

***Apistogramma barlowi* sp. n.:** **Description of a new facultative mouth-breeding cichlid species** **(Teleostei: Perciformes: Geophaginae) from Northern Peru**

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> Abstract

Apistogramma barlowi sp. n. is described based on a total of 32 specimens from small tributaries of the Rio Ampiyacu near the village of El Pozo, District Santa Maria, Province Mariscal Ramon Castilla, Departamento Loreto, Peru (near 71°55'W and 03°10'S). *Apistogramma barlowi* sp. n. is separated from all other *Apistogramma* species by the combination of over-proportionally large head and jaws, in males lyrate caudal-fin horizontally divided in two colour zones, extended first membranes of the dorsal fin, a distinct breast band in basal part of vertical bar 2 and posterior lateral spot in females, missing caudal peduncle spot, and, unique in *Apistogramma*, facultative biparental mouth-breeding. *Apistogramma barlowi* sp. n. is a representative of the *Apistogramma-cacatuoides*-complex living in small brooks.

> Resumen

Apistogramma barlowi sp. n. ha sido descrita en base de 32 especímenes, provenientes de pequeños tributarios del Rio Ampiyacu cerca de El Pozo, Distrito Pebas, Provincia Mariscal Ramon Castilla, Departamento Loreto, Perú (cerca 71°55'Oeste y 03°10'Sur). *Apistogramma barlowi* sp. n. es diferenciada de otras especies de *Apistogramma* por su combinación de: la cabeza y mandibulares relativamente grande, la aleta caudal tiene la forma de una lira en machos y que es dividida verticalmente en dos zonas diferentes (de la coloracion), las membranas de la aleta dorsal prolongadas, una banda distinta en la base de la banda vertical numero 2 y una mancha lateral caudal de la misma, absente de una mancha en la raiz de la aleta caudal, y, unico en el genero de *Apistogramma*, presencia facultativa de nidificacion en la boca biparental. *Apistogramma barlowi* sp. n. es un representante del *Apistogramma-cacatuoides*-complejo y vive en esteros pequenos bosquosos.

> Kurzfassung

Apistogramma barlowi sp. n. wird auf Basis von 32 Exemplaren beschrieben, die aus kleinen Zuflüssen des Rio Ampiyacu bei El Pozo stammen, Distrikt Pebás, Provinz Mariscal Ramon Castilla, Departamento Loreto, Peru (nahe 71°55'W / 03°10'S). Die Art ist unterschieden von allen anderen *Apistogramma*-Arten durch die Kombination von überproportional großem Kopf und Kiefern, bei Männchen leierförmiger Schwanzflosse, die längs in zwei unterschiedlich gefärbte Zonen geteilt ist, verlängerten vorderen Membranen der Dorsale, bei Weibchen deutlichem Brustband in der Basis des Querbandes 2 und dahinter liegenden Lateralfleck, fehlendem Schwanzwurzelfleck und, einzigartig in der Gattung *Apistogramma*, fakultativem biparentalen Maulbrüten. *Apistogramma barlowi* sp. n., ein Vertreter des *Apistogramma-cacatuoides*-Komplexes, lebt in kleinen Waldbächen.

> Key words

Systematics, ichthyology, freshwater, ecology, reproductive behaviour, new taxa.

Prefatory Remarks

In the last decades numerous new *Apistogramma* species have been discovered in Peru, including some taxa from the *Apistogramma cacatuoides* and *Apistogramma-nijsseni* phylogenetic groups. Some of these forms have been scientifically studied and described for the first time only in recent years (KULLANDER, 1980, 1986, RÖMER *et al.*, 2003, 2004a-b, 2006b-d, STAECK, 1991). However, there are still several of the Peruvian forms awaiting formal description. Amongst these we find one exceptional species with extraordinary behavioural pattern by showing out biparental mouth-breeding behaviour. This species, initially known under the trade-name *Apistogramma* sp. „breast-band“ and/or *Apistogramma* sp. „Maulbrüter“, was imported alive to Europe in autumn of the year 1999. First specimens collected from the field were available since early 2003 for our studies, but seemed not to be sufficient for a formal description, as only very large specimens and only two females had been preserved. Nevertheless, referring to our research carried out within the last four years these fish undoubtedly represent a distinct species and hence, after more freshly preserved and also material of smaller size from the field became available in 2007, can now be formally described.

Materials and methods

Methods of counts and measurements were described in detail by RÖMER (2006) and RÖMER *et al.* (2003, 2004, 2006). Exceptional deviations from this methodology are commented in the text. Specimens were preserved in 75 % ethanol (as justified by RÖMER 2000a). To gain optimal colouration results after preservation in *Apistogramma*, we have established a procedure to cool down specimens after narcotizing to temperatures close to freezing (~1 °C) before storing them in 75 % ethanol. Specimens treated like this are perfect for further taxonomical investigation, as they spread out their fins while temperatures are continuously falling. Under this conditions they also expose all significant black markings, as chromatophores are opening to their maximum. We are fully aware, that this procedure will be extremely complicated to realize in the field sometimes, especially in the Amazonian tropical rain forest. We therefore plead to collect and keep some specimens alive to be able to preserve them immediately after return to the laboratory (or to the next available refrigerator) in the given way. But *Apistogramma*-specimens put down by MS 222 or other chemicals usually show more or less contracted

chromatophores and in most cases folded fins, which makes especially smaller specimens more complicated to be handled during research work. DNA-samples of 29 specimens were taken for further investigation and registered under the same individual numbers as originating specimens. An extensive and sufficient description of live colouration of this species has already been presented by RÖMER (2006) at length in connection with numerous figures of several live specimens of both sexes in different behavioural stages and moods (RÖMER, 2006). These figures have to be included in this study as supplementary pictorial reference material. Therefore notes on live colouration are restricted to basically important diagnostic details on the basis of that publication (RÖMER, 2006). The description of preserved specimens is based on the holotype, supplemented by observations on all paratypes. Methods for behavioural diagnostics have been partially depicted by ECKERT-HETZEL *et al.* (2001), RÖMER & BEISENHERZ (2005, 2006), and RÖMER *et al.* (2006a). Apart from that, reproductive behaviour was observed in the laboratory. Fish were kept in either small sexually balanced groups of 10 specimens, giving them the opportunity for intra- and inter-sexual interaction as well as for free mate choice, or separated in pairs. All aquaria were filled with soft (100 μ S/cm) and slightly acid water (pH 6–6,5), fine silicate sand, some pieces of driftwood, beech leaves, and a surface cover of drifting plants (*Lemna* sp.).

Apistogramma barlowi sp. n.

(Figs. 1–8 & 10, Tabs. 1–3)

Material. Holotype. (fig.1) MTD F 30777, male, 60.0 mm SL, Peru, Departamento Loreto, Province Mariscal Ramon Castilla, District Pebas, in the vicinity of El Pozo, small forest creek tributating to the río Ampiyacu-system (about 71°55'W/03°10'S); March 2003, leg. Julio Melgar. **Paratypes:** 31 specimens: CAS 225474, 2 males, 47.9–63.7 mm SL, 1 female, 43.9 mm SL; CAS 225475, 3 males, 44.2–53.0 mm SL, 1 female, 46.4 mm SL; FMNH 117734, male, 57.2 mm SL; MTD F 30770, male, 48.6 mm SL, cleared & stained; MTD F 30772, male, 52.6 mm SL, cleared & stained; MTD F 30773, 2 males, 39.2–51.0 mm SL; same collection data as given for holotype. CAS 225477, 1 male, 36.9 mm SL, 1 female, 42.2 mm SL; FMNH 117735, 1 male, 53.5 mm SL; MTD F 30769, 1 male, 47.9 mm SL; MTD F 30771, 1 male, 50.1 mm SL, 1 female, 44.7 mm SL; Peru, Departamento Loreto, Province Mariscal Ramon Castilla, District Pebas, in the vicinity of El Pozo; small forest creek tributating to the río Ampiyacu-system (about 71°55'W/03°10'S); December 2002, leg. Julio Melgar, exported alive, preserved immediately after importation. CAS 225476, 1 male, 33.9 mm SL, 1 female, 29.7 mm SL; FMNH 117736, 3 males, 28.8–39.7 mm SL, 1 female, 37.3 mm SL; FMNH 117737, 2 females, 32.6–37.8 mm SL; FMNH 117738, male, 36.8 mm SL; MTD F 30768, 2 females, 31.2–34.9 mm SL; MTD F 30774, 1 male, 40.1 mm SL,

1 female, 31.4 mm SL; Peru, Departamento Loreto, Province Mariscal Ramon Castilla, District Pebas, in the vicinity of El Pozo; small forest creek tributating to the río Ampiyacu-system (about 71°55'W/03°10'S); February 2007, leg. Miguel Angel Espinoza & Andrew Rowe, exported alive, preserved two weeks after importation.

Supplementary material (non types). 25 live males and 25 live females kept in the aquarium for behavioural observation, which will be kept in the personal collection of UR after preservation, and figures of *Apistogramma barlowi* sp. n. in RÖMER (2006, under the name *Apistogramma* sp. "Brustband / breast-band"). **Comparative material.** As listed in RÖMER (1994, 1997, 2006), RÖMER & WARZEL (1998), and RÖMER *et al.* (2003, 2004, 2006b-d).

Diagnosis. The species is readily differentiated. *Apistogramma barlowi* sp. n. is distinguished from all other *Apistogramma* species known to date on the basis of the combination of the following characters: in adult males the disproportionately large head and the enormously enlarged mouth with massive jaws and hypertrophic lips, unique within the genus. *Apistogramma barlowi* sp. n. is a large (males up to 63 mm, females to 46 mm SL), high-backed, laterally compressed, and little elongated *Apistogramma* species from the *Apistogramma-cacatuoides*-complex, exhibiting a pronounced morphological sexual dimorphism and sexual dichromatism. This new species shows only 3 infraorbital pores, a lyrate caudal fin in adult males with immaculate lemon-yellow lower lobe and vertical rows of spots in its upper bluish hyaline lobe, truncate and immaculate in females. Sub-adult males show prolonged lappets in the anterior half of the dorsal fin, fully adult males in the entire length of the fin; old males develop lappets of the dorsal spines 4 to 6 of more than twice the length of the spines. No caudal-peduncle spot present, but a longitudinal band, about one and a half scales wide, extends to the base of the caudal fin. During threat display this longitudinal band fades partially on the anterior half of the body, at the same time becoming more intense on the posterior part, along with the vertical bars 4 to 7. Moreover in this mood or in aggression the lips often become deep grey to sooty black in colour. Most adult females show a unique pattern of black markings, consisting of a distinct lateral spot at the intersection of the longitudinal band with vertical bar 3 and a distinct vertical band (missing in small juvenile specimens) extending from the lower margin of the longitudinal band to the centre of the belly, anterior to the position of vertical bar 2, i.e. immediately behind the pectoral fin base. Females and juvenile males display a usually roundish, in exceptional cases squarish, lateral spot not extending above the margins of the longitudinal band. In most specimens the cheek stripe is about as wide as the pupil and extends from the eye to the lower posterior margin of the operculum in both sexes, but may be widened in a few females to about the width of the

eye. The throat membrane of adult specimens is dark brown to black.

Description. Morphological characters taken from 31 specimens (28.8 to 63.7 mm SL), one damaged, excluded from data. For biometric data see tables 1 & 2, for meristic data see table 3.

Habitus. [fig. 1–7, 9&10, for sketches of habitus see RÖMER (2006a)] The body of this sexually dimorphic species is overall remarkably deep (32.0–41.7 % SL, mean 36.2 % SL) compared to other species of the genus, distinctly compressed laterally, about twice deeper than wide, the head long (32.8–42.7 % SL, mean 36.8 % SL), altogether producing a strikingly robust appearance. There are statistically significant meristic differences in the morphometrics between sexes. Adult males are usually about a fifth to a quarter bigger than females, have slightly smaller eyes, bigger praeorbital depth, upper and lower jaws, wider interorbital bone, shorter pelvic, but longer last dorsal and anal fin spines. Upper head profile regularly convex, with a slight indentation above the eye, more expressed in bigger males, leaving a "humped" impression; lower head profile only slightly curved, in large males about straight from the lip to posterior margin to lower jaw where slightly curving upwards and continuing straight to the lower posterior edge of the unserrated operculum. The mouth is terminal and, in comparison, even for species of this phylogenetic group, notably large, jaws stout, long lower jaw (about 12.5–19.8 % SL, mean 16.8 % SL), allometry of jaws about linear in relation to body size in smaller specimens, in larger ones soft positive correlation; lips extremely thick and hypertrophied folded; maxillary extending to about a vertical between the front margin of the pupil and the centre of the eye; eye relatively small (diameter 8.7–12.7 % SL); cheeks and gill covers completely scaled, scale pattern as shown for *Apistogramma cacatuoides* HOEDEMAN, 1951 in KULLANDER (1986); 5 dentary and 3 infraorbital pores. Ventral fins [V I.5 (n = 31)] only slightly prolonged, in both males and females only exceptionally extending to the anus, in no specimen examined extending to the anal fin base. Pectoral fins [11 (n = 1), 12 (n = 26), 13 (n = 4)] transparent, with a few small spots of brownish pigment along the fin-rays. Dorsal fin [D. XIV.7 (n = 1), XIV.8 (n = 1), XV.6 (n = 2), XV.6.i (n = 5), XV.7 (n = 10), XV.8 (n = 2), XVI.6 (n = 5), XVI.7 (n = 3), XVI.7.i (n = 1)] extending back to the posterior margin of the caudal fin in adult males with significantly pointed soft partition, in some cases even to the tip of the caudal fin streamers, rounded, rarely slightly pointed but not extended in females; length of spines increasing from D1 to D6 or to D7, thereafter remaining roughly constant; last dorsal spine normally longest; dorsal membranes sig-



Fig. 1. *Apistogramma barlowi* sp. n., holotype, MTD F 30777, male, 60.0 mm SL.



Fig. 2. *Apistogramma barlowi* sp. n., paratypes, MTD F 30774; bottom: female, 31.4 mm SL, normal colour pattern; top: male, 40.1 mm SL, showing abnormal colour pattern of irregular black spots.

nificantly prolonged past the tips of the hard rays; in adult males extensions of all membranes except of D1 about double of the length of the spines; lappets 2 to 5, rarely to 7 longest and regularly reaching back beyond the posterior edge of the dorsal fin base. Anal fin [A. III.6 (n = 18), III.7 (n = 6), III.8 (n = 2), IV.5 (n = 1), IV.6 (n = 4)] pointed and extended with its soft portion to the posterior edge of the caudal fin in adult males, rounded in females and smaller males and reaching onto the first third of the caudal fin when folded. Caudal fin with 14 (n = 1), 15 (n = 1) to 16 (n = 29) principal soft rays; in males of about 35 mm SL or larger slightly asymmetrically lyrate, in females of about 35 mm SL or larger truncate, in exceptional cases carrying short tips in position of male's streamers, rounded in smaller specimens; lower lobe longer than upper; caudal rays V4 (-5) and D3 (-4) prolonged relative to the remaining rays (approx. up to 10 % of SL), the intervening rays around the same length and thus forming a straight edge, the outer rays decreasing rapidly in length; caudal fin in both sexes scaled on its first third to half. In adults, the caudal peduncle is 20 to 35 % deeper than long, in the larger specimens up to 50 %. Squamation as given for *Apistogramma martini* (RÖMER *et al.*, 2003); scales in a median longitudinal row 20 to 23 [20 (n = 1), 21 (n = 22), 22 (n = 6), 23 (n = 1), 1 damaged]; 14 scales around the caudal peduncle (n = 29). Dentition, gill rakers, and pharyngeal elements have been excluded from this study, as these are part of further investigations in progress.

Coloration of preserved specimens (described after preservation of six month and five to seven years in 75% ethanol; only slight differences visible between specimens in intensity of colouration after different times of conservation, fresh material from 2007 overall slightly darker) (fig. 1–2): Basic colour of body predominantly light brownish, somewhat darker on the dorsum in a number of specimens, margins of body scales with somewhat darker edgings. Several of the specimens examined show irregular sooty spots (fig. 2), which as far as known may be attributed either to virus and/or bacterial infections or to environmental disturbance of the calcium metabolism (and which could also be frequently detected in live specimens observed, compare fig. 7). Lips, unscaled lower parts of cheeks, praeoperculum, infraorbital, lower jaw, and pectoral fin base whitish. In a few specimens lips basically whitish blue with dusky frontal parts, in some half-grown specimens distinct blackish interorbital stripe with widened oval centre and narrowed edges close to the orbitals. Praeorbital, scaled parts of cheeks, and operculum light brownish; operculum with a more yellowish brown area directly above the blackish cheek stripe. Cheek in both sexes as wide as the pupil, beginning between foramina 1 and 2 of the

posterior orbital of the suborbital series (for terminology see KULLANDER, 1987), running backwards in a straight line between the lateral canal foramina (LCF) 10 and 11 across the posterior half of the cheek to the lower posterior margin of the operculum. Blackish grey snout stripe about half as wide as cheek stripe, visible in few specimens only. Chin and central parts of branchiostegal membrane dark grey to blackish. Forehead from the interorbital to the back below the first dorsal spine brownish like the upper parts of the body. Iris dark, bluish grey, in some specimens with greenish grey lower zone. Abdominal stripes and anal spot absent in all specimens studied. Lateral band straight, about one scale high in the frontal third, widening to about one and a half scale height in the posterior part, stretching from the hind edge of the orbital to just above the middle of the caudal fin base, absent in most bigger males. Other than in live specimens only in a few female specimens distinct blackish band on lower half of the body on position of vertical bar 2. Faint roundish to oval lateral spot at the position of vertical bar 3, missing in larger males. Seven vertical bars on the body visible only in sub-adult to semi-adult individuals, narrow below lateral band, about as wide as interspaces, wider on dorsal part of the body, leaving interspaces about half as wide as bars. No distinct dorsal spots. No caudal peduncle spot visible. In some males two irregular rows of four to six small blackish spots on the caudal peduncle, reminiscent of spots above the anal fin base in types of *Apistogramma atahualpa* RÖMER, 1997, *Apistogramma huascar* RÖMER *et al.*, 2006, or *Apistogramma payaminonis* KULLANDER, 1986. Under the microscope caudal fin with small light greyish to pale brownish spots, leaving cloudy milky to greyish white impression, upper lobe with 10 to 14 vertical rows of hyaline translucent spots, in females the whole fin without any pattern. Base colour of all other fins likewise cloudy milky to pale grey or, in some bigger males, light brownish. Pectorals finely greyish pigmented, little darker along the fin rays. Ventral fins in males without dark markings, in females the anterior part along the spine and the adjacent three (rarely four) soft rays densely speckled with dark black-brown spots leaving about two thirds of the fin blackish grey. Anal fin with a faint greyish edging. Colouration of dorsal fin uniform, without margins, bands or other distinct markings except first membrane, in both sexes significantly darker, in males dark greyish, in females blackish. Soft portion of dorsal fins with up to four, the anal fin in bigger specimens with up to six rows of hyaline spots (missing in anal fin of smaller males).

Coloration of live specimens and sexual dimorphism: *Apistogramma barlowi* sp. n. is highly sexually dimorphic and dichromatic. Mature males (fig. 3–5)



Fig. 3. *Apistogramma barlowi* sp. n., adult dominant male, not preserved, showing typical live colouration.

Fig. 4. *Apistogramma barlowi* sp. n., juvenile male, not preserved, showing colouration of beginning maturity.

initially have a truncate, later a clearly lyrate caudal fin, while in juvenile males and females it is rounded, and at most slightly truncate in older female individuals. In males the fin typically is divided in two colour zones horizontally, the upper lobe bluish with faint hyaline spots, the lower lobe unspotted yellowish to orange. The translucent caudal fin of females (fig. 6–7) is carrying no pattern, in some cases its basal third appears yellowish. The dorsal fin in males is serrate, with clear-

ly extended membranes in the anterior part, and with the soft-rayed portion prolonged to a point. In some adult males the tips of the fin membranes may show up in yellow or orange colour, just like the tip of the soft portion of the dorsal fin of such specimens. The dorsal fin of the female is neither pointed and prolonged nor serrate and missing any prolonged membranes, but may carry a dusky margin occasionally. The ventral fins in males are transparent whitish blue to yellowish



Fig. 5. *Apistogramma barlowi* sp. n., sub-adult male, not preserved, showing rarely visible lateral band.

Fig. 6. *Apistogramma barlowi* sp. n., adult female, not preserved, specimen in breeding colouration showing typical black breast pattern.

green with yellow-orange tips; those of the female, by contrast, are black or grey at the base, and yellow or red-orange posteriorly. Immature females may show four to five pronounced vertical bars (fig. 8). After the onset of sexual maturity, females usually show a yellowish-coloured body, typically exhibiting the specific conspicuous vertical black band on the flank immediately caudally to the pectorals (fig. 6–7), males by contrast only a small lateral spot (fig. 3).

Systematics. *Apistogramma barlowi* sp. n. is a member of the *Apistogramma-cacatuoides*-complex within the *Apistogramma-steindachneri*-lineage (nomenclature following RÖMER, 2006c). On the basis of cluster analysis studies of the phylogenetic relationships within the genus (RÖMER, 2006c), this species, along with two further forms (formerly three, compare below), constitutes the *Apistogramma*-sp.-“breast-band“-sub-complex (now to be named *Apistogramma-barlowi*-



Fig. 7. *Apistogramma barlowi* sp. n., adult female, not preserved, specimen in breeding colouration showing extreme irregular black spot pattern caused by unspecified disease.



Fig. 8. *Apistogramma barlowi* sp. n., juvenile female, not preserved, showing blackish band pattern.

subcomplex) within this species-rich phylogenetic group. This subcomplex represents the basal sister group to the remaining subcomplexes and species of the *Apistogramma-cacatuoides*-complex.

Distribution and ecology. The species is known only from around the “Tierra típica” northwest of Pebas in northern Peru (fig. 9). At present confirmed finds and ecological information relate solely to the type locality and a few small forest streams nearby. J. MELGAR (pers. comm. 2000 & 2001) has caught them in various little streams in the Rio Ampiyacu drainage north-

west of Pebas, but the collecting sites are only sporadically productive. The fact that this species is also caught only in ones and twos by other collectors, and offered in very small numbers, may additionally point to remoteness of collecting sites or to the extreme life history. On the basis of information provided by J. MELGAR (pers. comm.), *Apistogramma barlowi* sp. n. appears to be limited to forest streams (igarapés), with a preference for fast-flowing, cooler, and crystal-clear, acid to neutral water, which may be taken as an indication of habitats in the headwaters of the water systems inhabited. BREEZE (2007) recently published a reported

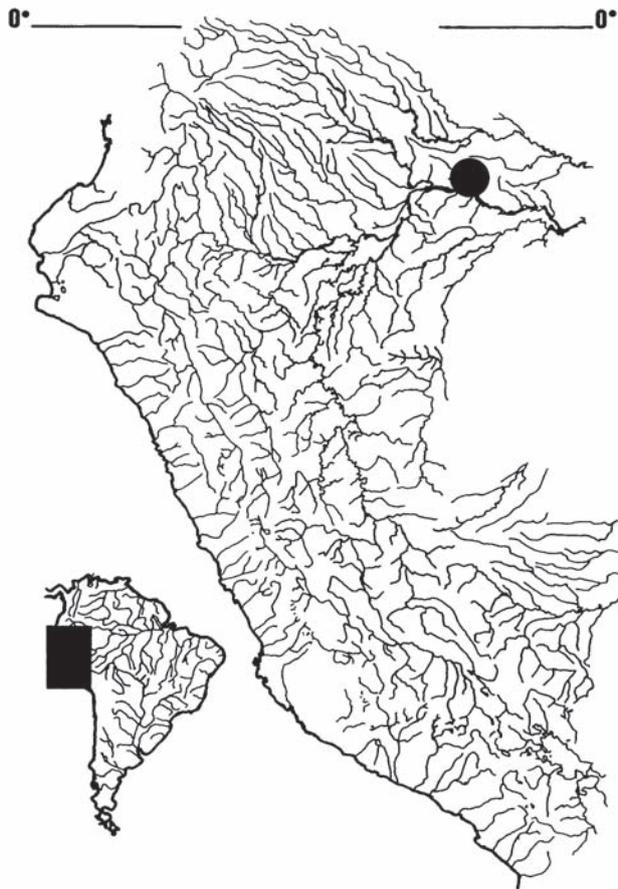


Fig. 9. Map of Peru, distribution of *Apistogramma barlowi* sp. n., type locality indicated by ●.

on his aquarium observations on the species, including a photograph of a collecting site as well as field data collected at the end of the dry season in October/November 2006 by Tom CHRISTOFFERSEN, who independently confirmed most of the known data. CHRISTOFFERSEN collected a reddish morph of *Apistogramma barlowi* sp. n. in a small clearwater igarapé, about one meter wide and approximately 30 cm deep, with fine white sand as bottom substrate, no submerged vegetation, rocks or pebbles, a pH of 4.8, electrical conductivity of $26 \mu\text{S}/\text{cm}$ at a temperature close to 29°C . The only other *Apistogramma*-species collected syntope was *Apistogramma agassizii* (STEINDACHNER, 1875). Judging this data base, distribution and ecology of *Apistogramma barlowi* sp. n. are only scarcely known and require further studies in the field.

Etymology. This species is named *barlowi* in honour of George W. BARLOW, one of the most productive and notably leading behavioural ichthyologists of the last decades. He was born on 15th June 1929 at Long Beach, California and passed away aged 78 years on 14th July 2007. His continuous work and publication on cichlid fish biology has substantially contributed to our present knowledge of this family of the *Teleostei*. He always had an open mind for new and surprising



10. *Apistogramma barlowi* sp. n., adult male, not preserved, frontal view while mouth-breeding.

biological ideas and consequently gave them a fair chance to be tested in his laboratory at the University of California at Berkeley. George was amongst the first to seriously discuss consequences of Environmental Sex Determination in *Apistogramma* species with UR in the 1990s, and, of course, noticed the potential behavioural and socio-biological impact of this fascinating mechanism for individual female as well as species reactions on environmental changes. His comments, always constructive and mostly humorous, have influenced the work of numerous ichthyologists including the authors of this paper. His latest book “The Cichlid Fishes: Nature’s Grand Experiment in Evolution” will, as already noted by Richard DAWKINS, “delight and enlighten naturalists for generations to come”.

Biology: A detailed summarizing report on the behaviour of this species in the aquarium has been given by RÖMER (2006a). Supplementary data on breeding behaviour may also be taken from BREEZE (2007). Most important behavioural features are the highly ritualised threat behaviour and facultative mouth-breeding. In frontal threat behaviour, males are digging and building up little sand piles possibly demonstrating the size of their mouth to opponents as well as their capacity to carry larvae or fry to females selecting their part-

ner for reproduction. Females take their larvae into the mouths and, unique within the genus, keep them inside almost constantly during their further development to the free-swimming stage. The larvae are usually put down only to permit feeding. In a significant number of cases facultative mouth-breeding by males has been registered too by different observers (fig. 10), but no published quantitative details are available on roles of the sexes in this specific brood care behaviour at the time being. According to our laboratory observation the degree of male participation, as well as the number of females carrying out mouth-breeding behaviour, may be dependent from maintenance conditions, especially the strength of current and the type of bottom substrate in the tank. We observed a significantly higher number of mouth-breeding females on fine sand and in strong current, mouth-breeding males exclusively under such conditions. Recently BREEZE (2007), based on observation of wild caught specimens, confirmed most of our observations on the reproductive behaviour, but was not able to observe male involvement in larvophilic mouth-breeding, which may be due to insufficient maintenance conditions for this. Facultative biparental mouth-breeding to date is unique within the genus and thus is diagnostic in determination of live specimens of this species. But as information on this behaviour is still incomplete, more investigations are required on it in the laboratory and in the field in particular.

Discussion

Amongst the described species of *Apistogramma* there is only one that somehow resembles the new species described here. Females of *Apistogramma panduro* RÖMER, 1997 may be mistaken for *Apistogramma barlowi* sp. n., but are easily distinguishable by the different position of the breast band on the lower half of the body: female *Apistogramma panduro* show the vertical band in position of bar 3, while those of *Apistogramma barlowi* sp. n. generally show it closer to the head immediately caudally to the pectoral fins in the position of the vertical bar 2. In spite of the fact, that we observed this vertical band in all female specimens kept alive, we can not confirm this for all specimens preserved in the field. From long time observations we have explaining evidence, that missing or extremely faded black markings in preserved *Apistogramma*-specimens are basically the result of sub-optimal to poor preservation techniques. We therefore judge this pattern as autapomorphic in *Apistogramma barlowi* sp. n.. In addition, we have not become aware any female of one of the two species in quest showing

bands in position of both vertical bars yet, but some in *Apistogramma panduro* that never developed a distinct breast band. These specimens usually show some variable black spots in the position where the band usually turns up. In addition, female *Apistogramma barlowi* sp. n. frequently show a black lateral spot in the crossing position of the lateral band and vertical bar 3, which is never the case in *Apistogramma panduro*. Males are easily distinguishable by the different shape of the dorsal (only slightly extended lappets in *A. panduro*) and caudal fins (rounded in *A. panduro*), and different colour of the caudal peduncle.

From *Apistogramma brevis* KULLANDER, 1980, *Apistogramma personata* KULLANDER, 1980, and the two still unidentified forms *Apistogramma* sp. "Breitbinden" and *Apistogramma* sp. "Tail-spot", the species newly described herein is distinguished by proportionally much larger head and jaws, narrow cheek stripe (instead of broadened spot like band), and lack of regular rows of black abdominal markings present in the other species mentioned. *Apistogramma barlowi* sp. n. is sufficiently distinguished from all other species within the genus by its unique shape, colouration, and behaviour. However, for unknown reasons KOSLOWSKI (2002) claimed to have found a specimen resembling the species we describe here amongst the type series of *Apistogramma klausewitzii* MEINKEN, 1962 (a junior synonym of *Apistogramma bitaeniata* PELLEGRIN, 1936). UR has back-checked the type material in quest (SMF 5526 to SMF 5531) twice (1994, 2006) and, following KULLANDER (1980, 1986), reconfirmed the identity of that specimens with *Apistogramma bitaeniata* (compare RÖMER 1998, 2006). Photos taken by UR at SMF in 1994 and published in RÖMER (2000a) [pp. 988 (all PT) and 992 (HT)] show the complete type series of *Apistogramma klausewitzii* and undoubtedly demonstrate the false of KOSLOWSKI's remark.

Several type specimens of *Apistogramma barlowi* sp. n. show irregular spots all over the body. The same type of spots has been observed regularly in specimens of *Apistogramma cactuoides* HOEDEMAN, 1951 collected at various locations in the wider surroundings of Iquitos (UR, unpublished data). At present no detailed information about its origin and frequency in the wild is available. The pathogenic character of the spots is stressed by the fact that the survival rate of infected specimens is significantly reduced in captivity compared to normal fish, as well by the fact that, following our observations, specimens kept in the aquarium lose this pattern under long time antibiotic treatment. The varying extend of the infection respectively the body surface covered by the spots may affect taxonomic studies on such specimens. Larger spots may camouflage normal black pattern of infected specimens, but in our case the size of the type series has given us the opportunity to leave out critical information on black

colour pattern taken from such doubtful specimens. In fact this was only the case in two specimens inspected in this study. We used these fish for clearing and staining procedure, which obviously leads to results independent from such problematic effects.

In the year 2006 RÖMER had claimed that the fish introduced under the provisional name *Apistogramma* sp. “Brustband / breast-band”, which we describe in this paper as *Apistogramma barlowi* sp. n., may consist of two different taxa, only distinguished by their reproductive behaviour (RÖMER, 2006a & c). One of this species would have to be seen as a cryptic syntope species, as both behavioural forms had been collected in the same location (J. MELGAR pers. comm. 2001). The concept of cryptic taxa, not mentioned explicitly before in connection with *Apistogramma* species, may be useful to be kept in mind for this species rich genus, as it may (and should) turn the awareness of researchers to the fact that standard methods in present research may not be sufficient to differentiate some of the taxa at hand. This, and findings published by RÖMER & BEISENHERZ (2005), stress the importance of qualified and reproducible ethological studies on *Apistogramma* species for taxonomic purposes (also compare RÖMER *et al.*, 2006a, RÖMER & BEISENHERZ 2006). Other investigations (READY *et al.*, 2006), in spite of some methodological problems, basically confirm the results published by RÖMER and co-workers. Further intense behavioural studies carried out on larger numbers of these fish since that publication (RÖMER 2006) could not confirm the “cryptic species hypothesis” to date. However, in the contrary, even for individual specimens extremely high plasticity and changeability of the reproductive behaviour of *Apistogramma barlowi* sp. n. as a response to environmental factors was repeatedly observed. We are therefore stressing here that, especially regarding this evidence, we are now judging the two behavioural morphs originally observed as belonging to only one single species, to *Apistogramma barlowi* sp. n.. Recently BREEZE (2007), based on observation of wild caught specimens, independently confirmed this opinion.

The most striking autapomorphic characters of *Apistogramma barlowi* sp. n. undoubtedly are the extraordinary reproductive behaviour (described at length by: RÖMER, 2006a-c, BREEZE, 2007) and the over proportionally head and mouth. The species of this genus of small (dwarf) cichlids have more or less regularly turned out to be extremely variable in morphology as well as in behaviour (summarised in RÖMER, 2000a, 2006a-c): Amongst mating strategies polygamy, polyandry, as well as monogamy have been reported in the genus. Even sex roles have been reversed in some species. As a result of variable mate choice systems, some species have evolved extreme sexual size polymorphism as well as some species show uniform or

even reversed sizes of sexes. Breeding has been reported from various habitats in the wild. Males may monopolise ecological resources as well as females or just sneak around in other males territories. Females have their own specific strategies, for example when stealing fry from neighbouring females or pairs to reduce the relative mortality of their own siblings. Environmental sex determination and female manipulation of sex ratio amongst offspring have also been detected and examined in extensive studies in the laboratory as well as in the field. The only strategy in reproductive biology missing was mouth-breeding amongst *Apistogramma* species. As one would have postulated that a fish should have a certain “critical” body size to be capable of mouth-breeding, one would not have expected *Apistogramma* to be able to carry out this efficient brood care behaviour well known from various Geophagines taking in mind the small size of *Apistogramma*-species known.

This idea erroneously ignores, that results of several observations on reproduction in the laboratory as well as in the field have shown, that the reproductive success of the *Apistogramma* species investigated significantly depends on the mouth-carrying capacity of the female guarding fry picking up its offspring when potential predators are present (RÖMER, 2000a, 2001). On this background mouth-breeding had to be expectable in the genus *Apistogramma*. However, none of the species investigated before had developed any form of real mouth-breeding behaviour, as larvae or fry are only picked up for short-time or short-distance transport. In *Apistogramma barlowi* sp. n. this is completely different. When the first specimens of *Apistogramma barlowi* sp. n. were imported in 1999, based on laboratory observations of the highly evolved intra-sexual threat and inter-sexual display behaviour of males, the unusual size and appearance were seen as the result of progressed sexual selection by female mate choice (RÖMER, 2000b).

After the species has been identified as facultative biparental mouth-breeding, this thesis may have to be partially revised. Size may not exclusively correlate with the mating system. In rapidly radiating species groups morphology may also turn out to be highly dependent from environmental factors. The fact that *Apistogramma barlowi* sp. n. may turn out to be the largest species of the genus known¹, may indeed be correlated with its Peruvian sub-andean origin. In this geological active region hydrological conditions may change extremely fast. Even small rivers for short periods may have comparably strong current, taking off the

¹ Only one specimen of the Guianan *Apistogramma steindachneri* (REGAN, 1908), a male of 65 mm SL, has been reported to be larger by KULLANDER (1986).

preferred elements structuring *Apistogramma* habitats like leaf litter or driftwood, and just leaving shear and possibly highly mobile sand, or just gravel, pebbles, or bigger logs and rocks. Such conditions would rapidly destroy the breeding resources of substrate oriented *Apistogramma* species and turn a given habitat into sub-optimal conditions for any *Apistogramma* species given. Data collected by D.J. STEWARDS in connection with the type material of *Apistogramma payaminonis* (compare KULLANDER, 1986) may indicate that such a scenario may indeed be realistic. And indicating that it may be a standard situation for *Apistogramma*-species even way off the Andean foot hills, this sort of scenario has also been reported from the central Amazon rain forest (RÖMER, 1994). Under such given circumstances facultative mouth-breeding could turn out to be a successful evolutionary stable strategy to keep up breeding success. Aquarium experiments in

progress have already shown that the mouth-breeding frequency amongst tested fish of both sexes increased significantly with growing current (RÖMER *et al.*, in prep.). These results may be interpreted as evidence for the facultative mouth-breeding strategy of *Apistogramma barlowi* sp. n. being evolved as a response to environmental factors rather than as a result of mate choice and intra-sexual competition. Species undergoing explosive adaptive radiation processes are typically showing high managing potentials for extreme environmental conditions. The genus *Apistogramma* does show indications of such an explosive radiation actually going on. And most *Apistogramma* species investigated clearly show such potentials, possibly making *Apistogramma barlowi* sp. n. an highly plastic example still in the process of undergoing an extreme adaptation to the environment.

Tab. 1: Biometric data taken from *Apistogramma barlowi* sp. n. type specimens (in % SL; SL given in mm).

	all specimens				males				females			
	(n)	Mean	Minimum	Maximum	(n)	Mean	Minimum	Maximum	(n)	Mean	Minimum	Maximum
SL	32	43.0	28.8	63.7	21	45.9	28.8	63.7	11	37.4	29.7	46.4
TL	32	131.6	118.7	147.0	21	132.1	118.7	147.0	11	130.7	125.6	135.8
TLS	32	133.9	121.7	147.0	21	135.3	121.7	147.0	11	131.0	125.6	139.1
HL	32	36.8	32.8	42.7	21	36.4	32.8	42.7	11	37.7	35.3	40.7
HD	32	29.5	26.7	35.5	21	29.6	26.7	35.5	11	29.1	27.4	32.3
BD	32	36.2	32.0	41.7	21	36.3	32.2	41.7	11	35.9	32.0	39.0
HW	32	19.6	17.5	23.7	21	19.7	17.5	23.8	11	19.4	18.0	22.4
PDL	32	39.3	36.5	43.1	21	39.3	36.9	42.2	11	39.4	36.5	43.1
TDL	32	89.7	87.0	101.3	21	90.0	87.3	101.4	11	89.2	87.0	92.0
PPL	32	41.6	38.5	47.3	21	41.8	39.6	47.3	11	40.8	38.5	43.3
PAL	32	75.1	11.0	82.6	21	74.2	11.0	82.6	11	76.7	72.7	82.4
TAL	32	87.6	82.1	96.4	21	88.1	83.8	96.4	11	86.8	82.1	90.7
Eye	32	10.5	8.8	12.9	21	10.2	8.8	11.8	11	11.0	9.7	12.9
SNL	32	11.3	8.7	14.1	21	11.3	9.4	13.9	11	11.1	8.7	14.1
CHD	32	10.6	8.7	12.6	21	10.7	8.7	12.6	11	10.4	9.1	12.0
POD	32	5.2	4.0	6.4	21	5.4	4.1	6.4	11	4.8	4.0	6.4
IOW	32	9.3	7.7	12.0	21	9.6	7.9	11.9	11	8.8	7.7	10.4
UJL	32	13.9	8.8	17.7	21	14.4	8.8	17.7	11	13.0	11.0	14.8
LJL	32	16.8	12.5	19.8	21	17.1	14.0	19.8	11	16.3	12.5	18.1
CPD	32	16.1	11.6	18.1	21	16.0	11.6	18.1	11	16.2	15.0	18.0
PL	32	13.5	10.6	18.4	21	13.9	10.6	18.4	11	12.9	10.7	14.2
DFB	32	57.3	54.0	69.9	21	57.7	54.3	69.9	11	56.6	54.0	59.9
AFB	32	18.9	14.9	22.1	21	19.3	14.9	22.2	11	18.2	17.1	20.1
PecL	32	27.4	21.3	30.7	21	26.7	21.3	30.7	11	28.6	23.0	30.7
PeiL	32	27.1	21.4	39.3	21	28.1	21.9	39.3	11	25.2	21.4	29.5
PeiSL	32	11.7	9.3	13.4	21	11.5	9.3	13.4	11	12.2	11.2	13.4
LDS	32	13.6	9.5	18.0	21	14.3	9.5	18.0	11	12.3	9.6	13.9
LAS	32	13.9	11.6	16.1	21	14.2	13.3	16.1	11	13.2	11.6	14.6

Tab. 2: Biometric data taken from *Apistogramma barlowi* sp. n. type specimens (given in mm, abbreviations see table 1).

Coll.-No	Sex	SL	TL	TLS	HL	HD	BD	HW	PDL	TDL	PPL	PAL	TAL
CAS 225474	♂ PT	63.7	75.6	82.9	22.7	18.9	24.2	13.0	25.3	56.9	27.2	43.7	55.1
CAS 225474	♂ PT	47.9	61.9	61.9	16.7	13.8	17.0	9.6	18.5	43.5	19.5	34.2	42.0
CAS 225474	♂ PT	43.9	56.1	56.1	16.3	13.6	16.3	9.8	18.9	39.7	19.0	32.9	39.8
CAS 225475	♂ PT	53.0	69.2	70.5	19.2	15.3	18.7	9.6	19.6	47.4	23.4	36.9	47.1
CAS 225475	♂ PT	45.3	61.6	63.6	16.6	12.8	14.8	7.9	18.5	41.0	18.2	31.7	40.5
CAS 225475	♂ PT	44.2	59.1	59.1	15.9	12.7	15.9	8.5	17.2	40.7	19.0	32.3	39.4
CAS 225475	♂ PT	46.4	60.9	60.9	17.5	13.2	18.0	8.5	18.0	41.9	19.4	32.2	40.6
CAS 225476	♂ PT	33.9	45.1	45.1	13.2	9.5	10.9	6.5	13.6	29.6	14.0	22.8	28.6
CAS 225476	♂ PT	29.7	37.3	37.3	10.6	8.2	9.5	5.4	10.8	25.8	11.7	19.6	24.4
CAS 225477	♂ PT	36.9	49.1	52.2	12.7	10.8	13.3	8.7	14.0	32.7	15.4	26.2	32.8
CAS 225477	♂ PT	42.2	54.9	54.9	15.8	12.5	16.0	9.1	16.5	37.1	17.8	29.8	37.0
FMNH 117734	♂ PT	57.2	75.2	77.3	20.5	17.4	20.9	12.2	22.1	51.1	25.2	41.8	51.7
FMNH 117735	♂ PT	53.5	70.1	70.1	17.6	14.3	19.0	10.1	20.5	47.6	22.1	37.2	47.6
FMNH 117736	♂ PT	39.7	54.6	57.0	17.0	12.5	15.0	8.2	16.7	35.6	16.6	28.2	34.6
FMNH 117736	♂ PT	34.0	45.2	45.7	12.2	9.8	12.0	6.3	14.0	30.5	14.6	23.9	29.6
FMNH 117736	♂ PT	28.8	38.7	38.7	10.2	8.5	9.9	5.5	11.6	25.5	11.7	19.8	24.6
FMNH 117736	♂ PT	37.3	49.3	49.3	13.8	11.4	14.1	7.5	14.2	33.0	15.0	25.3	32.0
FMNH 117737	♂ PT	37.8	49.4	49.4	15.2	12.2	13.2	7.2	15.7	33.4	16.0	26.2	32.1
FMNH 117737	♂ PT	32.6	42.9	42.9	11.5	8.9	11.2	6.1	12.5	29.1	13.1	22.4	28.1
FMNH 117738	♂ PT	36.8	48.8	50.4	14.3	11.3	13.7	7.1	15.0	32.3	15.0	25.4	30.8
MTD F 30768	♂ PT	34.9	46.1	46.1	12.8	10.1	12.4	6.3	13.9	30.5	13.4	24.6	30.1
MTD F 30768	♂ PT	31.2	40.6	40.6	11.7	8.8	10.7	5.9	12.2	27.6	12.4	21.5	26.7
MTD F 30769	♂ PT	47.9	63.3	66.1	16.9	13.7	16.8	9.3	17.8	42.6	19.7	33.3	42.3
MTD F 30770	♂ PT	48.6	64.4	64.4	17.0	15.0	17.8	9.7	18.3	43.4	19.2	34.1	42.1
MTD F 30771	♂ PT	50.1	73.6	73.6	18.7	17.8	20.9	11.5	21.1	50.7	23.7	37.5	48.3
MTD F 30771	♂ PT	44.7	60.6	62.1	17.4	12.8	17.4	9.0	17.8	41.1	18.7	31.9	40.0
MTD F 30772	♂ PT	52.6	64.0	64.0	18.9	16.8	20.4	10.3	19.5	48.7	21.8	39.5	49.1
MTD F 30773	♂ PT	51.0	66.2	68.8	18.6	15.0	20.6	9.7	20.3	46.2	20.3	45.1	45.6
MTD F 30773	♂ PT	39.2	53.0	55.0	14.7	11.5	13.3	7.3	14.8	34.4	16.6	26.2	33.7
MTD F 30774	♂ PT	40.1	53.5	54.8	15.1	11.6	14.5	7.8	16.3	35.7	16.3	27.7	34.0
MTD F 30774	♂ PT	31.4	40.8	40.8	12.8	8.6	10.5	5.9	12.2	28.7	12.5	21.7	27.7
MTD F 30777	♂ HT	60.0	77.6	82.5	20.6	17.0	22.0	11.7	22.7	53.3	24.6	41.3	52.0

Eye	SNL	CHD	POD	IOW	UJL	LJL	CPD	PL	DFB	AFB	PecL	PeL	PeSL	LDS	LAS
5.6	8.6	7.2	3.8	6.4	10.3	12.1	10.3	8.9	34.9	12.5	14.1	18.4	6.2	8.7	8.7
4.5	5.4	5.4	2.8	4.7	6.1	8.0	7.1	5.9	28.9	9.3	10.2	10.5	4.8	6.5	6.5
4.7	6.2	4.0	2.0	4.0	5.3	6.9	7.3	6.2	24.9	7.6	10.1	9.4	4.9	4.2	5.1
4.8	6.3	5.6	3.2	5.0	8.2	8.5	7.8	6.2	30.7	10.5	12.6	16.6	5.5	8.2	7.1
4.6	4.7	4.3	2.6	4.5	6.7	7.9	7.5	7.2	26.3	9.0	12.0	10.5	5.3	4.3	6.1
4.6	5.5	4.8	2.4	4.2	6.2	7.4	7.3	6.1	25.0	8.6	12.0	11.2	5.3	6.6	6.5
5.4	5.8	5.3	2.1	4.2	6.3	7.5	8.4	6.3	27.8	8.6	12.4	10.2	5.6	6.3	5.9
3.7	3.9	3.2	1.7	3.0	4.7	5.6	5.4	4.8	18.6	6.2	8.6	9.6	4.1	5.0	5.2
3.1	2.6	2.9	1.2	2.4	3.7	4.9	4.5	3.2	16.7	5.5	8.4	7.2	3.5	3.5	3.9
3.6	3.5	3.3	1.7	2.9	4.8	5.2	6.0	3.9	21.0	7.3	9.8	9.9	4.5	5.1	5.2
4.9	4.4	4.4	2.6	4.2	6.1	7.6	6.9	5.1	22.8	7.2	13.0	10.0	4.8	4.4	5.4
5.5	8.0	6.0	3.4	5.8	8.7	9.4	9.1	7.1	31.8	10.9	15.7	16.5	7.4	10.3	8.6
5.5	5.9	5.5	3.1	5.0	8.1	8.9	8.8	7.0	30.6	11.2	13.6	15.3	5.4	6.7	7.1
4.0	4.6	4.4	2.2	3.7	6.2	7.5	6.7	6.0	22.1	7.3	12.2	12.5	5.3	5.6	5.4
3.6	3.3	3.0	1.6	2.7	4.4	5.6	5.5	4.1	18.5	6.1	10.0	9.2	4.1	4.6	4.6
3.2	3.0	2.9	1.3	2.4	2.5	4.0	4.4	4.1	16.1	5.3	7.9	8.8	3.6	4.0	4.3
3.6	3.6	4.0	1.8	3.2	5.0	6.0	6.0	5.0	21.9	7.1	11.1	10.6	4.8	5.2	5.0
3.8	4.1	3.9	1.8	2.9	4.8	6.8	6.2	5.0	20.5	6.6	11.4	9.9	4.5	4.5	4.5
3.4	3.1	3.2	1.6	2.9	3.6	4.1	4.9	4.6	18.3	6.5	9.0	8.0	4.3	4.3	4.6
4.3	4.6	4.1	1.9	3.5	5.5	7.3	6.0	6.8	20.0	5.5	11.2	9.7	4.3	4.6	5.1
3.7	4.2	3.8	1.7	2.8	4.6	5.2	5.7	4.4	19.5	5.9	10.6	9.1	4.2	4.6	4.7
3.4	3.3	3.0	1.4	2.7	3.7	5.1	4.9	3.8	17.5	5.4	9.4	8.0	3.9	3.9	4.4
4.8	6.1	5.4	2.7	4.6	7.1	8.0	5.5	7.7	28.2	9.2	11.7	12.8	5.4	7.8	6.9
5.2	5.5	5.8	2.0	5.0	7.8	8.0	8.5	5.2	28.4	10.0	13.4	10.9	5.6	7.4	7.3
5.2	5.0	6.2	3.2	6.0	8.8	9.6	8.7	6.2	35.0	11.1	13.8	13.3	5.9	7.3	7.4
5.3	5.2	5.4	2.8	4.6	6.6	7.7	7.4	5.9	26.0	8.1	12.4	11.4	5.5	5.6	5.8
5.5	5.7	6.0	3.1	5.8	7.7	8.6	9.5	7.2	31.1	11.2	13.4	20.7	5.6	7.5	7.2
5.2	5.5	6.4	3.1	5.0	7.8	9.8	7.9	7.8	30.8	10.1	13.8	13.2	5.7	7.8	7.7
4.6	4.2	3.8	1.8	3.3	5.6	6.9	6.3	5.6	22.5	7.5	11.8	12.5	5.1	6.5	6.3
3.7	4.0	4.4	2.0	3.5	4.7	7.2	6.7	5.8	22.5	7.0	11.7	12.6	4.7	5.3	5.4
4.0	3.6	3.1	1.2	2.6	4.2	5.6	4.9	4.1	17.7	6.1	9.4	9.3	4.0	4.1	4.6
5.4	7.5	6.6	3.8	6.6	9.1	10.4	9.6	8.7	35.1	11.5	15.3	16.9	5.6	9.2	8.2

Tab. 3: Meristic data taken from *Apistogramma barlowi* sp. n. type specimens (SL given in mm, abbreviations see table 1).

Coll.-No	Sex	SL	DF (h)	DF (s)	DF (n)	AF (h)	AF (s)	PF (h)	PF (s)	PecF	CF	
CAS 225474	♂ PT	63.7	14	7	0	4	6	1	5	12	16	
CAS 225474	♂ PT	47.9	16	6	0	4	6	1	5	11	16	DF
CAS 225474	♂ PT	43.9	15	7	0	3	6	1	5	12	16	dorsal fin
CAS 225475	♂ PT	53.0	16	7	0	3	8	1	5	12	16	
CAS 225475	♂ PT	45.3	15	6	0	3	6	1	5	12	16	AF
CAS 225475	♂ PT	44.2	16	6	0	4	6	1	5	12	16	anal fin
CAS 225475	♂ PT	46.4	15	6	0	3	6	1	5	12	16	
CAS 225476	♂ PT	33.9	15	8	0	3	7	1	5	13	16	PF
CAS 225476	♂ PT	29.7	15	8	0	3	6	1	5	12	16	pelvic fin
CAS 225477	♂ PT	36.9	15	7	0	3	8	1	5	12	14	
CAS 225477	♂ PT	42.2	15	6	1	3	7	1	5	12	16	PecF
FMNH 117734	♂ PT	57.2	15	7	0	3	6	1	5	12	16	pectoral fin
FMNH 117735	♂ PT	53.5	16	6	0	3	7	1	5	12	16	
FMNH 117736	♂ PT	39.7	14	8	0	3	6	1	5	12	16	CF
FMNH 117736	♂ PT	34.0	16	6	0	3	6	1	5	13	16	caudal fin
FMNH 117736	♂ PT	28.8	15	7	0	3	6	1	5	12	16	
FMNH 117736	♀ PT	37.3	16	6	0	3	6	1	5	12	16	(h)
FMNH 117737	♀ PT	37.8	15	7	0	3	6	1	5	12	16	hard rays
FMNH 117737	♀ PT	32.5	15	7	0	3	7	1	5	12	16	
FMNH 117738	♀ PT	36.8	15	7	0	3	6	1	5	12	16	(s)
MTD F 30768	♀ PT	34.9	15	6	1	3	6	1	5	12	15	soft rays
MTD F 30768	♂ PT	31.2	15	7	0	3	6	1	5	12	16	
MTD F 30769	♂ PT	47.9	15	6	1	3	6	1	5	12	16	(n)
MTD F 30770	♂ PT	48.6	16	7	0	3	6	1	5	13	16	minor soft rays
MTD F 30771	♂ PT	50.1	15	6	1	3	6	1	5	12	16	
MTD F 30771	♂ PT	44.7	15	7	0	3	7	1	5	12	16	
MTD F 30772	♂ PT	52.6	15	6	1	3	7	1	5	13	16	
MTD F 30773	♂ PT	51.0	16	6	0	4	5	1	5	12	16	
MTD F 30773	♂ PT	39.2	15	7	0	3	6	1	5	12	16	
MTD F 30774	♂ PT	40.1	15	7	0	3	6	1	5	12	16	
MTD F 30774	♂ PT	31.4	16	7	1	3	6	1	5	12	16	
MTD F 30777	♂ HT	60,0	16	7	0	4	6	1	5	12	16	

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