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Lists of Species

Fishes (Osteichthyes: Actinopterygii) from igarapés of the rio Acre basin, Brazilian Amazon

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Abstract: This study presents a list of species from igarapés tributaries of the rio Acre, Acre State, Brazil. Fish assemblages were sampled in October 2009, August and October 2010, using standard ichthyological gear, along fifteen sampling sites. A total of 11,395 specimens, distributed in 94 species, 24 families and six orders were collected. The most species-rich orders were Characiformes with 45 species (48.4%) and Siluriformes with 33 species (34.7%); from which *Serrapinnus* gr. *microdon* (22.4%), *Otocinclus vittatus* (20.4%), *Phenacogaster pectinatus* (10.9%), *Brachychalcinus copei* (5.8%) and *Knodus* sp. (5.3%) represented 64.8 % of the specimens captured. The species accumulation curve does not present a stabilization tendency, indicating that, additional sampling can increase the number of species. This study has a high importance for the knowledge of the rio Acre fish fauna composition and adds 52 new records of species to the fish fauna of the rio Purus.

Introduction

The Amazon basin has the richest fish fauna worldwide; this diversity is associated with the world's largest river basin, formed by the rio Amazonas and an uncountable number of other rivers and streams (Goulding 1989; Lowe-McConnell 1999; Santos and Ferreira 1999). These streams, known as igarapés, form one of the densest hydrological networks in the world (Junk 1983). The igarapés are generally characterized by acid water and relative poor in nutrients; also, the dense forest cover impedes the entrance of light into the system, resulting in low primary productivity (Goulding 1980; Goulding *et al*. 1988; Walker 1995; Santos and Ferreira 1999), and generating high dependence of allochthonous sources from the riparian forest. This dependence generates an association between the characteristics of the forest adjacent to the igarapés with species richness, abundance and distribution (Walker 1991; Santos and Ferreira 1999).

The rio Acre basin has a high diversity of fishes, which can resulted the environmental heterogeneity (Souza *et al*. 2003). This great diversity is threatened by human activities, mainly by deforestation, expansion of agricultural frontiers and predatory fishing (Acre 2009; 2012). Despite the great diversity and the risk of extinction of some species, the fish fauna is still poorly known (Acre 2012), thus, inventories represent an important step in gathering information that may assist future works. The aim of this study was to describe the composition and distribution of the ichthyofauna from igarapés of the rio Acre basin.

Materials and Methods

Study area

The rio Acre basin is located in south-western Amazonia, arising out in Peruvian territory and running from west to east, making boundary between Brazil and Bolivia. The length of the rio Acre is approximately 1,190 km and flows toward to the rio Purus (Acre 2012). It presents two seasons marked by the water flow, higher flow rates are observed from January to April, whereas the minimum flows occur in the months of August and October (Silva and Latrubesse 1996).

Fifteen sites were sampled in igarapés of the rio Acre basin during the dry season, in October 2009, August and October 2010. Each igarapé can have more than one sample site. Information of geographic coordinates and altitude of igarapés and its sites are listed in Table 1 and Figure 1. Fish collecting were authorized by IBAMA (collecting permit number 12120-1), and were performed using standard ichthyological gear based on active capture with sieves, seine nets and throw nets. The sampling effort was of 60 minutes at each site. Exemplars were fixed in 10% formalin solution and after 48 hours transferred to 70% ethanol. Species were identified up to the lowest possible taxonomic level, using available literature and later confirmed by experts. The taxonomic classification follows Eschmeyer (2013). Voucher specimens were deposited in the fish collection of the Museu de Zoologia da Universidade Estadual de Londrina, Londrina, (MZUEL), Paraná State, Brazil. The voucher specimens and respective pictures are shown in Appendices 1 and 2.

Data analysis

Abundance data were fitted to the models of logarithmic series, geometric series, log-normal and broken stick models, and the fitting to the models was

evaluated by an adherence test of χ^2 (Zar 1999; Magurran 2004). Efficiency of sampling was assessed using species accumulation curves. Statistical estimators have been used for calculating and extrapolating species richness; among them are Chao 1 (Chao 1987) and ACE (Abundance-based Coverage Estimator, Lee and Chao 1994). Chao 1 is based on the abundance, and uses the number of rare species in a sample (one and two individuals) to calculate the expected richness. ACE is also based on relative abundance of the rarest species (<10 individuals), and it is completed by adding on the number of abundant species, that is those represented by > 10 individuals (Magurran 2004; Colwell 2009). These methods of estimation were applied to check the importance of the sampling. The program EstimateS 8.2 (Colwell 2009) was used for the calculations (Figure 3).

Results

In the rio Acre basin, 11,395 specimens were collected, distributed into 94 species belonging to 24 families and six orders (Table 2). Characiformes (45 spp.), Siluriformes (33 spp.), Gymnotiformes (8 spp.) and Perciformes (6 spp.), were the orders that showed highest species richness, representing 48.4%, 34.7%, 8.4% and 6.3% respectively of

Table 1. Geographical coordinates and altitude of 15 sample sites along igarapés from the rio Acre basin.

SITE	WATERCOURSES	LATITUDE (S)	LONGITUDE (W)	ALT (M)
T1	Igarapé Trombetão	09°45'00,7"	67°40'21,1"	159
T2	Igarapé São Lourenço	09°45'44,1"	67°39'50,7"	188
T3	Igarapé São Lourenço	09°45'42,7"	67°39'56,7"	169
T4	Igarapé São Lourenço	09°45'43,4"	67°39'49,4"	170
T5	Igarapé São Francisco	09°55'59,6"	67°53'15"	148
T6	Igarapé São Francisco	09°56'16,6"	67°52'49.9"	138
T7	Igarapé A	09°35'15,7"	67°33'28"	145
T8	Igarapé Caju	09°35'33,5"	67°34'40,2"	153
T9	Igarapé B	10°26'30,9"	67°42'40,9"	201
T10	Igarapé C	10°36'09,4"	67°44'9"	213
T11	Igarapé D	10°36'33,8"	67°48'13,6"	226
T12	Igarape Mapinguari	09°45'45,5"	68°03'49,6"	237
T13	Igarapé Marizinho	09°36'40,4"	68°14'44,1"	146
T14	Igarapé Fumaça	09°34'23,4"	68°16'49,7"	183
T15	Igarapé Pato	09°30'41,0"	68°20'8,7"	156

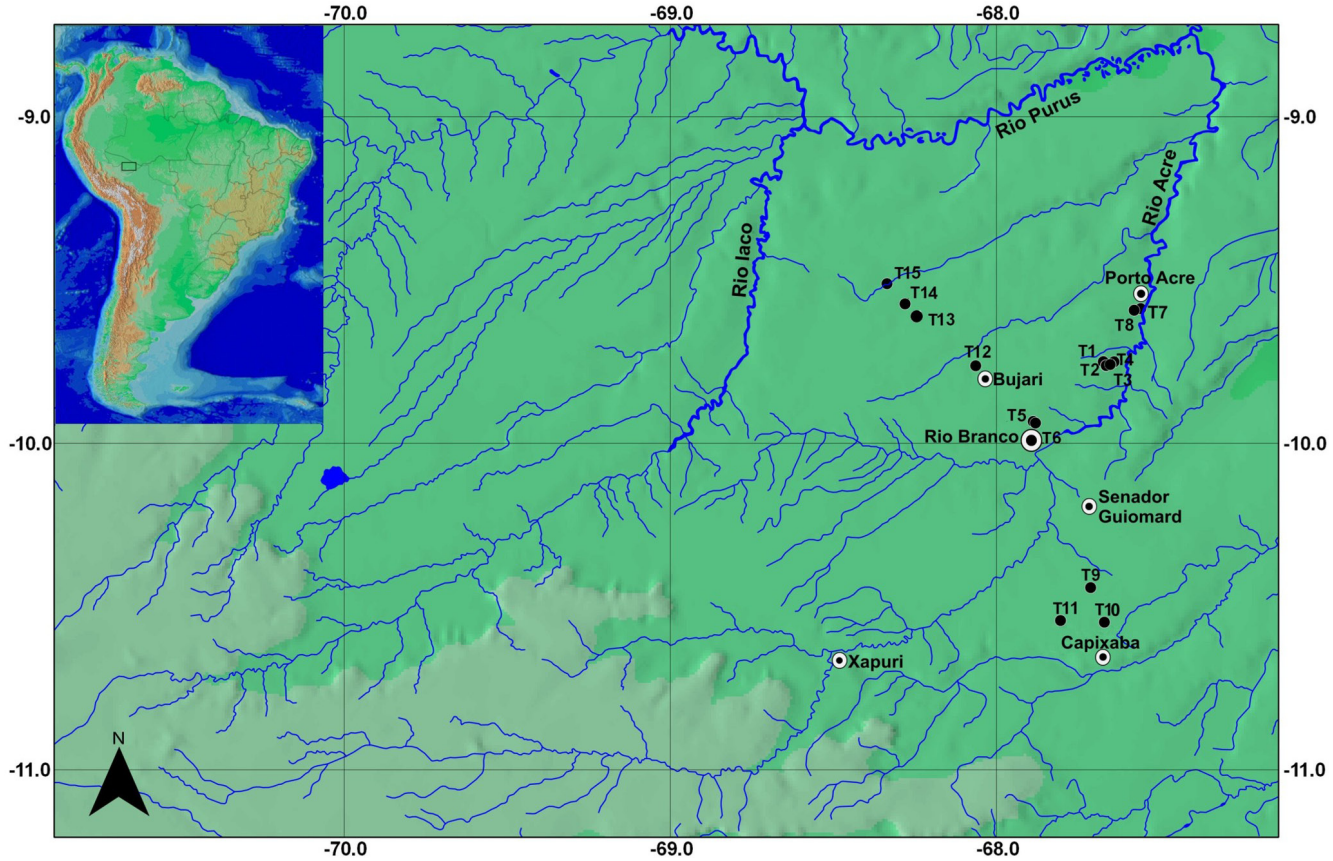

Figure 1. Map of the study area showing the collecting sites (black dots) in the rio Acre basin, Acre State, Brazil (based on Quantum Gis Sofware). Igarapé Trombetão (T1); Igarapé São Lourenço (T2, T3, T4), Igarapé São Francisco (T5, T6), Igarapé A (T7), Igarapé Caju (T8), Igarapé B (T9), Igarapé C (T10), Igarapé D (T11), Igarapé Mapinguari (T12), Igarapé Marizinho (T13), Igarapé Fumaça (T14), Igarapé Pato (T15). Cities represented by black dots with white margin.

total fish species collected. The predominant families were Characidae (32.6%), followed by Loricariidae (16.8%), Callichthyidae (6.3%), Cichlidae (6.3%), Heptapteridae (4.2%) and Gasteropelecidae (4.2%).

According to the species accumulation curve, based on two non parametric methods of species richness estimations, the number of species does not present a stabilization tendency. The expected species richness for the study area (Chao 1 = 124 and ACE = 119 species) is higher than that observed (94 species). In this way, additional sampling can increase the number of species. Despite the importance of additional samplings, this inventory represents a high percentage of species from the rio Acre basin (76 or 79% of species), that demonstrates good sampling efficiency (Figure 2).

The distribution of collected species abundances showed that only 18.1% had more than 100 individuals, 25.5% of the species presented less than 100 and more than 10 individuals, and 56.4% of the species were represented by 10 or fewer individuals. The most abundant species were *Serrapinnus* gr. *microdon* (22.4%), *Otocinclus vittatus* (20.4%), *Phenacogaster pectinatus* (10.9%), *Brachychalcinus copei* (5.8%) and *Knodus* sp. (5.3%); totaling 64.8% of the specimens captured. The species *Serrapinnus* gr. *microdon*, *Otocinclus vittatus* and *Hemigrammus ocellifer* showed high dominance in the igarapés A (92%) and Pato (68.6%), igarapé Mapinguari (60.2%) and igarapé C (65%) respectively.

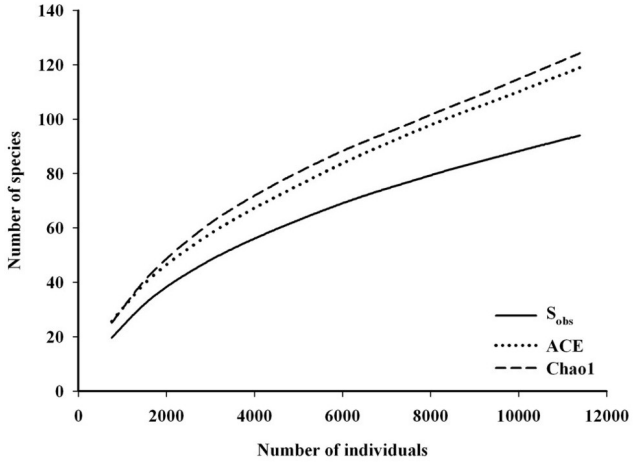

Figure 2. Comparison of species accumulation curves generated by species richness (S_{obs}) and the richness estimators (Chao 1 and ACE), for collections made in the igarapés tributaries of the rio Acre basin.

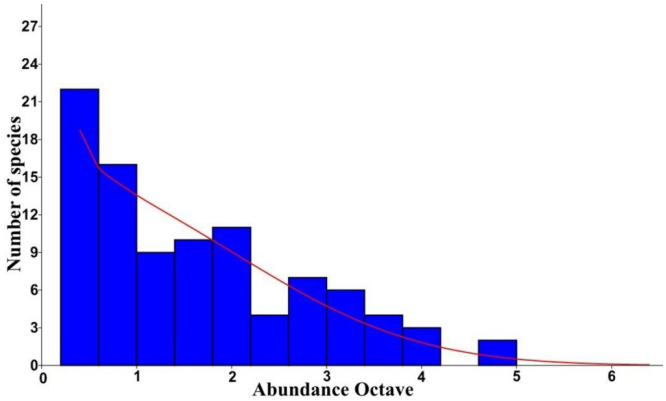

Figure 3. Distribution model of abundances of species with best fit log-normal; χ2 = 5,566; p = 0,695) applied the fish assemblages of rio Acre basin.

Distribution data exhibits substantially better adjust to the log-normal truncated distribution model ($\chi^2 = 5.566$; $p = 0.695$). The geometric, logarithmic and broken-stick abundance models did not show statistically significant adjustments ($p < 0.01$) (Figure 3). In this inventory were added 29 (30.8%) new records of fish species of the rio Purus basin (marked with an asterisk in Table 2) when compared to previous published studies, i.e., La Monte (1935), Ortega and de Rham. 2003; Rapp-Py-Daniel and Deus (2003), Anjos *et al*. (2008), Deus *et al.* (2010), Duarte *et al*. (2010), Silva *et al*. (2010), Albert *et al.* (2011), Barros *et al*. (2011), Albert *et al.* (2012). Additionally, 14 species were identified to the genus level and may be new records or new species. Within the new records are species of most collected orders (Characiformes (10), Siluriformes (15), Gymnotiformes (1), Ciprinodontiformes (1) and Perciformes (2)).

Discussion

Studies about the fish fauna composition in the Amazon basin show a great diversity of species, with Characiformes and Siluriformes as dominants (Sabino and Zuanon 1998; Mendonça *et al.* 2005; Anjos *et al.* 2008; Dias *et al.* 2009; Espírito-Santo *et al.* 2009; Albert *et al.* 2011; Albert *et al.* 2012). In this study, these two taxonomic groups represent more than 80% of total collected fish species. Other important groups were Gymnotiformes and Perciformes. The species richness (94 spp.) found in this basin may be influenced by the presence of a large river system and a variety of ecosystems (Souza *et al.* 2003).

The rio Acre is an important tributary of the right margin of the rio Purus. The rio Purus is characterized by the presence of different environments, which allow the existence of a high diversity of fish fauna (Rapp Py-Daniel and Deus 2003; Silva *et al.* 2010). Despite the increasing, in recent years, of comprehension of fish fauna composition from the rio Purus basin, principally for lower part of the basin, some important tributaries such as the rio Acre have been poorly studied. Thus, the present investigation has a high importance for the knowledgement of the rio Acre ichthyofauna and consequently for the entire rio Purus basin. It also revealed a great number of new records of species to the rio Purus.

The log-normal abundance distribution presents few species with low and high abundance and many species with intermediate abundance (Magurran 1996). This distribution is expected for communities with a large number of species functionally heterogeneous and influenced by many independent factors (Whittaker 1965; May 1975; Gray 1987). A log-normal truncated distribution does not present the left portion of the curve, which represents rare species (Magurran 1996); in this case, showing that many rare species or the less abundant were not collected.

Studies conducted by Santos and Ferreira (1999), observed that the values of relative frequency of most species were less than 1%, and for the dominant species between 15 and 30% in the Amazon region. In the present study, some species showed a high dominance, with values above 60% in frequency, as *Serrapinnus* gr. *microdon*, *Otocinclus vittatus* and *Hemigrammus ocellifer,* all small-sized species. High dominance of these species may be due

to the ability to exploration these environments, flexibility of eating habits, high reproductive capacity in different environments, resistance to environmental variations, presence of schools of fish or the effect of environmental changes caused by human activities (Gorman 1978; Horn 1998; Castro 1999).

Most of the fish fauna collected was composed of small-sized species, mainly from families Characidae and Loricariidae, result that contrasts with those found by other authors as Araújo-Lima *et al.* (1999); Sabino and Zuanon (1998); Bührnheim (2002) and Mendonça *et al.* (2005). In agreement with Castro (1999) the small size of individuals can bring some advantages and disadvantages, like the ability to occupy specific habitats in environments of reduced physical dimensions; and limit the movement of individuals, producing geographic restriction to species, facilitating allopatric speciation events.

The rio Acre basin is characterized by the intense human pressure on natural resources, this can lead to strong changes in aquatic habitats, affecting fish assemblages of these environments. The loss of riparian forests observed in many igarapés, due to disordered deforestation and burning, can induce strong variations in diversity, composition and spatial-temporal distribution of ichthyofauna (Silva 1995; Harding *et al*. 1998; Waite and Carpenter 2000; Bojsen and Barriga 2002). Currently, the lack of studies that provide historical information of fish assemblages composition and distribution in streams of this region complicates the conduction of evaluations on the conservation status of these ecosystems. For this reason, the results presented herein become very valuable information to be used as reference for the accomplishment of other researches, and for establishing conservation strategies for these aquatic ecosystems.

Table 2. Fish fauna collected at each sample site in the rio Acre basin, Acre State, Brazil. * New records of fish species of the rio Purus basin.

TAXA	SAMPLING SITES														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CHARACIFORMES															
Curimatidae															
Steindachnerina guentheri (Eigenmann and Eigenmann, 1889)	X	X	X		X	X		X	X			X	X	X	X
Steindachnerina pupula Vari, 1991*					X	X							X		
Anostomidae															
Leporinus parae Eigenmann, 1907*	X	X			X		X								
Chilodontidae															
Chilodus punctatus Müller and Troschel, 1844									X						
Erythrinidae															
Erythrinus erythrinus (Bloch and Schneider, 1801)				X											
Hoplerythrinus unitaeniatus (Agassiz, 1829)															X
Hoplias malabaricus (Bloch, 1794)	X	X			X	X			X	X			X		
Lebiasinidae															
Pyrrhulina obermulleri Myers, 1926*											X				
Gasteropelecidae															
Carnegiella myersi (Fernández-Yépez, 1950)	X		X	X										X	X
Carnegiella strigata (Günther, 1864)														X	
Gasteropelecus sternicla (Linnaeus, 1758)*												X	X	X	X
Thoracocharax stellatus (Kner, 1858)					X	X							X	X	
Acestrorhynchidae															
Acestrorhynchus falcatus (Bloch, 1794)					X										
Characidae															
Aphyocharax sp.												X		X	
Astyanax bimaculatus (Linnaeus, 1758)	X	X	X		X	X	X	X			X		X		
Astyanax sp.	X														
Brachychalcinus copei (Steindachner, 1882)*	X	X		X	X	X		X				X	X	X	X
Bryconops cf. *giacopinii* (Fernández-Yépez, 1950)*									X						
Charax tectifer (Cope, 1870)*	X	X	X	X				X							
Charax caudimaculatus Lucena, 1987					X	X							X	X	X
Chrysobrycon eliasi Vanegas-Rios, Azpelicueta and Ortega, 2011*	X				X						X				
Ctenobrycon hauxwellianus (Cope, 1870)		X	X	X	X	X				X		X	X	X	X
Gephyrocharax sp.	X	X		X	X	X		X					X	X	X
Hemigrammus bellottii (Steindachner, 1882)									X			X			
Hemigrammus lunatus Durbin, 1918													X		
Hemigrammus ocellifer (Steindachner, 1882)									X	X	X	X	X	X	X
Hemigrammus sp.													X	X	
Hyphessobrycon cf. *bentosi* Durbin, 1908									X						
Hyphessobrycon sp.									X			X	X	X	X
Knodus delta Géry, 1972*								X							
Knodus sp.	X	X	X	X	X	X							X	X	

Table 2. Fish fauna collected at each sample site in the rio Acre basin, Acre State, Brazil.

TAXA	SAMPLING SITES														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Moenkhausia cf. *comma* Eigenmann, 1908			X	X											
Moenkhausia cf. *collettii* (Steindachner, 1882)									X						
Moenkhausia intermedia Eigenmann, 1908													X		
Moenkhausia oligolepis (Günther, 1864)	X	X	X		X	X	X		X		X	X	X	X	X
Paragoniates alburnus Steindachner, 1876	X				X										
Phenacogaster pectinatus (Cope, 1870)	X	X		X	X	X	X	X	X				X	X	X
Prionobrama filigera Cope, 1870						X									
Serrapinnus gr. *microdon* (Eigenmann, 1915)		X			X	X	X	X				X	X	X	X
Tetragonopterus argenteus Cuvier, 1816					X										
Triportheus angulatus (Spix and Agassiz, 1829)	X														
Triportheus rotundatus (Jardine, 1841)												X			
Tyttocharax madeirae Fowler, 1913														X	
Crenuchidae															
Characidium cf. *etheostoma* Cope, 1872*	X				X	X						X	X	X	
Characidium sp.													X	X	
SILURIFORMES															
Auchenipteridae															
Centromochlus perugiae Steindachner, 1882*					X										
Tatia dunni Fowler, 1945*					X										
Pseudopimelodidae															
Batrochoglanis villosus (Eigenmann, 1912)*														X	
Pseudopimelodus bufonius (Valenciennes, 1840)*						X									
Heptapteridae															
Imparfinis stictonotus (Fowler, 1940)					X										
Phenacorhamdia boliviana (Pearson, 1924)*						X									
Pimelodella cf. *gracilis* (Valenciennes, 1835)	X				X	X							X		
Rhamdia quelen (Quoy and Gaimard, 1824)	X		X												X
Cetopsidae															
Helogenes cf. *gouldingi* Vari and Ortega, 1986*											X				
Aspredinidae															
Bunocephalus verrucosus (Walbaum, 1792)												X			
Trichomycteridae															
Ochmacanthus cf. *reinhardtii* (Steindachner, 1882)													X		
Callichthyidae															
Corydoras acrensis Nijssen, 1972*												X	X		
Corydoras aeneus (Gill, 1858)					X										
Corydoras cf. *stenocephalus* Eigenmann and Allen, 1942	X	X		X	X			X					X		
Corydoras elegans Steindachner, 1877*												X			
Corydoras zygatus Eigenmann and Allen, 1942*		X		X											
Megalechis thoracata (Valenciennes, 1840)												X			
Loricariidae															
Ancistrus sp. 1	X		X	X	X	X						X	X		X
Ancistrus sp. 2				X											
Farlowella cf. *oxyrryncha* (Kner, 1853)*	X				X	X		X							
Hemiodontichthys acipenserinus (Kner, 1853)	X				X	X							X		
Hypoptopoma cf. *baileyi* Aquino and Schaefer, 2010													X		
Hypoptopoma thoracatum Günther, 1868*												X			
Hypostomus cf. *pyrineusi* Miranda Ribeiro, 1920						X									
Hypostomus sp. 1	X														
Hypostomus sp. 2				X											
Loricaria cf. *simillima* Regan, 1904*	X				X										
Otocinclus vittatus Regan, 1904*					X	X		X				X	X		X
Peckoltia brevis (La Monte, 1935)						X									
Pterygoplichthys punctatus (Kner, 1854)*															X
Rineloricaria castroi Isbrücker and Nijssen, 1984					X	X						X	X		
Rineloricaria lanceolata (Günther, 1868)*	X				X	X									
Sturisoma sp.						X									

Table 2. Fish fauna collected at each sample site in the rio Acre basin, Acre State, Brazil.

TAXA	SAMPLING SITES														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
GYMNOTIFORMES															
Sternopygidae															
Eigenmannia virescens (Valenciennes, 1842)						X					X				X
Eigenmannia cf. *virescens* (Valenciennes, 1842)									X	X	X				
Sternopygus macrurus (Bloch and Schneider, 1801)					X										
Rhamphichthyidae															
Gymnorhamphichthys petiti Géry and Vu-Tân-Tuê, 1964											X				
Hypopomidae															
Brachyhypopomus sp. (Hopkins, 1991)									X						
Hypopygus lepturus Hoedeman, 1962											X				
Gymnotidae															
Gymnotus coropinae (Hoedeman, 1962)											X				
Gymnotus javari Albert, Crampton and Hagedorn, 2003*								X							
CYPRINODONTIFORMES															
Rivulidae															
Rivulus taeniatus Fowler, 1945*	X										X				
BELONIFORMES															
Belonidae															
Pseudotylosurus angusticeps (Günther, 1866)													X		
PERCIFORMES															
Cichlidae															
Aequidens cf. *tetramerus* (Heckel, 1840)		X	X		X				X	X	X	X	X		X
Apistogramma acrensis Staeck, 2003*	X				X				X	X	X	X	X		X
Bujurquina cf. *syspilus* (Cope, 1872)*	X	X			X	X		X							
Crenicichla semicincta Steindachner, 1892					X			X							
Crenicichla sp.			X	X	X	X			X	X			X		
Satanoperca cf. *jurupari* (Heckel, 1840)									X		X				

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Appendix 1. Voucher for specimens from the rio Acre basin, examined in the present study.

CHARACIFORMES: Curimatidae: *Steindachnerina guentheri* (MZUEL 5462, 6639, 6717, 6733, 6752, 6785, 6811, 6832, 6873, 6893, 6916), *Steindachnerina pupula* (MZUEL 5607, 6630, 6660, 6875). **Anostomidae**: *Leporinus parae* (MZUEL 5426, 6631, 6715, 6740, 6777). **Chilodontidae**: *Chilodus punctatus* (MZUEL 6805). **Erythrinidae:** *Erythrinus erythrinus* (MZUEL 6760), *Hoplerythrinus unitaeniatus* (MZUEL 6908), *Hoplias malabaricus* (MZUEL 5906, 5608, 6642, 6664, 6707, 6739, 6807, 6860, 6923). **Lebiasinidae:** *Pyrrhulina obermulleri* (MZUEL 6925). **Gasteropelecidae**: *Carnegiella myersi* (MZUEL 6716, 6750, 6761, 6878, 6901), *Carnegiella strigata* (MZUEL 6879), *Gasteropelecus sternicla* (MZUEL 6826, 6854, 6884, 6905). *Thoracocharax stellatus* (MZUEL 5465, 5610, 6626, 6874, 6894). **Acestrorhynchidae:** *Acestrorhynchus falcatus* (MZUEL 6638). **Characidae**: *Aphyocharax* sp. (MZUEL 6835, 6896), *Astyanax bimaculatus* (MZUEL 5430, 5432, 5560, 5561, 5562, 6643, 6652, 6728, 6741, 6751, 6776, 6845, 6953), *Astyanax* sp. (MZUEL 6719), *Brachychalcinus copei* (MZUEL 5466, 5467, 5611, 5612, 6637, 6656, 6705, 6737, 6763, 6781, 6829, 6846, 6877, 6900), *Bryconops* cf. *giacopinii* (MZUEL 6806), *Charax tectifer* (MZUEL 6727, 6738, 6753, 6764, 6782), *Charax caudimaculatus* (MZUEL 5434, 6629, 6849, 6882, 6902), *Chrysobrycon eliasi* (MZUEL 6676, 6722, 6933), *Ctenobrycon hauxwellianus* (MZUEL 5436, 5564, 5565, 6648, 6658, 6732, 6748, 6762, 6822, 6853, 6883, 6903, 6920), *Gephyrocharax* sp. (MZUEL 5439, 5567, 5568, 5569, 6628, 6654, 6723, 6747, 6772, 6784, 6855, 6885, 6906), *Hemigrammus bellottii* (MZUEL 6817, 6821), *Hemigrammus lunatus* (MZUEL 6858), *Hemigrammus ocellifer* (MZUEL 6808, 6837, 6857, 6887, 6907, 6922, 6928), *Hemigrammus* sp. (MZUEL 6856, 6886), *Hyphessobrycon* cf. *bentosi* (MZUEL 6810), *Hyphessobrycon* sp. (MZUEL 6819, 6838, 6861, 6888, 6909), *Knodus delta* (MZUEL 6788), *Knodus* sp. (MZUEL 5558, 5577, 5578, 5445, 5576, 6644, 6670, 6720, 6745, 6759, 6773, 6863, 6889), *Moenkhausia* cf. *comma* (MZUEL 6758, 6771), *Moenkhausia* cf. *collettii* (MZUEL 6818), *Moenkhausia intermedia* (MZUEL 6864), *Moenkhausia oligolepis* (MZUEL 5533, 5586, 5588; 5589, 6627, 6653, 6718, 6736, 6749, 6775, 6803, 6820, 5585, 6865, 6890, 6910, 6929), *Paragoniates alburnus* (MZUEL 5433, 6624, 6711), *Phenacogaster pectinatus* (MZUEL 5453, 5593, 5594, 5595, 5598, 6635, 6667, 6678, 6709, 6734, 6765, 6778, 6786, 6804, 6868, 6891, 6912), *Prionobrama filigera* (MZUEL 6666), *Serrapinnus* gr. *microdon* (MZUEL 5451, 5590, 5591, 5592, 6661, 6746, 6779, 6792, 6840, 6872, 6892, 6915), *Tetragonopterus argenteus* (MZUEL 6636), *Triportheus angulatus* (MZUEL 6704), *Triportheus rotundatus* (MZUEL 6823), *Tyttocharax madeirae* (MZUEL 6895). **Crenuchidae**: *Characidium* cf. *etheostoma* (MZUEL 5460, 5602, 5603, 5604, 5605, 6625, 6655, 6725, 6841, 6847, 6880), *Characidium* sp. (MZUEL 6848, 6881). **SILURIFORMES: Auchenipteridae:** *Centromochlus perugiae* (MZUEL 5484, 6622), *Tatia dunni* (MZUEL 6617). **Pseudopimelodidae:** *Batrochoglanis villosus* (MZUEL 6876), *Pseudopimelodus bufonius* (MZUEL 5517). **Heptapteridae:** *Imparfinis stictonotus* (MZUEL 6679), *Phenacorhamdia boliviana* (MZUEL 6681), *Pimelodella* cf. *gracilis* (MZUEL 5492, 5494, 6616, 6663, 6731, 6869), *Rhamdia quelen* (MZUEL 6712, 6754, 6914). **Cetopsidae:** *Helogenes* cf. *gouldingi* (MZUEL 5487). **Aspredinidae:** *Bunocephalus verrucosus* (MZUEL 6825). **Trichomycteridae:** *Ochmacanthus* cf. *reinhardtii* (MZUEL 6866). **Callichthyidae:** *Corydoras acrensis* (MZUEL 6833, 6851), *Corydoras aeneus* (MZUEL 6615, 6677), *Corydoras* cf. *stenocephalus* (MZUEL 5485, 6614, 6724, 6743, 6766, 6780, 6850), *Corydoras elegans* (MZUEL 6828), *Corydoras zygatus* (MZUEL 6735, 6774), *Megalechis thoracata* (MZUEL 6824). **Loricariidae:** *Ancistrus* sp. 1 (MZUEL 5496, 5497, 5498, 5499, 5500, 5501, 5502, 5503, 5504, 5505, 6641, 6668, 6730, 6757, 6769, 6839, 6843, 6898), *Ancistrus* sp. 2 (MZUEL 6770), *Farlowella* cf. *oxyrryncha* (MZUEL 5506, 5631, 6634, 6713, 6787), *Hemiodontichthys acipenserinus* (MZUEL 5507, 6632, 6680, 6706, 6859), *Hypoptopoma* cf. *baileyi* (MZUEL 6862), *Hypoptopoma thoracatum* (MZUEL 6831), *Hypostomus* cf. *pyrineusi* (MZUEL 6650), *Hypostomus* sp. 1 (MZUEL 6721), *Hypostomus* sp. 2 (MZUEL 6767), *Loricaria* cf. *simillima* (MZUEL 6640, 6708), *Otocinclus vittatus* (MZUEL 6619, 6662, 6790, 6830, 6867, 6911), *Peckoltia brevis* (MZUEL 5511, 5634), *Pterygoplichthys punctatus* (MZUEL 6913), *Rineloricaria castroi* (MZUEL 6623, 6659, 6682, 6827, 6871), *Rineloricaria lanceolata* (MZUEL 5512, 5635, 5636, 6633, 6657, 6710), *Sturisoma* sp. (MZUEL 5513, 6649). **GYMNOTIFORMES: Sternopygidae:** *Eigenmannia virescens* (MZUEL 6665, 5615, 6904), *Eigenmannia* cf. *virescens* (MZUEL 6809, 6921, 6926), *Sternopygus macrurus* (MZUEL 6618). **Rhamphichthyidae:** *Gymnorhamphichthys petiti* (MZUEL 5472). **Hypopomidae:** *Brachyhypopomus* sp. (MZUEL 6813), *Hypopygus lepturus* (MZUEL 6934). **Gymnotidae:** *Gymnotus coropinae* (MZUEL 6927, 6932), *Gymnotus javari* (MZUEL 6783). **CYPRINODONTIFORMES: Rivulidae:** *Rivulus taeniatus* (MZUEL 6714, 6930). **BELONIFORMES: Belonidae:** *Pseudotylosurus angusticeps* (MZUEL 6870). **Cichlidae:** *Aequidens* cf. *tetramerus* (MZUEL 6621, 6729, 6744, 6756, 6815, 6834, 5627, 6842, 6897, 6917), *Apistogramma acrensis* (MZUEL 6620, 6816, 6836, 6844, 6899, 6918, 6924), *Bujurquina* cf. *syspilus* (MZUEL 5476, 5477, 5478, 5622, 5623, 6647, 6651, 6726, 6742, 6789), *Crenicichla semicincta* (MZUEL 6645, 6791), *Crenicichla* sp. (MZUEL 5480, 5481, 6646, 6669, 6755, 6768, 6814, 6852, 6919), *Satanoperca* cf. *jurupari* (MZUEL 6812, 6931).

Appendix 2. Pictures of fishes from the rio Acre basin, Acre State, Brazil. Measurements are presented as standard length.

CHARACIFORMES

Curimatidae

Steindachnerina guentheri 50.7 mm MZUEL 6717

Steindachnerina pupula 69.8 mm MZUEL 6660

Anostomidae

Leporinus parae 73.1 mm MZUEL 6740

Chilodontidae

Chilodus punctatus 55.5 mm MZUEL 6805

Erythrinidae

Erythrinus erythrinus 80.8 mm MZUEL 6760

Hoplerythrinus unitaeniatus 162.7 mm MZUEL 6908

Hoplias malabaricus 113.9 mm MZUEL 6664

Lebiasinidae

Pyrrhulina obermulleri 30.9 mm MZUEL 6925

Gasteropelecidae

Carnegiella myersi 21.7 mm MZUEL 6761

Carnegiella strigata 23.1 mm MZUEL 6879

Gasteropelecus sternicla 39.5 mm MZUEL 6884

Thoracocharax stellatus 41.3 mm MZUEL 6626

Acestrorhynchidae

Acestrorhynchus falcatus 141.1 mm MZUEL 6638

Characidae

Aphyocharax sp. 25.6 mm MZUEL 6835

Astyanax bimaculatus 64.4 mm MZUEL 6652

Astyanax sp. 123.8 mm MZUEL 6719

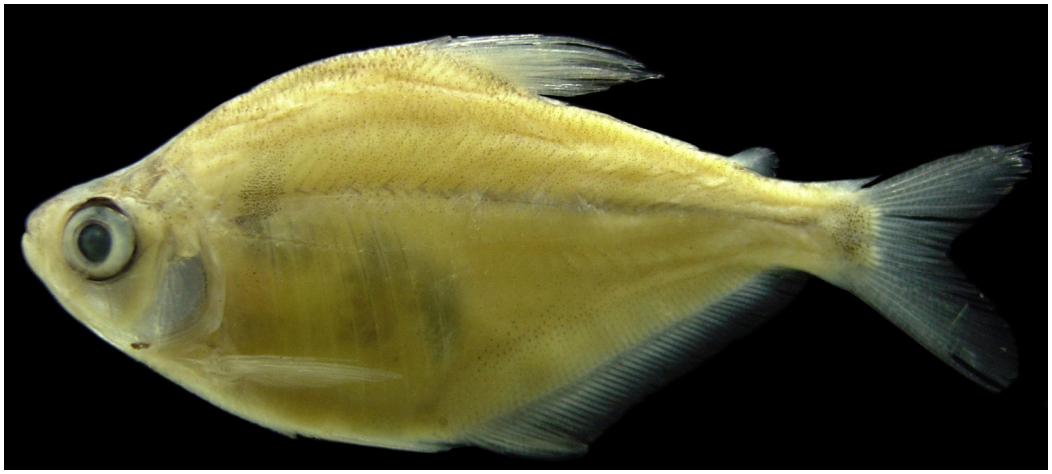
Brachychalcinus copei 40.9 mm MZUEL 6637

Bryconops cf. *giacopinii* 42.1 mm MZUEL 6806

Charax caudimaculatus 88.6 mm MZUEL 6629

Charax tectifer 103.2 mm MZUEL 6727

Chrysobrycon eliasi 35.1 mm MZUEL 6676



Ctenobrycon hauxwellianus 46.8 mm MZUEL 6732

Gephyrocharax sp. 42.3 mm MZUEL 6654

Hemigrammus bellottii 16.7 mm MZUEL 6817

Hemigrammus cf. *lunatus* 28.5 mm MZUEL 6858

Hemigrammus ocellifer 26.1 mm MZUEL 6837

Hemigrammus sp. 28.6 mm MZUEL 6886

Hyphessobrycon cf. *bentosi* 26.1 mm MZUEL 6821

Hyphessobrycon sp. 17.7 mm MZUEL 6909

Knodus delta 34.1 mm MZUEL 6788

Knodus sp. 33.2 mm MZUEL 6670

Moenkhausia cf. *comma* 33.7 mm MZUEL 6771

Moenkhausia collettii 40.2 mm MZUEL 6818

Moenkhausia intermedia 35.2 mm MZUEL 6864

Moenkhausia oligolepis 32.3 mm MZUEL 6775

Paragoniates alburnus 51 mm MZUEL 6711

Phenacogaster pectinatus 33.2 mm MZUEL 6778

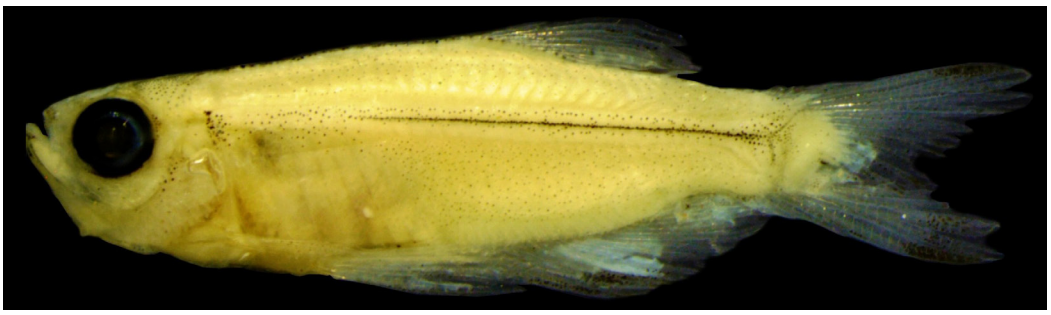
Prionobrama filigera 45.4 mm MZUEL 6666

Serrapinnus gr. *microdon* 27.8 mm MZUEL 6792

Tetragonopterus argenteus 39.5 mm MZUEL 6636

Triportheus angulatus 119.1 mm MZUEL 6704

Triportheus rotundatus 60 mm MZUEL 6823



Tyttocharax madeirae 14.3 mm MZUEL 6895

Crenuchidae

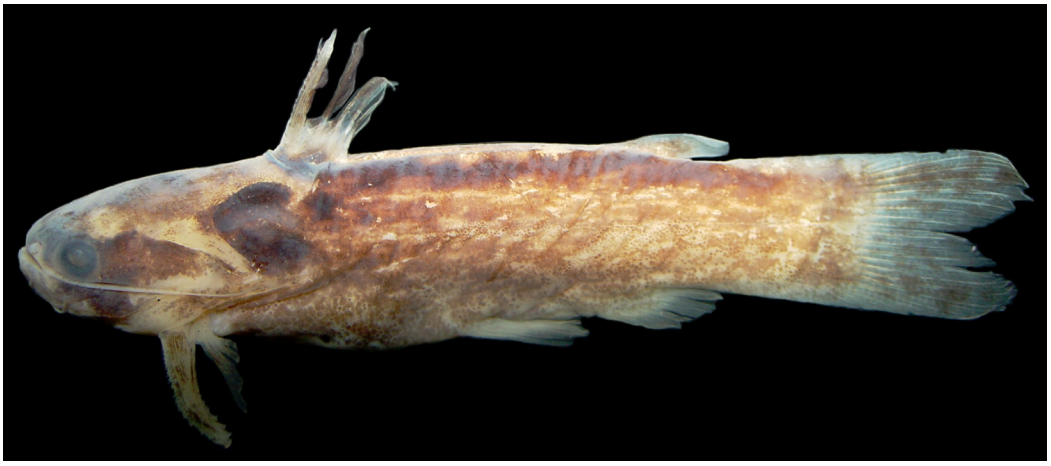
Characidium cf. *etheostoma* 33.1 mm MZUEL 6625

Characidium sp. 30.2 mm MZUEL 6848

SILURIFORMES

Auchenipteridae

Centromochlus perugiae 36.6 mm MZUEL 6622



Tatia dunni 41.4 mm MZUEL 6617

Pseudopimelodidae

Pseudopimelodus sp. 81.4 mm MZUEL 6517

Heptapteridae

Imparfinis stictonotus 31.9 mm MZUEL 6679

Phenacorhamdia boliviana 27.4 mm MZUEL 6681

Pimelodella cf. *gracilis* 105.6 mm MZUEL 6616

Rhamdia quelen 92.9 mm MZUEL 6712

Cetopsidae

Helogenes cf. *gouldingi* 43.5 mm MZUEL 5487

Aspredinidae

Bunocephalus verrucosus 73.7 mm MZUEL 6825

Trichomycteridae

Ochmacanthus cf. *reinhardtii* 37.1 mm MZUEL 6866

Callichthyidae

Corydoras acrensis 28.5 mm MZUEL 6833

Corydoras aeneus 39.6 mm MZUEL 6677

Corydoras cf. *stenocephalus* 48.2 mm MZUEL 6724

Corydoras elegans 23.6 mm MZUEL 6828

Corydoras zygatus 44.2 mm MZUEL 6774

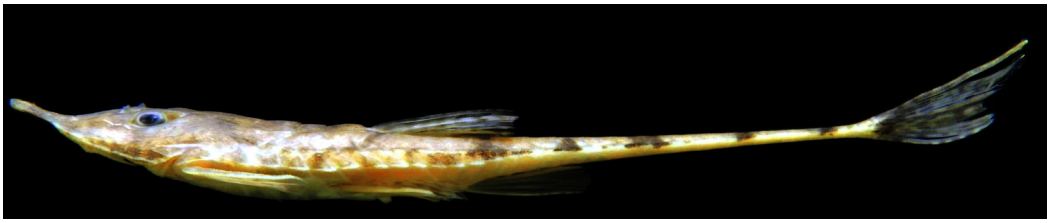
Megalechis thoracata 100.7 mm MZUEL 6824

Loricariidae

Ancistrus sp. 1 76.5 mm MZUEL 6641

Ancistrus sp. 2 107.8 mm MZUEL 6770

Farlowella cf. *oxyrryncha* 84.4 mm MZUEL 6713



Hemiodontichthys acipenserinus 118.1 mm MZUEL 6859

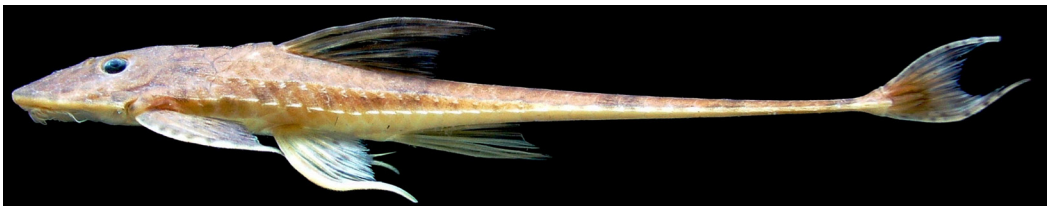
Hypoptopoma cf. *baileyi* 34.8 mm MZUEL 6862

Hypoptopoma thoracatum 38.6 mm MZUEL 6831

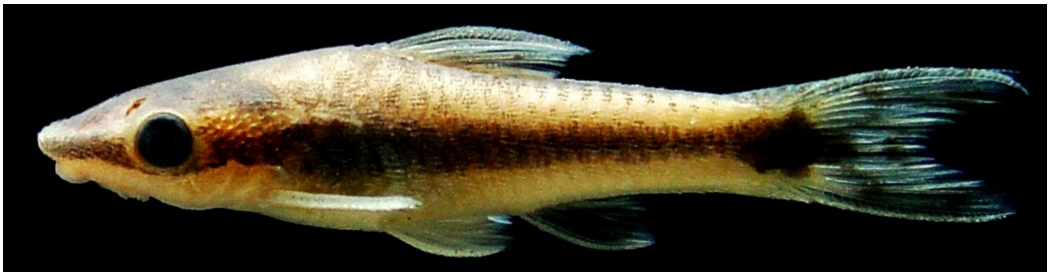
Hypostomus cf. *pyrineusi* 106.2 mm MZUEL 6650

Hypostomus sp. 1 161.3 mm MZUEL 6721

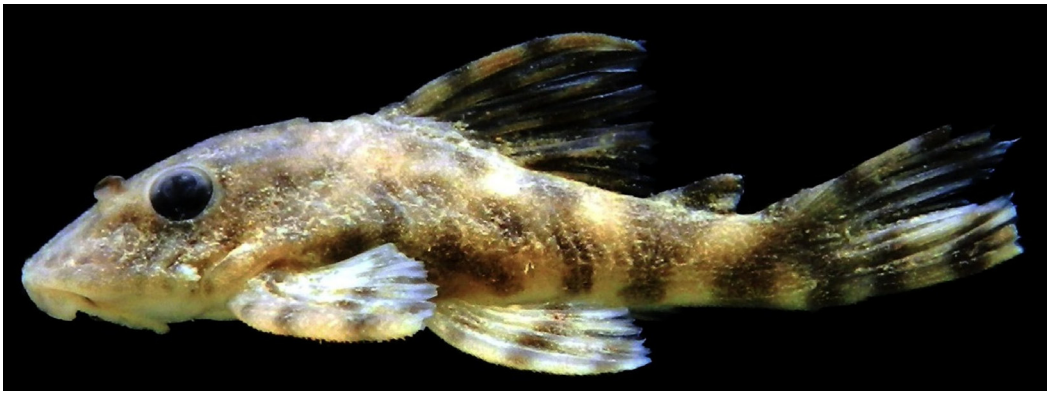
Hypostomus sp. 2 47.6 mm MZUEL 6767



Loricaria cf. *simillima* 153.8 mm MZUEL 6708



Otocinclus vittatus 29.4 mm MZUEL 6619

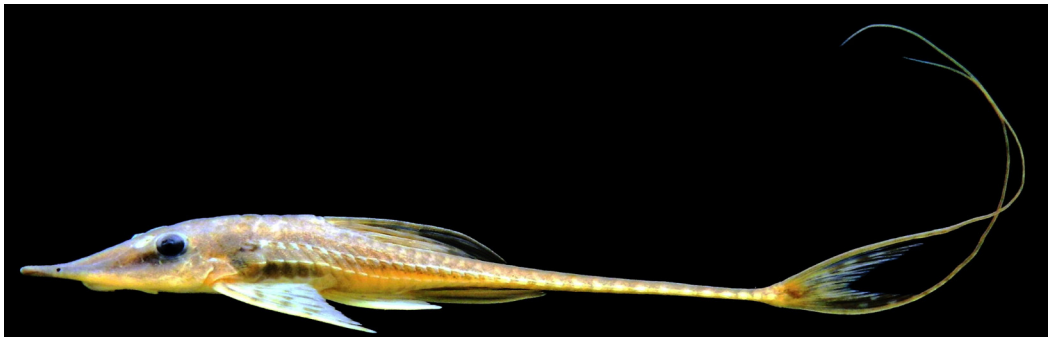


Peckoltia brevis 32.8 mm MZUEL 5634

Pterygoplichthys punctatus 159.8 mm MZUEL 6913

Rineloricaria castroi 67.9 mm MZUEL 6623

Rineloricaria lanceolata 94.8 mm MZUEL 6633

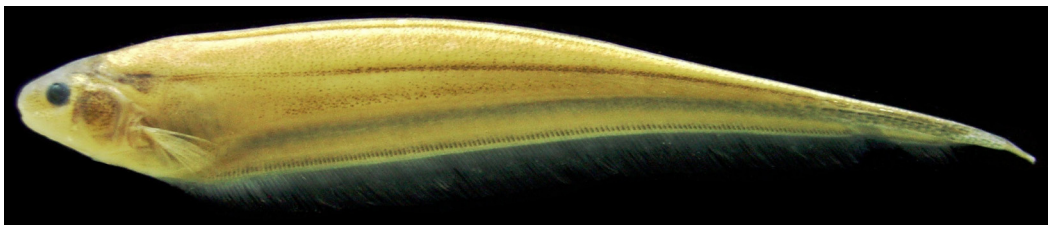


Sturisoma sp. 101.9 mm MZUEL 6649

GYMNOTIFORMES

Sternopygidae

Eigenmannia virescens 113.9 mm MZUEL 6665



Eigenmannia cf. *virescens* 142.1 mm MZUEL 6921

Sternopygus macrurus 186.5 mm MZUEL 6618

Rhamphichthyidae

Gymnorhamphichthys petiti 198 mm MZUEL 5472

Hypopomidae

Hypopygus lepturus 73.5 mm MZUEL 6934

Brachyhypopomus sp. 89.3 mm MZUEL 6813

Gymnotidae

Gymnotus coropinae 100.3 mm MZUEL 6927

Gymnotus javari 57.1 mm MZUEL 6783

CYPRINODONTIFORMES

Rivulidae

Rivulus taeniatus 24.4 mm MZUEL 6930

BELONIFORMES

Belonidae

Pseudotylosurus angusticeps 231 mm MZUEL 6870

PERCIFORMES

Cichlidae

Aequidens cf. *tetramerus* 97.9 mm MZUEL 6744

Apistogramma acrensis 30.2 mm MZUEL 6816

Bujurquina cf. *syspilus* 85.8 mm MZUEL 6789

Crenicichla semicincta 110.7 mm MZUEL 6645

Crenicichla sp. 106 mm MZUEL 6646

Satanoperca cf. *jurupari* 54.5 mm MZUEL 6812