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ABSTRACT

We provide an annotated list of fishes collected from the Tapanahony River, the largest tributary of the Marowijne River, in Suriname. A total of 19 sites were sampled in the Upper Tapanahony River during the minor dry season. The expedition yielded 127 species from 83 genera representing 29 families and four orders. Characiformes dominated collections in terms of species. In addition to collecting several taxa endemic to the Upper Tapanahony River, we report the first record of *Acestrorhynchus heterolepis* for Suriname as well as several likely undescribed taxa.

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INTRODUCTION

The Neotropics harbor the greatest freshwater fish diversity on earth with an estimated 9,000 species (Birindelli & Sidlauskas, 2018). However, this diversity remains relatively poorly documented, with only ~6200 species formally described (Reis et al., 2016; Albert et al., 2020). One of the least understood Neotropical regions is the Guiana Shield, which, for its size relative to other Neotropical regions, exhibits exceptional species richness that combines Amazonian faunal elements with high levels of endemic taxa (Abell et al., 2008; Vari & Ferraris, 2009; Alofs et al., 2014; Reis et al., 2016). Suriname, the smallest country in the Guiana Shield, is home to over 400 documented species of freshwater fishes (Mol, 2012). There are seven main river systems in Suriname, all of which drain toward the Atlantic (from east to west): Marowijne, Commewijne, Suriname, Saramacca, Coppename, Nickerie and Corantijn. Many fish species are endemic to a single river system (Kullander & Nijssen, 1989; Mol et al., 2012). Fish specimens derived from field expeditions in Suriname date back to the 18th century (see Kullander and Nijssen 1989 for a historical summary of the exploration of Suriname rivers), but many of the river basins remain poorly explored.

The Marowijne River (also known as the Maroni River in French) is the largest river system in Suriname, located in the east of the country on the border with French Guiana. The Marowijne basin has a total catchment area of 68,700 km^2 (Amatali, 1993) and is home to at least 319 species of fishes, 28 of which are endemic to the river system (Mol, 2012; Mol et al., 2012). While the major river systems of Suriname, including the Marowjine, drain into the Atlantic, the headwaters of the Marowijne reach into the southern Toemoek-Hoemak Mountains along the Brazilian border (also spelled Tumuc-Humuc (French) or Tumucumaque (Portuguese)). The Toemoek-Hoemak Mountains separate the northern-flowing Atlantic coastal drainages from the south-flowing tributaries of the Amazon by forming a continental divide within the eastern Guiana Shield. The headwaters of several river systems that flow north and south lie within the Toemoek-Hoemak Mountains and interdigitate with each other in this region. Three major tributaries of the Marowijne originate in these mountains, from east to west: the Litanie, Oelemari, and Tapanahony rivers. Several of these drainages are home to their own endemic fishes (e.g. the cichlids *Guianacara oelemariensis* Kullander and Nijssen 1989 and *Aequidens paloemeuensis*, Kullander and Nijssen, 1989). The region has likely influenced biogeographic links between the Atlantic draining Guiana Shield river basins and the Amazon, and may also harbor relictual links between the eastern and western lobes of the Guiana Shield (Kullander & Nijssen, 1989; Lehmberg et al., 2018). It has been proposed that stream capture events may play a large role in the dispersal of fishes from the Guiana Shield and the Amazon basins through this region (Nijssen, 1970). Of particular interest is the proximity of the Jari River, which is a south-flowing tributary of the Amazon. The Jari River basin may provide an avenue for Amazonian species to invade the northern-flowing rivers of the Atlantic coast of the Guiana Shield (Cardoso & Montoya-Burgos, 2009; Fisch-Muller et al., 2018; Lujan et al., 2018).

While there have been several scientific collections of fishes from the Marowijne River, these have mostly occurred in the Marowjine River proper and its upper reaches, the Lawa River, which forms the border between Suriname and French Guiana (Planquette et al., 1996; Mol et al., 2012). The Oelemari and Litanie Rivers have also been collected historically and in relatively recent biodiversity assessment expeditions (Ouboter et al., 1999; Mol et al., 2012). Contrastingly, while fishes from the Tapanahony exist in collections, the last major collection of the mainstem was in 1999 (Ouboter et al., 1999). Several large collections from the Paloemeu River, the largest Tributary of the Tapanahony (sometimes spelled Tapanahoni), resulted from the large 1966 expedition by King Leopold III of Belgium and two more recent expeditions in 2008 and 2012 (Mol & Wan Tong You, 2013). However, the upper Tapanahony upstream of the Paloemeu and its small tributary, the Blakawatra, remain relatively unexplored to the best of our knowledge.

Beyond the high potential to reveal unreported ichthyological diversity and contribute to clarifying the complex biogeography of the region, understanding the diversity of fishes in the Tapanahony is necessary for conservation purposes. Both legal and illicit goldmining are common in Suriname and pose threats to the fish in the region via increased erosion, sedimentation, mercury pollution, and changing riverine habitats and fish community structure (Mol et al., 2001; Mol & Ouboter, 2004; Ouboter et al., 2012). Gold mining also poses a threat to the Tiriyó and Wayana Amerindian communities that live along the Tapanahony river, as fish are a primary source of protein in these villages (Heemskerk & Delvoye, 2007; Heemskerk et al., 2007). Another threat to the fish fauna of the Marowijne River system are potential water diversion projects, such as the Tapajai project, which proposes diverting water from the Tapanahony River through Jai Creek into the Brokopondo Reservoir, which lies on the Suriname River, to increase hydroelectric power generation (Lachman et al., 2018). Such a project would impact the aquatic habitats of the Tapanahony and Marowijne Rivers by altering flow. This project would also pose major impacts on the biological diversity of these two river systems that both harbor a number of respective endemic species (Mol, 2012; Mol et al., 2012), which may lead to increased competition between fishes with similar ecology and/or hybridization with close relatives. The recent development of the Southern Suriname Conservation Corridor (Ramirez-Gomez et al., 2016) emphasizes sustainable development of the biodiversity-

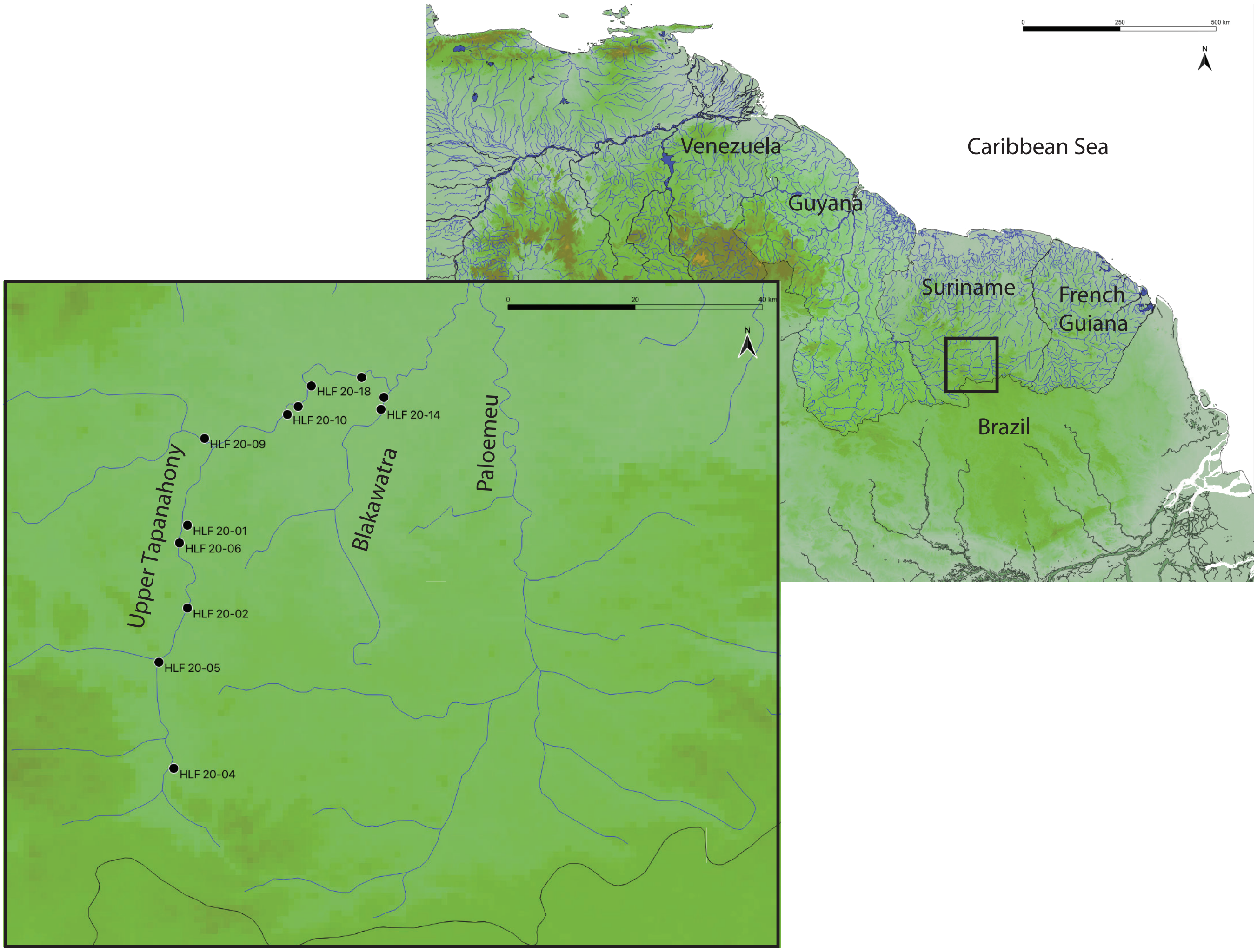

Figure 1: Map of the upper Tapanahony River showing collection localities. One symbol may represent more than one collection locality.

rich but incompletely assessed region that encompasses the upper tributaries of the Marowijne, including the remote and pristine Tapanahony.

Here we present the results of a 2020 expedition co-organized by the Fish Division of the University of Michigan Museum of Zoology and Conservation International Suriname to survey the fish diversity of the upper Tapanahony river.

MATERIALS AND METHODS

Study Area

The Tapanahony River is located between 2.25ºN – 4.25ºN and 54.5ºW – 56.25ºW in eastern Suriname and has a total catchment area of 19,715 km^2 and varies in topology from 39 – 911 m above sea level (Nurmohamed & Donk, 2013). Sampling was done between the upper Tapanahony mainstem (2º39'N, 55º52'W) and the lower portion of the Blakawatra River (at 3º11'N, 55º34'W), a small clearwater tributary of the Tapanahony approximately halfway between the Amerindian village of Pelelu Tepu and the mouth the Paloemeu River (Fig. 1 & 2). Details of the sampling localities are given in Table 1.

Methods

Fishes were sampled using the following methods depending on habitat conditions: seining, dip-netting, gill-netting, cast-netting, and hook and line-fishing. After capture, fishes were euthanized with an overdose of clove-oil (eugenol) following protocols approved by the University of Michigan Institutional Animal Care and Use Committee. Tissues were taken from a subset of fishes and stored in RNAlater. Specimens were fixed in 10% formalin and later transferred to 70% ethanol for long-term preservation. Specimens were identified to species using relevant keys and field guides for

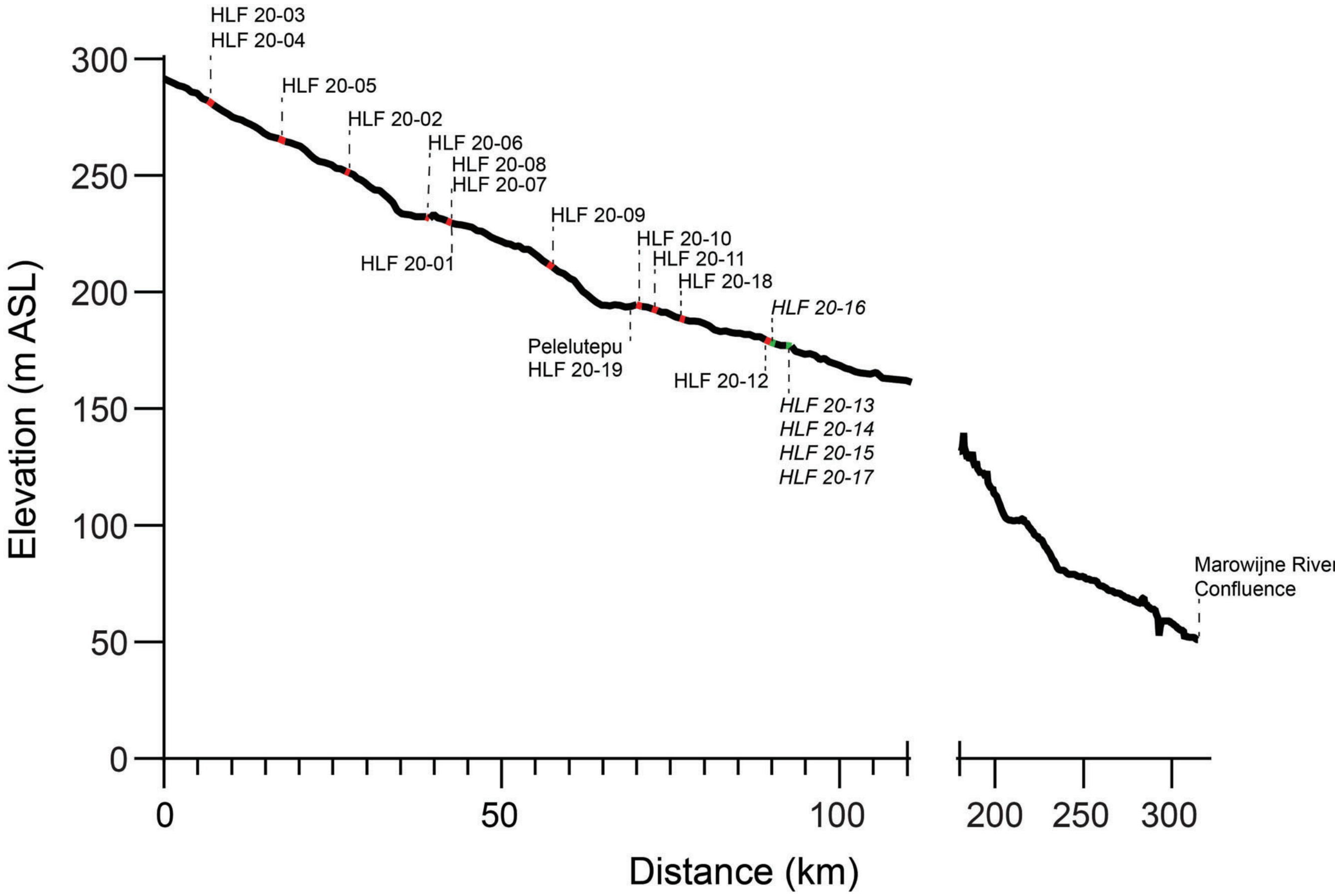

Figure 2: Transect showing the elevation gradient of the Upper Tapanahony River, and the sampling locations mentioned in Figure 1 and Table 1. Distance between sites in kilometers (km) is presented on the x-axis while the elevation change in meters above sea level (mASL) is on the y-axis.

the region (Kullander & Nijssen, 1989; Mol, 2012; van der Sleen & Albert, 2017). Taxonomic nomenclature reported in this paper follows that of the Catalog of Fishes (Eschmeyer et al., 2020). To assess the adequacy of our sampling, we calculated a species accumulation curve using the specaccum function in the R package vegan (Oksanen et al., 2015) to see how newly collected species accumulated given additional sampling throughout the expedition. Typically, species accumulation curves ascend rapidly at the beginning of sampling and begin to plateau as new sites are sampled, indicating that the system is fully sampled when reaching an asymptote.

Collection and export of specimens was performed under permits from of the Surinamese Ministry of Agriculture, Animal Husbandry and Fisheries. All voucher specimens have been deposited in the University of Michigan Museum of Zoology (UMMZ) and are accessible through iDigBio (https://www.idigbio.org/portal/search) using the institution code UMMZ and Collection Code ummz_fish or through FishNet2 (http://www.fishnet2.net/search.aspx) under the collection code UMMZ.

RESULTS

Sampling of fishes in the upper Tapanahony River occurred between February 28, 2020 and March 11, 2020 during the minor dry season (Mol, 2012). Water parameters recorded across field sites ranged from 23.4 – 26.9° C for temperature, 6.46 – 7.58 mg/L for dissolved oxygen (DO), 14.2 – 22.9 µS/cm for conductivity, and 9.457 – 14.382 mg/L for total dissolved solids (TDS). Due to equipment failure, we were unable to collect reliable pH measurements, but previous detailed physio-chemical data for the Tapanahony River reported a pH range of 5.8 – 6.1 (Leentvaar, 1975).

All sites were located between 2º39.506'N - 3º12.735'N and 55º34.919'W- 55º55.809'W in the upper Tapanahony. Sampled sites included a mix of blackwater and clearwater habitats which spanned a full gradient of water current between backwaters with no detectable current and rapids with a maximum measured current of 1.9 m/s (Fig. 3). We made a total of 19 collections that resulted in 2580 specimens representing 127 species (Fig. 4-10). These include several species of unclear taxonomic identity, and several have

Figure 3: Habitats of the Upper Tapanahony River. **A.** Site HLF 20-01, Perei Rapids. Photo by O. Lucanus. **B.** Site HLF 20-07, Jawi Sula. Photo by H. López-Fernández. **C.** The Tapanahony River at Pelelu Tepu. Photo by O. Lucanus. **D.** Site HLF 20-16, Blakawatra River. Photo by H. López-Fernández.

been determined to be new to science and will be described elsewhere. Altogether, the collections represented a total of 83 genera, 29 families, and four orders. Information on the species caught, ordered by taxonomy and site with the corresponding University of Michigan Museum of Zoology catalog numbers, is provided in Table 2. The species accumulation curve of our sampling efforts show that species diversity accumulated quickly early in the expedition and began to plateau, however, never fully reached an asymptote indicating that there were likely species not collected during our sampling (Fig. 11).

The most diverse order collected were the Characiformes which constituted roughly 61.5% of the total species collected. Of the remaining orders, Siluriformes, Gymnotiformes, and Cichliformes represented 27.7%, 6.2%, and 4.6% of the species collected. The family Characidae represents 25.4% of the total species caught, while Loricariidae, Anostomidae and Serrasalmidae species represented 15.4%, 7.7%, and 7.7% of the species sampled, respectively. The number of species in each of the remaining families collected represented less than 5% of the total number of species collected.

DISCUSSION

Our collections are similar to those reported from the Tapanahony by Ouboter & Mol (1993). The predominance of Ostariophysi fishes, especially Characiformes, is coincident both with their sampling of the region and with expectations for fish assemblages across Greater Amazonia (e.g. van der Sleen & Albert 2018).

The most notable difference in collections between our expedition and that of Ouboter & Mol (1993) is in the absence of several families of Siluriformes in our collections. Ouboter and Mol reported several *Tatia* (Auchenipteridae) species as well as various cetopsid catfishes that we did not obtain. Likewise, we only found a single species of callichthyid catfish (*Corydoras breei*), while they reported three species of *Corydoras* from the Tapanahony river in addition to *Callichthys callichthys*. Ouboter & Mol also reported more cichlids from the Tapanahony River drainage than we found, as well as two rivulid species, a family we did not collect.

In a survey of the Paloemeu River, the largest tributary of

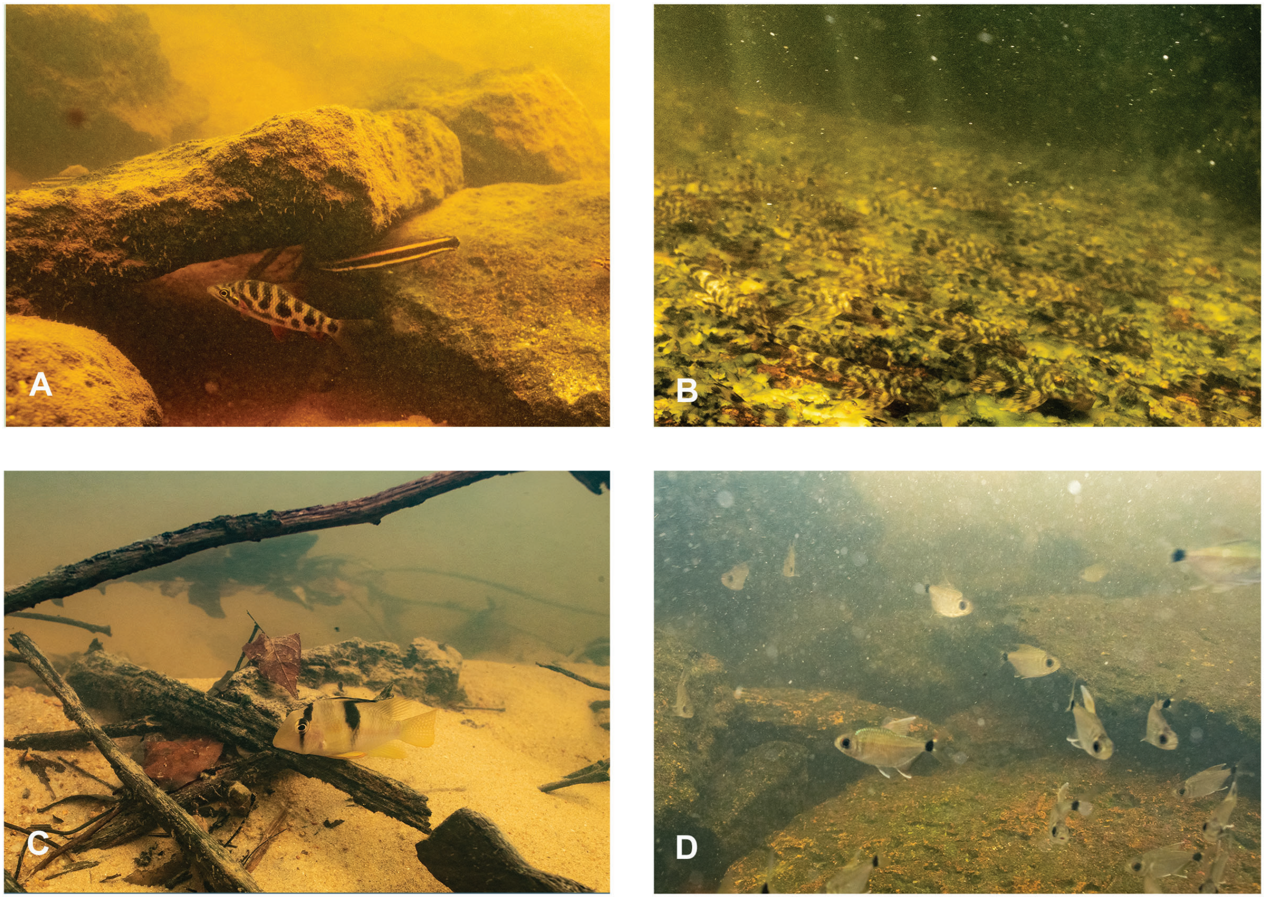

Figure 4: Underwater habitats and fishes of the Upper Tapanahony River. **A.** *Leporinus granti* (left) and *Anostomus ternetzi* (right), **B.** *Harttia guianensis*, **C.** *Guianacara owroewefi*, **D.** *Jupiaba meuneri*. All photos by O. Lucanus.

the Tapanahony, from October 2008 and March 2012, Mol & You (2013) reported 94 species. While there is considerable overlap between the taxa reported from the Paloemeu and our samples from the Upper Tapanahony River, they do report families such as Prochilodontidae, Cetopsidae, Auchenipteridae, Sciaenidae, and Rivulidae, which we did not collect in the upper reaches of the Tapanahony. One species currently known only from the Paloemeu River, *Hyphessobrycon* sp. "blackstripe", was caught by us at several sites, confirming the previous suggestion that it likely occurs in the Upper Marowijne River system in addition to the Paloemeu River (Mol, 2012).

While sampling methods and efficiency may be partly responsible for the differences between collections, other factors likely play a role as well. First, the data reported by Ouboter & Mol (1993) for the Tapanahony comprise numerous sampling events between 1987 – 1993, while our expedition spanned two weeks in the minor dry season. Likewise, our expedition focused on the upper-most reaches of the Tapanahony, whereas Ouboter & Mol worked further downstream, including areas around the Paloemeu River. The region where we worked is vastly dominated by rapids, waterfalls and a dominance of rheophilic habitats, particularly in localities upstream from the village of Pelelu Tepu (e.g. Fig. 2 & 3A-3C). Even though these habitats are challenging to sample and it is almost certain that our samples failed to include some species, the fact that our expedition resulted in a larger number of taxa than previously reported (127 versus 76) prompts additional explanations. Our collections in the farther upstream sites resulted in a heavy representation of rheophilic taxa, whereas species associated with slower currents were more diverse in the downstream tributary, the Blakawatra River (Fig. 4), which may be overall more similar to the Paloemeu area in fish diversity. This suggests that species turnover from upstream to downstream sites may have a role in the sampling differences, and that the absence of some fish families from the upstream portion of the Tapanahony may relate with environmental filtering that excludes taxa with preference for slower currents and more lentic habitats.

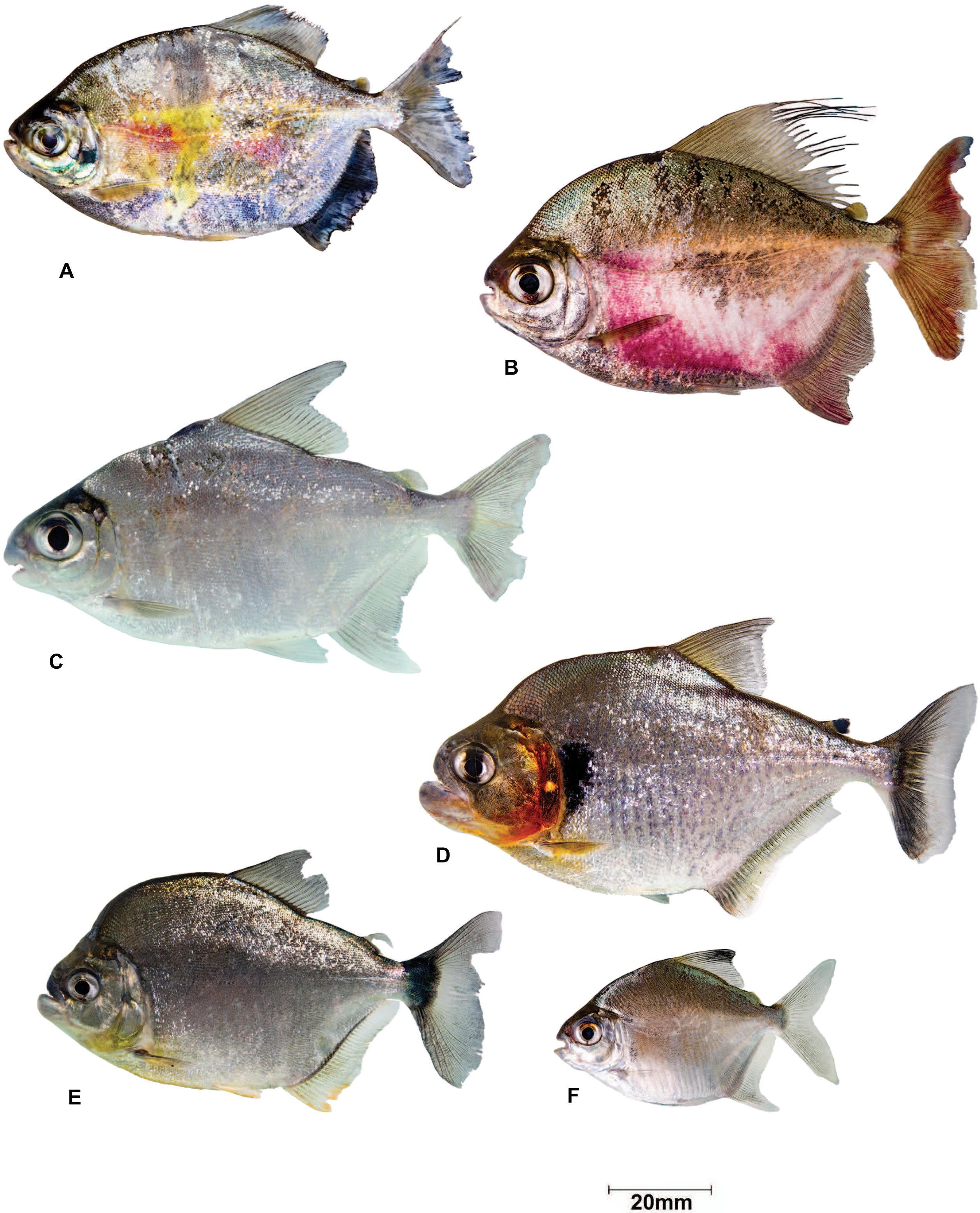

Figure 5: Serrasalmids of the Upper Tapanahony River. Scale bar represents 20 mm in length. **A.** *Paramyloplus* cf. *ternetzi,* **B.** *Myleus* cf. *planquettei,* **C.** *Acnodon oligacanthus,* **D.** *Serrasalmus eigenmanni*, **E.** *Pristobrycon striolatus,* **F.** *Prosomyleus rhomboidalis*. All photos by H. López-Fernández.

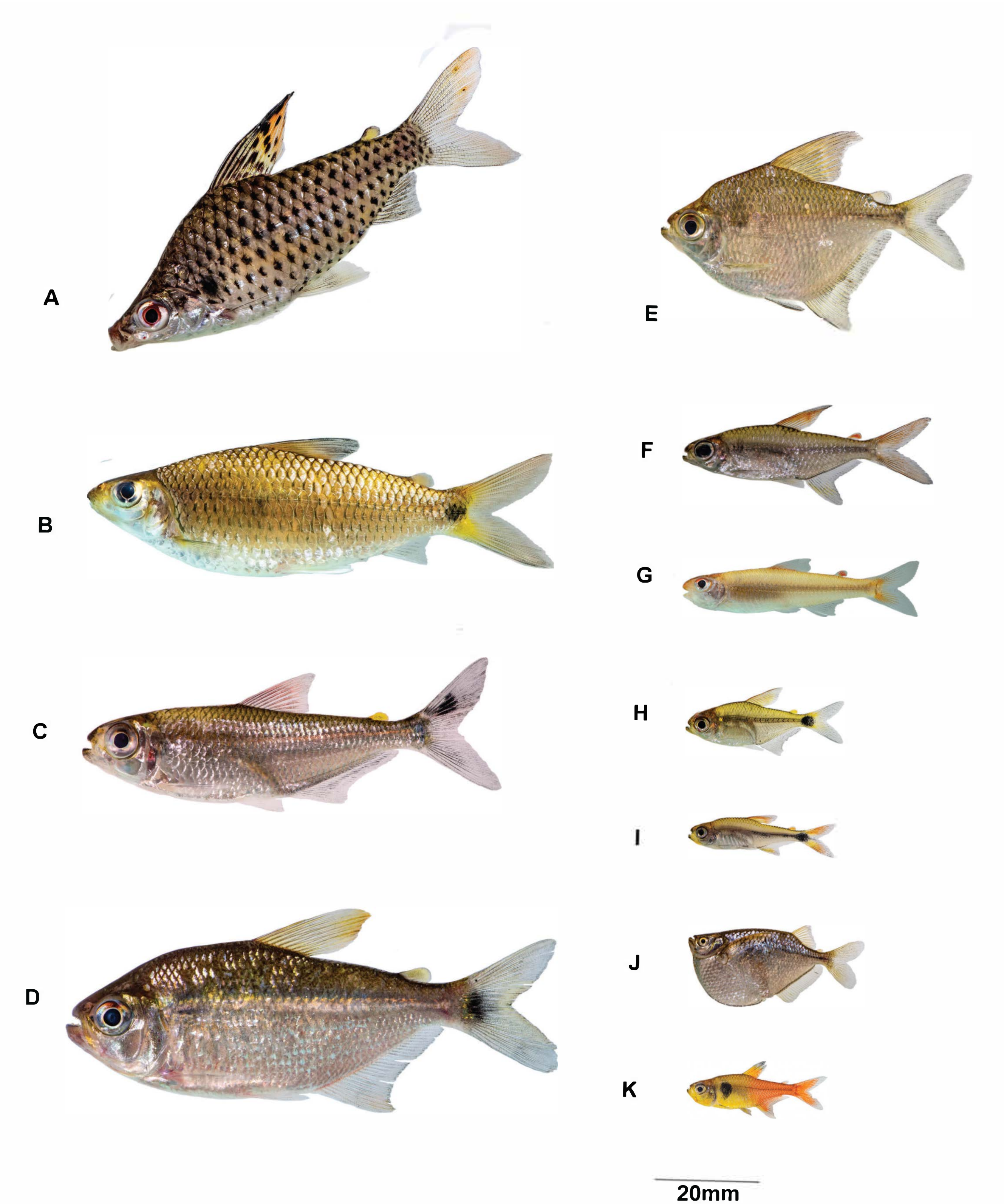

Figure 6: Characiformes of the Upper Tapanahony River. Scale bar represents 20 mm in length. **A.** *Chilodus zunevei,* **B.** *Cyphocharax spilurus,* **C.** *Moenkhausia hasemani,* **D.** *Moenkhausia chrysargyrea,* **E.** *Brachychalcinus orbicularis,* **F.** *Moenkhausia collettei,* **G.** *Creagrutus melanzonus,* **H.** *Jupiaba maroniensis,* **I.** *Hyphessobrycon* sp. 'blackstripe', **J.** *Gasteropelecus sternicla,* **K.** *Hyphessobrycon roseus*. Photos A-J by H. López-Fernández and photo K by S. Borstein.

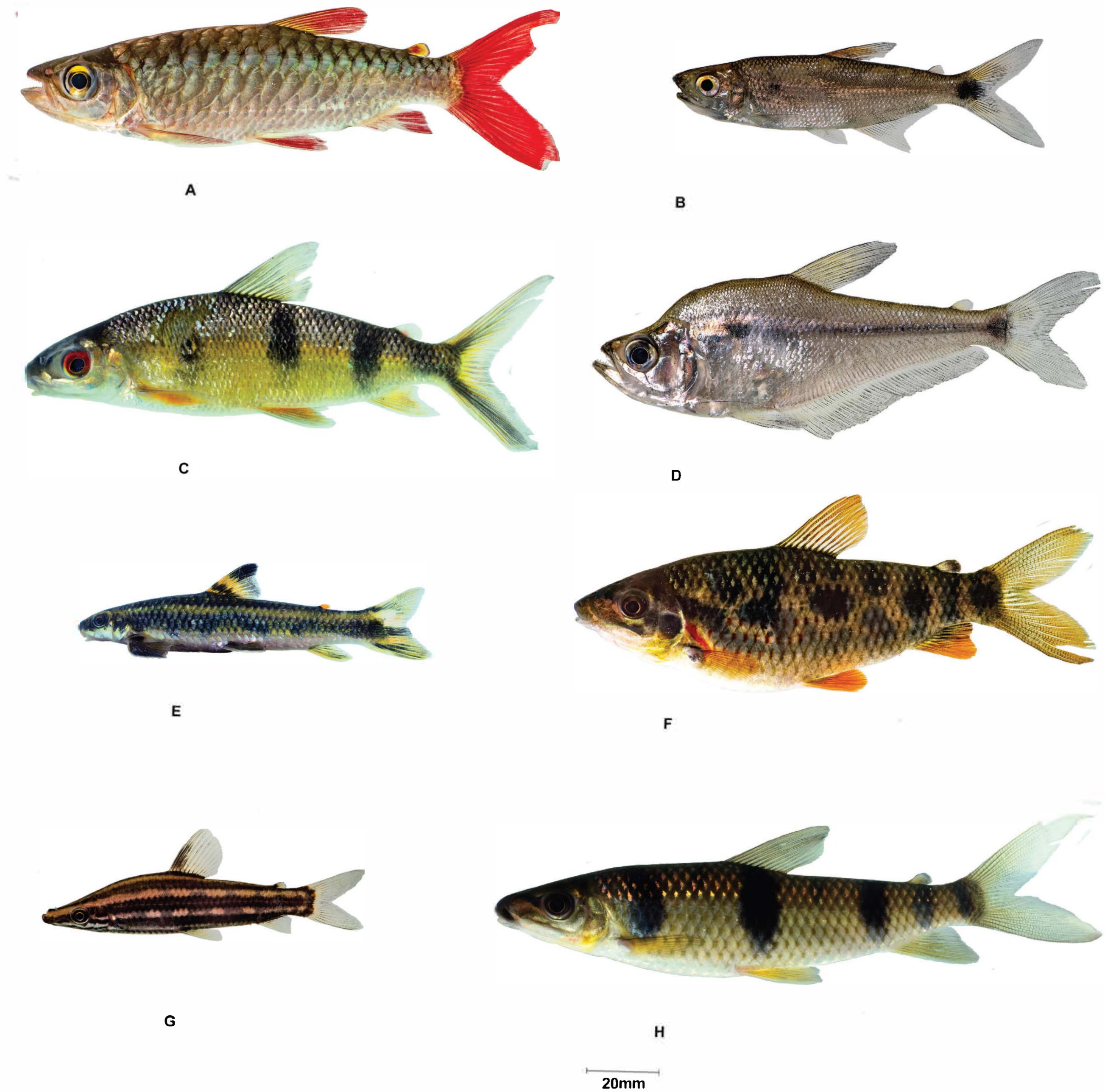

Figure 7: Characiformes of the Upper Tapanahony River. Scale bar represents 20 mm in length**. A.** *Chalceus macrolepidotus,* **B.** *Roeboexodon guyanensis,* **C.** *Hemiodus huraulti,* **D.** *Charax* aff. *pauciradiatus,* **E.** *Parodon guyanensis,* **F.** *Leporinus granti,* **G.** *Anostomus brevior,* **H.** *Leporinus maculatus*. Photos A-B and D-G by H. López-Fernández and photo C, E, and H by S. Borstein.

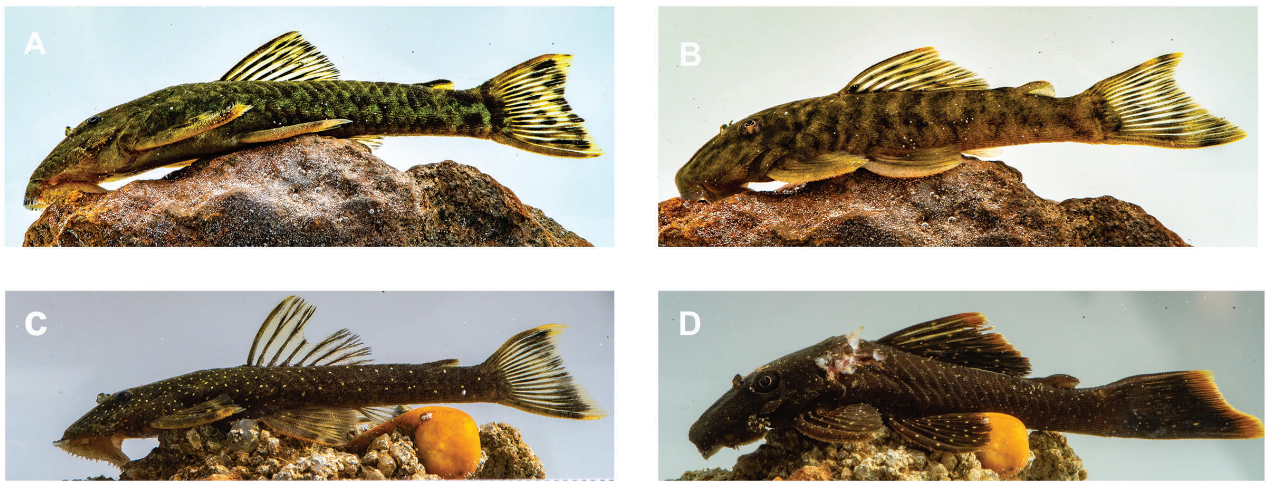

Figure 8: Loricariidae of the Upper Tapanahony River. **A.** *Paralithoxus* sp. *'green',* **B.** *Guyananacistrus brevispinis,* **C.** *Paralithoxus* cf. *planquettei,* **D.** *Ancistrus* cf. *temmincki*. All photos by H. López-Fernández

We collected several taxa endemic to the Upper Marowijne River System in at least five different families. These included *Cyphocharax biocellatus* Vari, Sidlauskas, & Le Bail (Curimatidae), *Hemiancistrus medians* (Kner, 1854), *gen. nov. sp.n. aff. Parotocinclus* (Loricariidae), *Jupiaba maroniensis* (Géry, Planquette & Le Bail, 1996), *Moenkhausia moisae* Géry, Planquette & Le Bail, 1995 (Characidae), *Pimelabditus moli* (Heptapteridae) Parisi & Lundberg, 2009, and *Platydoras* sp. "shallow scute" (Doradidae). While a few species have the Tapanahony River as their type locality, only two recognized species are endemic to the Tapanahony River basin itself. The annual killifish *Kryptolebias sepia* is endemic to the Tapanahony basin, including the Paloemeu River. We did not collect this species because it is found in isolated pools in the primary rainforest with extensive canopy cover, habitats we did not sample (Vermeulen & Hrbek, 2005). Another species, *Aequidens paloemeuensis*, is also endemic to the Tapanhony River basin, but it is known only from the Paloemeu River (Kullander & Nijssen, 1989; Mol & Wan Tong You, 2013), and our lack of collections support the notion that it is restricted to that drainage.

We also report what appears to be the first Surinamese record of *Acestrorhynchus heterolepis* Cope, 1878. Previously, *A. heterolepis* was formally known from the Amazon and Orinoco River basins in Bolivia, Brazil, Colombia, Ecuador, and Venezuela. Records of the species in Guyana's Essequibo and Berbice basins are also known from collections at the Royal Ontario Museum and the Academy of Natural Sciences of Philadelphia (ROM 86983, 87064, 86771, 83603, 83989, 83990, 83984, 83983, ANSP 176756). It is likely that this species has a wider distribution than previously reported. As has been the case with other widely distributed taxa (Sabaj et al., 2020), the finding of this species in Suriname adds to a series of Guiana Shield taxa with broader distributions into the Amazon and Orinoco basins that may reveal undetected diversity as well as inform historical biogeographic inference for the region.

Our field collections also revealed several potentially undescribed species. At several sites, we collected two species of the Guiana Shield endemic, rheophilic loricariid *Paralithoxus* in sympatry (Lujan et al., 2018). One of these species was dark brown to black with small light spots along the body and corresponds to *Paralithoxus planquettei* (Fig. 8C). The other, however, appears to be a new species and is a vibrant green color (Fig. 8A). This likely new species was caught in fast flowing shallow water in dense stands of an aquatic macrophyte of the family Podostemaceae.

Several Crenuchids were also collected during the expedition. The evolutionary relationships of Crenuchids are poorly understood. The species we refer to as *Characidium* sp. "*Awarape*" appears superficially similar to undescribed crenuchids caught in the Pakaraima mountains of Guyana (HLF pers. obs.). Currently two species of *Melanocharacidium* are reported from Suriname, *M. blennioides* and *M. dispilomma,* both of which occur in the Marowjine River. While we collected specimens resembling these two taxa, a high level of variation was found in these *Melanocharacidium*, including specimens with a mix of characters of the two species. It has

Figure 9: Gymnotiformes of the Upper Tapanahony River. Scale bar represents 20 mm in length**. A.** *Hypopomus artedi,* **B.** *Eigenmannia* sp. *1,* **C.** *Gymnotus coropinae,* **D.** *Hypopygus lepturus*. All photos by by H. López-Fernández.

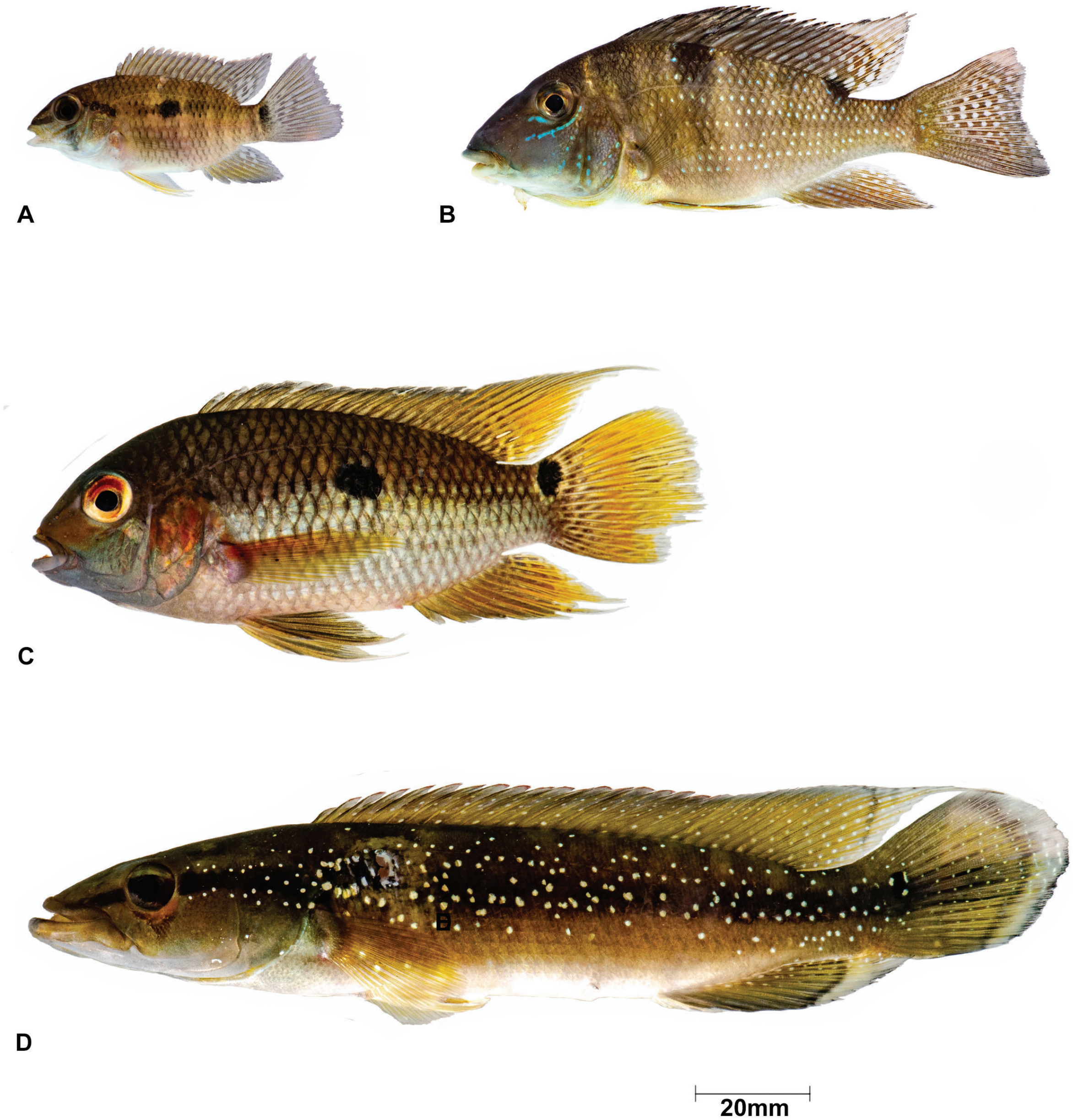

Figure 10: Cichlidae of the Upper Tapanahony River. **A.** *Krobia itanyi,* **B.** *Geophagus harreri,* **C.** *Aequidens tetramerus,* **D.** Male *Crenicichla albopunctata.* All photos by by H. López-Fernández.

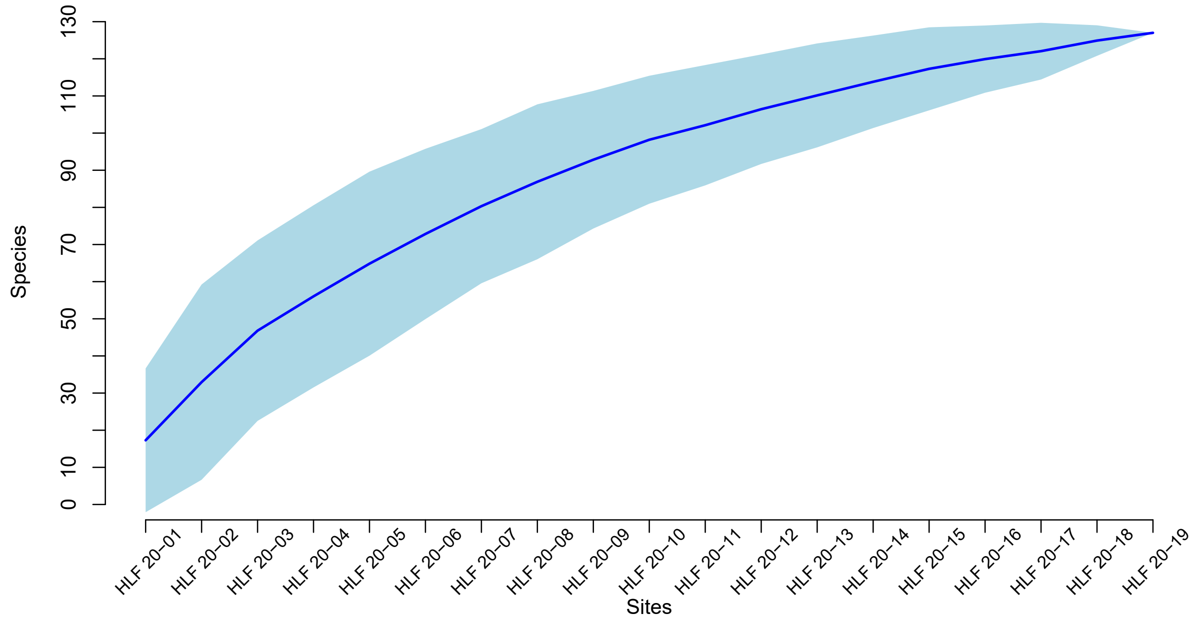

Figure 11: Species accumulation curve across 19 sampling localities. Information about each sampling locality can be found in Table 1. The blue line represents the estimated species accumulation curve while the light blue area represents the 95% confidence interval around the estimate. Species accumulated quickly early on in sampling and began to plateau; however, never fully reached an asymptote, indicating an incomplete sampling of expected diversity.

Table 1: Fish sampling sites. The latitude, longitude, and date the sites were sampled are included.

Field Number	Locality	Latitude	Longitude	Date
HLF 20-01	Perei rapids, Tapanahony River at camp 1	3º0.1726'N	55º51.589'W	2/28/2020
HLF 20-02	Tapanahony River at camp 2	2º53.139'N	55º51.590'W	2/29/2020
HLF 20-03	Mouth of Tuha Eku creek, tributary of upper Tapanahony	2º39.506'N	55º52.726'W	3/1/2020
HLF 20-04	Upper Tapanahony River across from mouth of Tuha Eku creek at camp 3	2º39.506'N	55º52.726'W	3/1/2020
HLF 20-05	Awarape creek, left bank tributary of Tapanahony river	2º48.536'N	55º54.002'W	3/2/2020
HLF 20-06	Tapanahony River at rapids 8	2º58.677'N	55º52.240'W	3/4/2020
HLF 20-07	Tapanahony River at Jawi Sula, rapids 7	2º59.684'N	55º51.809'W	3/4/2020
HLF 20-08	Tapanahony river at sandbanks and backwaters at bottom of Jawi Sula	2º59.684'N	55º51.809'W	3/5/2020
HLF 20-09	Curimau Creek, left bank tributary of Tapanahony River, ~1 km upstream from mouth	3º07.535'N	55º50.150'W	3/6/2020
HLF 20-10	Tapanahony River at Pelelu Tepu village	3º09.570'N	55º43.118'W	3/7/2020
HLF 20-11	Tapanahony River downstream from Pelelu Tepu	3º10.274'N	55º42.183'W	3/8/2020
HLF 20-12	Tapanahony River downstream from HLF20-11	3º12.735'N	55º36.795'W	3/8/2020
HLF 20-13	Blakawatra River around campsite, rocky shallows in front of camp	3º10.033'N	55º35.131'W	3/8/2020
HLF 20-14	Blakawatra River around campsite, small creek downstream of camp	3º10.033'N	55º35.131'W	3/8/2020
HLF 20-15	Blakawatra River around campsite, deeper section on downstream end of camp	3º10.033'N	55º35.131'W	3/8/2020
HLF 20-16	Blakawatra River, shallow sandy channel with overhanging vegetation	3º11.054'N	55º34.919'W	3/9/2020
HLF 20-17	Small creek tributary of Blakawatra river downstream from camp			3/9/2020
HLF 20-18	Tapanahony River, big rapids downstream from Pelelu Tepu	3º12.015'N	55º41.076'W	3/10/2020
HLF 20-19	Swamp approx. 1.5 km from Pelelu Tepu			3/11/2020

been previously suggested that the interior of Suriname may harbor several undescribed species (Mol, 2012). As is the case in other regions of the Guiana Shield (e.g. Armbruster et al., 2021), we expect further work into the taxonomy of Crenuchidae will reveal several unnamed taxa in Suriname.

Overall, the expedition highlights the diversity of fishes in the Tapanahony River. Our expedition recovered what are likely several new species as well as a new species record for Suriname, demonstrating the need for continued exploration of these remote regions to document Neotropical fish diversity. With high levels of endemicity in the Guiana Shield, it is critical to document the diversity of these rivers as many aquatic communities in this region are stressed by anthropogenic activities. Understanding the species diversity and distribution of these fishes is critical to developing effective conservation plans, as species restricted to the headwaters may require different planning than those further downstream. Besides providing a better estimate of the diversity of Neotropical fishes, further exploration of these headwaters may prove fruitful in understanding faunal interchanges between large river systems, such as the Amazon River and the Atlantic-draining rivers of Suriname, illuminating why the Neotropics harbors the greatest freshwater fish diversity on the planet.

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Table 2: List of species collected from sampling 19 sites in the Upper Tapanahony River. Species are organized by taxonomic group. Total Spec. indicates the total number of individuals of each species collected. An "x" represents the presence of a species in the collection of a respective sampling site. All voucher specimens are housed at the University of Michigan Museum of Zoology (UMMZ).

Order	Family	Species	Total Spec.	HLF 20-01	HLF 20-02	HLF 20-03	HLF 20-04	HLF 20-05	HLF 20-06	HLF 20-07	HLF 20-08	HLF 20-09	HLF 20-10	HLF 20-11	HLF 20-12
Characiformes	Acestrorhynchidae	*Acestrorhynchus falcatus*	1												
Characiformes	Acestrorhynchidae	*Acestrorhynchus heterolepis*	4		x										
Characiformes	Acestrorhynchidae	*Acestrorhynchus microlepis*	6					x		x	x				
Characiformes	Anostomidae	*Anostomus brevior*	18				x							x	
Characiformes	Anostomidae	*Anostomus ternetzi*	1												
Characiformes	Anostomidae	*Hypomasticus despaxi*	24	x			x								
Characiformes	Anostomidae	*Leporinus fasciatus*	2							x					
Characiformes	Anostomidae	*Leporinus friderici*	2		x			x							
Characiformes	Anostomidae	*Leporinus gossei*	1												
Characiformes	Anostomidae	*Leporinus granti*	9					x		x	x				
Characiformes	Anostomidae	*Leporinus maculatus*	5	x	x					x					
Characiformes	Anostomidae	*Leporinus nijsseni*	1												
Characiformes	Bryconidae	*Brycon pesu*	7		x			x							
Characiformes	Chalceidae	*Chalceus macrolepidotus*	2		x										
Characiformes	Characidae	*Astyanax bimaculatus*	19		x										
Characiformes	Characidae	*Brachychalcinus orbicularis*	8												
Characiformes	Characidae	*Bryconamericus aff. hyphesson*	55											x	
Characiformes	Characidae	*Bryconamericus guyanensis*	10	x				x		x					
Characiformes	Characidae	*Bryconamericus hyphesson*	2										x		x
Characiformes	Characidae	*Charax aff. pauciradiatus*	16												
Characiformes	Characidae	*Creagrutus melanzonus*	23			x	x	x			x		x		
Characiformes	Characidae	*Cynopotamus* cf. *essequibensis*	2												
Characiformes	Characidae	*Hemigrammus guyanensis*	24			x									
Characiformes	Characidae	*Hemigrammus unilineatus*	2												
Characiformes	Characidae	*Hyphessobrycon borealis*	2											x	
Characiformes	Characidae	*Hyphessobrycon roseus*	20			x							x	x	x
Characiformes	Characidae	*Hyphessobrycon sp. Blackstripe*	10												
Characiformes	Characidae	*Jupiaba keithi*	56			x	x							x	
Characiformes	Characidae	*Jupiaba maroniensis*	27	x	x			x		x	x			x	
Characiformes	Characidae	*Jupiaba meunieri*	39	x	x			x		x	x	x			
Characiformes	Characidae	*Moenkhausia chrysargyrea*	6					x			x				
Characiformes	Characidae	*Moenkhausia collettii*	4			x		x							
Characiformes	Characidae	*Moenkhausia grandisquamis*	4					x							
Characiformes	Characidae	*Moenkhausia hasemani*	37					x			x				
Characiformes	Characidae	*Moenkhausia inrai*	2											x	
Characiformes	Characidae	*Moenkhausia oligolepis*	10			x	x								
Characiformes	Characidae	*Moenkhausia sp.*	1		x										
Characiformes	Characidae	*Phenacogaster* cf. *wayana*	18												
Characiformes	Characidae	*Phenacogaster wayana*	12			x									
Characiformes	Characidae	*Poptella longipinnis*	32												
Characiformes	Characidae	*Roeboexodon guyanensis*	7		x	x		x							
Characiformes	Characidae	*Tetragonopterus chalceus*	16	x		x									
Characiformes	Characidae	*Tetragonopterus rarus*	2					x							
Characiformes	Characidae	*Characidae gen. sp. (juveniles?)*	10												
Characiformes	Chilodontidae	*Caenotropus maculosus*	1												
Characiformes	Chilodontidae	*Chilodus zunevei*	2												
Characiformes	Crenuchidae	*Characidium pellucidum*	59			x		x							
Characiformes	Crenuchidae	*Characidium sp. Awarape*	5					x							
Characiformes	Crenuchidae	*Characidium zebra*	28	x		x		x			x				
Characiformes	Crenuchidae	*Melanocharacidium blennioides*	6										x		
Characiformes	Crenuchidae	*Melanocharacidium dispilomma*	39			x		x							
Characiformes	Crenuchidae	*Microcharacidium eleotrioides*	3			x									x
Characiformes	Curimatidae	*Cyphocharax biocellatus*	3				x				x			x	
Characiformes	Curimatidae	*Cyphocharax helleri*	226		x			x		x	x				
Characiformes	Curimatidae	*Cyphocharax spilurus*	9								x		x	x	
Characiformes	Erythrinidae	*Hoplias aimara*	11		x	x							x	x	x
Characiformes	Gasteropelecidae	*Gasteropelecus sternicla*	13												
Characiformes	Hemiodontidae	*Bivibranchia bimaculata*	74		x			x			x		x		
Characiformes	Hemiodontidae	*Hemiodus huraulti*	1							x					
Characiformes	Iguanodectidae	*Bryconops affinis*	37	x	x						x				
Characiformes	Iguanodectidae	*Bryconops caudomaculatus*	12	x		x						x			
Characiformes	Iguanodectidae	*Bryconops* cf. *caudomaculatus* "half stripe"	91							x	x				
Characiformes	Iguanodectidae	*Bryconops* cf. *caudomaculatus* "thick stripe"	39								x				
Characiformes	Iguanodectidae	*Bryconops melanurus*	18	x	x		x	x							
Characiformes	Iguanodectidae	*Bryconops sp.*	1				x								
Characiformes	Lebiasinidae	*Nannostomus bifasciatus*	55			x		x							
Characiformes	Lebiasinidae	*Pyrrhulina stoli*	3												
Characiformes	Parodontidae	*Parodon guyanensis*	18	x	x					x					
Characiformes	Serrasalmidae	*Acnodon oligacanthus*	19								x				
Characiformes	Serrasalmidae	*Myleus planquetti*	2	x						x					
Characiformes	Serrasalmidae	*Myloplus rubripinnis*	5												
Characiformes	Serrasalmidae	*Paramyloplus cf. ternetzi*	23		x			x							
Characiformes	Serrasalmidae	*Prosomyleus rhomboidalis*	7					x		x	x			x	
Characiformes	Serrasalmidae	*Serrasalmus eigenmanni*	14	x	x					x					
Characiformes	Serrasalmidae	*Serrasalmus rhombeus*	3												
Characiformes	Serrasalmidae	*"Serrasalmus" striolatus*	5		x										
Characiformes	Triportheidae	*Triportheus brachipomus*	1					x							
Gymnotiformes	Gymnotidae	*Electrophorus electricus*	2							x					
Gymnotiformes	Gymnotidae	*Gymnotus coropinae*	4			x									x
Gymnotiformes	Hypopomidae	*Hypopomus artedi*	7			x									
Gymnotiformes	Rhamphichthyidae	*Hypopygus lepturus*	11												x
Gymnotiformes	Sternopygidae	*Eigenmannia sp. 1*	26												
Gymnotiformes	Sternopygidae	*Eigenmannia sp. 2 aff. virescens*	134	x							x				
Gymnotiformes	Sternopygidae	*Japigny kirschbaum*	1	x											
Gymnotiformes	Sternopygidae	*Sternopygus macrurus*	2												
Siluriformes	Callichthyidae	*Corydoras breei*	151			x	x	x			x		x		

Table 2: *Continued*

HLF 20-13	HLF 20-14	HLF 20-15	HLF 20-16	HLF 20-17	HLF 20-18	HLF 20-19	Vouchers
						X	UMMZ 252769
X							UMMZ 252406, UMMZ 252629
							UMMZ 252485, UMMZ 252523, UMMZ 252547
			X				UMMZ 252470, UMMZ 252603, UMMZ 252694
			X				UMMZ 252695
X		X	X		X		UMMZ 252393, UMMZ 252477, UMMZ 252642, UMMZ 252680, UMMZ 252715, UMMZ 252763
X							UMMZ 252536, UMMZ 252646
							UMMZ 252426, UMMZ 252503
						X	UMMZ 252784
			X				UMMZ 252504, UMMZ 252537, UMMZ 252569, UMMZ 252723
							UMMZ 252398, UMMZ 252427, UMMZ 252538
			X				UMMZ 252724
							UMMZ 252409, UMMZ 252487
							UMMZ 252412
						X	UMMZ 252407, UMMZ 252771
			X				UMMZ 252697
							UMMZ 252604
							UMMZ 252383, UMMZ 252488, UMMZ 252524
							UMMZ 252582, UMMZ 252620
			X				UMMZ 252699
							UMMZ 252445, UMMZ 252473, UMMZ 252494, UMMZ 252556, UMMZ 252584
X							UMMZ 252635
		X		X		X	UMMZ 252449, UMMZ 252676, UMMZ 252748, UMMZ 252776
						X	UMMZ 252777
							UMMZ 252611
						X	UMMZ 252455, UMMZ 252592, UMMZ 252612, UMMZ 252624, UMMZ 252780
			X			X	UMMZ 252714, UMMZ 252781
		X	X			X	UMMZ 252457, UMMZ 252479, UMMZ 252616, UMMZ 252681, UMMZ 252719, UMMZ 252782
X			X				UMMZ 252396, UMMZ 252424, UMMZ 252501, UMMZ 252534, UMMZ 252566, UMMZ 252613, UMMZ 252644, UMMZ 252720, UMMZ 252721
X			X				UMMZ 252397, UMMZ 252425, UMMZ 252502, UMMZ 252535, UMMZ 252567, UMMZ 252579, UMMZ 252645, UMMZ 252722
				X			UMMZ 252506, UMMZ 252571, UMMZ 252750
		X	X	X		X	UMMZ 252463, UMMZ 252507, UMMZ 252683, UMMZ 252727, UMMZ 252751, UMMZ 252785
							UMMZ 252508
X		X					UMMZ 252509, UMMZ 252572, UMMZ 252649, UMMZ 252684
							UMMZ 252615
		X		X		X	UMMZ 252464, UMMZ 252481, UMMZ 252685, UMMZ 252752, UMMZ 252786
							UMMZ 252428
		X					UMMZ 252688
			X				UMMZ 252467, UMMZ 252733
			X			X	UMMZ 252735, UMMZ 252787
			X				UMMZ 252437, UMMZ 252468, UMMZ 252515, UMMZ 252738
			X				UMMZ 252405, UMMZ 252469, UMMZ 252743
			X				UMMZ 252516, UMMZ 252744
						X	UMMZ 252789, UMMZ 252790
					X		UMMZ 252755
			X				UMMZ 252700
		X					UMMZ 252442, UMMZ 252491, UMMZ 252671
							UMMZ 252490
X					X		UMMZ 252387, UMMZ 252443, UMMZ 252492, UMMZ 252554, UMMZ 252631, UMMZ 252756
X					X		UMMZ 252594, UMMZ 252647, UMMZ 252764
X			X				UMMZ 252460, UMMZ 252505, UMMZ 252648, UMMZ 252725
							UMMZ 252461, UMMZ 252626
							UMMZ 252475, UMMZ 252558, UMMZ 252606
		X	X			X	UMMZ 252413, UMMZ 252496, UMMZ 252526, UMMZ 252559, UMMZ 252673, UMMZ 252704, UMMZ 252773
X				X			UMMZ 252560, UMMZ 252587, UMMZ 252607, UMMZ 252636, UMMZ 252746
		X			X		UMMZ 252418, UMMZ 252419, UMMZ 252420, UMMZ 252421, UMMZ 252422, UMMZ 252450, UMMZ 252591, UMMZ 252610, UMMZ 252623, UMMZ 252678,
			X			X	UMMZ 252710, UMMZ 252775
							UMMZ 252408, UMMZ 252486, UMMZ 252549, UMMZ 252581
							UMMZ 252532
							UMMZ 252384, UMMZ 252410, UMMZ 252551
		X					UMMZ 252385, UMMZ 252440, UMMZ 252576, UMMZ 252669
							UMMZ 252539, UMMZ 252552
							UMMZ 252553
			X			X	UMMZ 252386, UMMZ 252411, UMMZ 252489, UMMZ 252698, UMMZ 252772
							UMMZ 252471
		X	X	X			UMMZ 252465, UMMZ 252510, UMMZ 252686, UMMZ 252729, UMMZ 252753
						X	UMMZ 252788
X							UMMZ 252402, UMMZ 252430, UMMZ 252542, UMMZ 252652
					X		UMMZ 252548, UMMZ 252754
							UMMZ 252399, UMMZ 252540
			X				UMMZ 252728
		X					UMMZ 252439, UMMZ 252519, UMMZ 252667, UMMZ 252668
	X				X		UMMZ 252514, UMMZ 252543, UMMZ 252575, UMMZ 252618, UMMZ 252665, UMMZ 252767
			X				UMMZ 252404, UMMZ 252438, UMMZ 252545, UMMZ 252546, UMMZ 252739
		X					UMMZ 252692
			X				UMMZ 252432, UMMZ 252740
							UMMZ 252518
			X				UMMZ 252527, UMMZ 252707
							UMMZ 252448, UMMZ 252622
			X				UMMZ 252452, UMMZ 252716
			X				UMMZ 252625, UMMZ 252717
			X				UMMZ 252705
			X				UMMZ 252389, UMMZ 252561, UMMZ 252706
							UMMZ 252395
X			X				UMMZ 252658, UMMZ 252742
		X	X				UMMZ 252444, UMMZ 252472, UMMZ 252493, UMMZ 252555, UMMZ 252583, UMMZ 252672, UMMZ 252701

Table 2: *Continued*

Order	Family	Species	Total Spec.	HLF 20-01	HLF 20-02	HLF 20-03	HLF 20-04	HLF 20-05	HLF 20-06	HLF 20-07	HLF 20-08	HLF 20-09	HLF 20-10	HLF 20-11	HLF 20-12
Siluriformes	Loricariidae	*Ancistrus* cf. *temmincki*	1												
Siluriformes	Loricariidae	*Ancistrus temmincki*	3										X		
Siluriformes	Loricariidae	*Cteniloricaria platystoma*	7	X			X								
Siluriformes	Loricariidae	*Farlowella reticulata*	14												
Siluriformes	Loricariidae	*Farlowella rugosa*	11												
Siluriformes	Loricariidae	*Gen. nov. aff. Parotocinclus sp.*	181												
Siluriformes	Loricariidae	*Guyanancistrus brevispinis brevispinis*	22	X	X					X			X		
Siluriformes	Loricariidae	*Harttia guianensis*	61	X	X			X		X	X				
Siluriformes	Loricariidae	*Hemiancistrus medians*	3						X						
Siluriformes	Loricariidae	*Hypostomus gymnorhynchus*	12		X					X		X			
Siluriformes	Loricariidae	*Hypostomus sp.*	7	X		X		X							
Siluriformes	Loricariidae	*Metaloricaria paucidens*	7								X				
Siluriformes	Loricariidae	*Paralithoxus* cf. *planquettei*	2										X		
Siluriformes	Loricariidae	*Paralithoxus planquetti*	3	X											
Siluriformes	Loricariidae	*Paralithoxus sp. Green*	34	X	X					X					
Siluriformes	Loricariidae	*Parotocinclus britskii*	1				X								
Siluriformes	Loricariidae	*Pseudacanthicus serratus*	2												
Siluriformes	Loricariidae	*Pseudancistrus barbatus*	40		X				X	X					
Siluriformes	Loricariidae	*Rineloricaria cf. stewarti*	2				X								
Siluriformes	Loricariidae	*Rineloricaria sp.*	1											X	
Siluriformes	Trichomycteridae	*Ituglanis amazonicus*	4			X	X								
Siluriformes	Trichomycteridae	*Ochmacanthus reinhardtii*	5			X		X							
Siluriformes	Aspredinidae	*Bunocephalus aloikae*	7			X									
Siluriformes	Doradidae	*Platydoras sp.* Shallow scute	2												X
Siluriformes	Heptapteridae	*Chasmocranus brevior*	1												
Siluriformes	Heptapteridae	*Heptapterus tapanahoniensis*	1												
Siluriformes	Heptapteridae	*Imparfinis pijpersi*	2								X				
Siluriformes	Heptapteridae	*Pimelodella cristata*	60				X				X			X	
Siluriformes	Heptapteridae	*Pimelodella geryi*	3	X	X			X							
Siluriformes	Heptapteridae	*Rhamdia foina*	1												
Siluriformes	Pimelodidae	*Pimelabditus moli*	10								X				
Siluriformes	Pseudopimelodidae	*Batrochoglanis raninus*	1												
Siluriformes	Pseudopimelodidae	*Microglanis poecilus*	3			X									X
Siluriformes	Pseudopimelodidae	*Microglanis sp.*	5				X								
Siluriformes	Pseudopimelodidae	*Pseudopimelodus bufonius*	1		X										
Cichliformes	Cichlidae	*Aequidens tetramerus*	8												
Cichliformes	Cichlidae	*Crenicichla albopunctata*	10			X		X			X		X	X	
Cichliformes	Cichlidae	*Crenicichla multispinosa*	30						X	X			X		
Cichliformes	Cichlidae	*Geophagus harreri*	13		X					X	X	X	X	X	
Cichliformes	Cichlidae	*Guianacara owroewefi*	234	X	X	X	X	X		X	X		X	X	X
Cichliformes	Cichlidae	*Krobia itanyi*	35			X					X		X	X	

Table 2: *Continued*

HLF 20-13	HLF 20-14	HLF 20-15	HLF 20-16	HLF 20-17	HLF 20-18	HLF 20-19	Vouchers
			X				UMMZ 252693
							UMMZ 252580
X							UMMZ 252388, UMMZ 252474, UMMZ 252634
		X	X				UMMZ 252674, UMMZ 252708
			X				UMMZ 252709
			X		X		UMMZ 252711, UMMZ 252758
X					X		UMMZ 252391, UMMZ 252416, UMMZ 252530, UMMZ 252590, UMMZ 252638, UMMZ 252760
X					X		UMMZ 252392, UMMZ 252417, UMMZ 252498, UMMZ 252531, UMMZ 252564, UMMZ 252639, UMMZ 252640, UMMZ 252761
							UMMZ 252521
	X		X				UMMZ 252423, UMMZ 252533, UMMZ 252578, UMMZ 252664, UMMZ 252718
X							UMMZ 252394, UMMZ 252453, UMMZ 252454, UMMZ 252500, UMMZ 252643
					X		UMMZ 252570, UMMZ 252765
							UMMZ 252595
							UMMZ 252400
							UMMZ 252401, UMMZ 252429, UMMZ 252541
							UMMZ 252482
X							UMMZ 252657
X	X				X		UMMZ 252433, UMMZ 252434, UMMZ 252435, UMMZ 252522, UMMZ 252544, UMMZ 252655, UMMZ 252656, UMMZ 252666, UMMZ 252768
			X				UMMZ 252484, UMMZ 252737
							UMMZ 252619
							UMMZ 252456, UMMZ 252478
			X				UMMZ 252466, UMMZ 252511, UMMZ 252730
		X					UMMZ 252441, UMMZ 252670
		X					UMMZ 252628, UMMZ 252691
X							UMMZ 252632
X							UMMZ 252641
							UMMZ 252565
			X				UMMZ 252483, UMMZ 252574, UMMZ 252617, UMMZ 252734
							UMMZ 252403, UMMZ 252431, UMMZ 252513
			X				UMMZ 252736
		X					UMMZ 252573, UMMZ 252690
			X				UMMZ 252696
							UMMZ 252462, UMMZ 252627
							UMMZ 252480
							UMMZ 252436
X	X			X		X	UMMZ 252630, UMMZ 252659, UMMZ 252745, UMMZ 252770
	X		X				UMMZ 252446, UMMZ 252495, UMMZ 252557, UMMZ 252585, UMMZ 252605, UMMZ 252660, UMMZ 252702
X	X		X		X		UMMZ 252520, UMMZ 252525, UMMZ 252586, UMMZ 252633, UMMZ 252661, UMMZ 252703, UMMZ 252757
X	X						UMMZ 252414, UMMZ 252528, UMMZ 252562, UMMZ 252577, UMMZ 252588, UMMZ 252608, UMMZ 252637, UMMZ 252663
		X	X	X	X		UMMZ 252390, UMMZ 252415, UMMZ 252447, UMMZ 252476, UMMZ 252497, UMMZ 252529, UMMZ 252563, UMMZ 252589, UMMZ 252609, UMMZ 252621,
		X		X		X	UMMZ 252458, UMMZ 252568, UMMZ 252593, UMMZ 252614, UMMZ 252682, UMMZ 252749, UMMZ 252783