



The ichthyofauna of streams from the Purus-Madeira interfluve: composition, new records, and conservation status for the south of the Amazon

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Abstract: This study presents a survey of small-stream fish species from the Purus-Madeira interfluve, collected in four streams near Humaitá on the highway BR-319. The results reveal a rich and diversified ichthyofauna with 3016 collected individuals distributed in 84 species, six orders, 25 families, and 60 genera. Of all the specimens collected, the Characiformes was the most representative, with eight families, 26 genera, and 42 species, followed Siluriformes, with nine families, 20 genera, and 23 species. In terms of families, Characidae had the highest number of species (25), followed by Loricariidae (9), and Cichlidae (8). Among the 95 captured species, 11 are the first records for the region, evidencing a high diversity in these environments. Of the 84 species recorded in this study, 15 have not been assessed by the IUCN, while the remaining 62 include 23 listed as Least Concern (LC), three as data deficient (DD), and one as Near Threatened (NT). The southeastern Amazon region still has few fish surveys, especially in the region comprising the Purus-Madeira Interfluve, which highlights the importance of surveys to fill gaps and understand the biodiversity distribution patterns in the region.

Keywords: Checklist; fishes; BR-319; Amazonian; biodiversity; conservation.

A ictiofauna de igarapés do interflúvio Purus-Madeira: composição, novos registros de ocorrência e estado atual de conservação no sul do Amazonas

Resumo: Este estudo apresenta um levantamento das espécies de peixes de pequenos riachos do interflúvio Purus-Madeira, coletadas em quatro riachos perto de Humaitá na rodovia BR-319. Os resultados revelam uma ictiofauna rica e diversificada com 3016 indivíduos distribuídos em 84 espécies, seis ordens, 25 famílias e 60 gêneros. De todos os espécimes coletados, Characiformes foi a mais representativa, com oito famílias, 26 gêneros e 42 espécies, seguida da Siluriformes, com 9 famílias, 20 gêneros e 23 espécies. Em termos de famílias, Characidae apresentou o maior número de espécies (25), seguida de Loricariidae (9) e Cichlidae (8). Dentre as espécies capturadas, do total de 84 espécies, 11 são o primeiro registro da região, evidenciando uma alta diversidade nesses ambientes. Das 84 espécies registradas neste trabalho, 15 não foram avaliadas pela IUCN, 63 listadas como Menos Preocupante (LC), quatro como Deficientes em Dados (DD) e uma como Quase Ameaçada (NT). A região sudoeste da Amazônia ainda conta com poucos levantamentos de peixes, principalmente na região que compreende o Interflúvio Purus-Madeira, por isso é importante realizar levantamentos para preencher lacunas de coletas e compreender padrões de distribuição da biodiversidade da região.

Palavras-chave: Lista de espécies; peixes; BR-319; Amazônia; conservação; biodiversidade.

Introduction

Studies of small Amazonian streams have increased in the last two decades (Mendonça et al., 2005; Barros et al., 2011; Benone et al., 2017; Leitão et al., 2018; Stegmann et al., 2019; Benone et al., 2020), and show that the ichthyofauna in these environments is composed by at least 50% of medium to small-sized individuals (up to 150 mm length), and with high indices of endemism (Castro, 2021).

Small streams in forest areas are particularly vulnerable to human occupation (e.g. Dias et al., 2009), especially considering the high endemic-species diversity in this type of environment (Albert et al., 2011). However, studies of the composition and distribution of fish assemblages of small streams in the region affected by the Álvaro Maia Federal Highway (BR-319) are restricted to a few stretches of the interfluvium or in streams close to big rivers (Barros et al., 2011; Queiroz et al., 2013b; Vieira et al., 2016; Stegmann et al., 2019). The lack of governance along the BR-319, a road that connects the city of Manaus, in Amazonas state, to the city of Porto Velho, in Rondônia state, is responsible for several socioenvironmental impacts (Fearnside et al., 2009; Andrade et al., 2021).

Located in the Purus-Madeira interfluvium, its connection to the deforestation arch has generated opportunities for people to illegally occupy, deforest, and offer land for sale, including environmental protection areas (EPAs) and indigenous lands (Fearnside & Graça, 2009; Anjos et al., 2019; Ferrante et al., 2020; Ferrante et al., 2021). These protected areas are critical to biodiversity because they promote the conservation of the forest cover, a crucial factor in the ichthyological diversity (Castello et al., 2013; Lobón-Cerviá et al., 2015; Arantes et al., 2017; Frederico et al., 2018; Barros et al., 2020).

Small streams can be altered by anthropogenic impacts across watersheds (Leal et al., 2016) and must be monitored frequently, especially when considering the occupational processes occurring in the interfluvium region. Also, fishes are bioindicators that can provide excellent ecological answers since they are relatively easier to identify (at least as morphospecies) than other groups, have life cycles long enough to allow temporal comparisons, and are dependent on numerous biotic and abiotic factors (Mendonça et al., 2005). Here, we present a list of fish species recorded from small streams along the Purus-Madeira interfluvium to identify new occurrences and complement the assessments already undertaken along the interfluvium, including new surveys near the southern extremity of the BR 319 highway.

Material and Methods

1. Study area

The interfluvium region of the Purus and Madeira Rivers, both tributaries of the Amazon River, is part of the Içá formation, which is constituted by tabular formations with wide fluvial terraces and weak draining incision, and probably originated in the Pleistocene (CPRM, 1997). The Purus-Madeira interfluvium is approximately 800 km long and 150 km wide and holds a wide variety of habitats, including natural grasslands, upland and flooded forests (Rapp Py-Daniel et al., 2007; Campos, 2011).

Original data was collected in PPBio modules 12 and 13 near Humaitá, Amazonas. Module 13 is located 10 km from the Humaitá township, and module 12 is located 40 km away (Table 1), adjoining the BR-319 – and inside a military area (Figure 1).

Table 1. Coordinates of streams where the specimens were collected.

Streams	Collection coordinates
Stream 1 (Module 12)	7°27'42.88"S 63°13'19.94"W
Stream 2 (Module 12)	7°27'51.60"S 63°13'41.40"W
Stream 3 (Module 13)	7°33'32.30"S 63° 6'40.50"W
Stream 4 (Module 13)	7°34'13.20"S 63° 6'51.10"W

2. Data collection

Specimens were collected under the SISBIO permanent license N° 29476-4, following the methodology proposed by Mendonça et al. (2005), which consists of the active sampling of 50 m of a delimited part of the stream using fishnets with <3 mm mesh, and with an effort of 4 persons during one hour.

Seven collections were carried out over a period of three years in four small-streams from a Madeira River micro-basin. Four collections were made between 2018 and 2019 (Module 13), and three between 2019 and 2020 (Module 12). Initially, it was planned to have four collections in Module 12 as well. However, the COVID-19 pandemic made it impossible to carry out the fourth collection.

The collected individuals were euthanized with Eugenol, fixed in 10% formaldehyde, and stored in flasks with 70% ethanol. All captured specimens are deposited in the Laboratório de Ictiologia e Ordenamento Pesqueiro do Vale do Rio Madeira – LIOP, of the Universidade Federal do Amazonas – UFAM, Instituto de Educação, Agricultura e Ambiente – IEAA, in Humaitá, Amazonas State. The species' threatened status was derived from the IUCN Red List of Threatened Species (IUCN, 2024), criteria available in <https://www.iucnredlist.org/>.

3. Taxonomic identification

We separated, counted and identified the captured individuals to the lowest possible taxonomic level, using taxonomic keys and specialized literature (Weitzman 1960; 1978; Rosen & Rumney, 1978; Géry 1977; 1993; Kullander 1986; 1989; 1995; Vari and Ortega 1986; Weitzman and Vari 1987; Burgess 1989; Kullander and Ferreira 1991; Huber 1992; Vari 1992; Buckup 1993; Mago-Leccia 1994; Reis 1997; Schaefer 1997; Zarske and Géry 1997; Römer 2002; Crampton et al., 2003; Crampton and Albert 2003; Armbruster, 2004; Crampton et al., 2004; Crampton and Albert 2004; Crampton et al., 2005; Lundberg 2005; Reis et al., 2005; Sousa and Py-Daniel 2005; Zarske and Géry 2006; Rocha et al., 2008; Sarmiento-Soares and Martins-Pinheiro 2008; Oyakawa and Mattox 2009; Marinho and Langeani 2010; Queiroz et al., 2013a; Zuanon et al., 2015; Crampton et al., 2016).

Results

We captured 3016 individuals, distributed in six orders, 25 families, 60 genera, and 84 species (Table 2). Characiformes had the most species, totalizing 42 species distributed in eight families and 26 genera, mostly in the Characidae, which had 25 species. Siluriformes was the second most captured order, with 23 species distributed in nine families, and 20 genera, followed by Cichliformes, with nine species, and the Gymnotiformes, with eight species. Beloniformes and

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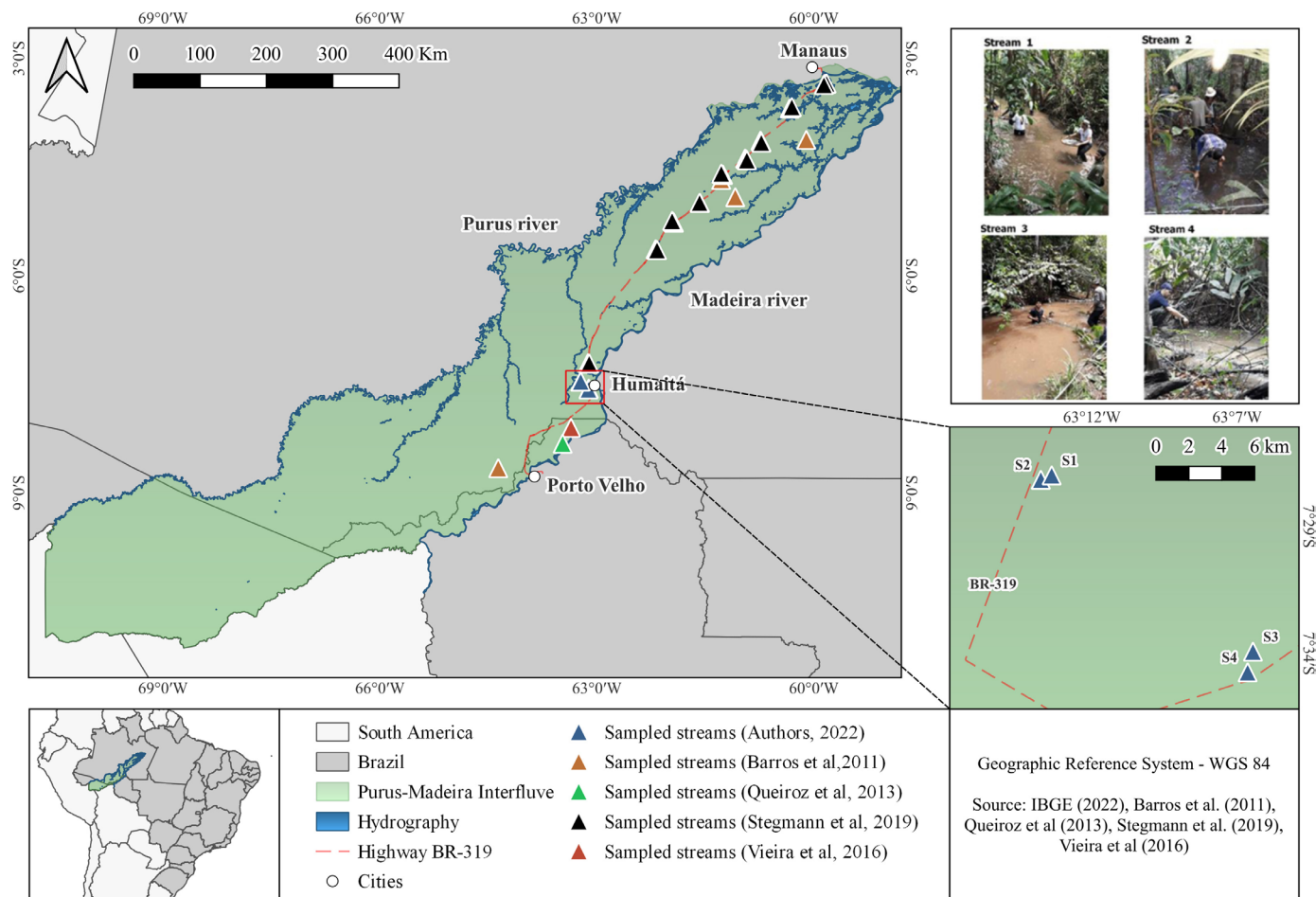


Figure 1. Location of the Purus-Madeira interfluvium showing sites investigated for the first time in this study and location of the other assessments made using the standardized methods given in Mendonça et al. (2005).

Synbranchiformes were the least captured orders with the lower species richness (Figure 2A).

In the module 13, Stream 4 had the highest species richness, with a total of 53 fish species recorded, followed by Stream 3, with 45 species. Fewer species were captured in module 12, with 15 species in Stream 1 and 17 in Stream 2 (Figure 2B,C). *Apistogramma agassizii*, *Gladioglanis conquistador*, *Hemigrammus ocellifer* and *Nannostomus eques* were recorded in all the streams of this study.

Of the 84 captured species, 11 are the first record of occurrence (Figure 3) in the Purus-Madeira interfluvium area for assessments made following the Mendonça et al. (2005) method (Barros et al., 2011; Queiroz et al., 2013a,b; Vieira et al., 2016; Stegmann et al., 2019). Of the species recorded in this study, 15 have not been assessed by the IUCN, and 63 of the remaining 68 are listed as Least Concern (LC), four as Data Deficient (DD), and one as Near Threatened species (NT) (Table 2).

Discussion

In accordance with other studies conducted in the Purus-Madeira interfluvium (Barros et al., 2011; Queiroz et al., 2013a,b; Vieira et al., 2016; Stegmann et al., 2019), there was a dominance of Characiformes,

followed by the Siluriformes, Cichliformes, and Gymnotiformes. The Amazon basin hosts a remarkably diverse ichthyofauna, comprising lineages from the basin and ancient continental connections, including Osteoglossiformes, Characiformes, Siluriformes, and Dipnoi. The basin also has dozens of species derived from ancestral marine species that invaded freshwater ecosystems. Notably, more than 80% of the species are Characiformes, Siluriformes, or Gymnotiformes (Dagosta & De Pinna, 2018; 2019).

Apistogramma agassizii, *Gladioglanis conquistador*, *Hemigrammus ocellifer* and *Nannostomus eques* were widely distributed in streams in the two studied modules. These species were also captured by Barros et al. (2011), Queiroz et al. (2013a), Vieira et al. (2016), and Stegmann et al. (2019), suggesting that they are commonly found in small streams along the Purus-Madeira interfluvium. Additionally, the species identified as “cf,” “aff,” and “sp” are probably related to new species, such as *Characidium* sp. ‘mancha pedúnculo,’ and little-known taxonomic groups, such as *Hemigrammus cf bellottii*.

The elevated diversity found in this stretch of the Purus-Madeira interfluvium highlights a rich ichthyofaunal diversity, also shown in other studies conducted in this region (see Barros et al., 2011; Queiroz et al., 2013a,b; Vieira et al., 2016; Stegmann et al., 2019). The Madeira

Table 2. Annotated list of species of fishes captured in small streams of the South Amazonas' Long-Term Ecological Research modules 12 (Stream 1 – S1; Stream 2 – S2) and 13 (Stream 3 – S3; Stream 4 – S4), Brazil. LC (Least Concern); DD (Deficient data); NE (Not Evaluated) NT (Near Threatened).

Taxon	IUCN	S1	S2	S3	S4	Vouchers (LIOP-UFAM)
BELONIFORMES						
Belonidae						
<i>Potamorhaphis guianensis</i> Jardine, 1843	LC				X	1594
CHARACIFORMES						
Acestrorhynchidae						
<i>Gnathocharax steindachneri</i> Fowler, 1913	LC				X	1497
Curimatidae						
<i>Cyphocharax spiluroopsis</i> (Eigenmann & Eigenmann, 1889)	NE				X	1603
<i>Cyphocharax spilurus</i> (Günther, 1864)	NE				X	1524
<i>Steindachnerina fasciata</i> (Vari & Géry, 1985)	LC				X	1533
Characidae						
<i>Amazonspinther dalmata</i> Bührnheim, Carvalho, Malabarba & Weitzman, 2008	LC	X	X		X	1532, 1644, 1650, 1659
<i>Astyanax</i> cf. <i>bimaculatus</i> (Linnaeus, 1758)	LC			X		15
<i>Axelrodia stigmatias</i> (Fowler, 1913)	LC	X			X	1496, 1629, 2046, 2047
<i>Bario steindachneri</i> (Eigenmann, 1893)	LC		X	X		1474, 1504, 1668
<i>Bryconella pallidifrons</i> (Fowler, 1946)	LC				X	1694
<i>Chrysobrycon hesperus</i> (Böhlke, 1958)	LC			X	X	1473, 1492, 1511, 1549, 1589, 1624
<i>Hemigrammus bellottii</i> (Steindachner, 1882)	NE		X			1578, 1580, 1663,
<i>Hemigrammus</i> cf. <i>bellottii</i> (Steindachner, 1882)		X	X	X	X	1472, 1513, 1520, 1536, 1628, 1654, 1643, 1669
<i>Hemigrammus coeruleus</i> Durbin, 1908	NE	X				2050
<i>Hemigrammus</i> cf. <i>geisleri</i> Zarske & Géry, 2007				X	X	1618
<i>Hemigrammus hyanuari</i>	NE		X			2052
<i>Hemigrammus geisleri</i> Zarske & Géry, 2007	NE			X		1477, 1550
<i>Hemigrammus ocellifer</i> (Steindachner, 1882)	NE	X	X	X	X	1514, 1527, 1648, 1666
<i>Hemigrammus</i> sp.	–	X				1652
<i>Hemigrammus vorderwinkleri</i> Géry, 1963	NE			X		1479
<i>Hyphessobrycon agulha</i> Fowler, 1913	LC			X		1558, 1574, 2051
<i>Hyphessobrycon bentosi</i> Durbin, 1908	LC		X	X	X	1481, 1500, 1535, 1563, 1662, 2049
<i>Hyphessobrycon ericae</i> Moreira & Lima, 2017	NE				X	1519
<i>Hyphessobrycon hasemani</i> Fowler, 1913	DD				X	1528, 1598
<i>Hyphessobrycon wosiackii</i> Moreira & Lima, 2017	NE		X			2045
<i>Microchemobrycon geisleri</i> Géry, 1973	LC			X	X	1499, 1534, 1559, 1599
<i>Moenkhausia melogramma</i> Eigenmann, 1908	LC			X	X	1484, 1508, 1553
<i>Moenkhausia bonita</i> Benine, Castro & Sabino, 2004	LC				X	1601
<i>Moenkhausia comma</i> Eigenmann, 1908	LC	X		X		1471, 1635
<i>Moenkhausia oligolepis</i> (Günther, 1864)	LC				X	1595
<i>Moenkhausia</i> sp.	–			X		1475
<i>Phenacogaster</i> cf. <i>beni</i> Eigenmann, 1911	LC			X	X	1537, 1557, 1600
<i>Phenacogaster</i> cf. <i>pectinatus</i> (Cope, 1870)	LC			X		1494, 1626
<i>Tytocharax madeira</i> Fowler, 1913	LC			X	X	1478, 1493, 1530, 1579, 2048
Chilodontidae						
<i>Chilodus punctatus</i> Müller & Troschel, 1844	LC			X		1585
Crenuchidae						
<i>Ammocryptocharax elegans</i> Weitzman & Kanazawa, 1976	LC				X	1495
<i>Characidium</i> aff. <i>etheostoma</i> Cope, 1872	LC	X	X			1651
<i>Characidium pteroides</i> Eigenmann, 1909	LC			X	X	1488, 1507, 1521, 1552, 1564
<i>Characidium</i> cf. <i>pteroides</i> Eigenmann, 1909					X	1592
<i>Characidium</i> sp. 'mancha pendúculo'				X	X	1581, 1607
<i>Crenuchus spilurus</i> Günther, 1863	LC	X	X		X	1625, 1638, 1653, 1667

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The ichthyofauna of BR-319 streams

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Taxon	IUCN	S1	S2	S3	S4	Vouchers (LIOP-UFAM)
<i>Elachocharax pulcher</i> Myers, 1927	LC			X	X	1510, 1523, 1555, 1583
Erythrinidae						
<i>Hoplias malabaricus</i> Bloch, 1794	LC	X				1639
Gasteropelecidae						
<i>Carnegiella strigata</i> (Günther, 1864)	LC	X		X	X	1476, 1482, 1512, 1516, 1546, 1562, 1614, 1637
<i>Gasteropelecus sternicla</i> (Linnaeus, 1758)	LC				X	1051, 1115, 1615
Lebiasinidae						
<i>Copella callolepis</i> (Regan, 1912)	LC	X				1636, 1640
<i>Nannostomus eques</i> Steindachner, 1876	LC	X	X	X	X	1515, 1538, 1606, 1658
<i>Pyrrhulina obermulleri</i>	DD		X		X	1531, 1627, 1632, 1641
CICHLIFORMES						
Cichlidae						
<i>Aequidens tetramerus</i> (Heckel, 1840)	LC		X			1661
<i>Apistogramma agassizii</i> (Steindachner, 1875)	NE	X	X	X	X	1517, 1556, 1582, 1602, 1633, 1642, 1649, 1655, 1665
<i>Apistogramma resticulosa</i> Kullander, 1980	NE			X		1470, 1506
<i>Bujurquina cordemadi</i> Kullander, 1986	LC				X	1485, 1621
<i>Crenicichla regani</i> Ploeg, 1989	LC				X	1518
<i>Crenicichla semicineta</i> Steindachner, 1892	LC			X		1566, 1620
<i>Laetacara thayeri</i> (Steindachner, 1875)	LC				X	1610
<i>Satanoperca acuticeps</i> (Heckel, 1840)	LC			X		1554
Polycentridae						
<i>Monocirrhus polyacanthus</i> Heckel, 1840	LC	X			X	1611, 1631
GYMNOTIFORMES						
Gymnotidae						
<i>Gymnotus coatesi</i> La Monte, 1935	LC			X		1547, 1587
<i>Gymnotus coropinae</i> Hoedeman, 1962	LC	X	X			1630, 1646, 1656
Hypopomidae						
<i>Brachyhypopomus regani</i> Crampton, de Santana, Waddell & Lovejoy, 2016	LC			X		1544
<i>Brachyhypopomus sullivanii</i> Crampton, de Santana, Waddell & Lovejoy, 2016	LC			X	X	1502, 1588, 1597
<i>Brachyhypopomus walteri</i> Sullivan, Zuanon & Cox Fernandes, 2013	LC		X	X		1569, 1670
<i>Hypopygus lepturus</i> Hoedeman, 1962	NE			X		1467, 1551, 1573
Rhamphichthyidae						
<i>Gymnorhamphichthys rondoni</i> (Miranda Ribeiro, 1920)	LC		X	X	X	1480, 1540, 1572, 1593, 1660
Sternopygidae						
<i>Eigenmannia gr. trilineata</i>	NE			X		1466
SILURIFORMES						
Aspredinidae						
<i>Bunocephalus coracoideus</i> (Cope, 1874)	LC			X	X	1543, 1575, 1612
Auchenipteridae						
<i>Tatia gyrina</i> (Eigenmann & Allen, 1942)	LC			X	X	1522, 1586
Callichthyidae						
<i>Corydoras narcissus</i> Nijssen & Isbrücker, 1980	DD				X	1608
<i>Corydoras urucu</i> Britto, Wosiacki & Montag, 2009	LC				X	1486
Cetopsidae						
<i>Helogenes marmoratus</i> Günther, 1893	LC			X		1469
Doradidae						
<i>Physopyxis lyra</i> Cope, 1871	LC			X		1570

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Taxon	IUCN	S1	S2	S3	S4	Vouchers (LIOP-UFAM)
Heptapteridae						
<i>Gladioglanis conquistador</i> Lundberg, Bornbusch & Mago-Leccia, 1991	LC	X	X	X	X	1491, 1545, 1568, 1591, 1634, 1645, 1657, 1664
<i>Imparfinis cochabambae</i> (Fowler, 1940)	NT			X		1619
<i>Mastiglanis asopos</i> Bockmann, 1994	LC				X	1498
<i>Pimelodella howesi</i> Fowler, 1940	LC				X	1483
Loricariidae						
<i>Ancistrusdubius</i> Eigenmann & Eigenmann, 1889	LC			X		1565
<i>Oxyropsis carinata</i> Steindachner, 1879	LC				X	1529
<i>Oxyropsis wrightiana</i> Eigenmann & Eigenmann, 1889	LC				X	1609
<i>Otocinclus mangaba</i> Lehmann A., Mayer & Reis, 2010	DD			X	X	1487, 1501, 1519, 1560, 1623
<i>Otocinclus mura</i> Schaefer, 1997	LC			X	X	1577, 1616
<i>Hypoptopoma thoracatum</i> Günther, 1868	LC			X	X	1468, 1509, 1541, 1576, 1613
<i>Hypoptopoma</i> cf. <i>thoracatum</i> Günther, 1868	–		X			1489
<i>Farlowella amazonum</i> (Günther, 1864)	LC			X		1505, 1571, 1590
<i>Rineloricaria</i> cf. <i>lanceolata</i> (Günther, 1868)	LC				X	1490
<i>Hemiodontichthys acipenserinus</i> (Kner, 1853)	LC				X	1622
Pseudopimelodidae						
<i>Microglanis poecilus</i> Eigenmann, 1912	LC			X	X	1542, 1548, 1567, 1617
Trichomycteridae						
<i>Ituglanis gracilior</i> (Eigenmann, 1912)	NE			X	X	1526, 1539, 1561
<i>Ituglanis</i> cf. <i>amazonicus</i> (Steindachner, 1882)	LC				X	1647
<i>Ochmacanthus reinhardtii</i> (Steindachner, 1882)	LC				X	1596
SYNBRANCHIFORMES						
Synbranchidae						
<i>Synbranchus</i> gr. <i>madeirae</i> Rosen & Rumney, 1972	LC			X		1503

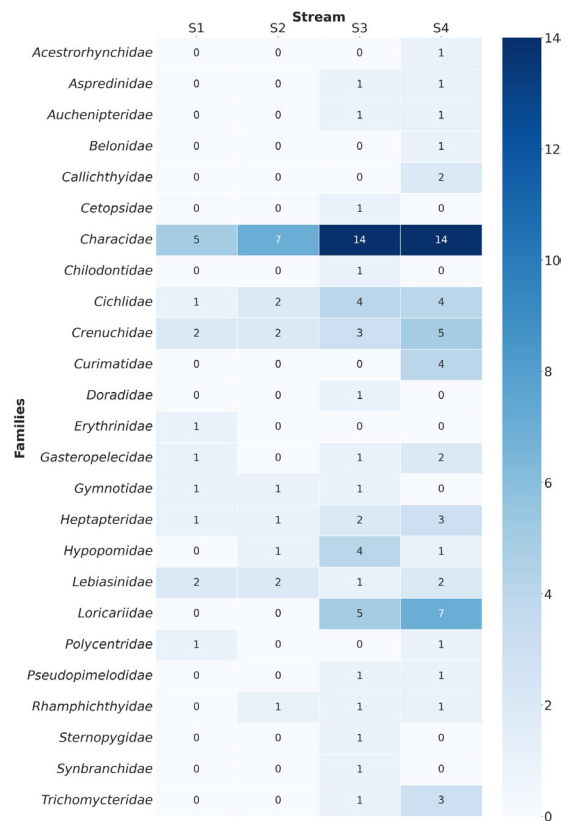
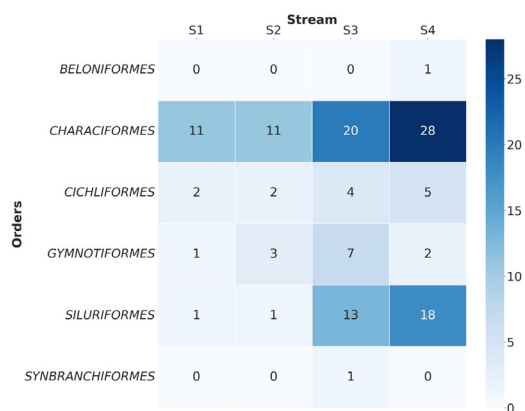
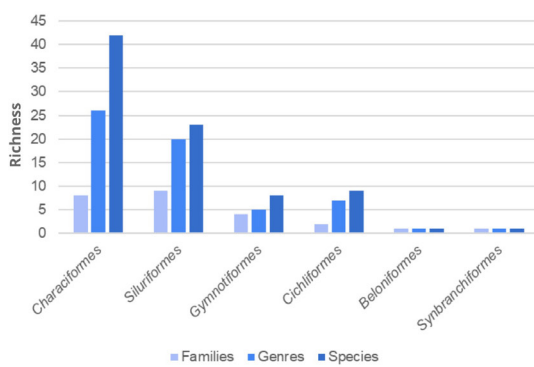


Figure 2. (A) Number of fish families, genera and species by order; (B) Number of species by order and locality; (C) number of species by family and locality.



Figure 3. Species with new occurrences for the region (1-*Brachyhyopomus regani*; 2-*Corydoras narcissus*; 3-*Corydoras urucu*; 4-*Cyphocharax spilurus*; 5-*Hyphessobrycon hasemani*; 6-*Hyphessobrycon wosiackii*; 7-*Microglanis poecilus*; 8-*Moenkhausia melogramma*; 9-*Otocinclus mangaba*; 10-*Oxyropsis carinata*; 11-*Steindachnerina fasciata*.) White bar equals 1 cm.

River is one of the most biodiverse Amazon-River tributaries, with over 1000 documented species (Ohara et al., 2015). It is situated in the Amazonian lowlands, and its tributaries originate from the Andean Mountains and Brazilian Shield, which are regions that host a many endemic species (Dagosta & De Pinna, 2019). One of the factors that may explain this elevated fish diversity in our study is the proximity of these areas to large rivers, such as the Madeira River (Stegmann et al., 2019), which allows an interchange of fish species during the flood period, when the refugia are amplified (Zuanon et al., 2015; Rapp Py-Daniel et al., 2017). Another fact to consider is that in the study conducted by Queiroz et al. (2013b), the fish were collected from streams that connect to Lake Cuniã and this in turn, connects to the Madeira River, providing a wide variety of environments and consequently, a greater diversity of fish.

Even though studies of stream fish have advanced (Castro et al., 2021), the basic biology of the ichthyofauna in the Purus-Madeira interfluvium is still largely unknown. Though 68 species are on the IUCN red list (IUCN, 2024), other authors, such as Ayla et al. (2021), only found 22 species listed in the IUCN red list of the 164 collected on the

lower reaches of the Ucayalli River, Peru. This lack of information impairs assertive evaluations of conservation status, and it is related to the difficulty of access to many areas, which generates information gaps in the Amazon's most remote regions (Carvalho et al., 2023). Biological surveys are needed to provide data about species richness and distribution, guiding the path to the delimitation of priority areas for conservation and the development of public policies.

We captured less species than previous studies in the region, but Queiroz et al. (2013b) used other sampling methods in addition to those used in this study, such as seine nets, gill nets and hand nets, and collected other environments, such as lakes and their tributaries, collecting 25 samples over two years, resulting in a total of 133 species. Vieira et al. (2016), also collected over two years and used complementary methods, such as fyke nets.

Another factor that also contributes to the high diversity records is the proximity of the sampled areas to the military area of the 54th Jungle Infantry Battalion. The four sampled streams in this study are inside military areas and have restricted access, which can indirectly promote the conservation of the vegetation cover – extremely

important for the maintenance of fish populations (Castello et al., 2013; Lobón-Cerviá et al., 2015; Arantes et al., 2017).

The presence of the military base increases the value of these areas as potential biodiversity refuges, especially for the streams S3 and S4 (Figure 1), which are located only a few kilometers from the military headquarters. Two results stand out regarding the surveys carried out in this study. The first concerns the 11 new species-occurrence records showing the enormous gaps in knowledge of biodiversity, and the need for better-informed public policies to guide territorial management along the Purus-Madeira interfluvium. The second result is related to the many of the species collected that could not be identified at the lowest taxonomic level, which indicates the need for further taxonomic studies.

As pointed by Espírito-Santo et al. (2009), changes in the fish-assemblages composition along the year must be evaluated carefully so as not to be confused with anthropic impacts, especially when considering the inundation pulses, which can cause serious limitations for the methodology proposed by Mendonça et al. (2005), and consequently, over management alternatives and conservation efforts, especially considering periods when the streams were too full to apply the method. In these regions with extreme seasonal differences in stream width and depth, complementary sampling methods (e. g., the use of stationary nets/non active assessments) are necessary to document the fish diversity.

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Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

Ethics

Authors have complied with the guidelines established by the ethics committees of their respective research institutions.

Data Availability

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References

- ALBERT, J.S., CARVALHO, T.P., PETRY, P., HOLDER, M.A., MAXIME, E.L., ESPINO, J. & REIS, R.E. (2011). Aquatic biodiversity in the Amazon: habitat specialization and geographic isolation promote species richness. *Animals*, 1(2):205–241.
- ARANTES, C.C., WINEMILLER, K.O., PETRERE, M., CASTELLO, L., HESS, L.L. & FREITAS, C.E. (2017). Relationships between forest cover and fish diversity in the Amazon River floodplain. *Journal of Applied Ecology*, 55(1):386–395.

- ANDRADE, M.B., FERRANTE, L. & FEARNESIDE, P.M. (2021). A rodovia BR-319 brasileira demonstra uma falta crucial de governança ambiental na Amazônia. *Conservação Ambiental*, 48(3):161–164.
- ANJOS, M.R., MACHADO, N.G., PEDERSOLI, M.A., PEDERSOLI, N.R.B., BARROS, B.S., LOURENÇO, I.H. & BARREIROS, J.P. (2019). Survey of fish species from the Lower Roosevelt River, Southwestern Amazon basin. *Biota Neotropica*, 19(4):e20180717. <https://doi.org/10.1590/1676-0611-BN-2018-0717>.
- ARMBRUSTER, J.W. (2004). Phylogenetic relationships of the suckermouth armored catfishes (Loricariidae) with emphasis on the Hypostominae and the Ancistrinae. *Zoological Journal of the Linnean Society*, 141:1–80.
- AYLAS, K., NÚÑEZ-RODRIGUEZ, D., ORTEGA, H., RIOFRIO, J.C., SICCHA-RAMIREZ, R., RAMIREZ, R., ... & BRITZKE, R. (2023). Fishes from Yarinacocha lake: an emblematic Amazonian ecosystem in the lower Ucayali River basin, Pucallpa, Peru. *Biota Neotropica*, 23:e20221424. <https://doi.org/10.1590/1676-0611-BN-2022-1424>.
- BARROS, D.F., ZUANON, J., MENDONÇA, F.P., SANTO, H.M.V.E., GALUCH, A.V. & ALBERNAZ, A.L.M. (2011). The fish fauna of streams in the Madeira-Purus interfluvial region, Brazilian Amazon. *Check List*, 7:768–773.
- BARROS, D.F., PETRERE-JR, M., LECOURS, V., BUTTURI-GOMES, D., CASTELLO, L. & ISAAC, V.J. (2020). Effects of deforestation and other environmental variables on floodplain fish catch in the Amazon. *Fisheries Research*, 230:105643.
- BENONE, N.L., LIGEIRO, R., JUAN, L. & MONTAG, L.F.A. (2017). Role of environmental and spatial processes structuring fish assemblages in streams of the eastern Amazon. *Marine and Freshwater Research*, 69(2):243–252.
- BENONE, N.L., LEAL, C.G., DOS SANTOS, L.L., MENDES, T.P., HEINO, J. & MONTAG, L.F.A. (2020). Unravelling patterns of taxonomic and functional diversity of Amazon stream fish. *Aquatic Sciences*, 82(4):1–11.
- BUCKUP, P.A. (1993). Review of the characidiin fishes (Teleostei: Characiformes), with descriptions of four new genera and ten new species. *Ichthyological Exploration of Freshwaters*, 4(2):97–154.
- BURGESS, W.E. (1989). *An atlas of freshwater and marine catfishes*. Neptune: TFH Publications. 784 p.
- CASTELLO, L., MCGRATH, D.G., HESS, L.L., COE, M.T., LEFEBVRE, P.A., PETRY, P. & ARANTES, C.C. (2013). The vulnerability of Amazon freshwater ecosystems. *Conservation Letters*, 6(4):217–229.
- CARVALHO, R.L., RESENDE, A.F., BARLOW, J., FRANÇA, F.M., MOURA, M.R., MACIEL, R., ... & DALY, D. (2023). Pervasive gaps in Amazonian ecological research. *Current Biology*.
- CASTRO, R.M.C. (2021). Evolução da ictiofauna de riachos sul-americanos (Castro, 1999) revisitado após mais de duas décadas. *Oecologia Australis*, 25(2):231–245. <https://doi.org/10.4257/oeco.2021.2502.02>.
- CAMPOS, M.C.C. (2011). *Caracterização e gênese de solos em diferentes ambientes fisiográficos na região sul do Amazonas*. Editora da PUC Goiás, 112 pp.
- CPRM. (1997). *Projeto de Zoneamento Ecológico-Econômico da Região Fronteira Brasil-Colômbia, Eixo Tabatinga-Apaporis*. Tome II. CPRM, Brasília/Manaus.
- CRAMPTON, W.G.R. & ALBERT, J.S. (2003). Redescription of *Gymnotus coropinae* (Gymnotiformes, Gymnotidae), an often misidentified species of Neotropical electric fish, with notes on natural history and electric signals. *Zootaxa*, 348:1–20.
- CRAMPTON, W.G.R., LOVEJOY, N.R. & ALBERT, J.S. (2003). *Gymnotus ucumara*: a new species of Neotropical electric fish from the Peruvian Amazon (Ostariophysi: Gymnotidae), with notes on ecology and electric organ discharges. *Zootaxa*, 277:1–18.
- CRAMPTON, W.G.R. & ALBERT, J.S. (2004). Redescription of *Gymnotus coatesi* (Gymnotiformes, Gymnotidae), a Rare Species of Electric Fish from the Lowland Amazon Basin, with Descriptions of Osteology, Electric Signals and Ecology. *Copeia*, 2004(3):525–533.
- CRAMPTON, W.G.R., HULEN, K.G. & ALBERT, J.S. (2004). *Sternopygus branco*: A new species of neotropical electric fish (Gymnotiformes: Sternopygidae) from the lowland Amazon basin, with descriptions of osteology, ecology, and electric organ discharges. *Copeia*, 2004(2):245–259.
- CRAMPTON, W.G.R., THORSEN, D.H. & ALBERT, J.S. (2005). Three new species from a diverse, sympatric assemblage of the electric fish *Gymnotus* (Gymnotiformes: Gymnotidae) in the lowland Amazon Basin, with notes on ecology. *Copeia* 2005(1):82–99.
- CRAMPTON, W.G., SANTANA, C.D.D., WADDELL, J.C. & LOVEJOY, N.R. (2016). A taxonomic revision of the Neotropical electric fish genus *Brachyhyopomus* (Ostariophysi: Gymnotiformes: Hypopomidae), with descriptions of 15 new species. *Neotropical Ichthyology*, 14:e150146.
- DAGOSTA, F.C. & DE PINNA, M.C. (2018). A history of the biogeography of Amazonian fishes. *Neotropical Ichthyology*, 16:e180023.
- DAGOSTA, F.C.P. & DE PINNA, M.C.C. (2019). The fishes of the Amazon: Distribution and biogeographical patterns, with a comprehensive list of species. *Bulletin of the American Museum of Natural History*, 431:1–163. <https://doi.org/10.1206/0003-0090.431.1.1>.
- DIAS, M.S., MAGNUSSON, W.E. & ZUANON, J. (2009). Effects of Reduced-Impact Logging on Fish Assemblages in Central Amazonia. *Conservation Biology* 24(1):278–286.
- ESPIRITO-SANTO, H.M.V., MAGNUSSON, W.E., ZUANON, J., MENDONÇA, F.P. & LANDEIRO, V.L. (2009). Seasonal variation in the composition of fish assemblages in small Amazonian forest streams: evidence for predictable changes. *Freshwater Biology*, 54(3):536–548.
- FEARNESIDE, P.M. & GRAÇA, P.M.L.A. (2009). Transporte hidroviário por cabotagem como alternativa à Rodovia Manaus-Porto Velho (BR-319). *Anais da IV Jornada de Seminários Internacionais sobre Desenvolvimento Amazônico*, 3:437–441.
- FEARNESIDE, P.M., GRAÇA, P.M.L.A., KEIZER, E.W.H., MALDONADO, F.D., BARBOSA, R.I. & NOGUEIRA, E.M. (2009). Modelagem de desmatamento e emissões de gases de efeito estufa na região sob influência da Rodovia Manaus-Porto Velho (BR-319). *Revista Brasileira de Meteorologia* 24(2):208–233. <https://doi.org/10.1590/S0102-77862009000200009>.
- FERRANTE, L., GOMES, M. & FEARNESIDE, P.M. (2020). Amazonian indigenous peoples are threatened by Brazil's Highway BR-319. *Land Use Policy*, 94:104548.
- FERRANTE, L., DE ANDRADE, M.B.T., LEITE, L., JUNIOR, C.S., LIMA, M., JUNIOR, M.C. & FEARNESIDE, P.M. (2021). BR-319: O caminho para o colapso da Amazônia e a violação dos direitos indígenas. *Amazônia Real*, 23.
- FREDERICO, R.G., ZUANON, J. & DE MARCO JR, P. (2018). Amazon protected areas and its ability to protect stream-dwelling fish fauna. *Biological Conservation*, 219:12–19.
- IBGE, *Fundação Instituto Brasileiro de Geografia e Estatística. Manual técnico da vegetação brasileira*. Rio de Janeiro: 2012. 323p.
- IUCN. 2023. *The IUCN Red List of Threatened Species*. Available at: www.iucnredlist.org. (Last access in 10 February 2024).
- Géry, J. (1977). *Characoids of the World*. Neptune: TFH Publications. 772 p.
- GÉRY, J. (1993). Description de trois espèces nouvelles du genre *Iguanodectes* (Pisces, Characiformes, Characidae), avec quelques données récentes sur les autres espèces. *Revue française d'Aquariologie* 19(4):97–105.
- HUBER, J.H. (1992). *Rivulus: Ecobiogeography – Relationships*. Laboratoire d'Ichtyologie general et appliquee. Paris: Museum National d'Histoire Naturelle. 572 p.
- KULLANDER, S.O. (1986). *Cichlid fishes of the Amazon River drainage of Peru*. Stockholm: Swedish Museum of Natural History. 431 p.
- KULLANDER, S.O. (1989). Description of a new *Acaronia* species from the Rio Orinoco and Rio Negro drainages. *Zoologica Scripta*, 18(3):447–452.
- KULLANDER, S.O. (1995). Three new cichlid species from southern Amazonia: *Aequidens gerchilae*, *A. epae* and *A. michaeli*. *Ichthyological Exploration of Freshwaters*, 6:149–170.
- KULLANDER, S.O. & FERREIRA, E.J.G. (1991). A new *Aequidens* species from the Rio Trombetas, Brasil, and redescription of *Aequidens pallidus*. *Zoologica Scripta*, 19(4):425–433.
- LEAL, C.G., POMPEU, P.S., GARDNER, T.A., LEITÃO, R.P., HUGHES, R.M., KAUFMANN, P.R., ZUANON, J., PAULA, F.R., FERRAZ, S.F.B., THOMSON, J.R., MAC NALLY, R., FERREIRA, J. & BARLOW, J. (2016). Multi-scale assessment of human-induced changes to Amazonian instream

- habitats. *Landscape Ecology*, 31:1725–1745. <https://doi.org/10.1007/s10980-016-0358-x>.
- LEITÃO, R.P., ZUANON, J., MOUILLOT, D., LEAL, C.G., HUGHES, R.M., KAUFMANN, P.R., VILLÉGER, S., POMPEU, P.S., KASPER, D., PAULA, F.R., FERRAZ, S.F.B. & GARDNER, A. (2018). Disentangling the pathways of land use impacts on the functional structure of fish assemblages in Amazon streams. *Ecography*, 41:219–232, 2018. <https://doi.org/10.1111/ecog.02845>.
- LOBÓN-CERVIÁ, J., HESS, L.L., MELACK, J.M. & ARAUJO-LIMA, C.A. (2015). The importance of forest cover for fish richness and abundance on the Amazon floodplain. *Hydrobiologia*, 750(1):245–255.
- LUNDBERG, J.G. (2005). *Gymnorhamphichthys bogardusi*, a new species of sand knife-fish (Gymnotiformes: Rhamphichthyidae) from the Rio Orinoco, South America. *Annals of the South African Museum*, 479:1–4.
- MAGO-LECCIA, F. (1994). *Electric fishes of the continental waters of America*. Caracas: Fundacion para el Desarrollo de las Ciencias Fisicas, Matematicas y Naturales. 206 p.
- MARINHO, M.M.F. & LANGEANI, F. (2010). A new species of *Moenkhausia* from the rio Amazonas and rio Orinoco basins (Characiformes: Characidae). *Zootaxa*, 2577:57–68.
- MENDONÇA, P.F., MAGNUSSEN, E.W. & ZUANON, J. (2005). Relationships Between Habitat Characteristics and Fish Assemblages in Small Streams of Central Amazonia; *Copeia* 2005:751–764.
- OHARA, W.M., DE QUEIROZ, L.J., ZUANON, J., TORRENTE-VILARA, G., VIEIRA, F.G., & DA COSTA DORIA, C.R. (2015). Fish collection of the Universidade Federal de Rondônia: its importance to the knowledge of Amazonian fish diversity. *Acta Scientiarum. Biological Sciences*, 37(2):251–258.
- OYAKAWA, O.T. & MATTOX, G.M.T. (2009). Revision of the Neotropical trahiras of the *Hoplias lacerdae* species-group (Ostariophysi: Characiformes: Erythrinidae) with descriptions of two new species. *Neotropical Ichthyology* 7(2):117–140.
- PY-DANIEL, L.R., DEUS, C.P., RIBEIRO, O.M. & SOUSA, L.M. (2007). Peixes. In: Py-Daniel LR, Deus CP, Henriques AL, DM Pimpão, Ribeiro OM (Ed.). *Biodiversidade do Médio Madeira: Bases científicas para propostas de conservação*. Manaus: INPA. P. 89–125.
- QUEIROZ, L.J., TORRENTE-VILARA, G., VIEIRA, F.G., OHARA, W.M., ZUANON, J. & DORIA, C.R. (2013). Fishes of Cuniã Lake, Madeira River Basin, Brazil. *Check List*. 9:540–548.
- QUEIROZ, L.J., TORRENTE-VILARA, G., OHARA, W.M., PIRES, T.H.S., ZUANON, J. & DORIA, C.R.C. (2013). *Peixes do Rio Madeira*. São Paulo: Diaeto Latin American Documentary: Vol. 1–3.
- RAPPY-DANIEL, L.H., BELTRÃO, H.D.A. & DUARTE, C. (2017). Ictiofauna do rio Jufari e aquipélago de Mariuá. In: Oliveira ML (Ed.) *A flora, a fauna e o homem no maior aquipélago fluvial do planeta*. Editora INPA, Manaus, 68–99. <https://doi.org/10.1590/2175-7860201768117>.
- REIS, R.E. (1997). Revision of the Neotropical genus *Hoplosternum* (Ostariophysi: Siluriformes: Callichthyidae) with the description of two new genera and three new species. *Ichthyological Exploration of Freshwaters* 7:299–326.
- REIS, R.E., LE BAIL, P.Y. & MOL, J.H.A. (2005). New arrangement in the synonymy of *Megalechis* Reis, 1997 (Siluriformes: Callichthyidae). *Copeia* 2005(3):678–682.
- ROCHA, M.S., DE OLIVEIRA, R.R. & PY-DANIEL, L.H.R. (2008). A new species of *Gladioglanis* Ferraris and Mago-Leccia from rio Aripuanã, Amazonas, Brazil (Siluriformes: Heptapteridae). *Neotropical Ichthyology*, 6(3):433–438.
- RÖMER, U. (2002). *Cichlid Atlas*, Volume 1. Natural History of South American Dwarf Cichlids. Parts 1 and 2. Germany: Mergus, Melle. 1311 p.
- ROSEN, D.E., & RUMNEY, A. (1972). Evidence of a second species of *Synbranchus* (Pisces, Teleostei) in South America. *American Museum Novitates*; no. 2497.
- SARMENTO-SOARES, L.M. & MARTINS-PINHEIRO, R.F. (2008). A systematic revision of *Tatia* (Siluriformes: Auchenipteridae: Centromochlinae). *Neotropical Ichthyology*, 6(3):495–542.
- SCHAEFER, S.A. (1997). The Neotropical cascudinhos: Systematics and biogeography of the *Otocinclus* catfishes (Siluriformes: Loricariidae). *Proceedings of the Academy of Natural Sciences of Philadelphia*, 148:1–120.
- SOUSA, L.M. & PY-DANIEL, L.H.R. (2005). Description of two new species of *Physopyxis* and redescription of *P. lyra* (Siluriformes: Doradidae). *Neotropical Ichthyology* 3(4):625–636.
- STEGMANN, L.F., LEITÃO, R.P., ZUANON, J. & MAGNUSSEN, W.E. (2019). Distance to large rivers affects fish diversity patterns in highly dynamic streams of Central Amazonia. *PLoS One*, 14(10), e0223880.
- VARI, R.P. (1992). Systematics of the Neotropical Characiform genus *Cyphocharax* Fowler (Pisces, Ostariophysi). *Smithsonian Contributions to Zoology* 529:1–137.
- VARI, R.P. & ORTEGA, H. (1986). The catfishes of the Neotropical family Helogenidae (Ostariophysi: Siluroidei). *Smithsonian Contributions to Zoology* 442:1–20.
- VIEIRA, F.G., MATSUZAKI, A.A., BARROS, B.S.F., OHARA, W.M., PAIXÃO, A.D.C., TORRENTE-VILARA, G., ZUANON, J. & DORIA, C.R.C. (2016). *Catálogo de peixes da ESEC Cuniã*.
- WEITZMAN, S.H. (1960). Further notes on the relationships and classification of the South American characid fishes of the subfamily Gasteropelecinae. *Stanford Ichthyological Bulletin* 7(4):217–239.
- WEITZMAN, S.H. (1978). Three new species of fishes of the genus *Nannostomus* from the Brazilian states of Pará and Amazonas (Teleostei: Lebiasinidae). *Smithsonian Contributions to Zoology*, 263:1–14.
- WEITZMAN, S.H. & VARI, R.P. (1987). Two new species and a new genus of miniature characid fishes (Teleostei: Characiformes) from northern South America. *Proceedings of The Biological Society of Washington*, 100(3):640–652.
- ZARSKÉ, A. & GÉRY, J. (1997). Ein neuer Salmmleraus Peru. *Das Aquarium*, 336:12–17.
- ZARSKÉ, A. & GÉRY, J. (2006). Zur identität von *Copella nattereri* (Steindachner, 1876) einschließlich der Beschreibung einer neuen Art (Teleostei: Characiformes: Lebiasinidae). *Zoologische Abhandlungen (Dresden)* 56:15–46.
- ZUANON, J., MENDONÇA, F.P., ESPÍRITO-SANTO, H.M., DIAS, M.S., GALUCH, A.V. & AKAMA, A. (2015). *Guia de Peixes da Reserva Ducke, Amazônia Central*. INPA, Manaus, 154 pp.

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