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LISTS OF SPECIES

Fish, upper Purus River, state of Acre, Brazil.

Helio Daniel Beltrão dos Anjos [1]
Jansen Zuanon [2]
Tony Marcos Porto Braga [3]
Keid Nolan Silva Sousa [4]

[1] *Laboratório de Bio-ecologia de Peixes INPA/Max-Planck, Instituto Nacional de Pesquisas da Amazônia - INPA*
Caixa Postal 478, CEP 69083-970, Manaus, AM, Brazil. E-mail: yas1072003@yahoo.com.br

[2] *Coordenação de Pesquisas em Biologia Aquática, Instituto Nacional de Pesquisas da Amazônia - INPA*
Caixa Postal 478, CEP 69083-970, Manaus, AM, Brazil.

[3] *Programa de Pós-graduação em Ecologia, Instituto Nacional de Pesquisas da Amazônia - INPA*
Caixa Postal 478, CEP 69083-970, Manaus, AM, Brazil.

[4] *Universidade Federal do Pará, Campus Avançado de Bragança.*
Alameda Leandro Ribeiro s/n, CEP 68600-000, Bragança, PA, Brazil.

Abstract: The ichthyofauna of the headwaters of the main tributaries of the mighty Solimões/Amazonas River has been little studied. Considering the importance of those environments for the overall fish diversity in that river system, we surveyed the composition of the fish fauna of the upper portion of Purus River and two of its tributaries (Caeté and Macapá rivers), state of Acre, Brazil. The collections were done in November 2004, using a seine net and a set of gillnets of different mesh sizes. A total of 735 specimens belonging to 86 species and 28 families were collected. Eight species, *Creagrutus occidaneus*, *Phenacogaster pectinatus*, *Prionobrama filigera*, *Moenkhausia* cf. *lepidura*, *Leptagoniates pi* (Characidade), *Henonemus punctatus* (Trichomycteridae), *Toracocharax stellatus* (Gateropelecidae), and *Eigenmannia macrops* (Sternopygidae) composed nearly half of the specimens collected. This survey adds 48 new records to the ichthyofauna of Purus River and elevates to 243 the number of known fish species in that river, but a greater sampling effort is necessary to produce a reasonably complete picture of the fish diversity in the basin.

Introduction

The Amazon basin harbors the highest diversity of freshwater fishes in the world with approximately 2,400 valid species (Levêque et al. 2008), and recent estimates suggest that this number may surpass 3,000 species (Carvalho et al. 2007). Most of fish fauna belongs to four main Orders (Characiformes, Siluriformes, Gymnotiformes, and Perciformes), with eleven additional orders represented by lower species richness (Roberts 1972; Lowe-McConnell 1987; Reis et al. 2003). Some fish groups are better studied taxonomically than others, and further studies focusing on some poorly known aquatic environments (such as small rivers and streams) and hard to reach areas may considerably increase the known fish species richness in the Amazon (Bohlke et al. 1978; Menezes 1996).

The state of Acre encompasses the upper portions of the Purus and Juruá rivers about 1,000 km upstream their confluences with Solimões-Amazonas River. The ichthyofauna of this area is still poorly known due to its geographical isolation, distance from the main centers of ichthyological studies in the country, and mainly in function of difficulties to sample some hard to reach places. A first survey on the ichthyofauna of the Purus River apparently was accomplished by La Monte (1935) who registered 29 fish species for that river. Cox-Fernandes (1995), sixty years later, studying the ecology of electric knife fishes (Gymnotiformes) of the main channel of the Amazon River and its tributaries, added 13 species to that list. More recently, Rapp-Py-Daniel and Deus (2003) collected 180 fish species along a stretch of 350 km in the lower Purus River between its confluence with the Solimões River upstream to the Abufari Biological Reserve (REBIO-Abufari), state of Amazonas.

The objective of the present study is to present new data regarding the ichthyofauna of the upper Purus River in the state of Acre, Brazil, aiming to contribute to a better knowledge of the fish diversity in the Western Brazilian Amazon and as a tool for conservation planning of aquatic environments in that region.

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Material and methods

Six samples were taken between 22 and 26 November 2004, in three places along the road BR-364 (state of Acre): 1) Purus River (08°53'03" S, 69°16'18" W); 2) Caeté River (09°03'43" S, 68°44'49" W), a tributary of the right margin of the Purus; and Macapá Stream (08°45'15" S, 69°28'28" W), a tributary of the left margin of the Purus River (Figure 1).

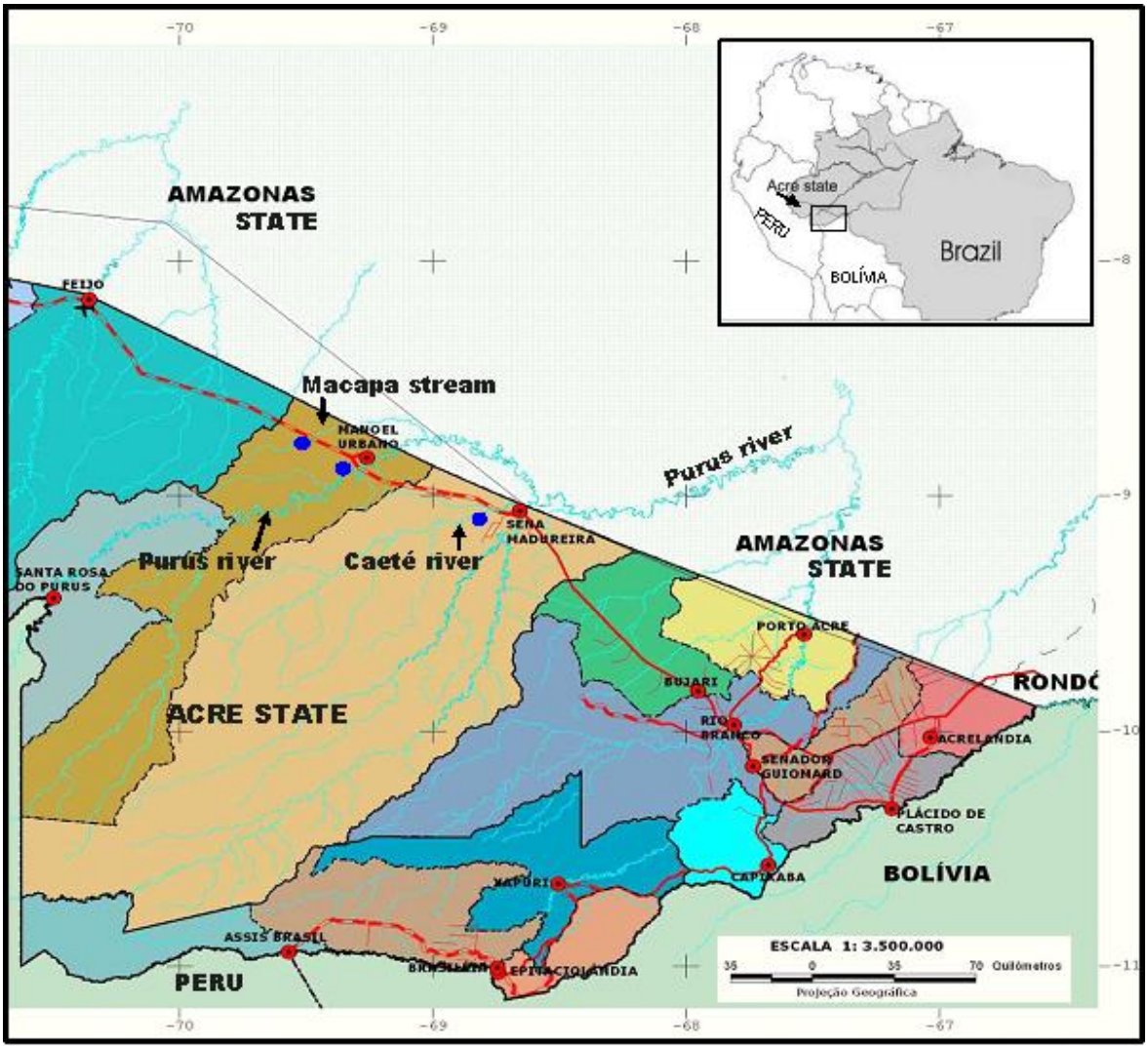

Figure 1. Map of study site showing the northwest portion of the state of Acre and the upper Purus River basin, with the location of sampling stations (blue dots) in the Purus, Caeté, and Macapá rivers (modified from the Ecological-Economical Zoning of Acre-ZEE-AC, *Secretaria de Ciência, Tecnologia e Meio Ambiente* – SECTMA-AC 1999).

The collections were accomplished using a set of gillnets (20, 25, 30, and 40 mm between adjacent knots), each net measuring 30 x 2 m. Overall, gillnets were set for 12 hours in each sampling place (08:00 h - 20:00 h). At the same time, a seine net (5 mm between adjacent knots, 5 x 1.5 m) was employed during one hour per collect point. The fishes were collected in accordance with the permit 1/2004-PESCA (process: 02002002800/04-50) of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA/Acre).

The fishes were preserved immediately in 10 % formalin. In the laboratory they were washed in running water by 24 hours and later conserved in ethanol 70 %. Fish identification was accomplished to the more precise taxonomic level, using bibliography and with the help of ichthyologists of the National Institute for Research in the Amazon (INPA). Voucher specimens were deposited at the Laboratory of Biology of the Federal University of Acre - UFAC and in INPA's Fish Collection.

Results and discussion

A total of 735 specimens belonging to 86 species, 28 families, and eight orders were collected. The list of species with their respective families, orders and occurrence places is presented in Table 1. The families with higher species richness were Characidae (24 species), Loricariidae (11 spp.), Auchenipteridae (7 spp.), Pimelodidae (5 spp.), and Curimatidae (5 spp.). Of the 28 families, 17 were represented by only one species and other five families by two species each. The most abundant species varied among sampling places: *Creagrutus occidaneus* (n = 55), *Moenkhausia* cf. *lepidura* (24), and *Eigenmannia macrops* (20) in Caeté River; *Henonemus punctatus* (61), *Creagrutus occidaneus* (51), and *Aphyocharax* cf. *alburnus* (18) in Purus River; and *Phenacogaster pectinatus* (57), *Torachocharax stellatus* (38), and *Prionobrama filigera* (29) in Macapá Stream. Additionally, four species (*Cyphocharax* aff. *vexillapinnus*, *Ancistrus* sp., *Aphanotorulus* sp., and *Cheirocerus* aff. *eques*) apparently represent new taxa and are now being carefully evaluated.

The Amazonian ichthyofauna is characterized by the dominance of Otophysi (Characiformes, 43 %; Siluriformes, 39 %, and Gymnotiformes, 3 %) representing approximately 85 % of the species, followed by Perciformes (12 %) and other orders (3 %) (Roberts 1972; Lowe-McConnell 1987). In conjunction, the structure of the ichthyofauna captured in the Caeté, Purus and Macapá rivers follows closely that proportions (Characiformes, 43.0 %; Siluriformes, 39.5 % and Gymnotiformes, 8.1 %; Perciformes, 4.7 %; Clupeiformes, Pleuronectiformes, Tetraodontiformes, and Beloniformes together, 4.7 %). Those values are also similar to the recorded by Rapp Py-Daniel and Deus (2003) in the lower Purus River. Nevertheless, the higher proportion of species of Gymnotiformes recorded by these authors (26 species, corresponding to 15 % of the overall species richness) probably reflects differences in the sampling effort and collecting methods employed. The use of bottom trawl nets ("otter trawl") by Rapp Py-Daniel and Deus (2003) arguably allowed a better survey of the fish fauna of the main river channel, a habitat dominated by Siluriformes and Gymnotiformes (Lundberg et al. 1996; Cox-Fernandes et al. 2004).

One of the main problems to compare species lists across time is the need to deal with the nomenclatural changes that occur along the taxonomic process. In the present study, a careful analysis of La Monte's (1935) list resulted in 29 species confidently recorded for Purus River. Further studies of Cox-Fernandes (1995) (13 species) and Rapp-Py-Daniel and Deus (2003) (180 spp.) resulted in an upgraded list of 195 fish species for that river. Although based on a relatively low sampling effort, the present study added 48 species records to the list, an increase of nearly 25 %. This high proportional increase may have resulted from the inclusion of two smaller tributaries of the Purus River in the samplings, which possibly added habitat heterogeneity and allowed the collection of different fish assemblages. Moreover, this high proportion of new records evidences our incipient knowledge about the true diversity of fishes in the Purus River system.

The knowledge accumulated so far indicates that the Purus River basin harbors a rich ichthyofauna distributed in diverse aquatic environments. Since many of these environments are still unexplored, a much greater sampling effort is necessary to produce a reasonably complete picture of the fish diversity in the basin, where potentially several new species may be discovered. Moreover, the Purus River is currently the main source of fish for human consumption in Manaus, the most populous city in Brazilian Central Amazon with 1.8 million people, which generates a high fishing pressure on its natural stocks. In face of this situation, a better understanding of the diversity and distribution of fishes in the Purus River is urgently needed.

LISTS OF SPECIES

Table 1. Lists of fish species and their respective abundances captured in the Caeté, Purus, and Macapá rivers, state of Acre, Brazil.

Order/ Family/Specie	Caeté River	Purus River	Macapá Stream	Total	%
CLUPEIFORMES					
Engraulididae					
Anchoviella jamesi (Jordan & Seale, 1926)	5	1		**6**	0.82
CHARACIFORMES					
Acestrorhynchidae					
Acestrorhynchus falcatus (Bloch, 1794)			2	**2**	0.27
Anostomidae					
Leporinus friderici (Bloch, 1794)			10	**10**	1.36
Characidae					
Aphyocharax cf. *alburnus* (Günther, 1869)		18		**18**	2.45
Brachychalcinus copei (Steindachner, 1882)	1		1	**2**	0.27
Charax aff. *gibossus* (Linnaeus, 1758)			1	**1**	0.14
Charax cf. *leticiae* (Lucena, 1987)			3	**3**	0.41
Clupeacharax anchoveoides (Pearson, 1924)	3	5		**8**	1.09
Creagrutus occidaneus (Vari & Harold, 2001)	55	51		**106**	14.42
Ctenobrycon hauxwellianus (Cope, 1870)			1	**1**	0.14
Galeocharax gulo (Cope, 1870)		2		**2**	0.27
Hemigrammus aff. *gracilis* (Lutken, 1875)			3	**3**	0.41
Hemigrammus aff. *ocellifer* (Steindachner, 1882)			8	**8**	1.09
Hyphessobrycon cf. *bentosi* (Durbin, 1908)			3	**3**	0.41
Leptagoniates pi (Vari,1978)	8		21	**29**	3.95
Moenkhausia oligolepis (Günther, 1864)			3	**3**	0.41
Moenkhausia cf. *lepidura* (Kner, 1858)	24		6	**30**	4.08
Odontostilbe nareuda (Burhnheim & Malabarba, 2006)	1			**1**	0.14
Paragoniates alburnus (Steindachner, 1876)			5	**5**	0.68
Phenacogaster pectinatus (Cope, 1870)	8	13	57	**78**	10.61
Prionobrama filigera (Cope, 1870)	9	2	29	**40**	5.44
Pristobrycon cf. *calmoni* (Steindachner, 1908)	1		1	**2**	0.27
Roeboides myersii (Gill, 1870)		1	1	**2**	0.27
Roeboides affinis (Günther, 1868)			1	**1**	0.14
Tetragonopterus argenteus (Cuvier, 1816)		1		**1**	0.14
Triportheus angulatus (Spix & Agassiz, 1829)	3		3	**6**	0.82
Triportheus auritus (Günther, 1864)		13		**13**	1.77

LISTS OF SPECIES

Table 1. Continued.

Order/ Family/Specie	Caeté River	Purus River	Macapá Stream	Total	%
Crenuchidae					
Characidium sp.			4	**4**	0.54
Curimatidae					
Curimata vittata (Kner, 1858)		1		**1**	0.14
Cyphocharax aff. *vexillapinnus* (Vari, 1992)	1		2	**3**	0.41
Potamorhina latior (Spix, 1829)	1	1		**2**	0.27
Psectrogaster amazonica (Eigenmann & Eigenmann, 1889)		1		**1**	0.14
Steindachnerina cf. *leucisca* (Günther, 1868)	2	4	1	**7**	0.95
Cynodontidae					
Rhaphiodon vulpinus (Spix & Agassiz, 1829)	1	3		**4**	0.54
Erytrinidae					
Hoplias malabaricus (Bloch, 1794)			6	**6**	0.82
Gasteropelicidae					
Thoracocharax stellatus (Kner, 1858)	2	8	38	**48**	6.53
Hemiodontidae					
Anodus elongatus (Agassiz, 1829)		6		**6**	0.82
Prochilodontidae					
Prochilodus nigricans (Agassiz, 1829)			1	**1**	0.14
SILURIFORMES					
Aspredinidae					
Pterobunocephalus cf. *depressus* (Haseman, 1911)	1			**1**	0.14
Auchenipteridae					
Ageneiosus atronasus (Eigenmann & Eigenmann, 1888)	1			**1**	0.14
Ageneiosus inermis (Linnaeus, 1766)			3	**3**	0.41
Ageneiosus ucayalensis (Castelnau, 1855)	3			**3**	0.41
Auchenipterus brachyurus (Cope, 1878)		7	5	**12**	1.63
Centromochlus heckeli (Filippi, 1853)	6			**6**	0.82
Centromochlus reticulatus (Mees, 1974)			1	**1**	0.14
Trachelyopterus galeatus (Linnaeus, 1766)			1	**1**	0.14
Callichthyidae					
Corydoras armatus (Günther, 1868)			3	**3**	0.41
Corydoras aff. *semiaquilus* (Weitzman, 1964)	2		2	**4**	0.54
Corydoras trilineatus (Cope, 1872)	1		21	**22**	2.99

LISTS OF SPECIES

Table 1. Continued.

Order/ Family/Specie	Caeté River	Purus River	Macapá Stream	Total	%
Cetopsidae					
Cetopsis coecutiens (Lichtenstein, 1819)	1			**1**	0.14
Doradidae					
Hassar sp.			2	**2**	0.27
Loricariidae					
Ancistrus sp.			3	**3**	0.41
Aphanotorulus sp.	1			**1**	0.14
Farlowella nattereri (Steindachner, 1910)	9	1		**10**	1.36
Hemiodontichthys acipenserinus (Kner, 1853)			2	**2**	0.27
Hypoptopoma aff. *gulare* (Cope, 1878)	5			**5**	0.68
Lamontichthys filamentosus (La Monte, 1935)	1			**1**	0.14
Otocinclus vitattus (Regan, 1904)			9	**9**	1.22
Peckoltia sp.		2		**2**	0.27
Rineloricaria castroi (Isbrucker & Nijssen, 1984)	4		2	**6**	0.82
Rineloricaria lanceolata (Günther, 1868)	3		1	**4**	0.54
Sturisoma cf. *lyra* (Regan, 1904)	6		3	**9**	1.22
Pseudopimelodidae					
Batrochoglanis cf. *raninus* (Valenciennes, 1840)			2	**2**	0.27
Pimelodidae					
Calophysus macropterus (Lichtenstein, 1819)	2	2		**4**	0.54
Cheirocerus cf. *eques* (Eigenmann,1917)	5			**5**	0.68
Pimelodus aff. *blochii* (Valenciennes, 1840)		1		**1**	0.14
Pininampus pirinampu (Spix & Agassiz, 1829)	1			**1**	0.14
Sorubim lima (Bloch & Schneider, 1801)	1		1	**2**	0.27
Heptapteridae					
Pimelodella aff. *buckleyi* (Boulenger, 1887)	3	3	2	**8**	1.09
Pimelodella steindachneri (Eigenmann, 1917)	1		1	**2**	0.27
Trichomycteridae					
Henonemus punctatus (Boulenger, 1887)	4	61	1	**66**	8.98
Vandellia cirrhosa (Valenciennes, 1846)		2		**2**	0.27
GYMNOTIFORMES					
Apteronotidae					
Apteronotus bonapartii (Castelnau, 1855)		1		**1**	0.14
Platyurosternarchus macrostomus (Günther, 1870)	1			**1**	0.14

LISTS OF SPECIES

Table 1. Continued.

Order/ Family/Specie	Caeté River	Purus River	Macapá Stream	Total	%
Rhamphichthyidae					
Rhamphichthys marmoratus (Castelnau, 1856)	1	1		**2**	0.27
Sternopygidae					
Eigenmannia limbata (Schreiner & Miranda Ribeiro, 1903)	8		3	**11**	1.50
Eigenmannia macrops (Boulenger, 1897)	20		4	**24**	3.27
Eigenmannia virescens (Valenciennes, 1842)	1			**1**	0.14
Sternopygus macrurus (Bloch & Schneider, 1801)	1		2	**3**	0.41
BELONIFORMES					
Belonidae					
Pseudotylosurus cf. *angusticeps* (Günther, 1866)			2	**2**	0.27
PERCIFORMES					
Cichlidae					
Apistogramma sp.	4			**4**	0.54
Bujurquina cf. *syspilus* (Cope, 1872)	3		4	**7**	0.95
Sciaenidae					
Pachypops trifilis (Müller & Troschel, 1849)		1		**1**	0.14
Plagioscion squamosissimus (Heckel, 1840)	2			**2**	0.27
PLEURONECTIFORMES					
Achiridae					
Hypoclinemus mentalis (Günther, 1862)		2		**2**	0.27
TETRAODONTIFORMES					
Tetraodontidae					
Colomesus asellus (Müller & Troschel, 1849)	2			**2**	0.27
Total n. individuals	**229**	**215**	**291**	**735**	100.00
Total n. species	**41**	**29**	**50**		

Acknowledgements

We thank the *Departamento de Estradas de Rodagem* of the state of Acre - DERACRE and *STCP Engenharia de Projetos*, for the financial and logistic support for collecting in the Purus River basin, and to IBAMA/Acre for the collecting permit.

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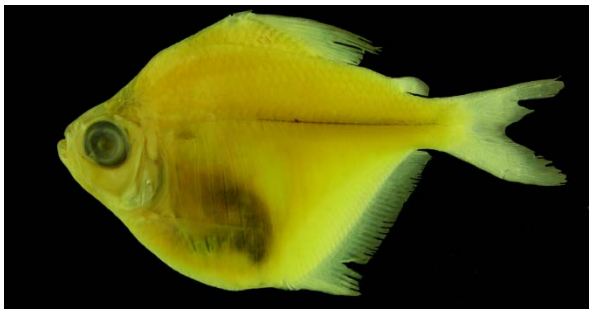
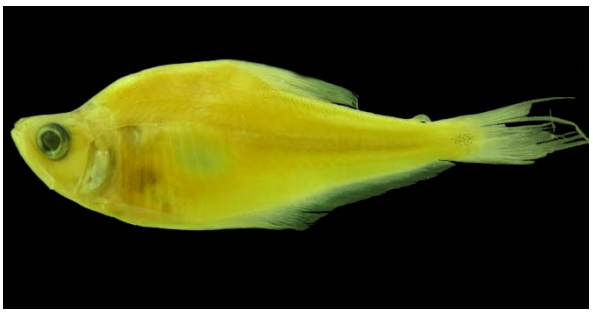
Appendix I. Voucher specimens from the upper Purus River basin deposited at the INPA fish collection.

CHARACIFORMES
CHARACIDAE



Brachychalcinus copei, 45 mm (INPA 28487)



Charax cf. *leticiae*, 66 mm (INPA 28512)

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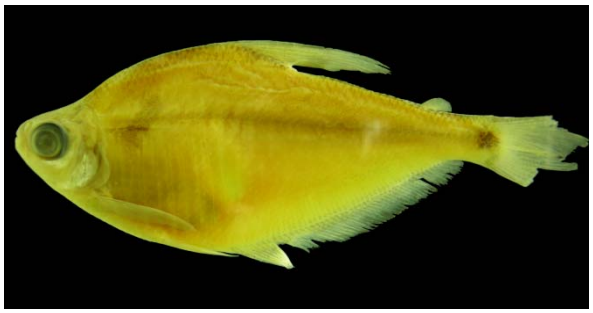
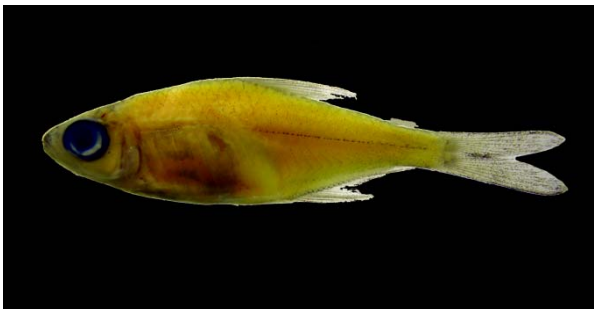
CHARACIDAE (continued)

Clupeacharax anchoveoides, 25 mm (INPA 28514)

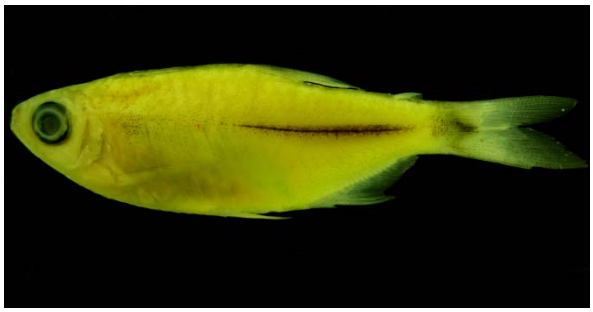
Creagrutus occidaneus, 33 mm (INPA 28488)



Ctenobrycon hauxwellianus, 64 mm (INPA 28513)

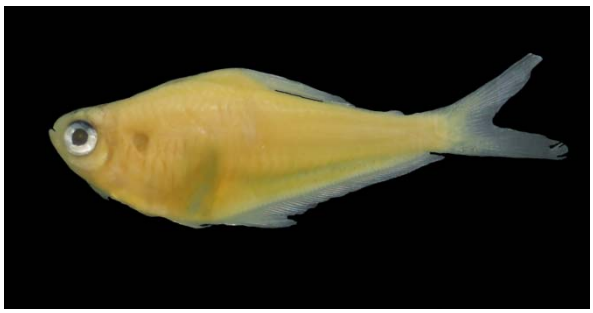


Hemigrammus aff. *gracilis*, 35 mm (INPA 28515)

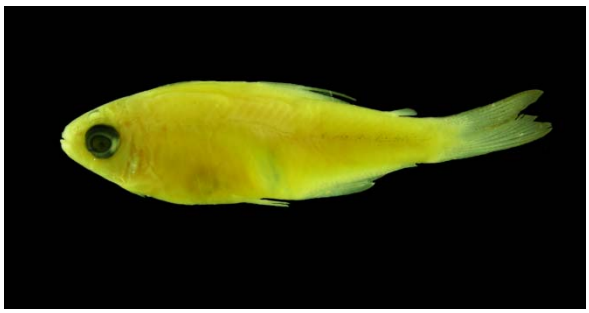


Hemigrammus aff. *ocellifer*, 41 mm (INPA 28516)

Hyphessobrycon cf. *bentosi*, 21 mm (INPA 28517)



Leptagoniates pi, 39 mm (INPA 28491)



Moenkhausia aff. *lepidura*, 32 mm (INPA 28490)

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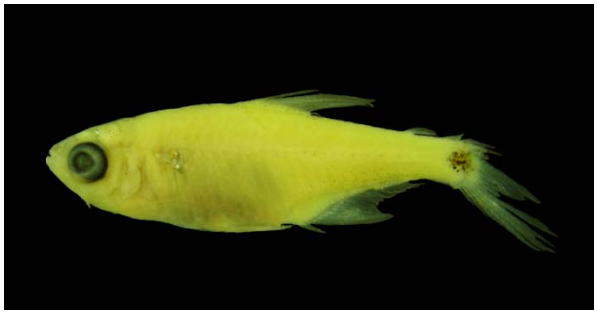
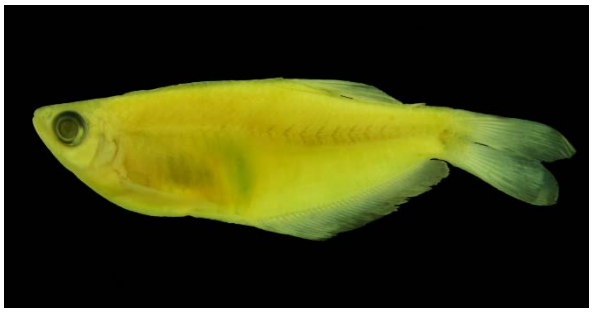
CHARACIDAE (continued)

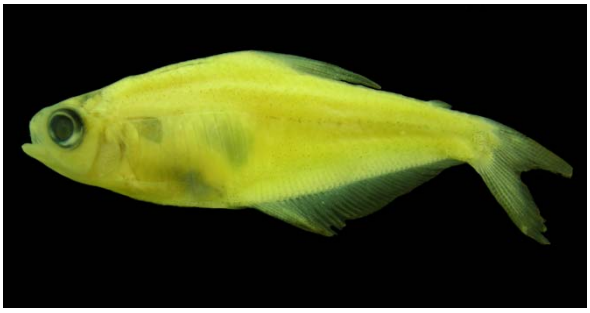
Moenkhausia oligolepis, 55 mm (INPA 28518)



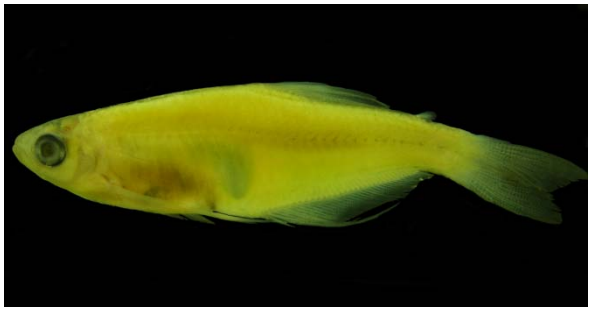
Odontostilbe nareuda, 21 mm (INPA 28543)



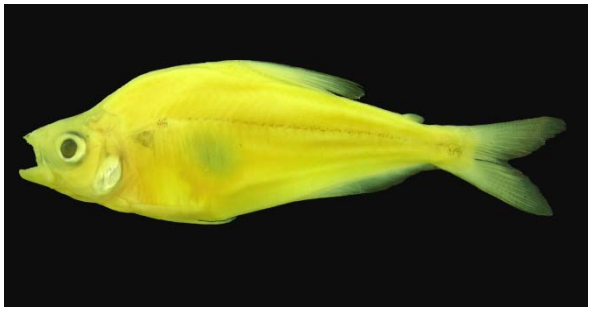
Paragoniates alburnus, 58 mm (INPA 28521)



Phenacogaster pectinatus, 39 mm (INPA 28520)



Prionobrama filigera, 45 mm (INPA 28492)



Roeboides affinis, 60 mm (INPA 28523)

CRENUCHIDAE

Characidium sp., 45 mm (INPA 28524)

LISTS OF SPECIES

CURIMATIDAE

Cyphocharax aff. *vexillapinnus*, 43 mm (INPA 28493)

ERYTRINIDAE

Hoplias malabaricus, 84 mm (INPA 28525)

GASTEROPELECIDAE

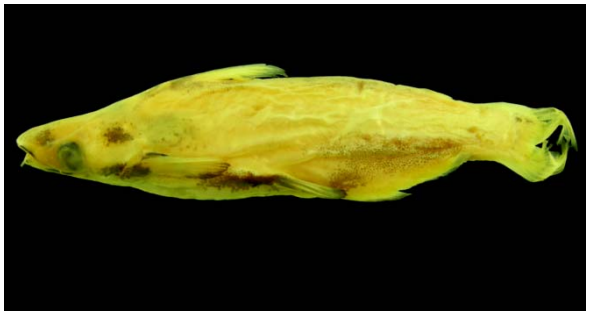
Thoracocharax stellatus, 35 mm (INPA 28526)

SILURIFORMES
ASPREDINIDAE

Pterobunocephalus cf. *depressus*, 41 mm (INPA 28542)

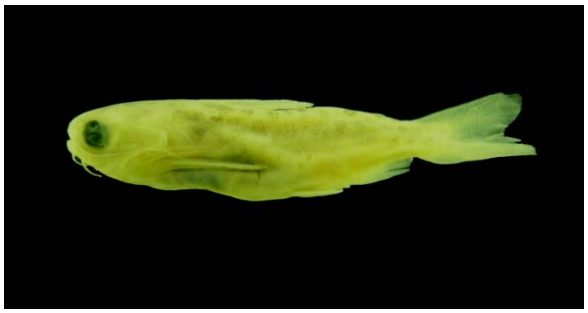
LISTS OF SPECIES

AUCHENIPTERIDAE



Ageneiosus atronasus, 86 mm (INPA 28507)

Auchenipterus brachyurus, 155 mm (INPA 28539)



Centromochlus reticulatus, 24 mm (INPA 28527)

CALLICHTHYDAE

Corydoras armatus, 32 mm (INPA 28528)

Corydoras aff. *semiaquilus*, 46 mm (INPA 28495)

Corydoras trilineatus, 30 mm (INPA 28530)

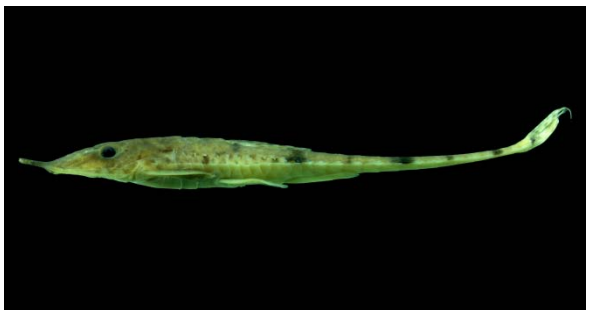
LISTS OF SPECIES

LORICARIIDAE

Ancistrus sp., 77 mm (INPA 28540)

Aphanotorulus sp., 52 mm (INPA 28498)

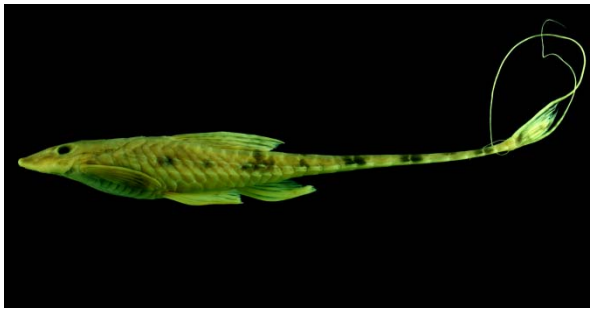
Farlowella nattereri, 70 mm (INPA 28497)



Hemiodontichthys acipenserinus, 125 mm (INPA 28541)

Lamontichthys filamentosus, 143 mm (INPA 28508)

Otocinclus vitattus, 24 mm (INPA 28531)

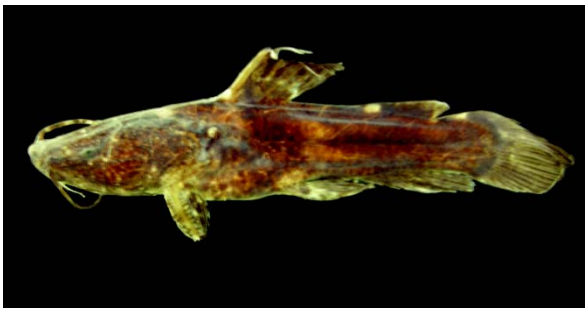


Rineloricaria castroi, 135 mm (INPA 28509)

Rineloricaria lanceolata, 68 mm (INPA 28500)

LISTS OF SPECIES

PSEUDOPIMELODIDAE



Batrochoglanis cf. *raninus*, 64 mm (INPA 28533)

PIMELODIDAE

Cheirocerus cf. *eques*, 73 mm (INPA 28501)

HEPTAPTERIDAE

Pimelodella aff. *buckleyi*, 55 mm (INPA 28502)

Pimelodella steindachneri, 60 mm (INPA 28534)

TRICHOMYCTERIDAE

Henonemus punctatus, 85 mm (INPA 28535)

LISTS OF SPECIES

GYMNOTIFORMES
STERNOPYGIDAE

Eigenmannia limbata, 222 mm (INPA 28510)

Eigenmannia macrops, 97 mm (INPA 28536)

Eigenmannia virescens, 102 mm (INPA 28504)

BELONIFORMES
BELONIDAE

Pseudotylosurus cf. *angusticeps*, 182 mm (INPA 28537)

LISTS OF SPECIES

PERCIFORMES
CICHLIDAE

Bujurquina cf. *syspilus*, 71 mm (INPA 28538)

TETRAODONTIFORMES
TETRAODONTIDAE

Colomesus asellus, 54 mm (INPA 28506)