

Nota

New records of the leaffish *Monocirrhus polyacanthus* (Perciformes, Polycentridae) in the upper Madeira River basin, Bolivia

Nuevos registros del pez hoja *Monocirrhus polyacanthus* (Perciformes, Polycentridae) en la cuenca alta del río Madera, Bolivia

Gustavo Alvarez^{1*}, Jaime Sarmiento² & Guido Miranda-Chumacero¹

¹Wildlife Conservation Society - Bolivia, Calle Gabino Villanueva #340, entre las calles 24 y 25 de Calacoto, La Paz, Bolivia. * Corresponding author: Gustavo Alvarez, galvarez@wcs.org

²Museo Nacional de Historia Natural, Colección Boliviana de Fauna. Calle 27, Cota Cota, Campus Universitario, Casilla 8706, La Paz, Bolivia.

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The Amazon leaffish, *Monocirrhus polyacanthus* Heckel 1840, belong to the family Polycentridae. South American polycentrids are small fishes reaching about 60-80 mm SL. The dorsal fin has 16-18 spines and 7-13 rays, the anal fin 12-13 spines and 7-14. There is no lateral line in the side (Britz & Kullander 2003). The family comprise three species: *Polycentrus schomburgkii* Müller & Troschel 1849 from coastal drainages of northeastern South America, *P. jundia* Coutinho & Wosiacki 2014 from the Rio Negro basin and *Monocirrhus polyacanthus* widely distributed throughout the Amazon and the Orinoco.

Monocirrhus polyacanthus is a small fish reaching approximately 80 mm of standard length (LS), with a remarkably laterally compressed body and long dorsal and anal fins. The mouth and head are characteristically large with a strongly protractile upper jaw and a mentonian filament resembling the petiole of a leaf (Eigenmann & Allen 1921, Britz & Kullander 2003, Nelson 2006). The color varies from orange-yellow to brown with remarkable mimicry through several markings that give the appearance of dry leaves (Fig. 1). The coloration can adapt to the environment and accentuates during reproductive periods.

The species prefer oxbow lakes and streams of black water rivers, with low pH (<5.0), low conductivity (<25 µS/cm), low sediment load, low concentration of nutrients, low current speed and high transparency. These streams are typically dark due to the decomposition of plants (Barros & Higuchi 2007). Adults of the species inhabit shallow waters, near fallen leaves on the surface, taking advantage of the leaf shape to feed on prey (Barros & Higuchi 2007).

The diet is dominated by fish (Characiformes, Perciformes) and lower proportions of invertebrates including crustaceans (Decapoda) and insects (Coleoptera, Hymenoptera, Ephemeroptera, Odonata) (Catarino &

Zuanon 2010). Reproduction is unknown in the wild; the only available information comes from specimens observed in aquariums. *M. polyacanthus* has an aggressive courtship, with parental care of eggs and larvae by the male, while the female is responsible for driving away intruders (Barlow 1967).

The species is present throughout the Amazon basin and exploited by the ornamental fish trade (Pitman 2004). The presence of this species was usually reported in well-preserved forest streams (Oliveira *et al.* 2009). However, it is not as abundant as other species commonly found in the same habitat (Gutiérrez 2003). Low abundance results in its rarity in fish collections and may explain the scarcity of information about its natural history and taxonomy. The group has never been thoroughly revised, and it is possible that there are more than one species in the genus (Britz & Kullander 2003).

Monocirrhus polyacanthus was previously known from three localities in Bolivia (Cardona & Osinaga 2006). R.M. Bailey collected this species for the first time in Bolivia at the beginning of the 60 in the northeast of the country, 4 km from the border with Brazil (Cardona & Osinaga 2006). Only half a century later, the species was registered again, this time in the western part of the country, close to 200 km from the previous point (Cardona & Osinaga 2006) (Table 1, Fig. 2). According to these authors, a third specimen was later reported from the Nereuda river basin, in the extreme north of the country (Table 1, Fig. 2).

Here, we present new occurrence locations of *Monocirrhus polyacanthus* in the Madre de Dios River watershed in northern Bolivia. In addition, we conducted a review of the currently known distribution in South America, including the habitats in which leaf fish were captured.

Methods

Specimens of the Amazon leaffish were captured in oxbow lakes of the right margin of the Toromonas stream, a small tributary of the right margin of the Madre de Dios River (Table 1, Fig. 3). All localities are less than 200 m of elevation. The vegetation is a high pluvial forest more than 30 m high, with many types of swamp forest near the river or lagoons. (Fig. 4). Tall evergreen forest surrounds the

lagoons that do not exceed three hectares, while depths reach a maximum of 4 m. The substrate is mostly muddy with leaves and submerged log (Fig. 3).

Fieldwork was carried out between June-2011 and April-2012. The fish were caught with trawls of 2 and 5 meters in length, in different water bodies (lagoons) in the Toromonas stream that flow into the Madre de Dios River (Fig. 2).



Figure 1. The *Monocirrhus polyacanthus* leaffish from northern Bolivia (CBF-14547).

Captured specimens were photographed alive in the field and preserved in 10% formaldehyde, and then deposited at the Colección Boliviana de Fauna under the collection codes: CBF-14755, CBF-14756, CBF-14547, CBF-14039, CBF-14757, CBF-14758, CBF-14072 and CBF-13513. For its later identification, cataloguing and final preservation in 75% alcohol. We collected the voucher specimens under scientific permits of the Dirección General de Biodiversidad - Bolivia (MMAyA-VMCC-DGBAP-UVSAP N° 463/09).

For taxonomic determination of the specimens we used the original description of the species (Heckel 1840), as well as

Eigenmann & Allen (1921), in which the species *Monocirrhus mimophyllus*, currently considered a junior synonym of *M. polyacanthus*, is described. *Monocirrhus polyacanthus* is readily distinguished by the presence of a mental filament; ventral border of lacrimal and preopercular without serrations; marbled color pattern without horizontal series of points; 23-24 anal fin pterygiophores; $\frac{3}{4}$ of caudal fin scaled; and posterior lateral line occasionally present in *Monocirrhus* (Coutinho & Wosiacki 2014). A strongly compressed body, very large protractile gape, and a color pattern mimicking dead leaves also characterize the species.

Table 1. Previous known and new locations of leaffish (*Monocirrhus polyacanthus*) in the Madeira River basin.

Basin	Localities	Latitude	Longitude	Altitude	Reference
Mamore	Arroyo Grande	10° 50.7008"S	65° 22.1892"W	124	FishNet 2 (GBIF)
Tahuamanu	Río Nareuda	11° 18.6188"S	68° 44.8745"W	227	Cardona & Osinaga 2006
Manupare	Cráter Iturralde	12° 34.2665"S	67° 39.5733"W	160	Cardona & Osinaga 2006
Mamore	Arroyo Prado II	11° 00.7500"S	65° 55.6998"W	126	ULRA - UMSS 13261
Madeira	Arroyo Yatorana	09° 57.3402"S	65° 21.1787"W	115	CIPA -
Madre de Dios	Laguna El Ocho	12° 13.8918"S	68° 15.2362"W	169	This paper / CBF-14755
Madre de Dios	Laguna Palizada	12° 14.0753"S	68° 15.2820"W	173	This paper / CBF-14756
Madre de Dios	Laguna Toromonas 2	12° 13.3585"S	68° 15.0583"W	170	This paper / CBF-14547/ CBF-14039
Madre de Dios	Laguna Cusisal	12° 15.0873"S	68° 15.9092"W	171	This paper / CBF-14757/ CBF-14758
Madre de Dios	Laguna Toromonas 1	12° 12.9200"S	68° 14.4362"W	163	This paper / CBF-14072/ CBF-13513

Monocirrhus from the upper Madeira River in Bolivia were found in small (< 3 ha) and shallow (< 4 m) black water lakes.

New records. Bolivia, La Paz, Laguna el ocho (12° 13.8918" S, 68° 15.2362" W), G. Alvarez coll., 07/07/2011, CBF-14755 (1). Bolivia, La Paz, Laguna Palizada (12° 14.0753" S, 68° 15.282" W), G. Alvarez coll., 08/07/2011, (CBF-14755 (1). Bolivia, La Paz, Laguna Toromonas 2 (12° 13.3585" S, 68° 15.0583" W), G. Alvarez coll., 05/07/2011, CBF-14547 (3). Bolivia, La Paz, Laguna Toromonas 2 (12° 13.3585" S, 68° 15.0583" W), G. Alvarez coll., 26/04/2012, CBF-14039 (1). Bolivia, La Paz, Laguna Cusisal (12° 15.0873" S, 68° 15.9092" W), G. Alvarez coll., 08/07/2011, CBF-14757 (4). Bolivia, La Paz, Laguna Cusisal (12°

15.0873" S, 68° 15.9092" W), G. Alvarez coll., 28/10/2011, CBF-14758 (1). Bolivia, La Paz, Laguna Toromonas 1 (12° 12.920" S, 68° 14.43.62" W), G. Alvarez coll., 27/04/2011, CBF-14072 (1).

Two further records of *Monocirrhus polyacanthus* were added for Bolivia: 1) the Yatorana stream in the Bruno Racua Wildlife Reserve of the Madeira River basin, from research carried out by Centro de Investigación para la Preservación de la Amazonia of the University of Pando (CIPA, UAP, H. Calderón, no collection number) and 2) in the Prado II stream of the Mamoré basin, based on studies by the Unidad de Limnología y Recursos Acuáticos of University of Cochabamba (ULRA, UMSS, M. Maldonado, collection number: UMSS 13261) (Table 1).



Figure 4. Distribution of *Monocirrhus polyacanthus* in South America.

Discussion

The current distribution map of *Monocirrhus polyacanthus* in South America, allows us to identify three large “distribution areas” of the species. The most obvious corresponds to the Orinoco basin in Colombia and Venezuela. Secondly, the main stem of the Amazon from upper Peru to the east coast of Brazil (in which two secondary areas can be differentiated upstream and downstream). Thirdly the most marginal area that includes the southern isolated localities of the upper Madeira River in Bolivia (Figs. 2 & 4). The *Monocirrhus polyacanthus* record in the Toromonas stream basin is the southernmost of the species for the Madeira River basin (Table 1).

Britz and Kullander (2003) estimated that the family Polycentridae possibly includes more species than the currently accepted. However a recent revision of the genus *Polycentrus*, the other genus in Polycentridae, identified the presence of at least four three new species (Coutinho 2010).

Keeping in mind the wide extension of *Monocirrhus*, the presence of physical barriers that could favor the processes of speciation and isolation (Losos & Schluter 2000, Dias *et al.* 2013), the idea currently accepted that fish (and other groups) speciation in the Amazon could be an event as recent as Late Miocene (Hoorn *et al.* 2010, Lundberg *et al.* 2010); and lifting of Fitzcarrald Arch that has probably controlled the speciation of aquatic populations such as freshwater fish

that began to diverge 4 My ago (Espurt *et al.* 2010, Hubert *et al.* 2007), it is possible to expect the presence of a hidden diversity in *Monocirrhus*.

The species would correspond, therefore, to the so-called forest species, for which the great white water rivers, characteristic of the upper Madeira River basin, represent insurmountable barriers, because the size of rivers and by the chemical nature of the waters (Weitzman & Weitzman 1982, Sstrom *et al.* 2009, Duncan & Fernandes 2010, Piggot *et al.* 2011).

A bibliographic review collected distributional information in the Madeira River basin and beyond, thereby detailing the known altitudinal gradient for the species, which runs from the Amazon estuary at sea level, to the highest point at 231 m elevation in the Venezuelan Orinoco. The highest records in the Amazon basin are presented in this study (170 and 229 m elevation).

The *Monocirrhus polyacanthus* record in the Toromonas stream basin is the southernmost of the species for the Madeira River basin (Table 1). This does not allow us to think that it could be a new genetic identity for *Monocirrhus*. Therefore, we suggest expanding biogeographic, genetics and classical morphology studies to determine the possibility of the existence of more than one species of *M. polyacanthus* in South America.

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