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Fishes of the Mitaraka Mountains (French Guiana)

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ABSTRACT
The "Our planet reviewed" expedition allowed to investigate the fish fauna from the Mitaraka Mountain Range (French Guiana). We sampled fishes at 14 sites using complementary sampling methods including rotenone, underwater observation, seine, cast nets, traps and hooks. We present the first detailed fish inventories from this region. Thirty eight species belonging to 16 families were observed, and at least one unknown species belonging to the genus *Jupiaba* Zanata, 1997 was collected. At two torrential sites we recorded an unusual fish assemblage made of a single Trichomycteridae species, *Ituglanis nebulosus* de Pinna & Keith, 2003. A few rare species were also recorded such as *Pimelodella procera* Mees, 1983 hereby extending its known distribution 100 km Southward. *Anablepsoides gaucheri* (Keith, Nandrin & Le Bail, 2006) was collected for the first time since its description in 2006. This species was collected in a stream located 15 km eastern from its type location, revealing its distribution might span over the entire Mitaraka range. Overall, the species turnover between sites was high even between sites with similar environmental conditions, suggesting that dispersal limitation is playing a significant role in fish assemblage composition. This indicates that complementary inventories in nearby areas may still provide new species and original information on the fish fauna inhabiting small streams of Southern French Guiana.

KEY WORDS
Community,
Guiana shield,
species list,
species distribution,
species assemblages,
mountain streams,
environmental characteristics.

RÉSUMÉ
Les poissons des monts Mitaraka (Guyane).
L'expédition « Notre planète revisitée » a permis d'inventorier les poissons des cours d'eau des monts Mitaraka (Guyane). Quatorze sites ont été prospectés en utilisant des méthodes d'échantillonnage complémentaires dont la pêche à la roténone, des observations subaquatiques, des sennes de plage, des éperviers, des nasses et de la pêche à la ligne. Nous présentons ici le premier inventaire détaillé des poissons de cette région. Trente-huit espèces, appartenant à 16 familles ont été observées, parmi lesquelles au moins une espèce inconnue du genre *Jupiaba* Zanata, 1997. Dans deux sites torrentiels, nous avons relevé un assemblage original de poissons, composé d'une seule espèce de Trichomyceteridae, *Ituglanis nebulosus* de Pinna & Keith, 2003. Quelques espèces rares ont également été rencontrées, parmi lesquelles *Pimelodella procera* Mees, 1983, dont la présence dans les cours d'eau du Mitaraka étend la distribution géographique de l'espèce de plus de 100 km vers le sud. Nous avons également collecté *Anablepsoides gaucheri* (Keith, Nandrin & Le Bail, 2006) pour la première fois depuis sa description en 2006. Cette espèce a été collectée 15 km à l'est de sa localité type, révélant qu'elle pourrait être présente sur l'ensemble du massif du Mitaraka. La prise en compte des assemblages locaux révèle un fort renouvellement d'espèces entre les sites, y compris entre sites présentant des conditions environnementales similaires, ce qui suggère un effet marqué de la limite à la dispersion dans la mise en place de ces assemblages. Ces résultats laissent penser que des inventaires complémentaires sont susceptibles d'apporter de nouvelles espèces ainsi que des informations complémentaires sur la distribution des espèces et la composition des assemblages de poissons des cours d'eau du sud de la Guyane.

MOTS CLÉS
Communautés,
plateau des Guyanes,
liste d'espèces,
distribution d'espèces,
assemblages d'espèces,
ruisseaux de montagne,
caractéristiques environnementales.

INTRODUCTION

Our knowledge of the freshwater fish fauna of French Guiana has benefitted from intensive fish inventories for more than 50 years. The seminal works (e.g. Puyo 1949; Planquette *et al.* 1996; Boujard *et al.* 1997; Keith *et al.* 2000; Le Bail *et al.* 2000), were recently updated (e.g. Le Bail *et al.* 2012; Melki 2016; Covain *et al.* 2012; Fisch-Muller *et al.* 2018) and the fish fauna of French Guiana is among the best known in the Guiana Shield. Such taxonomic knowledge, together with intensive field sampling occasions, led to the development of ecological approaches on the structure of fish communities (Cilleros *et al.* 2016, 2017) and their responses to anthropogenic stressors (Brosse *et al.* 2011; Allard *et al.* 2016). However, gaps in our knowledge remain since access to the southern half of the territory remain particularly difficult due to the absence of roads or tracks. This is an area of *c.* 30 000 km² of hilly and mountainous terrain covered by almost undisturbed tropical rainforest. Access to this zone is only possible by boat, and the fish fauna from most of the small streams of southern French Guiana, particularly those located far from navigable waterways, remains largely unknown. To remedy this deficiency, several research projects were initiated during the last decade to inventory the fish fauna of streams throughout French Guiana, leading to set an upstream-downstream fish typology for small streams (Cilleros *et al.* 2017). This typology identifies five successive types of stream fish assemblages from the source to the confluence with a larger river (i.e. more than ten meters wide and one metre deep). In this typology, the upstream zone account for the mountainous streams hosting only a few specialised fish species. Studies focussing on this particular zone revealed a strong fish micro-endemism (Covain *et al.* 2012; Brosse *et al.* 2013), but were limited to a few mountains due to access limitations. In this context, acquiring data from the Mitaraka Moutains, located in the southernmost region of French Guiana has a particular interest since: 1) this remote area of steep sloped granitic hills (also called inselbergs) has never been sampled for entire fish communities; and 2) studies on fish assemblages from Guiana Shield mountains remain particularly scarce, and the works of Mol *et al.* (2007) and Fisch-Muller *et al.* (2018) on Lely Nassau and Brownsberg Mountains (Suriname) and Brosse *et al.* (2013) on Itoupé mountain (French Guiana) remain, to our knowledge the only fish inventories on such kind of environment. Here we report on the fish assemblages from 14 environmentally contrasted sites in the Mitaraka Mountains and analyse faunistic differences between sites in relation to the environmental characteristics of the streams.

MATERIAL AND METHODS

The Mitaraka Mountains is a series of low altitude hills (not exceeding 600 meters a.s.l.), which constitute a part of the Tumuc-Humac mountain range (Hurault 1973). They constitute the Southeastern boundary between French Guiana and Brazil, and therefore the watershed divide between the Amazon Drainage in Brazil and the Maroni Drainage in French Guiana. These mountains are covered by dense rainforest, with the exception of their summit, where the granitic substratum is apparent, resulting in rocky islands emerging from the rainforest, also called inselbergs (Fig. 1). The southern slope of the Mitaraka Mountains is drained by several small streams flowing to the Alama River, a tributary of the Maroni. Due to the remoteness of the area, access to the base-camp (located close to site S11, Fig. 1) was only possible by helicopter, and

TABLE 1. — Latitude, longitude (UMT format) and environmental characteristics of the 14 sites: **Alt**, altitude a.s.l. in meters; **Temp**, water temperature in °C; **Cond**, conductivity in µS.cm-1; **Turbidity** in NTU, Velocity in m.s-1; **% coarse**, percentage of bottom covered by coarse grained particles (diameter > 10cm); **Width**, stream width in cm; **Depth**, stream depth in cm.

Site	Latitude	Longitude	Alt	Temp	pH	Cond	Turbidity	Velocity	% coarse	Width	Depth
S1	N 00248660	E 00112759	391	23.1	5.73	17.0	2.0	0.10	20	650	17.5
S2	N 00248486	E 00116892	316	23.2	5.22	12.9	1.7	0.13	0	210	17.4
S3	N 00248668	E 00116354	320	23.6	4.92	11.7	1.8	0.13	0	250	15.5
S4	N 00247718	E 00116350	382	23.2	4.85	13.9	8.5	0.17	0	110	8.6
S5	N 00247444	E 00116343	371	23.5	5.40	17.3	3.0	0.18	0	105	10.4
S6	N 00247137	E 00114845	410	23.2	4.93	8.4	1.0	0.42	75	150	23.1
S7	N 00247102	E 00115118	373	23.2	4.93	8.4	1.1	0.30	50	215	17.2
S8	N 00247694	E 00115928	318	23.4	4.83	13.9	2.4	0.22	0	195	55.5
S9	N 00249201	E 00113402	320	23.5	5.30	15.6	2.0	0.20	0	325	29.2
S10	N 00248642	E 00114724	326	23.7	4.63	13.2	2.0	0.20	0	145	30.0
S11	N 00247400	E 00116200	275	23.8	4.66	14.2	4.9	0.20	10	1000	113.3
S12	N 00248239	E 00116090	284	23.8	4.66	14.2	4.9	0.04	90	200	9.7
S13	N 00247687	E 00117863	317	23.8	4.52	10.8	7.0	0.06	0	110	7.2
S14	N 00247030	E 00115814	309	23.6	4.80	12.2	2.2	0.15	0	125	9.1

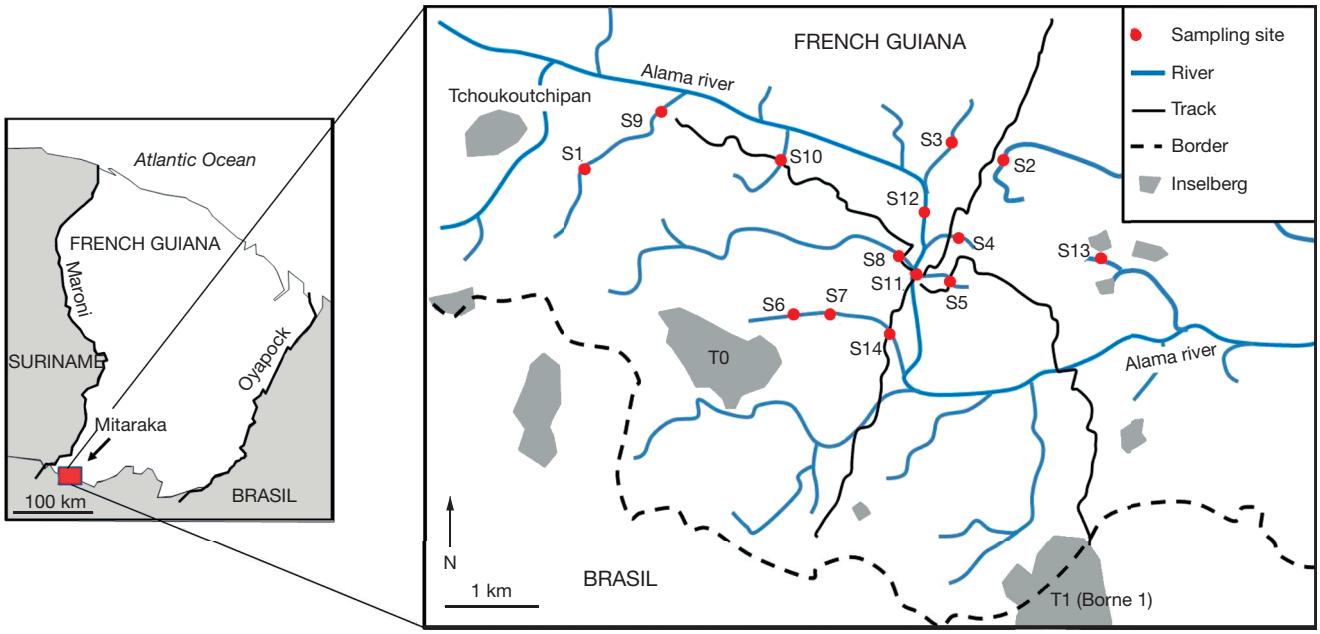

FIG. 1. — Location of the study site: **A**, general map of French Guiana showing the location of Mitaraka Mountains; **B**, detailed map of the study area showing the localities of the 14 sampling sites on the Alama River and its tributaries.

all the equipment was hand carried from the base-camp to the sampling sites, a reason why we were unable to sample more sites or cover a longer distance to find distant sampling sites. The fish samples were collected in March 2015. We sampled 14 sites (Fig. 1) belonging to the Alama main stream (site S11) and its tributaries (the remaining 13 sites). All the sites were GPS referenced and altitude was measured using a Garmin GPSMAP62. We measured the site physical characteristics by measuring the stream width, water depth and current velocity along three transects. Current velocity was estimated by measuring the time necessary for a floating object to cover a distance of one meter. The roughness of the stream granulometry was visually estimated as the percentage of large-sized pebbles and boulders (above 10 cm diameter). We also measured pH and water temperature with a WTW pH 3110 fitted with a WTW pH-Electrode SenTix 41. Turbidity was measured with an Eutech Instruments Tubidimeter TN-100, and water conductivity was measured with a WTW 3110 conductometer fitted with a tetraCon 325 sensor.

Fishes were collected using various sampling techniques in relation to the stream/site environmental characteristics, to maximize the probability to collect the entire fauna. At all stream sites with the exception of the Alama main stream (site S11) fishes were sampled using rotenone. At each site, a river section was isolated using two fine mesh (4 mm) stop nets. The length of each section was proportional to stream width and was on average 16.35 ± 5.85 m (mean ± SD). Fishes were collected after releasing a small quantity of rotenone (PREDATOX®: a 6.6% emulsifiable solution of rotenone extracted from *Derris elliptica* (Wallich) Benth. by Saphyr, Antibes, France) a

TABLE 2. — Species occurrence in each site and family membership of each species. The sites (**S**) are grouped in four types according to their physical characteristics and their fish fauna (see text for detail).

			Type of stream														
			1					2					3		4		
Family	**Species**	**Code**	**S4**	**S5**	**S12**	**S13**	**S14**	**S3**	**S8**	**S9**	**S10**	**S11**	**S1**	**S2**	**S6**	**S7**	
Anostomidae	*Leporinus gossei*	LGOS	–	–	–	–	–	–	–	–	–	×	–	–	–	–	
Anostomidae	*Leporinus granti*	LGRA	–	–	–	–	–	–	×	×	×	×	–	–	–	–	
Callichthyidae	*Callichthys callichthys*	CCAL	×	–	–	–	–	–	–	–	–	–	–	–	–	–	
Cetopsidae	*Cetopsidium orientale*	CORI	–	–	×	–	–	–	–	×	–	–	–	–	–	–	
Cetopsidae	*Helogenes marmoratus*	HMAR	–	–	–	–	–	–	–	–	×	–	–	–	–	–	
Characidae	*Astyanax validus*	AVAL	–	×	–	–	×	–	–	–	×	×	–	–	–	–	
Characidae	*Bryconamericus guyanensis*	BGUY	–	–	–	–	–	–	×	×	–	×	–	–	–	–	
Characidae	*Hemibrycon surinamensis*	HESU	–	–	×	–	×	×	×	×	×	×	–	–	–	–	
Characidae	*Jupiaba* sp.	JSP	–	–	–	–	–	–	–	–	–	–	–	×	–	–	
Characidae	*Moenkhausia moisae*	MMOI	–	–	–	–	–	–	×	×	–	×	–	–	–	–	
Cichlidae	*Aequidens tetramerus*	ATET	–	–	×	–	–	–	–	–	–	×	–	–	–	–	
Cichlidae	*Crenicichla albopunctata*	CALB	–	–	–	–	–	–	×	–	–	×	–	–	–	–	
Crenuchidae	*Characidium zebra*	CZEB	–	–	–	–	–	×	×	×	–	×	–	–	–	–	
Crenuchidae	*Characidium* sp.	CSP	–	–	–	–	–	–	×	×	–	–	–	–	–	–	
Crenuchidae	*Melanocharacidium dispilomma*	MDIS	–	–	×	–	–	–	–	–	–	–	–	–	–	–	
Erythrinidae	*Erythrinus erythrinus*	EERY	–	×	–	–	×	–	–	×	×	×	–	×	–	–	
Erythrinidae	*Hoplias malabaricus*	HMAL	×	–	×	–	×	–	–	–	–	×	–	–	–	–	
Gymnotidae	*Gymnotus carapo*	GCAR	×	×	×	×	×	–	–	×	×	×	–	–	–	–	
Gymnotidae	*Gymnotus coropinae*	GCOR	–	–	–	–	–	–	–	–	–	–	–	×	–	–	
Heptapteridae	*Chasmocranus brevior*	CBRE	–	–	–	–	–	–	×	×	–	–	–	–	–	–	
Heptapteridae	*Chasmocranus longior*	CLON	–	–	×	–	–	–	–	×	–	–	–	–	–	–	
Heptapteridae	*Heptapterus bleekeri*	CBLE	×	–	–	×	×	–	–	×	–	–	–	×	–	–	
Heptapteridae	*Pimelodella geryi*	PGER	–	–	–	–	–	–	–	–	×	×	–	–	–	–	
Heptapteridae	*Pimelodella procera*	PPRO	×	×	×	–	×	–	–	–	–	×	–	–	–	–	
Heptapteridae	*Rhamdia quelen*	RQUE	×	–	×	–	–	–	–	–	×	–	–	–	–	–	
Lebiasinidae	*Copella arnoldi*	CCAR	–	–	×	–	×	×	–	×	×	–	–	–	–	–	
Lebiasinidae	*Copella* aff. *arnoldi*	CARN	–	–	×	–	–	–	–	–	–	–	–	–	–	–	
Loricaridae	*Cteniloricaria platystoma*	CPLA	–	–	–	–	–	–	–	–	–	×	–	–	–	–	
Loricaridae	*Harttia guianensis*	HGUI	–	–	–	–	–	–	–	–	–	×	–	–	–	–	
Loricaridae	*Ancistrus temminckii*	ATEM	–	–	–	–	–	–	–	–	–	×	–	–	–	–	
Loricaridae	*Guyanancistrus megastictus*	GMEG	–	–	×	–	–	×	–	–	–	×	×	–	–	–	
Parodontidae	*Parodon guyanensis*	PGUY	–	–	–	–	–	–	×	–	–	×	–	–	–	–	
Pseudopimelodidae	*Batrachoglanis raninus*	BRAN	–	–	–	–	–	–	–	–	–	–	–	×	–	–	
Rivulidae	*Anablepsoides gaucheri*	AGAU	–	–	–	–	–	–	–	–	–	–	×	×	–	–	
Rivulidae	*Laimosemion geayi*	LGEA	×	–	–	–	×	–	–	–	–	×	–	×	–	–	
Sternopygidae	*Eigenmannia virescens*	EVIR	–	–	–	–	–	–	–	×	–	×	–	–	–	–	
Sternopygidae	*Sternopygus macrurus*	SMAC	–	–	–	–	–	–	×	×	×	×	–	–	–	–	
Trichomycteridae	*Ituglanis nebulosus*	INEB	–	–	–	–	–	–	–	–	–	–	–	–	×	×	

few meters upstream of the first net. Fishes were then collected with fine meshed dip nets (2-mm mesh). At the end of each sampling session we searched for fishes lying on the bottom or hidden in the leaves and debris. This sampling method has been described in detail by Mérigoux & Ponton (1999), and has been proved efficient to collect quantitative samples of fish assemblages in small Neotropical streams (Mérigoux & Ponton 1999). Nevertheless, as the section sampled by rotenone might not be representative of the overall stream habitat variability, rotenone samples were complemented by dip netting at all sites and by visual underwater observations at the sites S6, S8 and S12. In the latter sites we snorkelled different habitats to search for additional species. Finally, in site S11, the river was too large (> 10 m wide) and too deep (> 1 m deep) to use rotenone and we therefore ran day and night snorkelling observations and complemented these samples using dip and seine netting, baited and unbaited traps, and angling. The entire sampling protocol was approved by the Direction of Environment of the French ministry of Environment (DEAL) and the French Guiana National Park (Parc amazonien de Guyane). All the specimens collected benefited from the Access and benefit sharing agreement of the "Our Planet Reviewed" program (APA 973-1) (Touroult *et al.* 2018).

We collected 328 fish specimens that were identified in the field with Planquette *et al.* (1996), Keith *et al.* (2000) and Le Bail *et al.* (2000). Taxonomy was then updated according to Le Bail *et al.* (2012) and Melki (2016). For specimens of particular taxonomic interest, tissue samples were taken and stored in 96% ethanol for molecular analyses and the specimen was then fixed in 5% formaldehyde solution for taxonomic confirmation.

Fish data were compiled for each sampling site, and fish abundance was converted to occurrences in order to combine quantitative (rotenone) and qualitative (snorkelling, nets, traps) data and get species lists from the 14 sites. To ordinate sites according to their fish fauna, we ran a Principal Component Analysis (PCA) on fish species lists. Presence-absence data was here preferred to abundance data because sampling methods differ between sites. The sites S6 and S7 were excluded from the PCA because their fauna was made of a single species that was not encountered in any of the 12 other sites.

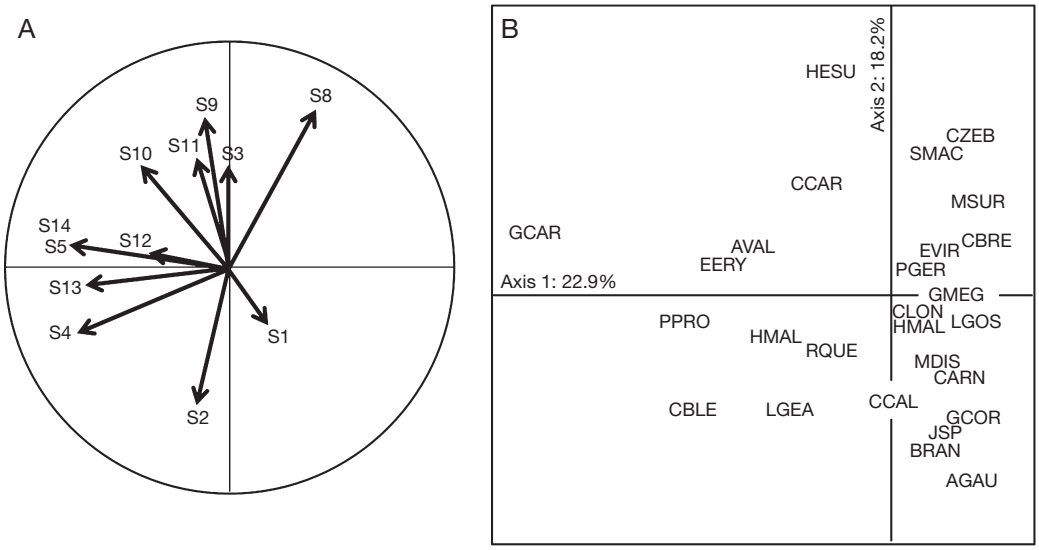

Fig. 2. — Principal Component Analysis (PCA) showing species assemblages according to the sites: **A**, Correlation circle; **B**, species shown on the two first axes plane. Inertia is indicated on each axis. Species codes are as in Table 2. 28 out of the 37 species were indicated on the figure. The remaining species (ATEM, ATET, BGUY, CALB, CSP, CORI, CTMA, HGUI, HMAR, LGRA) although considered in the PCA analysis were hidden by the group of species made of GMEG, LGOS, CLON, HMAL. Species codes are as in the species list.

Material deposit

Hydreco	Laboratoire Environnement de Petit Saut, Kourou;
MNHN	Muséum national d'Histoire naturelle, Paris.

RESULTS

The altitudinal range of the 14 sites varies from 275 to 410 m a.s.l. The sites are characterized by a low conductivity that never exceeded 17.3 µS.cm-1 and a turbidity lower than 8.5 NTU. Temperature and pH were also homogenous among sites and ranged from 23.1 to 23.8°C and between 4.52 and 5.73, respectively. Sites nevertheless differed in their size and slope (Table 1). Two sites were torrential streams with current velocities higher than 0.30 m.s-1 and coarse bottom substratum made of large boulders (site S6) or pebbles (site S7). All the other sites were characterised by a low current velocity (<0.25 m.s-1) and with the exception of site S12, a bottom substratum dominated by fine particles (sand, silt). Site S12 is a side arm of the Alama River, flowing on a granitic substratum, explaining its coarse substratum size despite its limited slope and current velocity. Finally, two groups of low current velocity sites can be distinguished according to their width and depths. Sites S4, S5, S12, S13 and S14 were small (width = 1.30 ± 0.40 m) and shallow (depth = 9.00 ± 1.22 cm); whereas sites S1, S2, S3, S8, S9 and S10 were larger (2.96 ± 1.84 m) and deeper (27.51 ± 15.10 cm). Finally, S11 is the Alama mainstream and it is therefore markedly larger and deeper than the other sites (Table 1).

Considering fish fauna, we collected 38 species in 16 families. Four families were represented by more than two species, namely Characidae (six species), Heptapteridae (six species), Loricariidae (four species) and Crenuchidae (three species). Among the 38 species, two are only known from the Mitaraka Mountains (*Anablepsoides gaucheri* Keith, Nandrin & Le Bail, 2006 and *Guyanancistrus megastictus* Fisch-Muller, Mol & Covain, 2018), two (*Characidium* sp. and *Copella* aff. *arnoldi*) are still unnamed but known species (Le Bail *et al.* 2012) and another one (*Jupiaba* sp.) is a new record for French Guiana. We were not able to identify this last species and it might be new to science. The fish assemblages are characterised by a low species richness ranging from one to 23 species according to the sites, and a marked species turnover between sites. Indeed, only two out of the 38 species occurred in more than half of the sites (*Gymnotus carapo* Linnaeus, 1758 and *Hemibrycon surinamensis* Gery, 1962), and 12 species occurred in a single site. Moreover, two sites (S6 and S7) were characterised by the presence of a single species (*Ituglanis nebulosus* de Pinna & Keith, 2003), that only occurs in those sites.

Ordinating 12 out of the 14 sites by PCA revealed three main types of sites according to their fish fauna (Fig. 2; Table 1). Sites S4, S5, S12, S13 and S14 (type 1), are small and shallow streams characterised by the presence of Gymnotidae (*G. carapo*), Erythrinidae (*Erythrinus erythrinus* Bloch & Schneider, 1801, *Hoplias malabaricus* Bloch, 1794) and Heptapteridae (*Pimelodella procera* Mees, 1983). Sites S9, S10, S11 and to a lower extent S3 and S8 (type 2) account for the Alama main stream and large (or deep, for site S3) tributaries of the Alama river (Table 1). Type 2 fish fauna was characterised by Characidae (*H. surinamensis*, *Moenkhausia moisae* Gery, Planquette & Le Bail, 1995), Crenuchidae (*Characidium zebra* Eigenmann, 1909) and Sternopygidae (*Sternopygus macrurus* (Bloch & Schneider, 1801)) (Fig. 2). Site S1 was characterised

by the presence of *A. gaucheri*, and Site S2 by *Jupiaba* sp. together with *A. gaucheri* and a few other accompanying species (type 3). Those two sites are located far from the confluence with the Alama river (Fig. 1). Finally, sites S6 and S7 (not included in the PCA) were torrential streams characterised by the presence of a single species, *Ituglanis nebulosus* de Pinna & Keith, 2003. Those two sites constitute another type of sites (type 4, Table 2).

The following list of the species observed in the Mitaraka Mountains area follows the arrangement in Le Bail *et al.* (2012) and provides ecological observations on the species. In accordance with Our Planet Reviewed taxonomic agreement, fish specimens are stored at MNHN. The following list of species is summarized in the Table 2 indicating fish occurrence per site.

Order CHARACIFORMES Goodrich, 1909
Family PARODONTIDAE Eigenmann, 1910
Genus *Parodon* Valenciennes, 1850

Parodon guyanensis Gery, 1959
(Fig. 3)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S8, S11.

SPECIMEN IN COLLECTION. — None.

DISTRIBUTION IN FRENCH GUIANA. — Widespread.

ECOLOGY. — Observed during underwater inventories in rapid and rocky areas.

SPECIES CODE. — PGUY.

Family ANOSTOMIDAE Günther, 1864
Genus *Leporinus* Agassiz, 1829

Leporinus gossei Géry, Planquette & Le Bail, 1991

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S11.

SPECIMEN IN COLLECTION. — None.

DISTRIBUTION IN FRENCH GUIANA. — Widespread.

ECOLOGY. — Only observed during underwater inventories in the Alama main stream. Inhabits large and deep streams, in pools and in slow flowing areas.

SPECIES CODE. — LGOS.

Leporinus granti Eigenmann, 1912
(Fig. 4)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S8, S9, S10, S11.

SPECIMENS IN COLLECTION. — 3 MNHN (MNHN-IC-2018-0421, MNHN-IC-2018-0422, MNHN-IC-2018-0423); 2 Hydreco.

DISTRIBUTION IN FRENCH GUIANA. — Widespread except in Oyapock drainage.

ECOLOGY. — Ubiquitous species. Captured using rotenone and by angling in both Alama mainstream and tributaries, in pools and in slow flowing areas. Also observed during underwater inventories.

SPECIES CODE. — LGRA.

Family CRENUCHIDAE Günther, 1864
Genus *Characidium* Reinhardt, 1867

REMARK

An undetermined morphospecies (*Characidium* sp., [Fig. 5]) is known from the Maroni drainage basin. It is referred as *Characidium* sp. 2 in Le Bail *et al.* (2012), but the particular colour pattern of the individuals collected in the Mitaraka might indicate another undetermined species, only known from Mitaraka, which was referred as *Characidium* sp. 3 by Melki (2016).

FIRST RECORD FOR THE MITARAKA. — Keith *et al.* 2006.

OCCURENCES. — S8, S9.

SPECIMENS IN COLLECTION. — 1 MNHN (MNHN-IC-2018-0424); 1 Hydreco.

ECOLOGY. — Observed in median sized streams with sandy bottoms and moderate current velocities. Captured using rotenone and observed in underwater inventories.

SPECIES CODE. — CSP.

Characidium zebra Eigenmann, 1909
(Fig. 6)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S3, S8, S9, S11.

SPECIMEN IN COLLECTION. — None.

DISTRIBUTION IN FRENCH GUIANA. — Widespread.

ECOLOGY. — Observed on sandy bottoms and moderate to high current velocities in both Alama mainstream and tributaries. Lies immobile head directed upstream, waiting for drifting food. Captured using rotenone and observed in underwater inventories.

SPECIES CODE. — CZEB.

Genus *Melanocharacidium* Buckup, 1993

Melanocharacidium dispilomma Buckup, 1993

FIRST RECORD FOR THE MITARAKA. — This study.

Fig. 3. — *Parodon guyanensis* Gery, 1959. Photograph: F. Melki.

Fig. 4. — *Leporinus granti* Eigenmann, 1912. Photograph: F. Melki.

Fig. 5. — *Characidium* sp. Photograph: F. Melki.

Fig. 6. — *Characidium zebra* Eigenmann, 1909. Photograph: F. Melki.

Occurences. — S12.

Specimens in collection. — 3 MNHN (MNHN-IC-2018-0425, MNHN-IC-2018-0426, MNHN-IC-2018-0427); 2 Hydreco.

Distribution in French Guiana. — Maroni, Mana and Sinnamary drainages. Only known from a few sites.

Ecology. — This rare species was only observed in a side arm channel of a rapid area of the Alama River. It was found in a bedrock and boulders habitat with turbulent water. Captured using rotenone.

Species code. — MDIS.

Family Characidae Latreille, 1825
Genus *Astyanax* Baird & Girard, 1854

Astyanax validus
Géry, Planquette & Le Bail, 1991
(Fig. 7)

First record for the Mitaraka. — This study.

Occurences. — S5, S10, S11, S14.

Specimens in collection. — 7 MNHN (MNHN-IC-2018-0428, MNHN-IC-2018-0429, MNHN-IC-2018-0430, MNHN-IC-2018-0431, MNHN-IC-2018-0432, MNHN-IC-2018-0433, MNHN-IC-2018-0434); 7 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in groups in both Alama mainstream and tributaries, in sandy areas with moderate current velocities. Captured using rotenone, seine nets and by angling. Also observed in underwater inventories.

Species code. — AVAL.

Genus *Bryconamericus* Eigenmann, 1907

Bryconamericus guyanensis
Zarske, Le Bail & Géry, 2010

First record for the Mitaraka. — Keith *et al.* 2006.

Occurences. — S8, S9, S11.

Specimens in collection. — 4 MNHN (MNHN-IC-2018-0435, MNHN-IC-2018-0436, MNHN-IC-2018-0437, MNHN-IC-2018-0438); 4 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in shallow sandy areas with moderate to high current velocities of the Alama mainstream and tributaries. Captured using rotenone.

Species code. — BGUY.

Genus *Hemibrycon* Günther, 1864

Hemibrycon surinamensis Géry, 1962
(Fig. 8)

First record for the Mitaraka. — This study.

Occurences. — S3, S8, S9, S10, S11, S12, S14.

Specimens in collection. — 10 MNHN (MNHN-IC-2018-0439, MNHN-IC-2018-0440, MNHN-IC-2018-0441, MNHN-IC-2018-0442, MNHN-IC-2018-0443, MNHN-IC-2018-0444, MNHN-IC-2018-0445, MNHN-IC-2018-0446, MNHN-IC-2018-0447, MNHN-IC-2018-0448); 10 Hydreco.

Distribution in French Guiana. — Known from Maroni, Mana, Comté, and Approuague rivers.

Ecology. — Widespread in the Mitaraka mountains. Observed in groups in Alama mainstream and tributaries, often in high current velocity areas. Captured using rotenone and observed in underwater inventories.

FIG. 7. — *Astyanax validus* Géry, Planquette & Le Bail, 1991. Photograph: F. Melki.

FIG. 8. — *Hemibrycon surinamensis* Géry, 1962. Photograph: F. Melki.

SPECIES CODE. — HESU.

Genus *Jupiaba* Zanata, 1997

REMARK

An undetermined morphospecies (*Jupiaba* sp.; [Fig. 9]) is only known by three specimens collected in a single site of the Mitaraka Mountains.

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S2.

SPECIMENS IN COLLECTION. — 2 MNHN (MNHN-IC-2018-0449, MNHN-IC-2018-0450); 1 Hydreco.

ECOLOGY. — Observed in a single median sized stream, in a sandy area with moderate current velocity. Captured using rotenone.

SPECIES CODE. — JSP.

FIG. 9. — *Jupiaba* sp. Photograph: S. Brosse.

Genus *Moenkhausia* Eigenmann, 1903

Moenkhausia moisae
Géry, Planquette & Le Bail, 1995
(Fig. 10)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S8, S9, S11.

SPECIMENS IN COLLECTION. — 6 MNHN (MNHN 2018-0451, MNHN-IC-2018-0452, MNHN-IC-2018-0453, MNHN-IC-2018-0454, MNHN-IC-2018-0455, MNHN-IC-2018-0456); 5 Hydreco.

DISTRIBUTION IN FRENCH GUIANA. — Maroni and Mana drainage basins.

ECOLOGY. — Observed in groups in both Alama mainstream and tributaries, in sandy areas with moderate current velocities. Captured using rotenone, seine nets and by angling. Also observed in underwater inventories.

SPECIES CODE. — MMOI.

Family ERYTHRINIDAE Valenciennes, 1847
Genus *Erythrinus* Scopoli, 1777

Erythrinus erythrinus (Bloch & Schneider, 1801)
(Fig. 11)

FIRST RECORD FOR THE MITARAKA. — Keith *et al.* 2006.

OCCURENCES. — S2, S5, S9, S10, S11, S14.

SPECIMENS IN COLLECTION. — 4 MNHN (MNHN-IC-2018-0457, MNHN-IC-2018-0458, MNHN-IC-2018-0459, MNHN-IC-2018-0460); 3 Hydreco.

DISTRIBUTION IN FRENCH GUIANA. — Widespread.

ECOLOGY. — Found in pools or hidden under branches in slow flowing and standing water areas in both Alama mainstream and tributaries. Observed individuals were red bellied and had an elongated dorsal fin. Captured using rotenone and in baited traps. Also observed in underwater inventories.

SPECIES CODE. — EERY.

Genus *Hoplias* Gill, 1903

Hoplias malabaricus (Bloch, 1794)
(Fig. 12)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S4, S11, S12, S14.

SPECIMENS IN COLLECTION. — 2 MNHN (MNHN-IC-2018-0461, MNHN-IC-2018-0462); 1 Hydreco.

DISTRIBUTION IN FRENCH GUIANA. — Widespread.

ECOLOGY. — Found in pools or hidden under branches in slow flowing and standing water areas in both Alama mainstream and tributaries. Captured using rotenone and in baited traps. Also observed in underwater inventories.

SPECIES CODE. — HMAL.

Family LEBIASINIDAE Gill, 1889
Genus *Copella* Myers, 1956

Copella arnoldi (Regan, 1912)

FIRST RECORD FOR THE MITARAKA. — Keith *et al.* 2006.

OCCURENCES. — S3, S9, S10, S12, S14.

SPECIMENS IN COLLECTION. — 2 MNHN (MNHN-IC-2018-0463, MNHN-IC-2018-0464); 1 Hydreco.

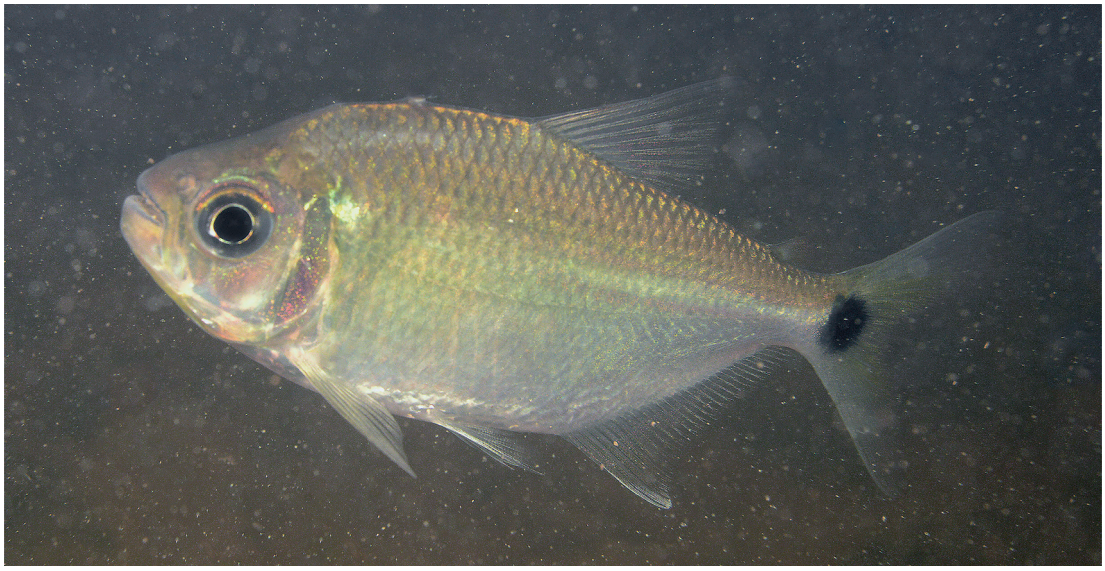

Fig. 10. — *Moenkhausia moisae* Géry, Planquette & Le Bail, 1995. Photograph: F. Melki.

Fig. 11. — *Erythrinus erythrinus* (Bloch & Schneider, 1801). Photograph: S. Brosse.

Fig. 12. — *Hoplias malabaricus* (Bloch, 1794). Photograph: F. Melki.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in shallow areas, near the surface and close to the banks. Captured using rotenone and observed in underwater inventories.

Species code. — CCAR.

Copella aff. ***arnoldi*** (Regan, 1912)

First record for the Mitaraka. — This study.

Occurences. — S12.

Specimen in collection. — None.

Distribution in French Guiana. — Only known from a few localities in the Maroni and the Comté drainages in French Guiana. This unnamed species is referred as *Copella* aff. *arnoldi* in Le Bail *et al.* (2012).

Ecology. — This rare species was only observed in a side arm channel of a rapid area of the Alama River. It was found in small rocky pools with low current velocity. Captured using rotenone.

Species code. — CARN.

Order SILURIFORMES Rafinesque, 1820
Family Cetopsidae Bleeker, 1858
Genus *Cetopsidium* Vari, Ferraris & de Pinna, 2005

Cetopsidium orientale (Vari, Ferraris & Keith, 2003)

First record for the Mitaraka. — This study.

Occurences. — S9, S12.

Specimens in collection. — 1 MNHN (MNHN-IC-2018-0465); 1 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in both Alama mainstream and tributaries. Nocturnal species that hides during the day. Captured using rotenone.

Species code. — CORI.

Genus *Helogenes* Günther, 1863

Helogenes marmoratus Günther, 1963

First record for the Mitaraka. — This study.

Occurences. — S10.

Specimens in collection. — 1 MNHN (MNHN-IC-2018-0466); 1 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in a single small stream site. Nocturnal species that hides during the day. Captured using rotenone.

Species code. — HMAR.

Family Trichomycteridae Bleeker, 1858
Genus *Ituglanis* Costa & Bockmann, 1993

Ituglanis nebulosus de Pinna & Keith, 2003
(Fig. 13)

First record for the Mitaraka. — Keith *et al.* 2006.

Occurences. — S6, S7.

Specimens in collection. — 10 MNHN (MNHN-IC-2018-0467, MNHN-IC-2018-0468, MNHN-IC-2018-0469, MNHN-IC-2018-0470, MNHN-IC-2018-0471, MNHN-IC-2018-0472, MNHN-IC-2018-0473, MNHN-IC-2018-0474, MNHN-IC-2018-0475, MNHN-IC-2018-0476); 10 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Found in two torrential streams, with rocky substratum. Observed active during the day in pools and hidden under the rocks in fast flowing areas. Captured using rotenone and observed in underwater inventories.

Species code. — INEB.

Family Callichthydae Bonaparte, 1835
Genus *Callichthys* Scopoli, 1777

Callichthys callichthys (Linnaeus, 1758)
(Fig. 14)

First record for the Mitaraka. — This study.

Occurences. — S4.

Specimen in collection. — None.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in a single small stream, in a low current velocity area. Captured using rotenone.

Species code. — CCAL.

Family Loricaridae Rafinesque, 1815
Genus *Cteniloricaria* Isbrücker & Nijssen, 1979

Cteniloricaria platystoma (Günther, 1868)
(Fig. 15)

First record for the Mitaraka. — This study.

Occurences. — S11.

Specimen in collection. — None.

Distribution in French Guiana. — Maroni, Mana and Sinnamary basins

Ecology. — Found on sandy bottoms, only in Alama mainstream. Only observed in underwater inventories.

Species code. — CPLA.

Fig. 13. — *Ituglanis nebulosus* de Pinna & Keith, 2003. Photograph: F. Melki.

Fig. 14. — *Callichthys callichthys* (Linnaeus, 1758). Photograph: F. Melki.

Fig. 15. — *Cteniloricaria platystoma* (Günther, 1868). Photograph: F. Melki.

Genus *Harttia* Steindachner, 1877

Harttia guianensis Rapp Py-Daniel & Olivieira, 2001
(Fig. 16)

First record for the Mitaraka. — This study.

Occurences. — S11.

Specimen in collection. — None.

Distribution in French Guiana. — Widespread between Maroni and Approuague rivers.

Ecology. — Species living on rocks, only in Alama mainstream. Only observed in underwater inventories.

Species code. — HGUI.

Genus *Ancistrus* Kner, 1854

Ancistrus temminckii (Valenciennes, 1840)
(Fig. 17)

First record for the Mitaraka. — This study.

Occurences. — S11.

Specimen in collection. — None.

Distribution in French Guiana. — Only known from the Maroni river drainage.

Ecology. — Only found in Alama mainstream, on flooded woods in medium flow areas. Only observed in underwater inventories.

Species code. — ATEM.

Genus *Guyanancistrus* Isbrücker, 2001

Guyanancistrus megastictus
Fisch-Muller, Mol & Covain, 2018
(Fig. 18)

First record for the Mitaraka. — Fisch-Muller *et al.* 2018.

Occurences. — S1, S3, S11, S12.

Specimens in collection. — 4 MNHN (MNHN-IC-2018-0477, MNHN-IC-2018-0478, MNHN-IC-2018-0479, MNHN-IC-2018-0480); 3 Hydreco.

Distribution in French Guiana. — Restricted to the Mitaraka Mountains.

Ecology. — Found in both Alama mainstream and tributaries. Species living mainly on rocks but also found on flooded woods. Captured using rotenone and observed in underwater inventories.

Species code. — GMEG.

Family Pseudopimelodidae
Fernández-Yépez & Antón, 1966
Genus *Batrochoglanis* Gill, 1858

Batrochoglanis raninus (Valenciennes, 1840)

First record for the Mitaraka. — This study.

Occurences. — S2.

Specimens in collection. — 2 MNHN (MNHN-IC-2018-0481, MNHN-IC-2018-0482); 1 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Found in a single small stream site. Captured using rotenone.

Species code. — BRAN.

Family Heptapteridae Gill, 1861
Genus *Chasmocranus* Eigenmann, 1912

Chasmocranus brevior Eigenmann, 1912

First record for the Mitaraka. — This study.

Occurences. — S8, S9.

Specimens in collection. — 1 MNHN (MNHN-IC-2018-0483); 1 Hydreco.

Distribution in French Guiana. — Known from a few small stream sites in the Maroni and Mana drainage basins.

Ecology. — Observed in median to large streams sites, in low current velocity areas. Nocturnal species that hides during the day. Captured using rotenone.

Species code. — CBRE.

Chasmocranus longior Eigenmann, 1912

First record for the Mitaraka. — This study.

Occurences. — S9, S12.

Distribution in French Guiana. — Widespread.

Specimens in collection. — 6 MNHN (MNHN-IC-2018-0484, MNHN-IC-2018-0485, MNHN-IC-2018-0486, MNHN-IC-2018-0487, MNHN-IC-2018-0488, MNHN-IC-2018-0489); 5 Hydreco.

Ecology. — Observed in the Alama mainstream and in a large tributary, in a large range of local habitats. Nocturnal species that hides during the day. Captured using rotenone.

Species code. — CLON.

Genus *Heptapterus* Bleeker, 1858

Heptapterus bleekeri Boesman, 1953

First record for the Mitaraka. — This study.

Fig. 16. — *Harttia guianensis* Rapp Py-Daniel & Olivieira, 2001. Photograph: F. Melki.

Fig. 17. — *Ancistrus temminckii* (Valenciennes, 1840). Photograph: F. Melki.

Fig. 18. — *Guyanancistrus megastictus* Fisch-Muller, Mol & Covain, 2018. Photograph: F. Melki.

Occurences. — S2, S4, S9, S13, S14.

Specimens in collection. — 4 MNHN (MNHN-IC-2018-0490, MNHN-IC-2018-0491, MNHN-IC-2018-0492, MNHN-IC-2018-0493); 3 Hydreco.

Distribution in French Guiana. — Known from a few small stream sites of the Maroni, Approuague and Oyapock drainage basins.

Ecology. — Observed in streams, in low current velocity areas. Nocturnal species that hides during the day. Captured using rotenone.

Species code. — CBLE.

Genus *Pimelodella* Eigenmann & Eigenmann, 1888

Pimelodella geryi Hoedeman, 1961
(Fig. 19)

First record for the Mitaraka. — This study.

Occurences. — S10, S11.

Specimen in collection. — None.

Distribution in French Guiana. — Widespread.

Ecology. — Only observed in the Alama mainstream. Nocturnal species that hides during the day. Captured using rotenone and observed in underwater inventories.

Species code. — PGER.

Pimelodella procera Mees, 1983
(Fig. 20)

First record for the Mitaraka. — This study.

Occurences. — S4, S5, S11, S12, S14.

Specimens in collection. — 7 MNHN (MNHN-IC-2018-0494, MNHN-IC-2018-0495, MNHN-IC-2018-0496, MNHN-IC-2018-0497, MNHN-IC-2018-0498, MNHN-IC-2018-0499, MNHN-IC-2018-0500); 7 Hydreco.

Distribution in French Guiana. — Only known from headwater streams of the Maroni drainage basin.

Ecology. — Observed in both Alama mainstream and tributaries, widespread in the Mitaraka area. Underwater observations revealed this species was active during the day contrary to the other species of *Pimelodella*. Captured using rotenone and observed in underwater inventories.

Species code. — PPRO.

Genus *Rhamdia* Bleeker, 1858

Rhamdia quelen (Quoy & Gaimard, 1824)

First record for the Mitaraka. — This study.

Occurences. — S4, S10, S,12.

Specimens in collection. — 2 MNHN (MNHN-IC-2018-0501, MNHN-IC-2018-0502); 1 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Ubiquitous species observed in both Alama mainstream and tributaries, and under various habitats and water velocities. Captured using rotenone.

Species code. — RQUE.

Order GYMNOTIFORMES
Family Gymnotidae Rafinesque, 1815
Genus *Gymnotus* Linnaeus, 1758

Gymnotus carapo Linnaeus, 1758

First record for the Mitaraka. — This study.

Occurences. — S4, S5, S9, S10, S11, S12, S13, S14.

Specimens in collection. — 10 MNHN (MNHN-IC-2018-0503, MNHN-IC-2018-0504, MNHN-IC-2018-0505, MNHN-IC-2018-0506, MNHN-IC-2018-0507, MNHN-IC-2018-0508, MNHN-IC-2018-0509, MNHN-IC-2018-0510, MNHN-IC-2018-0511, MNHN-IC-2018-0512); 10 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in both Alama mainstream and tributaries. This nocturnal species hides during the day in submersed tree roots and undercut banks. Captured using rotenone.

Species code. — GCAR.

Gymnotus coropinae Hoedeman, 1962

First record for the Mitaraka. — This study.

Occurences. — S2.

Specimen in collection. — None.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in a single small and shallow stream. This nocturnal species hides during the day in submersed tree roots and undercut banks. Captured using rotenone.

Species code. — GCOR.

Family Sternopygidae Cope, 1871
Genus *Eigenmannia* Jordan & Evermann, 1896

Eigenmannia virescens (Valanciennes, 1836)

First record for the Mitaraka. — This study.

Occurences. — S9, S11.

Specimen in collection. — None.

Distribution in French Guiana. — Widespread.

Fig. 19. — *Pimelodella geryi* Hoedeman, 1961. Photograph: F. Melki.

Fig. 20. — *Pimelodella procera* Mees, 1983. Photograph: F. Melki.

Ecology. — Observed in both Alama mainstream and large tributaries. This nocturnal species hides in the undercut banks during the day. Captured using rotenone and observed in underwater inventories.

Species code. — EVIR.

Genus *Sternopygus* Müller & Troschel, 1849

Sternopygus macrurus (Bloch & Schneider, 1801)

First record for the Mitaraka. — This study.

Occurences. — S8, S9, S10, S11.

Specimens in collection. — 2 MNHN (MNHN-IC-2018-0513, MNHN-IC-2018-0514); 1 Hydreco.

Distribution in French Guiana. — Widespread.

Ecology. — Observed in both Alama mainstream and tributaries. This nocturnal species hides in the undercut banks and in submersed tree roots during the day. Captured using rotenone.

Species code. — SMAC.

Order CYPRINODONTIFORMES Berg, 1940
Family Rivulidae Myers, 1925
Genus *Anablepsoides* Huber, 1992

Anablepsoides gaucheri
(Keith, Nandrin & Le Bail, 2006)
(Fig. 21)

First record for the Mitaraka. — Keith *et al.* 2006.

Occurences. — S1, S2.

Specimens in collection. — 10 MNHN (MNHN-IC-2018-0515, MNHN-IC-2018-0516, MNHN-IC-2018-0517, MNHN-IC-2018-0518, MNHN-IC-2018-0519, MNHN-IC-2018-0520, MNHN-IC-2018-0521, MNHN-IC-2018-0522, MNHN-IC-2018-0523, MNHN-IC-2018-0524); 10 Hydreco.

Distribution in French Guiana. — Only known from the Mitaraka Mountains. This species might be a junior synonym of *Kryptolebias sepia* Vermeulen & Hrbek, 2005, known from the Tapanahoni River (Maroni drainage) in Surinam (Vermeulen 2015).

FIG. 21. — *Anablepsoides gaucheri* (Keith, Nandrin & Le Bail, 2006). Photograph: F. Melki.

ECOLOGY. — Observed in small to median sized streams, close to the bank in shallow areas. Captured using rotenone.

SPECIES CODE. — AGAU.

Genus *Laimosemion* Huber, 1999

Laimosemion geayi (Vaillant, 1889)
(Fig. 22)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S2, S4, S11, S14.

SPECIMENS IN COLLECTION. — 10 MNHN (MNHN-IC-2018-0525, MNHN-IC-2018-0526, MNHN-IC-2018-0527, MNHN-IC-2018-0528, MNHN-IC-2018-0529, MNHN-IC-2018-0530, MNHN-IC-2018-0531, MNHN-IC-2018-0532, MNHN-IC-2018-0533, MNHN-IC-2018-0534); 10 Hydreco.

DISTRIBUTION IN FRENCH GUIANA. — Maroni, Mahury, Approuague, and Oyapock drainages.

ECOLOGY. — Observed in small and shallow streams with low current velocities and in the flooded forest areas of larger streams. Captured using rotenone.

SPECIES CODE. — LGEA.

Order PERCIFORMES Bleeker, 1859
Family CICHLIDAE Bonaparte, 1835
Genus *Aequidens* Eigenmann & Bray, 1894

Aequidens tetramerus (Heckel, 1840)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S11, S12.

SPECIMEN IN COLLECTION. — None.

DISTRIBUTION IN FRENCH GUIANA. — Widespread.

ECOLOGY. — Observed only in the Alama mainstream, in low current velocity areas. Captured using rotenone.

SPECIES CODE. — ATET.

Genus *Crenicichla* Heckel, 1840

Crenicichla albopunctata Pellegrin, 1904
(Fig. 23)

FIRST RECORD FOR THE MITARAKA. — This study.

OCCURENCES. — S8, S11.

SPECIMEN IN COLLECTION. — None.

DISTRIBUTION IN FRENCH GUIANA. — Known from Maroni, Mana, Mahury, and Approuague drainages.

ECOLOGY. — Observed in both Alama mainstream and tributaries, in low current velocity areas. Captured using rotenone and observed in underwater inventories.

SPECIES CODE. — CALB.

DISCUSSION

The fish fauna from the Mitaraka Mountains included 38 species, which was lower than the fish species diversity recorded in similar size pristine rainforest streams. For instance, Brosse *et al.* (2011) counted 69 species from nine lowland and headwater tributaries of the Arataye river in the center part of French Guiana. Similarly, 58 species were collected in a set of 10 sampling sites from lowland, mountain and headwater tributaries of the Limonade river, in a highly comparable environmental context to this study (similar altitude, spatial extent and size of the main river)

FIG. 22. — *Laimosemion geayi* (Vaillant, 1889). Photograph: F. Melki.

FIG. 23. — *Crenicichla albopunctata* Pellegrin, 1904. Photograph: F. Melki.

(Brosse *et al.* 2018). Such a low richness might be explained by the upstream position of the sampling sites in the Maroni basin, limiting therefore fish dispersal between tributaries (Brown & Swan 2010; Schmera *et al.* 2018). Dispersal limitation is indeed known as one of the main processes determining the species composition in local fish faunas of Guianese streams (Cilleros *et al.* 2016). This dispersal limitation effect is also confirmed by the marked species turnover between sites, even within a similar environmental context. For instance, the small and shallow sites (depth ≤ 11 cm and width ≤ 2 m; S4, S5, S12, S13, S14) have a dissimilarity of 77.2% ± 8.4% (mean ± SD, Jaccard dissimilarity index).

We identified four types of fish assemblages in relation to the physical characteristics of the streams. The two torrential streams, S6 and S7 (type 4), both located on the same tributary, are characterised by an unusual fish fauna made of a single Trichomycteridae species (*I. nebulosus*). Although this species has already been reported from both floodplain and mountain headwater streams (De Pinna & Keith 2003; Mol *et al.* 2007; Brosse *et al.* 2013), it is unusual to record a stream assemblage made of a single species. This is quite surprising since the torrential hydrology of this stream (see Fig. 24 for a picture of the stream) appears as a favourable habitat for a few other species as predicted by the stream fish typology of Cilleros *et al.* (2017). Moreover, Mol *et al.* (2007) and Brosse *et al.* (2013) reported the presence of several Loricaridae (e.g. *Guyanancistrus* and *Hartiella*), and/or Rivulidae (e.g. *Anableposides* or *Laimosemion*) from similar torrential streams in French Guiana and Suriname.

Fig. 24. — Picture of the Site 7 torrential stream, colonised by a single species, *Ituglanis nebulosus* de Pinna & Keith, 2003. Photograph: S. Brosse.

In contrast, small and shallow streams with lower current velocities (type 1) were colonised by more diverse assemblages and host 6.80 ± 3.96 species. Those species are able to inhabit shallow waters (e.g. *Lamosemion geayi;* Keith *et al.* 2000) and to survive to temporary drying by air breathing while sheltering in relictual water pools (e.g. *G. carapo*, *H. malabaricus* Liem *et al.* 1984; Rantin *et al.* 1992). Larger and deeper streams (type 2 and 3) have a slightly more diversified fauna with 8.00 ± 4.69 species. Those sites are dominated by characids that are more sensitive to anoxia. Finally, the Alama main stream has a more diverse fauna with 20 recorded species, including most of the species found in the above discussed large and deep tributaries, revealing an accumulation of fish species according to the distance from the source, as already reported by Cilleros *et al.* (2017).

Among the fish assemblages, a few rare or unknown species were recorded, such as *G. megastictus*, a recently described Loricariidae species (Fisch-Muller *et al.* 2018) which distribution appears limited to the Mitaraka Mountains. We also recorded *P. procera*, an endemic species from the Maroni Basin. Its previously recorded southern limit of distribution was the Nouvelle France River (Brosse *et al.* 2018). The occurrence of *P. procera* in the Mitaraka streams therefore extends its known spatial distribution of more than 100 km to the south. We also collected *A. gaucheri* in two localities (S1 and S2), while the species was only known from a few Alama drainage tributaries located 10 to 15 km to the west of the study sites (Keith *et al.* 2006). This species, only known from the Mitaraka Mountains, might be endemic from the Alama Drainage. Although probably having a restricted distribution, it occurs in several tributaries of the Alama River. Finally, three adult individuals from a large (*c.* 60 mm SL) unknown species belonging to the genus *Jupiaba* were collected in site S2. The description of this species is currently pending.

To conclude, the fish fauna of the Mitaraka Mountains, although not very diverse, includes some micro-endemic species and unusual fish assemblages. Complementary samples in the southern part of French Guiana are thus needed to complement the taxonomic knowledge of the fish fauna of French Guiana and to document the structure of Guianese mountain streams fish assemblages.

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