A preliminary survey of the fish fauna in the vicinity of Santa Ana del Yacuma in Bolivia (río Mamoré drainage)

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Abstract: The inventory of fish species of the río Mamoré sub-drainage in the Bolivian Amazon is far from being complete. This article informs about a small scale species inventory in the close vicinity of the town Santa Ana del Yacuma (drained by the río Yacuma, a left side tributary of the río Mamoré). Sampling four habitat types, 615 fish specimens belonging to 101 species were collected. Four species were reported for the first time from the río Mamoré sub-drainage: *Aphyocharax rathbuni*, *Apistogramma erythrura*, *Apistogramma similis* and *Hyphessobrycon elachys*. Differences in species composition among sampled habitats stress the importance of including a high number of collecting sites across biotic and abiotic environmental gradients to reliably survey species diversity.
Keywords: *fish inventory, distribution, first record, Amazon basin, fish diversity, río Yacuma, río Mamoré, Bolivia.*

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Resumen: Aún no se tiene completo el inventario de los peces de la sub-cuenca del río Mamoré en la Amazonía. Este articulo incluye un inventario al nivel regional en las proximidades de la ciudad Santa Ana del Yacuma (sub-cuenca del río Yacuma, río Mamoré). En cuatro tipos de hábitat, 615 especímenes perteneciendo a 101 especies fueron coleccionados). Cuatro especies fueron registrados en la sub-cuenca del río Mamoré por la primera vez: *Aphyocharax rathbuni*, *Apistogramma erythrura*, *Apistogramma similis* y *Hyphessobrycon elachys*. Diferencias entre los hábitats en la composición de especies indican la importancia incluir un gran número de sitios de colecta a través de gradientes de ambientes bióticos y abióticos para un registro fiable de la diversidad de especies.
Palabras claves: *inventario de peces, distribución, primero registro, Amazonía, diversidad de peces, río Yacuma, río Mamoré, Bolivia.*

Introduction

Species inventories are valuable tools in conservation biology, but also have applications in ecology, biogeography and systematics. They are the primary source for spatial information on biodiversity and can be used as references to governmental authorities (e.g. Aguirre et al. 2009). Species inventories often come along with information on environmental parameters and habitat use (e.g. Killeen & Schulenberg 1998, Chernoff & Willink 1999) and may be used for further studies concerning patterns of species distribution on various spatial scales (e.g. Hubert & Renno 2006). Inventories also often lead to new records for the geographical region under investigation, refining the known distribution area for these taxa or the discovery of new species (e.g. Zarske & Gery 2001, Hein et al. 2002).

The inventory of fish species of the río Mamoré sub-drainage is far from being complete. Although a new checklist of fish species of the Bolivian Amazon has been published recently (Pouilly et al., 2010), the authors did not re-identify reference specimens in Museum collections and the list suffered from many species misidentifications. Other surveys focused on an regional scale covering the Llanos de Moxos (Castelló 1987), the río Ichilo (Maldonado 1997), the río Mamoré (Pouilly & Rodríguez 2004) and the río Ibabo (Farell 2006). Although these studies were quite exhaustive and provided large numbers of new geographical reports, they are either biased towards large species (due to choices in fishing gear and sampling techniques), neglect seasonal variability or omit certain mesohabitats. Consequently, such studies often miss a considerable portion of the local species richness. Because fish distribution may be structured on a small spatial scale (Pouilly & Rodriguez 2004), a dense net of sampling sites is needed for the río Mamoré sub-drainage, covering the complete variety of geographical regions and habitats.

In the present article I inform about a small scale species inventory in the close vicinity of Santa Ana del Yacuma in the Bolivian Amazon (río Yacuma drainage, left side tributary of the río Mamoré). Special focus was set on small fish species living in oxbow lakes, seasonal floodplains and artificial ponds.

Materials and Methods

Fish were collected using dip and cast nets in October 2009 (dry season) and February 2010 (rainy season). Collection sites included the río Yacuma, the río Rapulo (white water rivers with an average width of about 70 and 50 m respectively), three oxbow lakes (surface of about 5 to 15 ha), the floodplain and small artificial ponds (about 0.01-0.1 ha) around Santa Ana del Yacuma (Figure 1). Oxbow lakes were only sampled during the dry season when they were not directly connected to rivers. Nomenclature follows Eschmeyer & Fricke (2012) for most taxa (exceptions are discussed below). Species were identified on basis of identification keys (Gery 1977, Burgess 1989, Mago-Leccia 1994, Armbruster & Page 2006, Covain & Fisch-Muller 2007, Menezes 2007), field guides (Stawikowski & Werner 1998, Britski et al. 1999, Evers & Seidel 2002, Koslowski 2002, Stawikowski & Werner 2004, Fuller & Evers 2005, Seidel & Evers 2005), faunal surveys (Fowler 1940, Kullander 1986), taxonomic revisions (Kullander 1983, Vari 1984, Reis 1989, Schaefer 1989, Costa 1990, Kullander & Silfvergrip 1991, Vari 1991, Vari 1992a, b, Armbruster & Page 1996, Weitzman & Palmer 1997, Malabarba 1998, Ferraris Junior & Vari 1999, Zarske & Gery 1999, De Lucena 2003, Malabarba 2004, Zanata & Toledo-Piza 2004, Kullander & Ferreira 2006, Reis & Borges 2006, De Lucena 2007) and single taxonomic accounts (Gery 1973, Vari 1977, Weitzman 1984, Seegers 1988, Hopkins 1991, Menezes 1992, Littmann et al. 2001, Zarske & Gery 2001, Staeck 2003, Zarske & Gery 2004, Costa 2005, Staeck & Schindler 2008, Benine et al. 2009). The collected specimens have been deposited in the ichthyological collection of the Centro de Investigación de Recursos Aquáticos in Trinidad, Bolivia.

Differences in fish community composition among habitat types were assessed with presence/absence data using the Jaccard index (Janson & Vegelius 1981). Four discrete macrohabitat categories were considered: oxbow lakes (sites 1-3), rivers (sites 4-6), temporary water bodies (sites 7-10) and artificial ponds (sites 11-14).

Throughout this article I refer to the río Mamoré sub-drainage as defined by Lauzanne et al. (1991), explicitly excluding the Río Yata and río Iténez drainages.

Results

615 fish specimens belonging to 101 species were collected in the four habitat types (Table 2). Due to technical constraints in sampling methods and effort, a considerable portion of fish species occurring in water bodies around Santa Ana may not be covered by this study. Sampling material was limited to dip and cast nets, which are unsuited to collect in the open water column or in the deep channels of larger rivers. Some species groups occurring in such mesohabitats (i.e. species belonging to the families Pimelodidae, Anostomidae and Serrasalmidae) may be disproportionally underrepresented in the present study.

Observed species richness varied among habitat types and reached from 27 (artificial ponds) to 61 (oxbow lakes). Habitat specificity of fish taxa was high, reflected by a low number of shared species among habitat types and consequently low Jaccard indeces (Table 1). Differences in species composition was highest in a comparison between lotic (rivers) and lentic (oxbow lakes, ponds and floodplaines) waters (Jaccard indeces ranging from 0.02-0.15) and lowest between floodplaines and artificial ponds (Jaccard index 0.41; Table 1).

Within habitat differences were calculated for three oxbow lakes. Although no water parameters have been measured in the field, it was observed that the lakes differed in water transparency and aquatic vegetation. Jaccard indexes among lakes were 0.12, 0.17 and 0.20 and hence within the range of between habitat differences. Similar patterns of differentiation in species communities among oxbow lakes have been obtained in a study of the río Mamoré in the vicinity of Trinidad, where structure of species community segregation seems to be correlated mostly with water transparency and connectivity with the river during yearly floodings (Pouilly & Rodríguez 2004).

Within habitat differences among sample sites were not estimated for rivers, artificial ponds and floodplains. In rivers, the number of collected species per site was comparatively low, reflecting a sampling bias by limited accessibility of the sampling sites due to dense terrestrial vegetation bordering the rivers. Artificial ponds and small floodplain lakes were often inhabited by only 1-5 species. Jaccard indeces are consequently highly variable and range from 0 to 1 (not shown).

Seasonal differences in species composition were observed, but not discussed in this study as they may reflect restricted accessibility of sampling sites during rainy season (flooded river banks and oxbow lakes) rather than actual shifts in species occurrences. Two killifish species (*Pterolebias longipinnis* Garman, 1895 and *Trigonectes rogoaguae* (Pearson & Myers, 1924)) have an annual lifecycle and were only observed during rainy season. Of some taxa

Table 1. Jaccard-indeces among habitat types.

Habitat type	oxbow lakes	rivers	artificial ponds
Rivers	0.13		
Artificial ponds	0.19	0.00	
Floodplain	0.22	0.07	0.44

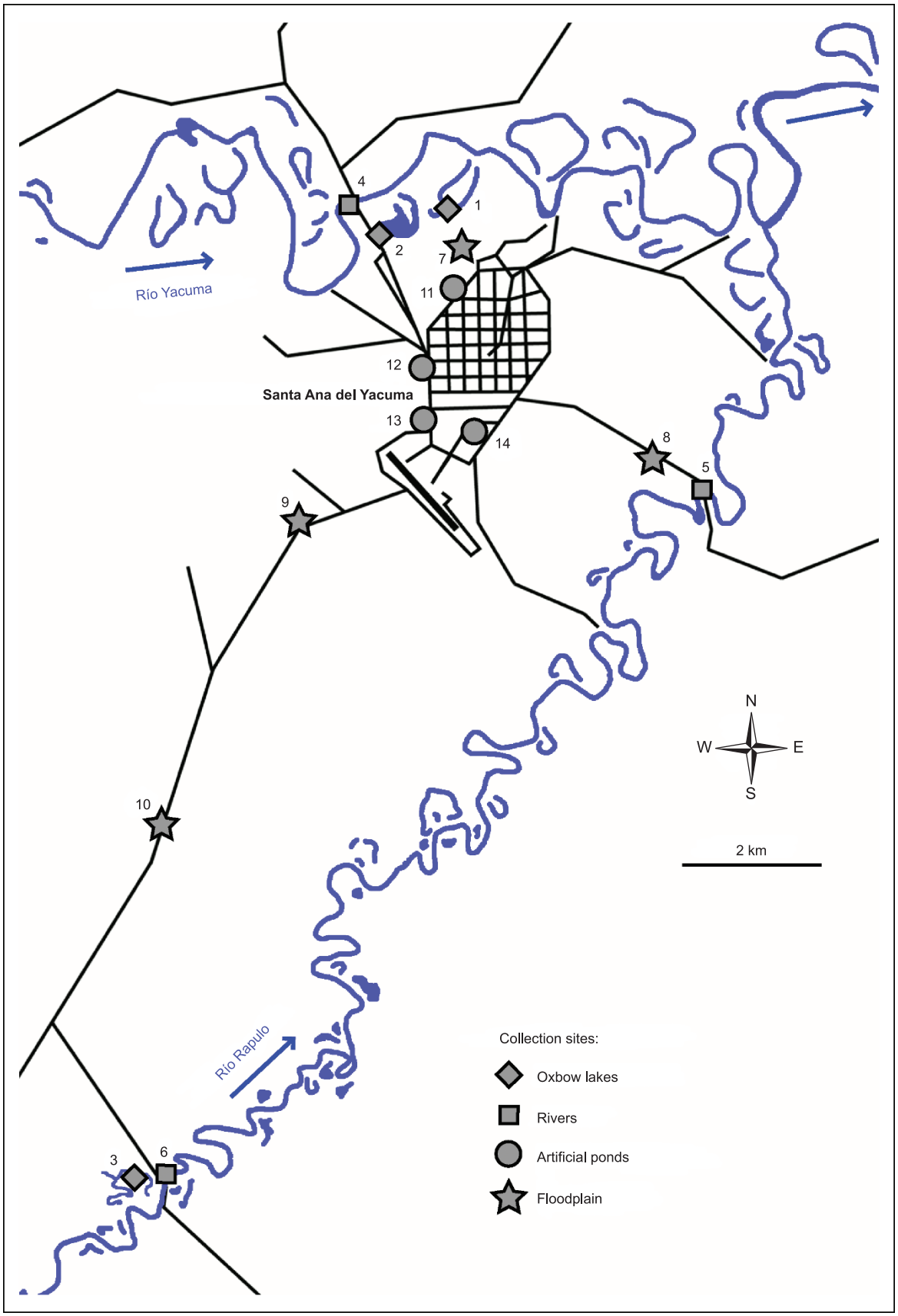

Figure 1. Collection sites in the vicinity of Santa Ana del Yacuma, Province of Yacuma, Department of Beni, Bolivia. 1) 13° 43' 31" S and 65° 25' 54" W, 2) 13° 43' 92" S and 65° 26' 27" W, 3) 13° 51' 08" S and 65° 28' 18" W, 4) 13° 43' 28" S and 65° 26' 39" W, 5) 13° 45' 45" S and 65° 23' 44" W, 6) 13° 51' 09" S and 65° 28' 11" W, 7) 13° 44' 06" S and 65° 25' 58" W, 8) 13° 45' 29" S and 65° 24' 11" W, 9) 13° 46' 04" S and 65° 27' 06" W, 10) 13° 48' 31" S and 65° 28' 12" W, 11) 13° 44' 11" S and 65° 25' 53" W, 12) 13° 44' 46" S and 65° 26' 04" W, 13) 13° 45' 09" S and 65° 26' 02" W, 14) 13° 45' 15" S and 65° 25' 43" W.

Table 2. Species collected and indication of habitat type.

Family	Species	Oxbow lake	River	Artificial ponds	Floodplain
Engraulidae	*Anchoviella carrikeri* Fowler, 1940	X			
Anostomidae	*Leporinus friderici* (Bloch, 1794)				X
	Schizodon fasciatus Spix & Agassiz, 1829	X			
Characidae	*Acestrorhynchus pantaneiro* Menezes, 1992	X			
	Aphyocharax nattereri (Steindachner, 1882)			X	X
	Aphyocharax alburnus (Günther, 1869)		X		
	Aphyocharax rathbuni Eigenmann, 1907	X		X	X
	Astyanax sp.	X		X	X
	Chalceus sp.	X	X		
	Ctenobrycon hauxwellianus (Cope, 1870)	X		X	X
	Cynopotamus amazonum (Günther, 1868)	X		X	X
	Gymnocorymbus ternetzi (Boulenger, 1895)				X
	Gymnocorymbus thayeri Eigenmann, 1908				X
	Hemigrammus cf. *bellottii*	X		X	
	Hemigrammus lunatus Durbin, 1918	X		X	
	Hemigrammus cf. *marginatus*			X	
	Hemigrammus sp.	X	X		
	Hyphessobrycon elachys Weitzman, 1984			X	
	Hyphessobrycon cf. *eques*	X		X	X
	Moenkhausia cf. *cotinho*	X	X		
	Moenkhausia dichroura (Kner, 1858)	X			
	Moenkhausia cf. *forestii*	X		X	X
	Moenkhausia jamesi Eigenmann, 1908	X			
	Moenkhausia cf. *lepidura* I		X		
	Moenkhausia cf. *lepidura* II	X	X		
	Piabucus melanostoma Holmberg, 1891	X			
	Poptella compressa (Günther, 1864)	X			
	Prionobrama filigera (Cope, 1870)		X		X
	Roeboides affinis (Günther, 1868)	X			
	Roeboides biserialis (Garman, 1890)	X			
	Roeboides descalvadensis Fowler, 1932	X			
	Roeboides myersii (Gill, 1870)	X	X		
	Serrapinnus sp.	X		X	X
	Stethaprion crenatum Eigenmann, 1916		X		
	Tetragonopterus argenteus Cuvier, 1816	X			
	Triportheus albus Cope, 1872	X			
	Triportheus angulatus (Spix & Agassiz, 1829)	X			
	Tyttobrycon dorsimaculatus Gery, 1973	X			
	Tyttobrycon spinosus Gery, 1973			X	
Crenuchidae	*Characidium* cf. *zebra*				X
Curimatidae	*Curimatella dorsalis* (Eigenmann & Eigenmann, 1889)	X	X		
	Curimatella immaculata (Fernández-Yépez, 1948)	X	X		X
	Curimatella meyeri (Steindachner, 1882)		X		
	Cyphocharax plumbeus (Eigenmann & Eigenmann, 1889)	X		X	X
	Cyphocharax spiluropsis (Eigenmann & Eigenmann, 1889)	X			
	Potamorhina altamazonica (Cope, 1878)	X			
	Potamorhina latior (Spix & Agassiz, 1829)	X			
	Steindachnerina leucisca (Günther, 1868)		X		
Erythrinidae	*Hoplias malabaricus* (Bloch, 1794)	X		X	
Gasteropelecidae	*Gasteropelecus sternicla* (Linnaeus, 1758)	X			
	Thoracocharax securis (Filippi, 1853)		X		

Table 2. Continued...

Family	Species	Oxbow lake	River	Artificial ponds	Floodplain
Lebiasinidae	*Pyrrhulina australis* (Eigenmann & Kennedy, 1903)	X		X	X
Serrasalmidae	*Catoprion mento* (Cuvier, 1819)	X			
	Metynnis cf. *maculatus*	X			
	Myleus sp.		X		X
	Mylossoma duriventre (Cuvier, 1818)		X		
	Pygocentrus nattereri (Kner, 1860)			X	
	Serrasalmus hollandi (Eigenmann, 1915)	X			
Hypopomidae	*Brachyhypopomus* cf. *pinnicaudatus*	X			X
	Hypopomus cf. *brevirostris*	X			X
Sternopygidae	*Eigenmannia* sp.			X	X
Auchenipteridae	*Auchenipterus* sp.	X			
	Entomocorus benjamini Eigenmann, 1917	X			
	Trachelyopterus coriaceus Valenciennes, 1840			X	
Callichthyidae	*Corydoras* cf. *negro*		X		
	Corydoras hastatus Eigenmann & Eigenmann, 1888	X		X	X
	Corydoras cf. *armatus*		X		
Doradidae	*Agamyxis pectinifrons* (Cope, 1870)	X			
	Anadoras weddellii (Castelnau, 1855)			X	
Heptapteridae	*Pimelodella* sp.	X	X		
Loricariidae	*Ancistrus* sp.	X			
	Aphanotorulus unicolor (Steindachner, 1908)		X		
	Hemiodontichthys acipenserinus (Kner, 1853)	X			
	Hypoptopoma thoracatum (Günther, 1868)		X		
	Loricaria sp.		X		
	Loricariichthys sp.	X			
	Pterygoplichthys ambrosettii (Holmberg, 1893)	X			
	Pterygoplichthys lituratus (Kner, 1854)	X			
	Squaliforma horrida (Kner, 1854)		X		
	Sturisoma cf. *nigrirostrum*		X		
Pimelodidae	*Pimelodus* cf. *blochii*		X		
	Sorubim maniradii Littmann, Burr & Buitrago-Suarez, 2001		X		
Scoloplacidae	*Scoloplax dicra* Bailey & Baskin, 1976				X
Trichomycteridae	*Ochmacanthus* sp.	X			
Rivulidae	*Pterolebias longipinnis* Garman, 1895			X	
	Anablepsoides bolivianus (Seegers, 1988)			X	X
	Trigonectes rogoaguae (Pearson & Myers, 1924)			X	X
Belonidae	*Potamorrhaphis eigenmanni* Miranda Ribeiro, 1915				X
Cichlidae	*Aequidens viridis* (Heckel, 1840)	X	X		
	Apistogramma erythrura Staeck & Schindler, 2008			X	X
	Apistogramma similis Staeck, 2003	X	X		
	Astronotus crassipinnis (Heckel, 1840)	X			
	Bujurquina cf. *vittata*	X	X		
	Chaetobranchus flavescens (Heckel, 1840)				X
	Cichla pleiozona Kullander & Ferreira, 2006	X			
	Cichlasoma boliviense Kullander, 1983	X			X
	Crenicichla lepidota Heckel, 1840				X
	Laetacara dorsigera (Heckel, 1840)			X	X
	Mesonauta festivus (Heckel, 1840)			X	X
	Mikrogeophagus altispinosus (Haseman, 1911)	X			
	Satanoperca cf. *pappaterra*	X			
Total		61	29	27	31

(Anostomidae sp., *Chalceus* sp., *Myleus* sp. and *Pygocentrus nattereri* Kner, 1858), juveniles were only collected during high water level in February.

Discussion

The present survey is among the first in the Llanos de Moxos. The high number of taxa not identified at species level reflects a high proportion of undescribed species, but may also partially be attributed to the unavailability of appropriate identification literature. An immediate need for taxonomic studies in the study area is evident. Of some taxa only juveniles, which did not show the known diagnostic characters, were caught.

Differences in species composition at a small spatial scale stress the importance of a high number of sampling sites to reliably survey the species diversity at a regional scale. This study further indicates a strong bias in taxonomical composition of the collected fish species. For most ichthyological inventories within the Bolivian Amazon gill nets or seines have been used. These methods do not seem to be appropriate to catch small fish species or species living associated with drift wood or in dense vegetation. Dip nets are suited to catch fish hiding in leave litter such as *Apistogramma* Regan, 1913 or Aspredinidae and can also be handled in flooded terrestrial vegetation to catch small characids or rivulids. Cast nets have been reported to be the method of choice to catch certain species of the dwarf catfish species *Corydoras* Lacepède, 1803 which are difficult to catch with other methods (Knaack 2002). *Corydoras* is among the most species rich fish genera in South America (Fuller & Evers 2005) and their diversity within Bolivia is currently severely underestimated.

1. Species range expansions

In this study four fish species were reported for the first time in the río Mamoré sub-drainage (see pictures on Figure 2). Five other species have been reported only be Pouilly et al. (2010), who did not provide any information about identification literature or reference collections. Several of these species experienced a substantial expansion of their known distribution range. For some species, major range expansion have already been documented by aquarium hobbyists. As access to these foreign language reports is limited, I will cite them below.

The tetragonopterine species *Hyphessobrycon elachys* Weitzman 1984 has already been reported by Staeck (2008) from the Lago Largo in the río Yata drainage (tributary of the río Mamoré). The type locality of this species lies outside of Amazonia in the río Paraguay drainage (Weitzman 1984). Such a distribution across the Amazon-Paraguay watershed is common for fish species in the upper río Madera drainage and about 25 other species found in the region of Santa Ana del Yacuma show this pattern (see also a review by Carvalho & Albert (2011) on biogeographical patterns across the Amazon-Paraguay watershed). Among these species is the large loricariid *Pterygoplichthys ambrosettii* (Holmberg 1893), which has been thought to be restricted to the La Plata basin (Weber, 2003). The individuals of *P. ambrosettii* caught in the course of the present survey were identified on the basis of a recent key by Armbruster & Page (2006). In the past *P. ambrosettii* may have frequently been confounded with *P. disjunctivus* (Weber, 1991), from which it differs by the broad white vermaculations on the ventral side of the body and the lack of vermaculations on the head (Armbruster & Page 2006).

Aequidens viridis (Heckel, 1840), *Aphyocharax rathbuni* Eigenmann, 1907, *Catoprion mento* (Cuvier, 1819) and *Cyphocharax plumbeus* (Eigenmann & Eigenmann, 1889) are reported for the first or second time respectively from río Mamoré sub-drainage. These four species have been found to be abundant in the río Iténez drainage (Vari 1992a, b, Lasso et al. 1999, Sarmiento 1999, Fuentes Rojas & Rumiz 2008; personal observations). The first three species have, like *H. elachys*, been reported earlier from the Lago Largo (río Yata drainage) in the aquarium hobbyist literature (Staeck 2010a, b).

Trigonectes rogoaguae has, to my knowledge, only been reported from its type locality at Laguna Rogoagua (Pearson 1924). I compared the specimens from Santa Ana with specimens I collected in the vicinity of the type locality (swamp at Laguna Brava and río Yacuma near Santa Rosa del Yacuma) and found it to be conspecific. The species is even more widespread and also occurs in San Borja, Magdalena and Trinidad (personal observation).

The report of *Apistogramma erythrura* Staeck & Schindler, 2008 represents the southernmost formal observation of this species, but its distribution range certainly extends further south as it also occurs in the vicinity of Reyes (personal observation). Its congeneric *A. similis* Staeck, 2003 is reported for the first time outside its type locality in the río Yata drainage. The species is widespread in rivers and ponds in the lowlands of the río Mamoré sub-drainage west of the main course of the río Mamoré (personal observations).

Tyttocharax dorsimaculatus Gery, 1973 and *Tyttocharax spinosus* Gery, 1973 have, to my knowledge, only been reported from their type locality in the upper course of the río Chapare and río Chipiriri (both tributaries of the upper río Mamoré) in the Bolivian Department Chochabamba (Gery 1973). The present report of these two species therefore represent a major extension of their known distribution range.

2. Underestimated diversity of small characids

Characids are the fourth largest fish family of the world (Eschmeyer & Fricke 2012). Within the río Mamoré drainage in Bolivia, they may account for up to one fourth of all fish species (personal observations). Many of this species are small, not exceeding five centimeter in standard length and their collection therefore requires appropriate methods. Whereas in this study 36 species of characids have been collected with dip and cast nets (35.6% of total species number) a study focusing on oxbow lakes of the río Mamoré using gill nets reported only 24 species (17.1%) (Pouilly & Rodríguez 2004). Maldonado & Carvajal (2005) caught 9 characid species using gill nets (12.2%). Farell (2006) used a broad variety of sampling techniques and obtained similar numbers of characids as in this study (40 species, 31.5%).

Species identification in the characid subfamilies Tatragonopterinae and Stevardiinae often requires detailed microscopic examination of head and teeth morphology. Even when such effort is undertaken, comparison with already described species frequently leads to unsatisfying results as morphologic description in the literature is often incomplete or covers only a small part of the geographical range of a species. Taxonomical accounts on small characids of the Bolivian characids are scarce and many species still await description. Many species can best be distinguished by their live coloration which consists mainly of black, red and yellow chromatophores and should be taken into account for future species descriptions. Whereas black markings persist in formalin or ethanol preserved specimens, red and yellow coloration often disappear after short time during the preservation process. Species identification should therefore be conducted on freshly preserved material. Pictures taken from living specimens would highly facilitate verification of species identity and would allow comparisons across collection sites and study areas.

3. Spatial and temporal occurrence of Rivulidae

Many species of the cyprinodontiform family Rivulidae are known for their seasonal life history. They grow fast and are sexually mature within a short period of time and spawn during the rainy season. They are often the most abundant fish family in temporal

Figure 2. Pictures of fishes discussed in the text: a) *Pterygoplichthys ambrosettii*, lateral view; b) *P. ambrosettii*, ventral view; c) *P. disjunctivus* (specimen collected in the río Negro (río Blanco drainage, Bolivia)); d) *Aphyocharax rathbuni*; e) *Hyphessobrycon elachis*; f) *Tyttobrycon spinosus*; g) *Cyphocharax plumbeus*; h) *Aequidens viridis* (semiadult specimen); i) *Apistogramma erythrura* (male); j) *A. erythrura* (female in breeding coloration); k) *A. similis* (male); l) *A. similis*; M) *Anablepsoides bolivianus* (male); n) *A. bolivianus* (female); o) *Pterolebias longipinnis* (male); p) *P. longipinnis* (female); q) *Trigonectes rogoaguae* (male); r) *T. rogoaguae* (female).

ponds. At the end of the rainy season, when these ponds are drying out, the fish spawn and their eggs outlast the desiccation in the substrate (Costa 2003). As access to sampling sites is limited and fish density is low during the rainy season, most ichthyological surveys are conducted in the dry season and many rivulid species are notoriously not recorded (Costa 1995). Although at least 12 species occur in the Bolivian Amazon (personal observations), ichthyological surveys rarely report more than one or two species, if any.

All three rivulid species reported here are widespread and abundant in the río Mamoré and the río Iténez drainages (personal observations). Two of them (*Pterolebias longipinnis* and *Trigonectes rogoaguae*) are strictly seasonal. The third species (*Anablepsoides bolivianus* (Seegers, 1988)) may be not annual, because no diapause is necessary to complete its reproductive cycle (Staeck 2002) and the species can be found throughout the year in its natural habitat (personal observations). A detailed study of its reproductive biology is pending. In contrast to Costa (2006) I do not consider *A. bolivianus* as a junior synonym of *A. beniensis* (Myers, 1927), following the argumentation in Seegers (1988). Pictures of these three rivulid species can be found in Figure 2.

Conclusion

Clearly, more surveys and many taxonomical studies are necessary to document the ichthyofauna of the río Mamoré sub-drainage. Sampling efforts should cover a broad variety of mesohabitats and include different sampling techniques. Taking pictures of living specimens documenting the live coloration should become common practice as they would highly facilitate species identification.

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