on Río Yutupis, from small quebrada. LACM 41993-6, 2, 66.9-68.3 mm SL, 3 km upstream from Caterpiza. LACM 41995-3, 71.1 mm SL, 3 km upstream from Caterpiza - Kusuim. LACM 36329-6, 41.4 mm SL, Caterpiza, quebrada. LACM 41946-1, 38.3 mm SL, 200 m upstream from Caterpiza. LACM 39952-1, 4, 43.6-72.9 mm SL, Small Quebrada in Galilea, tributary to Río Santiago. AMNH 218002, 76.7 mm SL, Río Santiago. **Ecuador:** Napo: FMNH 97595, 2, 67.6-73.5 mm SL, Quebrada Apoalla, tributary to lower Río Shushufindi, Napo drainage. FMNH 97596, 2, 74.1-78.4 mm SL, lower Río Bobonaza at Chicherata, about 25 km upstream from mouth of Río Pastaza. FMNH 97593, 41.4 mm SL, Estero Samonayacu, about 3.5km SW of the bridge over Río Napo along road from Coca to Río Tiputini. *Panaqolus gnomus*: **Ecuador:** Pastaza: FMNH 70860, holotype, 56.5 mm SL, Cusuimi, on Río Cusuimi, about 150 km. SE of Puyo. FMNH 97598, paratypes, 2, 56.0-56.1 mm SL, Río Bobonaza at Sarayacu, Pastaza drainage. FMNH 97597, paratypes, 3, 53.0-55.7 mm SL, Cusuimi, on Río Cusuimi, about 150 km SE of Puyo. Orellana: USNM 163912, paratype, 60.9 mm SL, Orellana, Río Suno, upper, Napo drainage. **Peru:** Amazonas: FMNH 96950, paratype, 69.2 mm SL, Río Cenepa, vicinity of Huampami, elevation 700m. LACM 42005-11, paratype, 62.0 mm SL, 1 km upstream from Caterpiza. LACM 42115-7, paratypes, 2, 59.9-67.7 mm SL, Caterpiza. LACM 41992-6, paratypes, 2, 59.3-63.6 mm SL, 500 m upstream from Caterpiza. LACM 36330-4, paratypes, 2, 59.8-63.2 mm SL, Caterpiza, quebrada. AUM 45505, 5, 51.0-64.3 mm SL, Río Marañón, log riffle, 1.57 km ENE of Juan Valesco (Sta Maria de Nieva). AUM 45501, 10, 47.0-68.3 mm SL, same data as AUM45505. *Panaqolus koko*: SMF 9702, 84.7 mm SL, **French Guyana:** Saint Laurent du Maroni: Maroni River, Saut Ga-kaba to Apatou. *Panaqolus maccus*: **Venezuela:** MCBUCV-V 24010, holotype, 66.0 mm SL, Portuguesa, Río Las Marinas, upstream from bridge on Route 5 east of Cuanare, tributary of Río Portugesa. FMNH 97603, paratypes, 3, 29.0-49.8 mm SL, same data as holotype. FMNH 105998, 3, 31.8-52.2 mm SL, Barinas, Río Anaro, ca. 10 minutes from mouth in Río Suripa, Río Apuré drainage. USNM 265675, 31.6 mm SL, Bolivar, Río Orinoco, Cove, Tslote de Fajardo, 182 nautical miles upstream from Sea Buoy. *Panaqolus nocturnus*: **Peru:** Amazonas: LACM 41729-51, holotype, 138.9 mm SL, Río Santiago at La Poza. FMNH 96955, paratypes, 137.8 mm SL, Río Santiago at La Poza, outside mouth of quebrada by airport. LACM 41729-35, paratypes, 4, 71.3-123.4 mm SL, Río Santiago at La Poza. LACM 41723-5, paratypes, 4, 111.1-123.5 mm SL, Río Santiago at La Poza. AUM 45558, 6, 68.4-116.6 mm SL, Río Marañón, 6.3 km NE of Juan Velasco (Santa Maria de Nieva). AUM 45500, 2, 130.5-143.9 mm SL, Río Marañón, log riffle, 1.57 km ENE of Juan Velasco (Santa Maria de Nieva). AUM 45508, 3, 69.8-101.5 mm SL, Río Marañón, 12 km N Imacita. **Ecuador:** Pastaza: FMNH 97600, paratypes, 2, 66.7-96.9 mm SL, lower Río Bobonaza at Chicherota, ca. 25 km upstream from mouth with Río Pastaza. Napo: FMNH 97599, paratypes, 121.5 mm SL, Río Aguarico near Destacamento militar Cuyabeno and confluence of Río Cuyabeno - Río Aguarico, Napo drainage. USNM 167907, paratypes, 2, 103.5-109.0 mm SL, Río Bobonaza, Napo drainage. USNM 177209, paratype, 92.2 mm SL, Río Bobonaza at Chicherota, about 25 km upstream from mouth in Río Pastaza. *Panaqolus purusiensis*: **Brazil:** Acre: AMNH 12600, holotype, 106.7 mm SL; vicinity of the mouth of Rio Macauã (or Macauhan), a tributary of rio Iaco (or Yaco), which, in turn, is a tributary of rio Purus. USNM 94665, 1,

110.6 mm SL, same data as holotype. MSNM Pi43, 1, 126.4 mm SL, same data as holotype; UFRO-I 17720, 11, 15.5-83.1 mm SL, Rio Macauã near mouth with Rio Iaco. UFRO-I 17723, 1, 15.7 mm SL, Rio Macauã near mouth with Rio Iaco. MCP 35621, 2, 59.7-78.1 mm SL, Rio Riozinho do Andirá at BR-364 between Rio Branco and Sena Madureira. **Peru:** Ucayali: MCP 45733, 2, 107.6-114.0 mm SL, Río Curanja near confluence with Río Purús. MUSM 39425, 1, 130.4 mm SL, Río Curanja at mouth with Río Purus. *Panaqolus* sp.: **Brazil**: Pará: INPA 31777, 34, (1 c&s), 26.7-78.9 mm SL, rio Xingu near Vitória do Xingu. *Panaque armbrusteri*: **Brazil:** Pará: INPA 37460, 6, 70.9-74.7 mm SL, Xingu drainage. ZMA 120.179, 1, 345 mm SL, rio Itacaiunas. *Panaque* sp.: **Brazil:** Goiás: MNRJ 13299, 7, 103.1-122.0 mm SL, rio Tocantins near Minaçu. MNRJ 13297, 1, 209.0 mm SL, rio Tocantins near Minaçu.

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References

Armbruster, J. W. 2004. Phylogenetic relationships of the suckermouth armoured catfishes (Loricariidae) with emphasis on the Hypostominae and the Ancistrinae. Zoological Journal of the Linnean Society, 141: 1-80.

Braitmayer, S. 2010. L-Nummern aus Kolumbien (II). Die Aquarien und Terrarien Zeitschrift (DATZ), 63: 32-34.

Camargo, M., H. Gimenes Junior, L. M. Sousa & L. H. Rapp Py-Daniel. 2013. Loricariids of the Middle rio Xingu - Loricariiden des mittleren rio Xingu. Hannover, Panta Rhei. 288p.

Chockley, B. R. & J. W. Armbruster. 2002. *Panaque changae*, a new species of catfish (Siluriformes: Loricariidae) from eastern Peru. Ichthyological Exploration of Freshwaters, 13: 81-90.

Cramer, C. A. 2014. Redescription of *Panaqolus purusiensis* (LaMonte, 1935) (Siluriformes: Loricariidae) with identification key to the species of the genus. Neotropical Ichthyology, 12: 61-70.

Cramer, C. A., S. L. Bonatto & R. E. Reis. 2011. Molecular phylogeny of the Neoplecostominae and Hypoptopomatinae (Siluriformes: Loricariidae) using multiple genes. Molecular Phylogenetics and Evolution, 59: 43-52.

Doria, C. R. C., L. J. Queiroz, W. Ohara, G. Torrente-Vilara, J. S. Zuanon, C. P. Röpke & A. C. Ribeiro. 2011. Megadiversidade de Peixes no Rio Madeira. Revista Amazônia, 6: 12-19.

Evers, H.-G. 2005. Harnischwelse aus dem Río-Madre-de-Dios-Einzug. Die Aquarien und Terrarien Zeitschrift (DATZ), 58: 36-37.

Evers, H.-G. & I. Seidel. 2005. Wels Atlas 2. Melle, Mergus.

Ferraris, Jr. C. J. 2007. Checklist of catfishes, recent and fossil (Osteichthyes: Siluriformes), and catalogue of siluriform primary types. Zootaxa, 1418: 1-548.

Fisch-Muller, S., J. I. Montoya-Burgos, P.-Y. Le Bail & R. Covain. 2012. Diversity of the Ancistrini (Siluriformes: Loricariidae) from the Guianas: the *Panaque* group, a molecular appraisal with descriptions of new species. Cybium, 36: 163-193.

Goulding, M., R. Barthem & E. G. Ferreira. 2003. The Smithsonian atlas of the Amazon. Washington, D. C., Smithsonian Books. 253p.

Günther, A. 1868. Diagnoses of some new freshwater fishes from Surinam and Brazil, in the collection of the British Museum. Annals and Magazine of Natural History, 1: 475-481.

International Union for Conservation of Nature (IUCN) Standards and Petitions Subcommittee. 2014. Guidelines for using the IUCN Red List Categories and Criteria. Version 11. Prepared by the Standards and Petitions Subcommittee. Available from http://www.iucnredlist.org/documents/RedListGuidelines.pdf (Date of access - 12 February 2015).

Isbrücker, I. J. H., I. Seidel, J. Pieter-Michels, E. Schraml & A. Werner. 2001. Diagnose vierzehn neuer gattungen der Familie Loricariidae Rafinesque, 1815 (Teleostei, Ostariophysi). Die Aquarien und Terrarienzeitschrift, Sonderheft Harnischwelse, 2: 17-24.

Kanazawa, H. 1958. A new species of catfish, family Loricariidae, from Ecuador. Copeia, 4: 327-328.

LaMonte, F. R. 1935. Fishes from Rio Jurua and Rio Purus, Brazilian Amazonas. American Museum Novitates, 784: 1-8.

Lujan, N. K., J. W. Armbruster, N. R. Lovejoy & H. López-Fernández. 2015. Multilocus molecular phylogeny of the suckermouth armored catfishes (Siluriformes: Loricariidae) with a focus on subfamily Hypostominae. Molecular Phylogenetics and Evolution, 82: 269-288.

Lujan, N. K., M. Hidalgo & D. J. Stewart. 2010. Revision of *Panaque* (*Panaque*), with Descriptions of Three New Species from the Amazon Basin (Siluriformes, Loricariidae). Copeia, 4: 676-704.

Lujan, N. K., S. Steele & M. Velasquez. 2013. A new distinctively banded species of *Panaqolus* (Siluriformes: Loricariidae) from the western Amazon Basin in Peru. Zootaxa, 3691: 192-198.

Miller, M. A. 2002. Loricariiden aus dem Takutu River. Die Aquarien und Terrarien Zeitschrift (DATZ), 55: 56-57.

Queiroz, L. J., G. Torrente-Vilara, W. M. Ohara, T. H. S. Pires, J. Zuanon & C. R. C. Doria (Orgs.). 2013. Peixes do rio Madeira. São Paulo, Dialeto Latin American Documentary, 3 v. 1142p.

Schaefer, S. A. & D. J. Stewart. 1993. Systematics of the *Panaque dentex* species group (Siluriformes: Loricariidae), wood-eating armored catfishes from tropical South America. Ichthyological Exploration of Freshwaters, 4: 309-342.

Seidel, C. 2001. Harnischwelse aus dem Rio Aripuanã. Die Aquarien und Terrarien Zeitschrift (DATZ), 54: 34-37.

Zawadzki, C. H. & C. C. Chamon. 2013. Hypostominae. Pp. 302-337. In: Queiroz, L. J., G. Torrente-Vilara, W. M. Ohara, T. H. S. Pires, J. Zuanon & C. R. C. Doria (Orgs.). 2013. Peixes do rio Madeira. São Paulo, Dialeto Latin American Documentary, v. 2.

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