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

Christian Andreas Cramer¹ and Lúcia Helena Rapp Py-Daniel²

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 Rio 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 m³/s and a total drainage area of 1,370,000km² 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 Rio 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 Aripuanâ, 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

¹Universidade Federal de Rondônia - Laboratório de Ictiologia e Pesca - Departamento de Biologia - BR 364, km 9.5, Sentido Rio Branco, S/N, 76801-059 Porto Velho, Rondônia, Brazil. cramerce@gmx.de (corresponding author)

²Instituto Nacional de Pesquisa da Amazônia - Coleção de Peixes - Av. Andre Araújo 2936, Petrópolis, 69060-001 Manaus, Amazonas, Brazil. lucia.rapp@gmail.com
A new *Panaqolus* from the rio Madeira

& Stewart, 1993), *P. nocturnus* (Schaefer & Stewart, 1993), *P. chagae* (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

urn:lsid:zoobank.org:act:42F632D8-A127-4092-B09B-708882C0C3B9

(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. 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 141009, 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°32'32.70"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, 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 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.


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 posterovertrally slanted between dorsal-fin origin and adipose-fin origin, gently concave through caudal peduncle to posterior tip of
A new *Panaqolus* from the rio Madeira

Procurent 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 Lujan et al., 2010).

<table>
<thead>
<tr>
<th>ILM</th>
<th>Measurement</th>
<th>H</th>
<th>n</th>
<th>range</th>
<th>mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-20</td>
<td>Standard length (mm)</td>
<td>110.1</td>
<td>47</td>
<td>32.84-112.2</td>
<td>82.44</td>
</tr>
<tr>
<td>1-10</td>
<td>Predorsal length</td>
<td>43.1</td>
<td>47</td>
<td>40.1-44.5</td>
<td>42.3±1.0</td>
</tr>
<tr>
<td>1-7</td>
<td>Head length</td>
<td>35.7</td>
<td>47</td>
<td>33.2-39.3</td>
<td>35.2±1.3</td>
</tr>
<tr>
<td>8-9</td>
<td>Cleithral width</td>
<td>31.5</td>
<td>47</td>
<td>30.8-34.3</td>
<td>32.3±0.9</td>
</tr>
<tr>
<td>8'9'</td>
<td>Cleithral width ventral</td>
<td>29.5</td>
<td>47</td>
<td>29.0-33.8</td>
<td>31.0±1.2</td>
</tr>
<tr>
<td>1-12</td>
<td>Head-pectoral length</td>
<td>27.0</td>
<td>47</td>
<td>22.4-28.2</td>
<td>25.5±1.3</td>
</tr>
<tr>
<td>12-13</td>
<td>Thorax length</td>
<td>25.3</td>
<td>47</td>
<td>22.7-30.7</td>
<td>26.4±2.0</td>
</tr>
<tr>
<td>12-29</td>
<td>Pectoral-spine length</td>
<td>31.1</td>
<td>46</td>
<td>29.5-34.9</td>
<td>32.0±1.4</td>
</tr>
<tr>
<td>13-14</td>
<td>Abdominal length</td>
<td>23.8</td>
<td>47</td>
<td>20.5-24.3</td>
<td>22.4±0.9</td>
</tr>
<tr>
<td>13-30</td>
<td>Pelvic-spine length</td>
<td>27.8</td>
<td>46</td>
<td>25.7-31.2</td>
<td>28.1±1.1</td>
</tr>
<tr>
<td>13-13'</td>
<td>Pelvic girdle width</td>
<td>20.2</td>
<td>47</td>
<td>19.4-22.7</td>
<td>20.9±0.7</td>
</tr>
<tr>
<td>14-15</td>
<td>Postanal length</td>
<td>34.8</td>
<td>47</td>
<td>31.7-37.6</td>
<td>34.9±1.3</td>
</tr>
<tr>
<td>14-31</td>
<td>Anal-fin spine length</td>
<td>18.3</td>
<td>46</td>
<td>12.8-18.3</td>
<td>15.3±1.2</td>
</tr>
<tr>
<td>10-12</td>
<td>Dorsal-pectoral depth</td>
<td>29.7</td>
<td>47</td>
<td>26.9-30.3</td>
<td>28.6±1.0</td>
</tr>
<tr>
<td>10-11</td>
<td>Dorsal-spine length</td>
<td>27.5</td>
<td>39</td>
<td>26.2-32.5</td>
<td>29.5±1.5</td>
</tr>
<tr>
<td>10-16</td>
<td>Dorsal-fin base length</td>
<td>27.5</td>
<td>47</td>
<td>20.5-28.8</td>
<td>25.3±1.3</td>
</tr>
<tr>
<td>16-17</td>
<td>Dorsal-adipose distance</td>
<td>17.7</td>
<td>46</td>
<td>13.7-19.4</td>
<td>17.2±1.2</td>
</tr>
<tr>
<td>17-18</td>
<td>Adipose-spine length</td>
<td>5.7</td>
<td>47</td>
<td>5.7-10.0</td>
<td>8.2±0.7</td>
</tr>
<tr>
<td>17-19</td>
<td>Adipose-upper caudal distance</td>
<td>12.0</td>
<td>47</td>
<td>12.0-20.7</td>
<td>15.8±1.4</td>
</tr>
<tr>
<td>15-19</td>
<td>Caudal peduncle depth</td>
<td>10.8</td>
<td>47</td>
<td>9.3-11.4</td>
<td>10.6±0.4</td>
</tr>
<tr>
<td>20-32</td>
<td>Caudal peduncle-middle caudal ray</td>
<td>23.5</td>
<td>42</td>
<td>9.5-26.0</td>
<td>17.7±4.1</td>
</tr>
<tr>
<td>20-33</td>
<td>Caudal peduncle-dorsal caudal spine</td>
<td>47.0</td>
<td>17</td>
<td>33.7-81.7</td>
<td>51.8±13.0</td>
</tr>
<tr>
<td>15-17</td>
<td>Adipose-lower caudal depth</td>
<td>20.5</td>
<td>47</td>
<td>20.5-25.2</td>
<td>22.6±1.1</td>
</tr>
</tbody>
</table>

Percent of Head Length

<table>
<thead>
<tr>
<th>ILM</th>
<th>Measurement</th>
<th>H</th>
<th>n</th>
<th>range</th>
<th>mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-7</td>
<td>Head-eye length</td>
<td>35.6</td>
<td>47</td>
<td>35.2-41.5</td>
<td>37.8±1.3</td>
</tr>
<tr>
<td>4-5</td>
<td>Orbit diameter</td>
<td>13.5</td>
<td>47</td>
<td>12.5-16.8</td>
<td>14.3±1.0</td>
</tr>
<tr>
<td>1-4</td>
<td>Snout length</td>
<td>61.0</td>
<td>47</td>
<td>49.7-63.7</td>
<td>59.5±2.2</td>
</tr>
<tr>
<td>2-3</td>
<td>Internares width</td>
<td>11.8</td>
<td>47</td>
<td>10.5-14.7</td>
<td>12.2±0.9</td>
</tr>
<tr>
<td>5-6</td>
<td>Interorbital width</td>
<td>51.8</td>
<td>46</td>
<td>46.5-54.6</td>
<td>49.6±1.6</td>
</tr>
<tr>
<td>5'-6'</td>
<td>Dorsal interorbital width</td>
<td>35.0</td>
<td>47</td>
<td>34.4-39.3</td>
<td>36.7±1.2</td>
</tr>
<tr>
<td>7-12</td>
<td>Head depth</td>
<td>70.3</td>
<td>47</td>
<td>61.7-75.4</td>
<td>69.3±2.2</td>
</tr>
<tr>
<td>1-24</td>
<td>Mouth length</td>
<td>46.2</td>
<td>46</td>
<td>36.2-50.5</td>
<td>42.7±3.7</td>
</tr>
<tr>
<td>21-22</td>
<td>Mouth width</td>
<td>42.0</td>
<td>46</td>
<td>34.4-46.4</td>
<td>39.9±3.2</td>
</tr>
<tr>
<td>22-23</td>
<td>Barbel length</td>
<td>13.6</td>
<td>46</td>
<td>9.7-19.6</td>
<td>13.8±2.5</td>
</tr>
</tbody>
</table>
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 unicuspitate 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. Dots faded to absent in preserved specimens, especially on trunk, but usually visible on fins. 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.
A new *Panaqolus* from the rio Madeira

**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. 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).
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 Marañón 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 fins.

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 Panagolus 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 \N; 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, rio 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 raininages) .................................................. 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 a posterodorsal to anteroverentral direction......................................... 7

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 (Rio 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 (Rio 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, Rio Pucuno, tributary of Suno (altitude 350-400 m). USNM 167910, paratype, 81.7 mm SL, Rio Cotapino, tributary of Rio Pucuno. USNM 167908, paratypes, 4, 48.5-78.5 mm SL, Pastaza, Rio Bobonaza, Pastaza drainage. **Peru:** Amazonas: AUM 45502, 5, 39.6-103.7 mm SL, Rio Marañón, log riffle, 1.57 km ENE of Juan Velasco (Sta Maria de Nieva). AUM 45507, 5, 79.1-114.8 mm SL, Rio Marañón, log riffle, 1.57 km ENE of Juan Velasco (Sta Maria de Nieva). LACM 36357-33, 72.3 mm SL, Rio Cenepa, vicinity of Huampami. LACM 42001-9, 2, 91.4-113.3 mm SL, 100 m downstream from Caterpiza. LACM 41720-18, 99.8 mm SL, Rio Marañón at confluence with Rio Nieva at Sta. Maria de Nieva. LACM 41720-5, 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, Rio La Poza. LACM 42115-6, 54.8 mm SL, Caterpiza. UFRO-1 17825, 77.5 mm SL, aquarium specimen. *Panaque changae.* **Peru:** Loreto: MUSM 17107, holotype, 58.8 mm SL, Rio Itaya, 11 km SSW center of IQUITOS at bearing 39°. SIU 29928, paratype, 45.2 mm SL, Rio Itaya, 11 km SSW center of IQUITOS at bearing 39°. INHS 42419, paratypes, 2, 38.5-83.0 mm SL, Rio Itaya, 11 km SSW center of IQUITOS at bearing 39°. AUM 28908, 5, 53.0-84.5 mm SL, Rio Momon, ca. 8 hours by boat from IQUITOS. *Panaque dentex.* **Peru:** Loreto: BMNH 1867.6.13.37, holotype, 58.8 mm SL, Rio Xeberos, Huallaga drainage. Amazonas: FMNH 96952, 73.8 mm SL, Peru, Amazonas, Caterpiza. LACM 39892-1, 3, 46.9-67.7 mm SL, Shaine, village on Rio 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 Rio Santiago. AMNH 218002, 76.7 mm SL, Rio Santiago. **Ecuador:** Napo: FMNH 97595, 2, 67.6-73.5 mm SL, Quebrada Apoalla, tributary to lower Rio Shushufindi, Napo drainage. FMNH 97596, 2, 74.1-78.4 mm SL, lower Rio Bobonaza at Chicherata, about 25 km upstream from mouth of Rio Pastaza. FMNH 97593, 41.4 mm SL, Estero Samayacu, about 3.5 km SW of the bridge over Rio Napo along road from Coca to Rio Tiptutini. *Panaque gnomus.* **Ecuador:** Pastaza: FMNH 70860, holotype, 56.5 mm SL, Cusuimi, on Rio Cusui, about 150 km. SE of Puyo. FMNH 97598, paratypes, 2, 56.0-56.1 mm SL, Rio Bobonaza at Sarayacu, Pastaza drainage. FMNH 97597, paratypes, 3, 53.0-55.7 mm SL, Cusuimi, on Rio Cusui, about 150 km SE of Puyo. Orellana: USNM 163912, paratype, 60.9 mm SL, Orellana, Rio Suno, upper, Napo drainage. **Peru:** Amazonas: FMNH 96950, paratype, 69.2 mm SL, Rio 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, Rio 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. *Panaque koko.* SMF 9702, 84.7 mm SL, *French Guyana:* Saint Laurent du Maroni: Maroni River, Saut Ga-kaba toapatou. *Panaque maccus.* **Venezuela:** MCBUCV-V 24010, holotype, 66.0 mm SL, Portuguesa, Rio Las Marinas, upstream from bridge on Route 5 east of Cuanare, tributary of Rio Portuguesa. FMNH 97603, paratypes, 3, 29.0-49.8 mm SL, same data as holotype. FMNH 105998, 3, 31.8-52.2 mm SL, Barinas, Rio Anaro, ca. 10 minutes from mouth in Rio Suripa, Rio Aparú drainage. USNM 265675, 31.6 mm SL, Bolivar, Rio Orinoco, Cove, Tsle de Fajardo, 182 nautical miles upstream from Sea Buoy. *Panaque nocturnus.* **Peru:** Amazonas: LACM 41729-51, holotype, 138.9 mm SL, Rio Santiago at La Poza. FMNH 96955, paratypes, 137.8 mm SL, Rio Santiago at La Poza, outside mouth of quebrada by airport. LACM 41729-35, paratypes, 4, 71.3-123.4 mm SL, Rio Santiago at La Poza. LACM 41723-5, paratypes, 4, 111.1-123.5 mm SL, Rio Santiago at La Poza. AUM 45558, 6, 68.4-116.6 mm SL, Rio Marañón, 6.3 km NE of Juan Velasco (Santa Maria de Nieva). AUM 45500, 2, 130.5-143.9 mm SL, Rio Marañón, log riffle, 1.57 km ENE of Juan Velasco (Santa Maria de Nieva). AUM 45508, 3, 69.8-101.5 mm SL, Rio Marañón, 12 km N Imacita. **Ecuador:** Pastaza: FMNH 979600, paratypes, 2, 66.7-96.9 mm SL, lower Rio Bobonaza at Chicherota, ca. 25 km upstream from mouth with Rio Pastaza. Napo: FMNH 97599, paratypes, 121.5 mm SL, Rio Aguarico near Destacamento militar Cuyabeno and confluence of Rio Cuyabeno - Rio Aguarico, Napo drainage. USNM 167907, paratypes, 2, 103.5-109.0 mm SL, Rio Bobonaza, Napo drainage. USNM 177209, paratypes, 92.2 mm SL, Rio Bobonaza at Chicherota, about 25 km upstream from mouth in Rio Pastaza. *Panaque purusiensis.* **Brazil:** Acre: AMNH 12600, holotype, 106.7 mm SL; vicinity of the mouth of Rio Macauá (or Macauan), 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 Pr43, 1, 126.4 mm SL, same data as holotype; UFRO-I 17720, 11, 15.5-83.1 mm SL, Rio Macaúba near mouth with Rio Iaco. UFRO-I 17723, 1, 15.7 mm SL, Rio Macaúba near mouth with Rio Iaco. MCP 35621, 2, 59.7-78.1 mm SL, Rio Riziohino do Andirá at BR-364 between Rio Branco and Sena Madureira. Peru: Ucayali: MCP 45733, 2, 107.6-114.0 mm SL, Rio Curanja near confluence with Rio Purús. MUSM 39425, 1, 130.4 mm SL, Rio Curanja near mouth with Rio Purús. 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.

Acknowledgements

Thanks are due to James Maclaine (BMNH), Giorgio Bardelli (MSNM), Jonathan Armbruster (AUM), Richard Vari (USNM), Leo Smith and Kevin Swagel (FMNH), and Rick Feeney (LACM) for receiving CAC at their museum collections. Andreas Tanke (Neustadt am Rübenberge, Germany) contributed with valuable discussions about the genus Panaqolus. Diogo Hungria compiled the distribution map. Kevin Swagel and Julian Dignall improved considerably the English of the manuscript. Financial support: CAC benefited from a DCR fellowship from Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq and SEPLAN-RO (process 350674/2010-8). LRP benefited from CNPq financial support through processes n. 562215/2010-7 and 474236/2004-8.

References


