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Inventory

Survey of fish species from the Lower Roosevelt River, Southwestern Amazon basin

Marcelo Rodrigues dos Anjos[1,2], Nadja Gomes Machado[3], Mizael Andrade Pedersoli[1,2], Nátia Regina Braga Pedersoli[1,2], Bruno Stefany Barros[1], Igor Hister Lourenço[1] & João Pedro Barreiros[4]*

[1]*Universidade Federal do Amazonas, Instituto de Educação, Agricultura e Ambiente, Laboratório de Ictiologia e Ordenamento Pesqueiro do Vale do Rio Madeira, Humaitá, AM, Brasil*
[2]*Universidade Federal do Amazonas, Instituto de Educação, Agricultura e Ambiente, Programa de Pós-Graduação em Ciências Ambientais, Humaitá, AM, Brasil*
[3]*Instituto Federal de Mato Grosso, Campus Cuiabá Bela Vista, s/n, Cuiabá, MT, Brasil*
[4]*Universidade dos Açores, Faculdade de Ciências Agrárias e do Ambiente, Centre for Ecology, Evolution and Environmental Changes/ABG Azorean Biodiversity Group, Angra do Heroísmo, Portugal*
**Corresponding author: Marcelo Rodrigues dos Anjos, e-mail: anjos@ufam.edu.br*

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Abstract: This study presents an inventory of the ichthyofauna of the lower Roosevelt River sub-basin and its associated tributaries. Fish sampling with fishing nets and measurements of environmental parameters of water occurred in November/2012 (rising water), February/2013 (flooding), May/2013 (falling water) and August/2013 (drought). Depth mean was 8.86 m, water transparency was 0.6 m, conductivity was 22.7 µS.cm^{-1}, pH was 6.59, dissolved oxygen was 7.63 mg.l^{-1} and temperature was 28°C. The total estimated capture area was 68,829.6 m^2 during 2,880 hours. The catch per unit Effort (CPUE) was 0.37 individuals m^{-2}.day^{-1}. Species were spatially aggregated in all sampling points and river water levels. A total of 5,183 individuals distributed in 7 orders, 29 families, 104 genders and 188 species were sampled in this survey. The diversity index was 4.121 and equitability index was 0.789. The Characiforms order was the most abundant with 106 species, followed by Siluriforms with 63 species and Cichliforms with 23 species. The most abundant species was *Serrasalmus rhombeus* (Linnaeus, 1766) with 327 individuals (5.9%), followed by *Chalceus epakros* (Cope, 1870) with 309 individuals (5.6%) and *Acestrorhynchus microlepis* (Schomburgk, 1841) with 250 individuals (4.5%). Trophicity was characterized by omnivorous (28.6%), piscivorous (14.3%), carnivorous (13.8%) and detritivorous (12.8%). According to IBAMA's regulation, 29.25% of captured species presents ornamental potential.
Keywords: *Icthyofauna; Inventory; Biodiversity; Madeira River Basin.*

Levantamento de espécies de peixes do Baixo Rio Roosevelt, Sudoeste da Bacia Amazônica

Resumo: Este estudo apresenta um inventário da ictiofauna da sub-bacia do baixo Rio Roosevelt e seus tributários associados. As coletas de peixes com malhadeiras e as medições de parâmetros ambientais da água ocorreram em Novembro/2012 (enchente), Fevereiro/2013 (cheia), Maio/2013 (vazante) e Agosto/2013 (seca). A média da profundidade foi 8,86 m, da transparência da água foi 0,6 m, da condutividade foi 22,7 µS.cm^{-1}, do pH foi 6,59, do oxigênio dissolvido foi 7,63 mg.l^{-1} e da temperatura da água foi 28°C. A área total de captura estimada foi 68.829,6 m^2 durante 2880 horas. A captura por unidade de esforço (CPUE) foi 0,37 indivíduos m^{-2}.dia^{-1}. As espécies foram espacialmente agregadas em todos os pontos de coleta e períodos de coleta. Um total de 5183 peixes em 7 ordens, 29 famílias, 104 gêneros e 188 espécies foram coletados. O índice de diversidade foi 4,121 e o índice de equidade foi 0,789. As ordens Characiforme, Siluriforme e Cichliforme foram as mais abundantes. As espécies *Serrasalmus rhombeus* Linnaeus 1766 com 327 indivíduos (5,9%), *Chalceus epakros* (Cope 1870) com 309 indivíduos (5,6%) e *Acestrorhynchus microlepis* Schomburgk 1841 com 250 indivíduos (4,5%) foram as mais abundantes. Os onívoros (28,6%), piscívoros (14,3%), carnívoros (13,8%) e detritívoros (12,8%) foram os indivíduos mais abundantes. De acordo com o IBAMA, 29,25% das espécies capturadas tem potencial ornamental.
Palavras-chave: *Ictiofauna; Inventário; Biodiversidade; Bacia do Rio Madeira.*

Introduction

Roosevelt River is a clear water tributary of the right-bank of the Aripuanã River which is an important tributary of the east side of the Madeira River basin (Pedroza et al., 2012). Nine different protected areas in the Southeast of Amazonas state comprises the Mosaic of Apuí with approximately 2.5 million hectares (Ribeiro et al., 2011). This mosaic has an important role to contain the spread of the arc of deforestation, minimizing the loss of biodiversity. Unsustainable human practices such as hydropower expansion (Lees et al., 2016), deforestation (Soares-Filho et al., 2014) and mining (Meira et al., 2016) are imperiling the remarkable biodiversity of the Amazon River Basin.

Neotropical freshwater fishes are the most diverse on the planet with more than 4,000 species described (Toussaint et al., 2016), representing about one-third of all freshwater fishes worldwide (Reis et al., 2016). National policies in most countries in the Latin America historically encouraged unsustainable practices over the preservation of fish biodiversity (Pelicice et al., 2017). In this case, Neotropical region can be considered a hotspot for fish conservation. However, 28% of the known fauna was described in just the past 11 years and most reasonable estimates for the actual total number of freshwater fishes in the Neotropical region exceed 8000 species (Reis et al., 2016).

Nearly half of the Neotropical fish species are known to occur in Brazil, with at least 2,587 species (Buckup et al. 2007), but probably more than 1,000 fish species were not yet described (Junk et al., 2007). On the other hand, São Francisco River Basin has 200 fish species (Alves & Pompeu, 2001) and Paraguay River Basin has about 330 estimated species (Reis et al., 2003) which is a reasonable well-studied Brazilian basin. Studies over the Brazilian ichthyofauna are still recent (Camargo & Giarizzo, 2007; Perin et al., 2007; Rapp Py-Daniel et al., 2007; Araújo et al., 2009; Pedroza et al., 2012; Queiroz et al., 2013) when compared to another Amazonian region (Lauzanne & Loubens, 1985; Lauzanne et al., 1991; Chernoff et al., 2000). Recent studies indicate high species richness in Madeira River tributaries (Rapp Py-Daniel et al., 2007; Torrente-Vilara et al., 2011; Pedroza et al., 2012), numbering over 900 species (Queiroz et al., 2013).

Most studies of the Amazonian ichthyofaunal diversity have concentrated in the floodplains adjacent to large rivers and next to urban areas, but there are few reports in areas of high conservation value (Costa et al., 2017). Ichthyological surveys assess the biodiversity of water bodies (Silveira et al., 2010), resulting in new discoveries of undescribed species (Frota et al., 2016) and basis for conservation actions (Ferreira et al., 2017). Improving scientific information from conservation sites is crucial for guiding policy and management decisions (Willink et al., 2013), such as for fishery management (Agostinho et al., 2016). In order to know the ichthyofauna from part of Southwestern Amazon basin, this study provides a survey of fish in the Lower Roosevelt River and some of its tributaries.

Material and Methods

1. *Study area*

The study area is located at the lower Roosevelt River sub-basin and its small associated tributaries (Figure 1). The Roosevelt River is a clear water tributary on the right bank of the Aripuanã River, one of the most important tributaries on the east side of the Madeira River Basin (Anjos et al., 2016). The 30 sampling points were distributed over 168 km between parallels 7° and 8° S, and meridians 60° and 61° (Table 1). Riparian forest established along its shores and Open Ombrophilous forest over the sub-basin were well preserved. According to Köppen classification, the regional climate is Am which represents a tropical moonson climate with annual rainfall around 2,800 mm per year (Alvares et al., 2014). The wet season is from October to March and the dry season from June to August (Vidotto et al., 2007).

2. *Stream and fish sampling*

A graduated ruler and Secchi disk were used to measure water depth and transparency, respectively. A portable multiparameter probe (YSI 6600, YSI Environmental Company, Bahrain) was used in each point to measure conductivity, pH, dissolved oxygen and temperature. Fish sampling lasted 20 days and occurred following river water levels: rising water (November/2012), flooding (February/2013), falling water (May/2013) and drought (August/2013). Chico Mendes Institute for Biodiversity Conservation granted a fishing license (35382-1) for fish collection and transportation.

Fish were sampled using fishing nets of mesh sizes of 20, 30, 40, 50, 60, 70, 80, 90, 100, 120, 140, 160, 180 and 200 mm with 10 m long and height varying between 1.5 to 4.0 m. Total capture area was 573.58 $m^2.day^{-1}$ per sampling point. Nets were visited every six hours. Sampled fish were anesthetized with Eugenol solution and subsequently fixed by immersion in 4% formaldehyde solution for at least 48 hours. Specimens were then washed and transferred to 70% ethanol.

Fish identification was performed mainly using Lauzanne & Loubens (1985), Ferreira et al. (1998), Silvano (2001), Reis et al. (2003), Menezes et al. (2003), Buckup et al. (2007), Fricke & Eschmeyer (2019), Queiroz et al. (2013), and Van Der Laan, Fricke & Eschmeyer (2019). Voucher specimens were cataloged with labels which contained information on location, geographic coordinates, date and time of capture, type of environment, and fishing equipment used. They were deposited in the fish collection at Laboratório de Ictiologia e Ordenamento Pesqueiro do Vale do Rio Madeira (LIOP) in the Federal University of Amazonas (UFAM).

3. *Data analysis*

Fish with ornamental potential were defined according to IBAMA Normative Instruction number 001, from January 3, 2012. Fish species was checked on the Brazilian Red List established by Ordinances number 444/14 and 445/14 of the Ministry of the Environment.

Results

Depth mean was 8.86 m, water transparency was 0.6 m, conductivity was 22.7 $\mu S.cm^{-1}$, pH was 6.59, dissolved oxygen was 7.63 $mg.l^{-1}$ and temperature was 28°C (Table 2). The total estimated capture area was 68,829.6 m^2 during 2,880 hours. The catch per unit effort (CPUE) was 0.37 individuals $m^{-2}.day^{-1}$. Species were spatially aggregated in all sampling points and river water levels. A total of 5,183 individuals distributed in 7 orders, 29 families, 104 genders and 188 species were sampled in this survey (Table 3). The diversity index was 4.121 and equitability index was 0.789. The Characiforms order was the

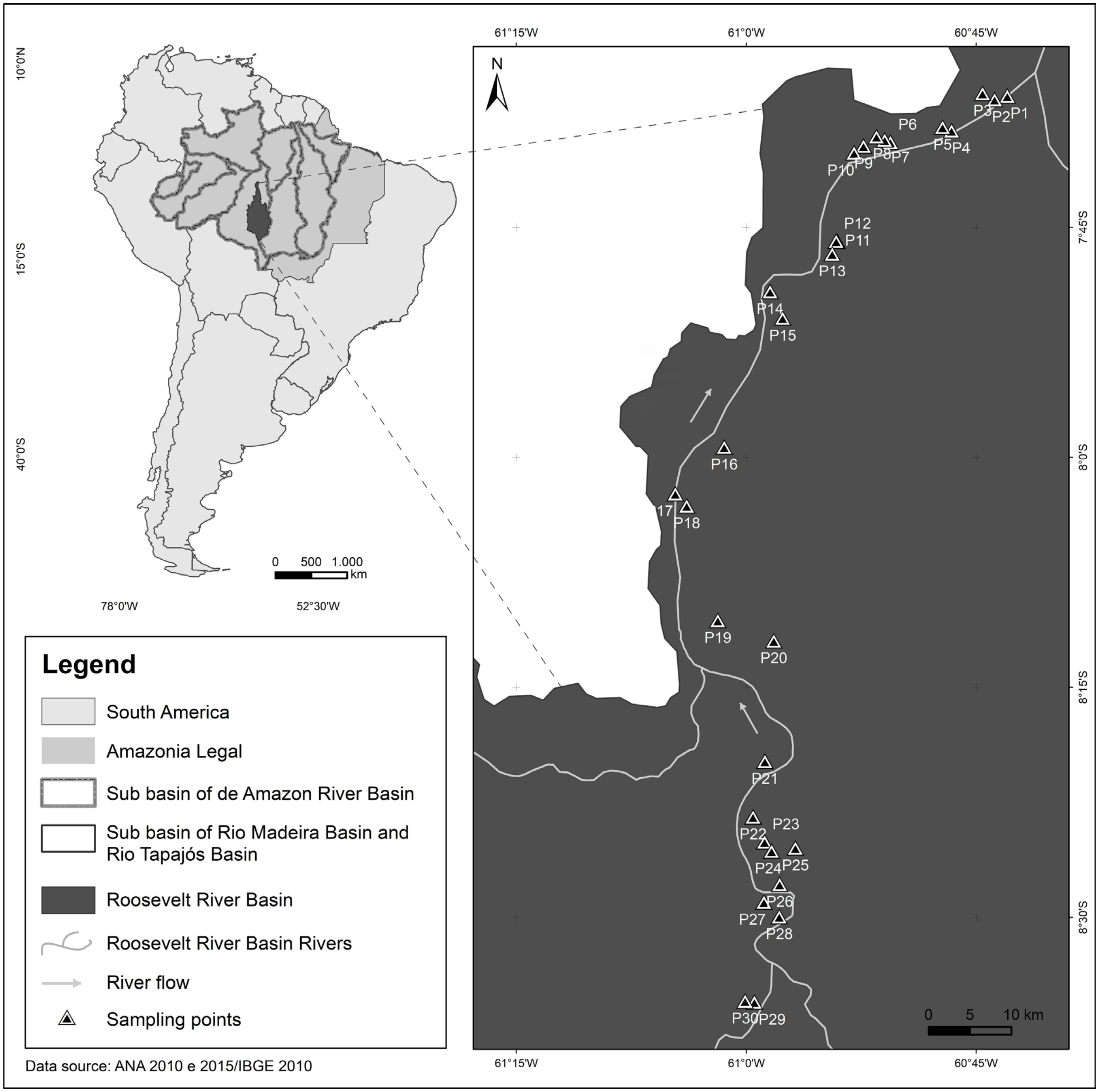

Figure 1. Lower Roosevelt River sub-basin sampling points location, Brazilian Southwest Amazon.

most abundant with 106 species and 4,246 individuals, followed by Siluriforms with 63 species and 863 individuals and Cichliforms with 23 species and 276 individuals (Figure 2 and Table 3). The most abundant species was *Serrasalmus rhombeus* (Linnaeus, 1766) with 327 individuals (5.9%), followed by *Chalceus epakros* (Cope, 1870) with 309 individuals (5.6%) and *Acestrorhynchus microlepis* (Schomburgk, 1841) with 250 individuals (4.5%). Trophicity (Figure 3) was characterized by omnivorous (28.6%), piscivorous (14.3%), carnivorous (13.8%) and detritivorous (12.8%). According to IBAMA's regulation, 29.25% of captured species presents ornamental potential (Table 3).

Discussion

Few species (about 2.13%) found in this survey were recorded by Pedroza et al. (2012) in the Roosevelt River, indicating a total of 209 species for this study area. The total number of species found in the present study is in accordance with other studies in the Amazon River Basin. Some studies recorded 67 fish species in the Tapajós River (Keppeler et al., 2016), 86 species in the Purus River (Anjos et al., 2008), 90 species in the Juruá River (Silvano et al., 2000), 90 species in the Teles Pires River (Dary et al., 2017), 133 species in the Madeira

Table 1. Description of sampling points and its location at Lower Roosevelt River, Southwestern Amazon basin.

Point	Locality	Latitude	Longitude	Environment
P1	Sereia Stream	S 07°36'26.3"	W 60°42'57.5"	Lotic
P2	Macimiano Lake	S 07°36'40.2"	W 60°43'47.2"	Lentic
P3	Piquiá Backwater	S 07°36'16.1"	W 60°44'34.1"	Lentic
P4	Pium Stream	S 07°38' 42.3"	W 60°46'35.8"	Lotic
P5	Ariranha Stream	S 07°38'28.5"	W 60°47'10.9"	Lotic
P6	Pium Backwater	S 07°39'27.0"	W 60°50'35.0"	Lentic
P7	Cutia Stream	S 07°39'18.4"	W 60°50'58.2"	Lotic
P8	Tracajá Backwater	S 07°39'05.4"	W 60°51'29.9"	Lentic
P9	Goiaba Brava Stream	S 07°39'41.9"	W 60°52'20.6"	Lotic
P10	Pedral Stream	S 07°40'08.9"	W 60°52'57.6"	Lotic
P11	Apuí Grande Stream	S 07°45'55.6"	W 60°54'04.0"	Lotic
P12	Apuizinho Stream	S 07°45'54.1"	W 60°54'07.7"	Lotic
P13	Sombra Backwater	S 07°46'43.8"	W 60°54'23.3"	Lentic
P14	Torre da Lua Stream	S 07°49'11.4"	W 60°58'26.3"	Lotic
P15	Piranha Stream	S 07°50'55.1"	W 60°57'36.9"	Lotic
P16	Gavião Stream	S 07°59'20.2"	W 61°01'25.7"	Lotic
P17	Praia Stream	S 08°02'22.1"	W 61°04'36.8"	Lotic
P18	Camponesa Stream	S 08°03'09.6"	W 61°03'52.8"	Lotic
P19	Machadinho Stream	S 08°10'38.0"	W 61°01'50.9"	Lotic
P20	Cujubim Stream	S 08°11'57.3"	W 60°58'11.6"	Lotic
P21	Morcega Stream	S 08°19'49.0"	W 60°58'46.5"	Lentic
P22	Zé Comprido Pit	S 08°23'26.0"	W 60°59'33.2"	Lentic
P23	Inferninho Pit	S 08°25'04.2"	W 60°58'47.6"	Lentic
P24	Diogo Pit	S 08°25'40.2"	W 60°58'20.4"	Lentic
P25	Perneta Pit	S 08°25'28.0"	W 60°56'47.3"	Lentic
P26	Glória Pit	S 08°27'49.9"	W 60°57'48.9"	Lentic
P27	Esperança Pit	S 08°28'59.7"	W 60°58'50.4"	Lentic
P28	Santa Rita Pit	S 08°29'56.6"	W 60°57'50.3"	Lentic
P29	Pirarara Pit	S 08°35'30.4"	W 60°59'27.7"	Lentic
P30	Tucunaré Lake	S 08°35'25.8"	W 61°00'04.1"	Lentic

River Basin (Camargo & Giarrizzo, 2007), 148 species in the Xingu River (Fitzgerald et al., 2017) and 160 species in the Guariba River (Pedroza et al., 2012).

The Amazon River Basin contains the highest fish species diversity of any region on earth (Reis et al., 2003). The biodiversity results from processes operating at multiple spatial and temporal scales (Peláez & Pavanelli, 2018). Heterogenous environments can contribute to maintain biodiversity (Peláez et al., 2017). A strong environmental control on species composition is expected at intermediate spatial scales, where dispersal is neither too high to mask the effects of environmental variables (Heino et al., 2015) nor too low for the differences in species composition to be related to historical processes (Villéger et al., 2013). A major environmental factor on the Amazon Basin system is the water seasonal variation that constitutes an annual hydrological cycle, with changes in water level that can exceed 15 m between high and low water periods that can strongly affect fish assemblages (Scarabotti et al., 2011). Changes in environmental variables over the hydrologic seasons of the year are likely to change the relative importance of biotic interactions such as predation and competition, which may increase when low water crowds populations, creating non-random assortments of fish species (Fernandes et al., 2009). Abiotic influences such as temperature, oxygen concentration, and transparency also change over the hydrologic cycle and differ among water bodies, which can be the basis of habitat selection among fish (Freitas et al., 2010; Miyazono et al., 2010; Van der Wolfshaar et al., 2011).

Characiformes and Siluriformes were the predominant orders, following the Neotropical pattern for freshwater fish diversity (Lowell-McConnell, 1999). We emphasize that none of the sampled species are on the Brazilian Red List. The higher number of species registered in this study is probably due to the environmental heterogeneity (Teresa et al., 2010). However, the diversity may have been underestimated. Several sampled species were discriminated with the use of "cf", indicating that the number of new species may be higher. Ten taxa were provisionally identified, due to their uncertain taxonomic status. They may be records

Table 2. Environmental variables and Morisita index (If) to the survey of fish species from the Lower Roosevelt River, Southwestern Amazon basin.

Points	Depth (m)	Transparency (cm)	Conductivity (µS.cm^{-1})	pH	Dissolved O2 (mg.L^{-1})	Temperature (°C)	*If*
	Min-max(mean)						
P1	2.1-8.2 (4.9)	35.0-80.0 (58.8)	9.3-26.8 (17.0)	6.3-7.4 (6.9)	8.5-9.8 (9.0)	25.6-31.1 (28.2)	10.53
P2	3.8-8.6 (5.6)	30.0-75.0 (53.0)	8.0-32.5 (17.9)	6.4-7.5 (6.7)	8.4-9.8 (8.9)	25.6-31.4 (28.5)	7.68
P3	3.1-13.5 (7.9)	33.0-80.0 (56.0)	8.8-28.0 (17.1)	6.6-7.3 (6.9)	9.2-9.8 (9.4)	26.4-31.2 (28.7)	7.39
P4	2.7-14.3 (7.8)	56.0-80.0 (69.0)	9.3-34.0 (26.6)	6.6-7.3 (6.9)	7.3-9.7 (8.2)	25.5-31.1 (28.3)	9.62
P5	3.8-15.7 (8.9)	38.0-85.0 (65.8)	9.3-35.5 (27.3)	6.2-7.3 (6.9)	7.4-9.9 (8.2)	24.7-31.2 (27.9)	12.26
P6	4.2-5.4 (4.6)	38.0-86.0 (64.8)	11.3-36.3 (27.5)	6.0-7.1 (6.5)	9.5-10.0 (9.7)	27.2-30.3 (28.5)	8.04
P7	3.3-12.3 (7.0)	45.0-85.0 (65.0)	10.5-36.0 (29.6)	6.4-7.1 (6.8)	7.1-9.9 (8.1)	26.2-30.4 (28.4)	7.27
P8	5.2-13.8 (8.1)	53.0-85.0 (68.3)	9.8-31.0 (22.3)	6.6-7.2 (7.0)	9.1-9.7 (9.3)	25.4-30.6 (27.8)	10.92
P9	4.1-12.9 (7.5)	55.0-100.0 (76.3)	9.8-25.5 (16.9)	6.6-7.3 (7.0)	8.6-9.9 (9.1)	25.7-30.8 (28.0)	22.83
P10	2.3-9.1 (5.1)	60.0-100.0 (77.5)	9.8-26.0 (16.8)	6.5-7.3 (6.9)	7.3-9.8 (8.2)	25.9-30.8 (28.3)	6.90
P11	3.2-8.5 (5.1)	50.0-85.0 (67.5)	7.3-25.5 (16.2)	5.9-7.5 (6.8)	8.8-10.0 (9.4)	25.5-30.5 (26.8)	7.61
P12	1.9-12.6 (6.5)	36.0-70.0 (56.5)	8.8-28.0 (16.7)	6.2-7.7 (6.6)	8.5-9.9 (9.4)	26.8-31.7 (28.8)	9.12
P13	2.4-11.3 (5.9)	38.0-80.0 (60.8)	10.0-27.3 (17.1)	6.3-8.1 (7.2)	7.4-10.4 (8.5)	24.8-31.5 (27.9)	7.86
P14	4.4-11.9 (7.9)	40.0-80.0 (65.0)	12.0-27.0 (17.6)	6.4-7.0 (6.7)	6.3-7.0 (6.6)	26.5-30.7 (27.9)	15.73
P15	4.1-7.3 (5.7)	40.0-80.0 (62.5)	13.5-25.3 (17.6)	6.6-6.9 (6.7)	6.7-7.7 (7.1)	26.0-29.1 (27.7)	7.20
P16	3.4-10.1 (6.0)	38.0-70.0 (53.3)	10.0-31.3 (25.9)	6.4-7.2 (6.8)	6.6-9.6 (7.4)	25.5-30.2 (27.3)	11.33
P17	4.1-9.1 (5.8)	40.0-80.0 (61.3)	15.3-35.8 (30.6)	6.5-6.7 (6.7)	5.2-6.8 (5.8)	25.4-30.2 (27.6)	10.68
P18	2.8-13.7 (7.1)	37.0-70.0 (56.8)	15.5-35.8 (30.7)	6.2-6.6 (6.4)	5.7-9.2 (7.0)	25.3-29.4 (27.9)	8.94
P19	2.2-9.3 (5.5)	50.0-150.0 (95.0)	16.0-32.0 (28.0)	5.5-6.1 (5.8)	5.7-8.3 (6.7)	26.4-29.1 (27.5)	7.89
P20	1.7-12.2 (6.3)	20.0-30.0 (27.5)	15.3-29.3 (24.5)	5.5-6.7 (6.1)	6.1-9.4 (7.3)	24.7-28.9 (26.9)	21.24
P21	3.7-12.6 (6.9)	35.0-80.0 (62.5)	15.0-35.8 (30.6)	6.5-7.5 (6.8)	6.3-8.9 (7.3)	24.7-30.6 (27.5)	8.56
P22	6.8-16.9 (10.3)	35.0-75.0 (61.3)	13.8-32.3 (27.6)	5.7-6.6 (6.3)	6.6-8.4 (7.4)	25.6-29.2 (26.8)	12.39
P23	4.1-7.3 (6.0)	37.0-85.0 (65.5)	14.0-32.5 (24.9)	5.4-6.7 (6.3)	4.6-8.4 (5.9)	24.7-29.9 (28.0)	15.33
P24	5.1-16.6 (9.7)	36.0-80.0 (62.8)	13.5-32.5 (23.6)	5.7-6.6 (6.4)	6.6-9.3 (7.7)	25.7-29.2 (27.9)	6.02
P25	8.3-21.5 (12.8)	34.0-75.0 (58.5)	11.3-30.5 (18.7)	5.3-6.7 (6.2)	5.6-8.0 (6.5)	24.7-30.0 (27.7)	5.46
P26	9.4-27.4 (15.8)	38.0-85.0 (63.3)	16.5-27.3 (20.1)	5.3-6.7 (6.2)	5.5-8.2 (6.5)	25.6-29.0 (27.4)	6.38
P27	7.5-25.6 (14.1)	39.0-90.0 (64.8)	11.3-26.8 (17.0)	5.5-6.8 (6.2)	6.1-8.4 (6.9)	26.3-29.9 (28.1)	8.43
P28	3.3-11.3 (6.5)	55.0-75.0 (65.0)	10.3-27.3 (17.3)	6.0-6.7 (6.3)	6.0-8.5 (6.9)	25.7-29.7 (27.8)	6.09
P29	4.3-14.9 (8.5)	15.0-30.0 (23.8)	12.0-27.5 (18.5)	5.7-6.7 (6.2)	6.5-8.6 (7.2)	26.6-30.0 (28.0)	6.99
P30	5.5-18.1 (10.3)	15.0-30.0 (23.8)	11.5-24.5 (16.9)	5.5-6.6 (6.1)	6.5-8.5 (7.2)	25.5-30.2 (27.8)	12.56

Table 3. Survey of fish species from the Lower Roosevelt River, Southwestern Amazon basin, indicating number of captured individuals (N), ornamental potential (OP) and trophicity.

Order/Family/Specie	N	OP	Trophicity
BELONIFORMS: Belonidae			
Potamorrhaphis sp.	19	yes	unknown
Pseudotylosurus microps (Günther, 1866)	04		unknown
CHARACIFORMS: Acestrorhynchidae			
Acestrorhynchus falcirostris (Cuvier, 1819)	9	yes	piscivorous
Acestrorhynchus heterolepis (Cope, 1878)	1		piscivorous
Acestrorhynchus microlepis (Schomburgk, 1841)	250	yes	piscivorous
CHARACIFORMS: Anostomidae			
Anostomoides laticeps (Eigenmann, 1912)	10		omnivorous
Hypomasticus pachycheilus (Britski, 1976)	3		unknown

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Continuation Table 3.

Order/Family/Specie	N	OP	Trophicity
Laemolyta proxima (Garman, 1890)	9		omnivorous
Laemolyta taeniata (Kner, 1859)	7	yes	omnivorous
Leporellus vittatus (Valenciennes, 1850)	1	yes	omnivorous
Leporinus aripuanensis (Garavello & dos Santos, 1981)	2		omnivorous
Leporinus brunneus (Myers, 1950)	63		omnivorous
Leporinus cylindriformes (Borodin, 1929)	14		omnivorous
Leporinus desmotes (Fowler, 1914)	70		omnivorous
Leporinus fasciatus (Bloch, 1794)	83	yes	omnivorous
Leporinus friderici (Bloch, 1794)	82		omnivorous
Leporinus jamesi (Garman, 1929)	4		omnivorous
Leporinus polymaculatus (Géry, 1977)	1		omnivorous
Pseudanos gracilis (Kner, 1859)	1	yes	omnivorous
Schizodon fasciatus (Spix & Agassiz, 1829)	1		herbivorous
CHARACIFORMS: Bryconidae			
Brycon amazonicus (Spix & Agassiz, 1829)	24		omnivorous
Brycon cf. *pesu* (Müller &Troschel, 1845)	14		omnivorous
Brycon falcatus (Müller &Troschel, 1844)	54		omnivorous
Brycon melanopterus (Cope, 1872)	3		omnivorous
Brycon pesu (Müller &Troschel, 1845)	55		omnivorous
Brycon sp.	12		omnivorous
CHARACIFORMS: Characidae			
Acestrocephalus pallidus (Menezes, 2006)	5		carnivorous
Astyanax cf. *anterior* (Eigenmann, 1908)	12		omnivorous
Astyanax cf. *maximus* (Steindachner, 1876)	5		omnivorous
Astyanax maximus (Steindachner, 1876)	4		omnivorous
Astyanax sp.	3		omnivorous
Charax sp. "cuniã" (Peixes R. Madeira, 2013)	4		carnivorous
Ctenobrycon spilurus (Valenciennes, 1850)	1		omnivorous
Jupiaba citrina (Zanata & Ohara, 2009)	3		omnivorous
Moenkhausia grandisquamis (Müller &Troschel, 1845)	14		invertivorous
Moenkhausia lata (Eigenmann,1908)	1	yes	unknown
Moenkhausia sp. “lepidura longa” (Peixes R. Madeira, 2013)	5	yes	omnivorous
Tetragonopterus chalceus (Spix & Agassiz, 1829)	21	yes	omnivorous
CHARACIFORMS: Chalceidae			
Chalceus epakros (Cope, 1870)	308		omnivorous
CHARACIFORMS: Chilodontidae			
Caenotropus cf. *schizodon* (Scharcansky & Lucena, 2007)	16		omnivorous
Caenotropus labyrinthichus (Kner, 1858)	5		iliophagus
CHARACIFORMS: Ctenoluciidae			
Boulengerella cuvieri (Agassiz, 1829)	217		piscivorous
Boulengerell amaculata (Valenciennes, 1850)	50	yes	piscivorous
CHARACIFORMS: Curimatidae			
Curimata inornate (Vari, 1989)	29		detritivorous
Curimata ocellata (Eigenmann & Eigenmann, 1889)	1		

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Continuation Table 3.

Order/Family/Specie	N	OP	Trophicity
Curimata roseni (Vari, 1989)	19		detritivorous
Curimatella alburna (Müller & Troschel, 1844)	29	yes	detritivorous
Potamorhina latior (Spix & Agassiz, 1829)	12		detritivorous
CHARACIFORMS: Cynodontidae			
Cynodon gibbus (Agassiz, in Spix & Agassiz, 1829)	3		piscivorous
Hydrolycus scomberoides (Cuvier, 1816)	137		piscivorous
Hydrolycus tatauaia (Toledo-Piza, Menezes & Santos, 1999)	102	yes	piscivorous
Rhaphiodon vulpinus (Agassiz, in Spix & Agassiz, 1829)	18		piscivorous
CHARACIFORMS: Erythrinidae			
Hoplerythrinus unitaeniatus (Agassiz, in Spix& Agassiz, 1829)	4		carnivorous
Hoplia saimara (Valenciennes, 1847)	1		piscivorous
Hoplias malabaricus (Bloch, 1794)	8	yes	piscivorous
CHARACIFORMS: Hemiodontidae			
Argonectes longiceps (Kner, 1858)	167		omnivorous
Bivibranchia fowleri (Steindachner, 1908)	11		invertivorous
Hemiodus atranalis (Fowler, 1940)	32		herbivorous
Hemiodus gracilis (Günther, 1864)	1	yes	herbivorous
Hemiodus semitaeniatus (Kner, 1858)	18		herbivorous
Hemiodus unimaculatus (Bloch, 1794)	132		herbivorous
CHARACIFORMS: Iguanodectidae			
Bryconops alburnoides (Kner, 1858)	40		omnivorous
Bryconops cf. *caudomaculatus* (Günther, 1864)	4	yes	omnivorous
Bryconops giacopinii (Fernández-Yépez, 1950)	1		omnivorous
Iguanodectes geisleri (Géry, 1970)	10	yes	insectivorous
Iguanodectes spilurus (Günther, 1864)	30		unknown
CHARACIFORMS: Prochilodontidae			
Prochilodus nigricans (Agassiz, 1829)	218		detritivorous
Semaprochilodus brama (Valenciennes, 1850)	6		detritivorous
Semaprochilodus insignis (Jardine, 1841)	4		detritivorous
CHARACIFORMS: Serrasalmidae			
Catoprion mento (Cuvier, 1819)	3	yes	lepidophagus
Colossoma macropomum (Cuvier, 1818)	4		omnivorous
Myleus micans (Müller & Troschel, 1844)	2		frugivorous
Myleus schomburgkii (Jardine, 1841)	38	yes	frugivorous
Myleus setiger (Müller & Troschel, 1844)	3		frugivorous
Myleus sp.	10		unknown
Myleus torquatus (Müller & Troschel, 1845)	38		frugivorous
Myloplus asterias (Müller & Troschel, 1844)	227	yes	frugivorous
Myloplus cf. *rubripinnis* (Müller & Troschel, 1844)	121		frugivorous
Myloplus lobatus (Valenciennes, 1850)	9		frugivorous
Myloplus rubripinnis (Müller & Troschel, 1844)	147	yes	frugivorous
Mylossoma duriventre (Cuvier, 1818)	5		omnivorous
Piaractus brachypomus (Cuvier, 1818)	1		frugivorous
Pristobrycon striolatus (Steindachner, 1908)	12	yes	carnivorous

Continuation Table 3.

Order/Family/Specie	N	OP	Trophicity
Pygocentrus nattereri (Kner, 1858)	30	yes	omnivorous
Serrasalmus cf. *maculatus* (Kner, 1858)	1		carnivorous
Serrasalmus compressus (Jégu, Leão & Santos, 1991)	1		piscivorous
Serrasalmus eigenmanni (Norman, 1929)	8	yes	piscivorous
Serrasalmus elongatus (Kner, 1858)	14	yes	piscivorous
Serrasalmus gr. *humeralis* (Valenciennes, 1850)	20		piscivorous
Serrasalmus gr. *rhombeus* (Linnaeus, 1766)	14		carnivorous
Serrasalmus humeralis (Valenciennes, 1850)	14	yes	piscivorous
Serrasalmus maculatus (Kner, 1858)	1		carnivorous
Serrasalmus manueli (Fernández-Yépez& Ramírez, 1967)	160		piscivorous
Serrasalmus rhombeus (Linnaeus, 1766)	323	yes	carnivorous
Serrasalmus spilopleura (Kner, 1858)	76	yes	piscivorous
Tometes sp.	9		unknown
Utiaritichthys longidorsalis (Tito de Morais & Santos, 1992)	4		unknown
Utiaritichthys sennaebragai (Miranda Ribeiro, 1937)	3		herbivorous
CHARACIFORMS: Triportheidae			
Agonia teshalecinus (Müller & Troschel, 1845)	143		carnivorous
Triportheus angulatus (Spix & Agassiz, 1829)	4	yes	omnivorous
Triportheus auritus (Valenciennes, in Cuvier & Valenciennes, 1850)	138		omnivorous
Triportheus cf. *auritus* (Valenciennes, in Cuvier & Valenciennes, 1850)	80		omnivorous
CICHLIFORMS: Cichlidae			
Acarichthys heckelii (Müller & Troschel, 1849)	1	yes	herbivorous
Acaronia nassa (Heckel, 1840)	1	yes	herbivorous
Biotodoma cupido (Heckel, 1840)	3	yes	omnivorous
Caquetaia spectabilis (Steindachner, 1875)	6	yes	unknown
Cichla cf. *pinima* (Kullander & Ferreira, 2006)	32		piscivorous
Cichla monoculus (Agassiz, 1831)	33		piscivorous
Cichla ocellaris (Bloch & Schneider, 1801)	18		piscivorous
Cichla pinima (Kullander& Ferreira, 2006)	4		piscivorous
Cichla sp.	1		unknown
Crenicichla cf. *marmorata* (Pellegrin, 1904)	4		carnivorous
Crenicichla johanna (Heckel, 1840)	12	yes	carnivorous
Crenicichla marmorata (Pellegrin, 1904)	5	yes	carnivorous
Crenicichla strigata (Günther, 1862)	1	yes	carnivorous
Geophagus miriabilis (Deprá et al., 2014)	1	yes	omnivorous
Geophagus megasema (Heckel, 1840)	22	yes	omnivorous
Geophagus surinamensis (Bloch, 1791)	4		omnivorous
Mesonauta festivus (Heckel, 1840)	9	yes	omnivorous
Retroculus lapidifer (Castelnau,1855)	1	yes	insectivorous
Satanoperca jurupari (Heckel, 1840)	14	yes	detritivorous
Satanoperca lilith (Kullander & Ferreira, 1988)	2	yes	detritivorous
CICHLIFORMS: Sciaenidae			
Pachyurus schomburgkii (Günther, 1860)	1		invertivorous
Petilipinnis grunniens (Jardine in Schomburgk, 1843)	9		piscivorous

Continuation Table 3.

Order/Family/Specie	N	OP	Trophicity
Plagioscion squamosissimus (Heckel, 1840)	59		carnivorous
CLUPEIFORMS: Engraulidae			
Lycengraulis batesii (Gunther, 1868)	47		omnivorous
CLUPEIFORMS: Pristigasteridae			
Pellona castelnaeana (Valenciennes, 1847)	32		piscivorous
Pellona flavipinnis (Valenciennes, 1836)	3		piscivorous
Pristigaster cayana (Cuvier, 1829)	6		invertivorous
GYMNOTIFORMS: Gymnotidae			
Electrophorus electricus (Linnaeus, 1766)	1		piscivorous
MYLIOBATIFORMS: Potamotrygonidae			
Potamotrygon motoro (Müller & Henle, 1841)	1		carnivorous
SILURIFORMS: Auchenipteridae			
Ageneiosus inermis (Linnaeus, 1766)	22		carnivorous
Ageneiosus sp.	1		carnivorous
Ageneiosus ucayalensis (Castelnau, 1855)	20		carnivorous
Auchenipterichthys longimanus (Günther, 1864)	128		omnivorous
Auchenipterichthys thoracatus (Kner, 1858)	6		omnivorous
Auchenipterus ambyiacus (Fowler, 1915)	17		insectivorous
Auchenipterus brachyurus (Cope, 1878)	4		carnivorous
Centromochlus heckelii (De Filippi, 1853)	10		carnivorous
Centromochlus schultzi (Rössel, 1962)	2		unknown
Tatia aulopygia (Kner, 1857)	1		unknown
Trachelyopterichthys taeniatus (Kner, 1858)	1	yes	carnivorous
Trachelyopterus galeatus (Linnaeus, 1766)	13	yes	carnivorous
SILURIFORMS: Cetopsidae			
Cetopsis coecutiens (Lichtenstein, 1819)	2	yes	necrophagous
SILURIFORMS: Doradidae			
Leptodoras linnelli (Eigenmann, 1912)	3	yes	invertivorous
Lithodoras dorsalis (Valenciennes, 1840)	9		herbivorous
Nemadora strimaculatus (Boulenger, 1858)	2	yes	insectivorous
Oxydoras niger (Valenciennes, 1821)	1		omnivorous
Platydoras costatus (Linnaeus, 1758)	2		unknown
Pterodoras granulosus (Valenciennes, 1821)	4		omnivorous
SILURIFORMS: Heptapteridae			
Pimelodella steindachneri (Eigenmann, 1917)	1		unknown
SILURIFORMS: Loricariidae			
Ancistrus sp.	1	yes	unknown
Aphanotrulus rubrocauda (Oliveira, Py-Daniel &Zawadski, 2017)	15		
Hypoptopoma gulare (Cope, 1878)	3		detritivorous
Hypoptopoma incognitum (Aquino & Schaefer, 2010)	9		detritivorous
Hypostomus cf. *plecostomus* (Linnaeus, 1758)	7		detritivorous
Hypostomus cf. *pyrineusi* (Miranda Ribeiro, 1920)	13		detritivorous
Hypostomus emarginatus (Valenciennes, 1840)	2		detritivorous
Hypostomus gr. *cochliodon* (Kner, 1854)	12		detritivorous

Continuation Table 3.

Order/Family/Specie	N	OP	Trophicity
Hypostomus Plecostomus (Linnaeus, 1758)	1	yes	detritivorous
Hypostomus pyrineusi (Miranda Ribeiro, 1920)	55		detritivorous
Hypostomus sp.	9		detritivorous
Lasiancistrus schomburgkii (Günther, 1864)	6		detritivorous
Lasiancistrus scolymus (Gunther, 1864)	3	yes	detritivorous
Limatulichthys griseus (Eigenmann, 1909)	4		detritivorous
Loricaria cataphracta (Linnaeus, 1758)	1		detritivorous
Loricariichthys nudirostris (Kner, 1853)	2		detritivorous
Panaque armbrusteri (Lujan, Hidalgo & Stewart, 2010)	3		perifitivorous
Pterygoplichthys pardalis (Castelnau, 1855)	1	yes	unknown
Squaliformae marginata (Valenciennes, 1840)	8	yes	unknown
SILURIFORMS: Pimelodidae			
Aguarunichthys torosus (Stewart, 1986)	1		unknown
Brachyplatystoma filamentosum (Lichteinstein, 1819)	1		carnivorous
Calophysus macropterus (Lichtenstein, 1819)	2		carnivorous
Hemisorubim platyrhynchos (Valenciennes, 1840)	7		carnivorous
Hypophthalmus marginatus (Valenciennes, 1840)	5		planctophagus
Hypophthalmus sp.	1		planctophagus
Leiarius marmoratus (Gill, 1870)	1		carnivorous
Phractocephalus hemioliopterus (Bloch & Schneider, 1801)	8		omnivorous
Pimelodus blochii (Valenciennes, 1840)	48	yes	omnivorous
Pimelodus cf. *blochii* (Valenciennes, 1840)	1		omnivorous
Pimelodus cf. *maculatus* (Lacepède, 1803)	2		omnivorous
Pimelodus ornatus (Kner, 1857)	10	yes	omnivorous
Pinirampus pirinampu (Spix & Agassiz, 1829)	17		carnivorous
Pseudoplatystoma punctifer (Castelnau, 1855)	4		piscivorous
Pseudoplatystoma tigrinum (Valenciennes, 1840)	3		piscivorous
Sorubim elongatus (Littmann, Burr, Schmidt & Isern, 2001)	12		carnivorous
Sorubim lima (Bloch & Schneider, 1801)	152		carnivorous
SILURIFORMS: Pseudopimelodidae			
Batrochoglanis villosus (Eigenmann, 1912)	1	yes	unknown

of new species, such as *Hypophthalmus* sp., *Cichla* sp. and *Astyanax* sp. Among the sampled species in Lower Roosevelt River sub-basin are included in the ornamental fish list of IBAMA such as *Acestrorhynchus microlepis* (Schomburgk, 1841), *Leporinus fasciatus* (Bloch, 1794), *Boulengerella maculata* (Valenciennes, 1850), *Hydroly custatauaia* (Toledo-Piza, Menezes & Santos, 1999); *Mylo plusasterias* (Müller & Troschel, 1844), *Mylo plusrubripinnis* (Müller & Troschel, 1844), *Serrasalmus rhombeus* (Linnaeus, 1766); *Serrasalmus spilopleura* (Kner, 1858) e *Pimelodus blochii* (Valenciennes, 1840). Some species considered rare due to their shortage in ichthyological collections were sampled in this study, including the Characiform species such as *Acestrorhynchus heterolepis* (Cope, 1878) and *Acestrocephalus pallidus* (Menezes, 2003), and the Siluriform species such as *Pimelodella steindachneri* (Eigenmann, 1917) and *Panaquearm brusteri* (Lujan, Hidalgo & Stewart, 2010).

The most abundant species were *Serrasalmus rhombeus* (Linnaeus, 1766) (Serrasalmidae) and *Chalceus epakros* (Zanata & Toledo-Piza, 2004) (Characidae). *S. rhombeus* is the largest piranha species, with adults reaching 50 cm in length, and is considered to be one of the most successful fish species in Amazonian reservoirs (Santo & Santos, 2005). It has non-migratory habit, is predominantly carnivorous, and is considered a top-chain species (Goulding, 1988; Lowell-McConnell, 1987); therefore, it reflects the environmental quality of the aquatic ecosystem (Borges et al., 2018). This piranha species is a Neotropical predator that occur in many environments of the Amazon Basin (Sá-Oliveira et al., 2017). On the other hand, *C. epakros* has a much wider distribution throughout the central and lower portions of the Amazon Basin (including the lower course of the Madeira River), middle and upper Orinoco River Basin, the Essequibo River in Guyana and the Nanay River in Peru (Zanata & Toledo-Piza, 2004).

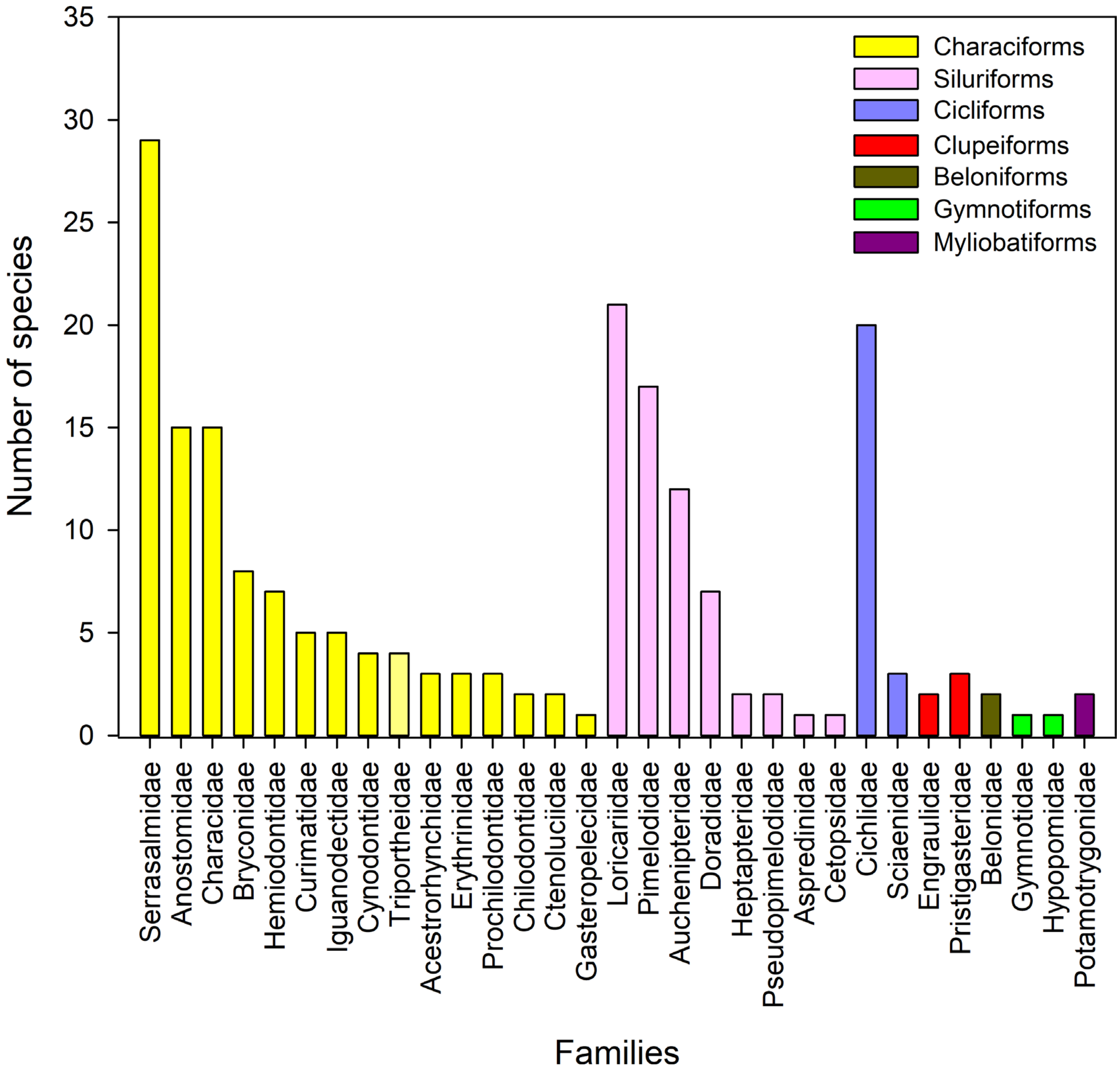

Figure 2. Number of species per families per order from the survey of fish species from the Lower Roosevelt River, Southwestern Amazon basin.

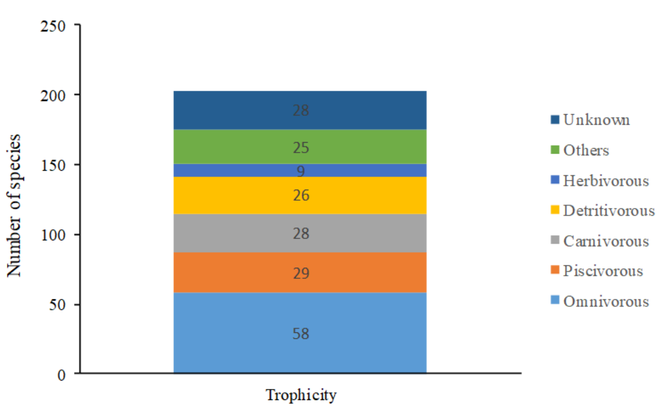

Figure 3. Trophicity from the survey of fish species from the Lower Roosevelt River, Southwestern Amazon basin.

Our work highlights the importance of conducting fish survey within Roosevelt River Basin. Fish have an important socio-economic role for human communities living along tropical rivers and are a major protein source for these people (Fabré & Alonso, 1998; Cerdeira et al., 2008; Santos & Santos, 2005; Santos et al., 2014). It is important to monitor native fish diversity in this region, both to preserve biodiversity and to ensure sustainable levels of fish stocks for harvesting.

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Authors' Contributions

Marcelo Rodrigues dos Anjos: Contributions to: elaboration of study's concept and design; data collection, analysis, and interpretation; and preparation of manuscript.

Nadja Gomes Machado: Substantial contribution to: study's concept and design; data interpretation; manuscript preparation; and critical revision.

Mizael Andrade Pedersoli: Contributions to: data collection, analysis, and interpretation.

Nátia Regina Braga Pedersoli: Contributions to: data collection, analysis, and interpretation.

Bruno Stefany Barros: Contributions to: data analysis, and interpretation; manuscript preparation; and critical revision.

Igor Hister Lourenço: Contributions to: data collection; and manuscript preparation.

João Pedro Barreiros: Contributions to: critical revision and addition of intellectual content.

Conflicts of Interest

The authors declares that there are no conflict of interests related to the publication of this manuscript.

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