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A new species of *Microglanis* (Siluriformes: Pseudopimelodidae) from the upper rio Tocantins basin, Goiás State, Central Brazil

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A new species of *Microglanis* is described from the upper rio Tocantins basin, Barro Alto, Goiás State, Brazil. This species is distinguished from the others by presenting a unique color pattern, consisting of round spots in the flank between the larger dark brown blotches. Moreover, it can be distinguished by the combination of the following features: caudal fin emarginate, the upper lobe slightly larger than the lower, lateral line relatively long, reaching vertical through posterior margin of the pelvic fin, and light stripe on supra-occipital region absent or very narrow and with irregular shape.

Uma espécie nova de *Microglanis* é descrita da bacia do alto rio Tocantins, Barro Alto, estado de Goiás, Brasil. Essa espécie distingue-se das demais por apresentar um padrão de colorido único, constituído por manchas arredondadas no flanco entre as manchas castanho escuras maiores. Além disso, pode ser diferenciada pela combinação dos seguintes caracteres: nadadeira caudal emarginada, com o lobo superior ligeiramente maior que o inferior, linha lateral relativamente longa, atingindo a vertical que passa pela margem posterior da nadadeira pélvica, e faixa clara na região supraoccipital ausente ou muito estreita e com formato irregular.

Key words: Bumble-bee catfish, Multivariate morphometrics, Neotropical, Systematics.

Introduction

Microglanis Eigenmann, 1912 is a group of catfishes easily identified by the small size (less than 8 cm SL), incomplete lateral line, body with large dark brown blotches, and premaxillary tooth plate laterally rounded (Schultz, 1944; Gomes, 1946; Mees, 1974).

The geographic distribution is very broad in South America, occurring in coastal rivers of the trans-Andean region of Peru and Ecuador, and in major watersheds of cis-Andean region (Shibatta, 2003). Among these, the Araguaia-Tocantins basin was only recently recognized as area of distribution of genus, with the description of three new species (Ruiz & Shibatta, 2010; Ruiz & Shibatta, 2011). Particularly to the rio Tocantins basin, only *M. robustus* Ruiz & Shibatta, 2010 was described to date, but with known distribution restricted to the region of Tucuruí hydroelectric power plant, in Jatobal, Pará State.

Recently, analyzing the collection of *Microglanis* of Instituto Nacional de Pesquisas da Amazônia (INPA), a new species was discovered from the upper rio Tocantins basin, rio dos Patos, Barro Alto. With the description of this new species, the number of known species of *Microglanis* (Jarduli & Shibatta, 2013) is increasing to 22, highlighting the Araguaia-Tocantins basin as one of the richest in *Microglanis* species.

Material and Methods

Morphometric variables of four specimens were taken point-to-point with digital caliper with accuracy of 0.01 mm, under a stereomicroscope. Both counts and measurements were taken on the left side of specimens whenever possible. Measurements were taken following Mori & Shibatta (2006), with addition of head depth (measured at vertical through posterior margin of eye), and body depth at dorsal fin origin, totaling 22 morphometric variables. All measurements were presented as percents of standard length (SL), and the subunits of head were also presented as percents of head length (HL). Meristic data included counts of gill-rakers,

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serrations of pectoral-fin spine, lateral line pores, and dorsal, pectoral, pelvic, anal and caudal-fin rays. Roman numerals indicate unbranched rays and Arabic numerals represent branched rays. In the diagnosis and description of species, the frequency of each meristic data is presented in parenthesis and the counts of the holotype are followed by asterisks. Only the holotype was x-rayed to count ribs and vertebrae. Two additional specimens of the new species were collected with sieves, euthanized by hyper exposure of anesthetic Eugenol (*c*. 3000 mg/L; Lucena *et al.*, 2013), fixed in 10% formalin solution and preserved in 70% ethanol. Specimens of *M. robustus*, other species of rio Tocantins basin, were used to perform the sheared Principal Components Analysis (McLeod, 1990). For this analysis, 19 variables were selected from original morphometric list (excluding pelvic fin length, posterior cleithral process length, and caudal peduncle length, due to limitations on number of morphometric variables accepted by the program). Physical (temperature) and chemical (dissolved oxygen, pH, and conductivity) variables were taken with multiparameter equipment, depth of water and river width were taken with measuring tape, and the velocity of water was calculated as the time (in seconds) covered by an fluctuant object in a distance of five meters.

Institutional abbreviations are: ANSP (Academy of Natural Sciences of Drexel University, Philadelphia); CAS (California Academy of Sciences, San Francisco); INPA (Instituto Nacional de Pesquisas da Amazônia, Manaus); MCP (Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre); MEPN (Museo de la Escuela Politécnica Nacional de Quito, Ecuador); MNHNP (Museu Nacional de Historia Natural del Paraguay, San Lorenzo); MNRJ (Museu Nacional, Rio de Janeiro); MZUEL (Museu de Zoologia da Universidade Estadual de Londrina, Paraná); MZUSP (Museu de Zoologia da Universidade de São Paulo, São Paulo); MHNG (Muséum d'histoire naturelle de la Ville de Genève, Geneva); USNM (National Museum of Natural History, Smithsonian Institution,Washington, DC); and ROM (Royal Ontario Museum, Toronto).

Microglanis maculatus, new species

Figs. 1-3

Holotype. INPA 41133, 36.5 mm SL, Brazil, Goiás, município de Barro Alto, upper rio Tocantins basin, ribeirão Pouso Alegre, tributary of rio dos Patos, 15°01'26"S 48°49'51"W, 12 Jul 2010, O. A. Shibatta, A. Claro-García, L. R. Jarduli & E. Santana da Silva.

Paratypes. INPA 24044, 2, 21.4-25.8 mm SL, Brazil, Goiás, município de Barro Alto, Igarapé Veredas, rio dos Patos basin, 17 Jun 2004, G. M. dos Santos. MZUEL 5925, 1, 20.5 mm SL, same data as holotype.

Diagnosis. *Microglanis maculatus* differs from all its congeners by the presence of rounded spots in the flank. Furthermore, it differs from its congeners, except *M. robustus*, by the following combination of features: caudal fin emarginated with upper lobe slightly longer than the lower, light spot in nuchal region very small or absent. *Microglanis maculatus* differs from *M. robustus* by single hooks on anterior margin of pectoral-fin spine (*vs*. bifurcated hooks between antrorse and retrorse hooks), rays of pectoral fin I, 6 (*vs*. I, 5); anterior blotch of trunk U shaped (*vs*. inverted U shaped); broad dark stripes on dorsal and caudal fins (*vs*. thin), lower values of dorsal-fin spine length (6.9-11.1% SL *vs*. 11.3-15.4% SL), pectoral-fin spine length (12.9-17.7% SL, *vs*. 16.4-20.6% SL), and orbital diameter (11.5-12.6% SL *vs*. 14.7-16.4% SL); and higher values of mouth width (16.8-17.5% SL *vs*. 11.4-13.2% SL).

Description. Morphometric data are presented in Table 1. Body depressed from snout to dorsal-fin origin; posteriorly compressed. Profile slightly oblique upward from snout tip to posterior nostril, slightly convex from posterior nostril to nape, and convex from nape to dorsal-fin origin. Profile from dorsal-fin origin to end of adipose-fin base almost straight (not considering adipose fin), oblique downward. Dorsal profile straighter on small specimens (Fig. 2). Ventral profile from tip of lower jaw to end of anal-fin base slightly convex, almost straight. More convex in young specimens (Fig. 2). Head large, wider than deep. Mouth terminal, slightly prognathous. Opercular membrane large, well developed. Eye relatively small, lateral-superiorly positioned, covered by skin. Anterior nostril tubular, over lip. Maxillary barbel reaching distal opercular edge. Outer mental barbel reaching pectoral-fin base. Anterior cranial fontanel not extending beyond posterior orbital border.

Dorsal fin trapezoidal; posterior border rounded; origin anterior to midpoint of standard length; not reaching adipose-fin origin when adpressed; first lepidotrichium ("spinelet") small and rigid, forming dorsal-fin locking mechanism; second ray forming spine; I, 6*(4). Adipose fin slightly elongated, posterior border angular and free. Pectoral fin triangular, not reaching pelvic-fin origin when adpressed; first ray rigid and strongly serrate on both sides (only retrorses hooks on anterior margin of pectoral fin in small specimens, and antrorses and retrorses in large specimen (Fig. 3), all single; I, 6*(4). Pelvic fin rounded, originating just posterior to vertical through end of dorsal-fin base, not reaching anal-fin origin when adpressed; i, 5*(4). Distal profile of anal fin rounded; anal-fin base length slightly smaller than adipose-fin base; iii, 7*(2) or iv, 5(2). Caudal fin emarginated, lobes distal profile rounded, upper lobe slightly longer than lower lobe; principal rays 7, 8*(4).

Pores of lateral-line extending just beyond vertical through posterior margin of pelvic-fin. Total gill rakers 7(1), 8(1), or 9*(2). Axillary pore absent. Six ribs; free vertebral centra 26 (total = 32 vertebrae) in holotype.

Color in alcohol. Dorsal region of head, from tip of snout to nape, dark brown, ventrally continuing in suborbital and opercular region to horizontal passing through angle of mouth; intermediate region with light blotch. Ventral region

Fig. 1. *Microglanis maculatus*, holotype, INPA 41133, 36.5 mm SL, ribeirão Pouso Alegre, tributary of rio dos Patos, upper rio Tocantins basin, Barro Alto, Goiás State, Brazil.

Fig. 2. *Microglanis maculatus*, paratype, MZUEL 5925, 20.5 mm SL, ribeirão Pouso Alegre, tributary of rio dos Patos, upper rio Tocantins basin, Barro Alto, Goiás State, Brazil.

of head light with dark spots. Trunk between nape and end of dorsal fin with "U" shaped dark brown blotch. Dorsal region between end of dorsal and adipose fins with dark stripe. Second dark stripe extending along axis of body. Dark blotch at end of caudal peduncle elongated, roughly hexagonal. Lateral and ventral region of body light with several small rounded spots, several merged forming clumps. First pectoral-fin ray with faint dark spot; other pectoral fin rays with series of dots in middle region. Dorsal fin bearing a broad "C"-shaped dark blotch, elongated; upper edge of dorsal fin and inner area of "C"-shaped blotch hyaline. Adipose fin with dark blotch in its middle region, edges light brown. Pelvic and anal fins hyaline, with dark spots along approximately half length of rays. Caudal-fin dark stripe approximately "3"-shaped, broad, top, and bottom edges contacting caudal-peduncle dark blotch.

Table 1. Morphometric data of *Microglanis maculatus* (n = 4). SD = standard deviation.

	Holotype	Paratypes Min.-Max.	Mean±SD
Standard length (mm)	36.5	20.5-36.5	-
Percents of standard length			
Head length	28.2	26.3-28.2	27.4±0.958
Head depth	10.5	10.3-11.3	10.8±0.459
Interorbital width	12.4	12.4-13.5	12.9±0.455
Orbital diameter	3.3	3.2-3.6	3.3±0.155
Snout length	11.6	9.6-11.6	10.7±0.834
Mouth width	17.0	16.8-17.5	17.1±0.305
Maxillary barbel length	26.6	19.0-30.4	24.5±5.001
Pelvic fin length	17.4	17.4-20.0	18.5±1.252
Dorsal-fin spine length	10.2	6.9-11.1	9.8±1.961
Pectoral-fin spine length	14.2	12.9-17.7	15±2.009
Posterior cleithral process length	10.2	9.6-10.6	10.1±0.432
Predorsal length	36.6	35.8-38.3	36.8±1.063
Prepelvic length	50.3	47.2-50.5	48.8±1.826
Preanal length	70.6	67.2-70.6	69.1±1.490
Caudal peduncle depth	11.6	11.6-15.7	13.2±1.821
Caudal peduncle length	17.0	15.2-18.2	16.7±1.276
Body width	26.6	25.2-27.2	26.3±0.854
Body depth at dorsal fin	17.6	17.6-20.5	19.6±1.390
Dorsal-fin base length	13.3	12.1-13.3	12.8±0.515
Adipose-fin base length	28.7	21.0-28.7	24.4±3.351
Anal-fin base length	13.7	13.5-14.9	14.0±0.633
Percents of head length			
Interorbital width	43.8	43.8-49.6	47.2±2.436
Orbital diameter	11.5	11.5-12.6	12.1±0.439
Snout length	41.1	34.2-41.7	39.1±3.420
Mouth width	60.3	60.3-66.5	62.7±2.719
Maxillary barbel length	94.2	70.9-115.4	89.7±19.67
Head depth	37.0	37.1-43.0	39.4±2.527

Distribution. *Microglanis maculatus* is known from the rio dos Patos basin, upper rio Tocantins basin, in Barro Alto, Goiás State, Brazil (Fig. 4).

Habitat. The specimens from the ribeirão Pouso Alegre were collected at the mouth of a creek amid the adventitious roots

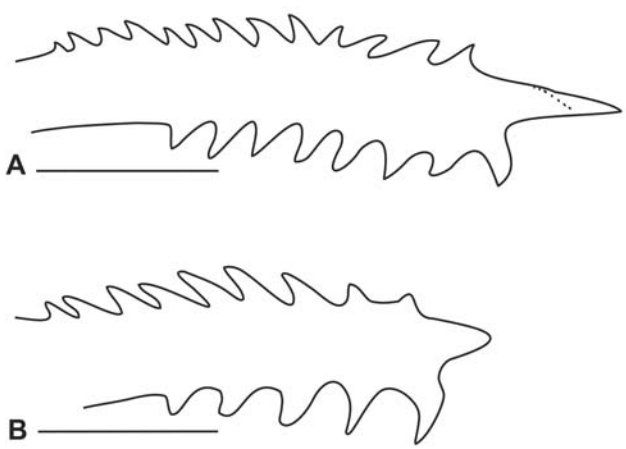

Fig. 3. Dorsal view of left pectoral-fin spine of (a) holotype (INPA 41133, 36.5 mm SL) and (b) paratype (MZUEL 5925, 20.5 mm SL) of *Microglanis maculatus*, from ribeirão Pouso Alegre, tributary of rio dos Patos, upper rio Tocantins basin, Barro Alto, Goiás State, Brazil. Scale bar = 1 mm.

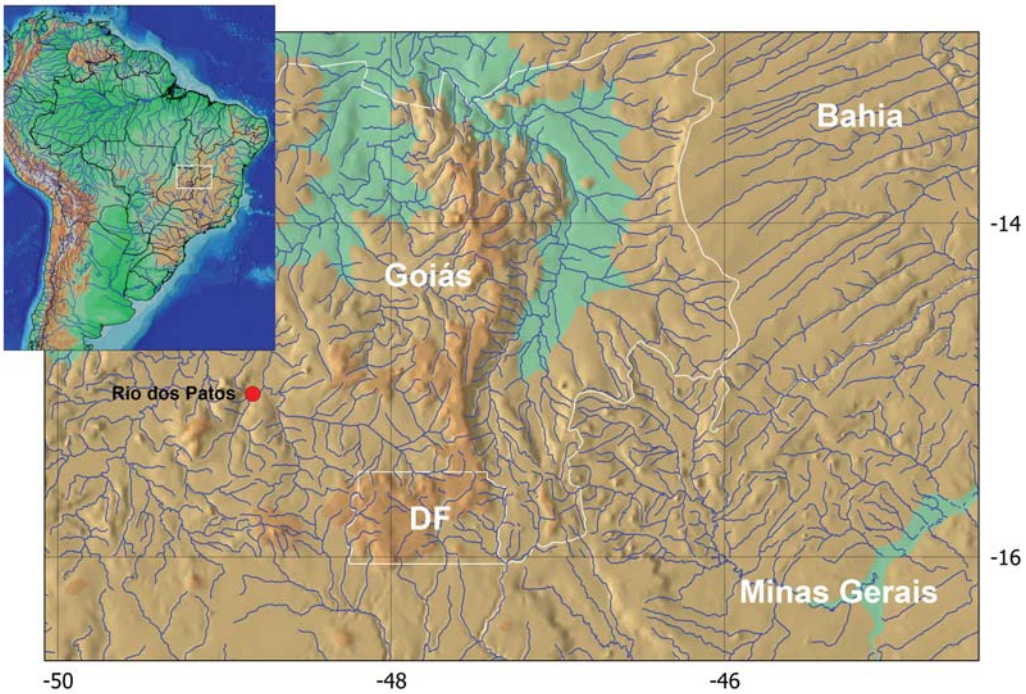

Fig. 4. Type locality of *Microglanis maculatus* (red circle), ribeirão Pouso Alegre, tributary of rio dos Patos, upper rio Tocantins basin, Barro Alto, Goiás State, Brazil.

of riparian trees that stand out from the banks. Attempts were made to collect in the region above this point, where the bed was rocky, but no specimen was captured. The ribeirão Pouso Alegre presents riparian vegetation in good condition, bedrock, with sand, clay litter, logs and branches at the mouth (Fig. 5), dissolved oxygen 7.8 mg/L, pH 7.65, conductivity 85ì S/cm, water temperature 22.5° C, mean depth 6.5±0.93 cm, mean width 4.1±0.66 m, mean speed water 0.12±0.02 m/s. Other nine species of fish were collected in the same location and are listed in Claro-García & Shibatta (2013).

Etymology. The specific epithet *maculatus* means spotted, an adjective from the Latin *macula*, in reference to the dark brown spots on the trunk.

Multivariate morphometrics analysis. The first principal component retained 76.5% of the variance of morphometric variables, and all eigenvalues showed positive signs, which allows to interpret it as the representative of size (larger specimens to the right of graph). The second component retained 7.8% of the variance and on this axis there was discrimination between species (Fig. 6). *Microglanis maculatus* differed from *M. robustus* in this analysis by higher values of anal-fin base length, interorbital width and eye diameter (positive highest values), and smaller values of pectoral fin spine length, dorsal fin spine length and adipose fin base length (negative highest values; Table 2). The discriminatory nature of some characters coincided with its proportions with SL or HL (Table 1).

Fig. 5. Ribeirão Pouso Alegre, tributary of rio dos Patos, Barro Alto, Goiás State, type locality of *Microglanis maculatus.* Specimens collected just in the mouth of stream (brightest area).

Discussion. The color pattern of *M. maculatus* was the first character to draw attention to a new species, and this study evidenced its uniqueness among congeners. Coloration pattern in *Microglanis* is quite variable and complex, resulting in a large number of configurations among the species of the genus. Even so, it is possible to observe in the literature that the color pattern proved to be useful for species identification. For example, among the species of the Araguaia-Tocantins basin, *M. robustus* has a dark and thin stripe at the base of the caudal-fin rays, at middle of caudal fin and at middle of dorsal fin (Ruiz & Shibatta, 2010), and *M. xylographicus* has dark brown body with light streaks on the flanks (Ruiz & Shibatta, 2011). *Microglanis oliveirai* is the only species that does not have a unique distinctive mark (Ruiz & Shibatta, 2011), although this condition helps to distinguish it from the other species of the basin.

The shape of hooks on the anterior margin of the pectoral-fin spine have been used as well to distinguish *Microglanis*

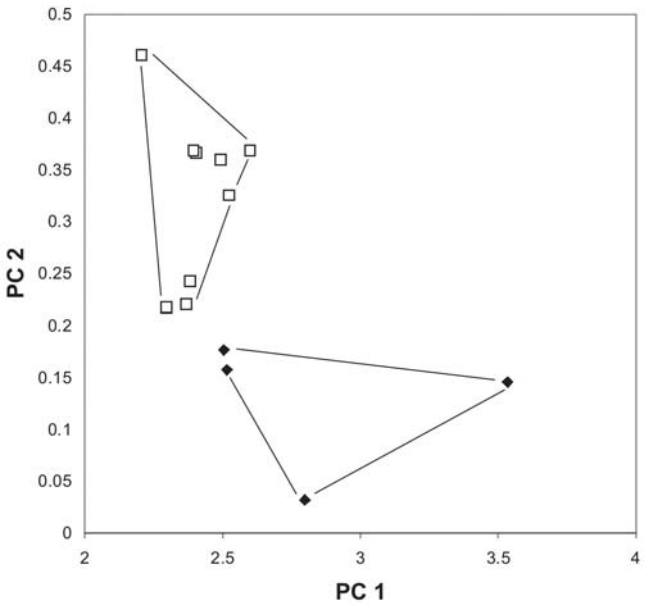

Fig. 6. Principal component analysis (PC1 *vs*. sheared PC2) of combined samples of *Microglanis maculatus* (black diamonds; n = 4) and *M. robustus* (light squares; n = 9).

Table 2. Morphometric data loadings, eigenvalues and percentages relating to the first (PC1) and second (sheared PC2) eigenvectors of Principal Components obtained from the analysis of combined samples of *Microglanis maculatus* (n = 4) and *M. robustus* (n= 9).

	PC1	Sheared PC2
Standard length	0.239280	-0.038350
Head length	0.278703	-0.103961
Head depth	0.171251	-0.112866
Interorbital width	0.242410	-0.242650
Orbital diameter	0.209448	-0.213312
Snout length	0.313553	-0.113407
Mouth width	0.205055	-0.014658
Maxillary barbel length	0.200505	-0.024377
Dorsal-fin spine length	0.084876	0.489930
Pectoral-fin spine length	0.056110	0.519076
Predorsal length	0.220810	0.002021
Prepelvic length	0.231539	0.028533
Pelvic to anal length	0.249099	0.016903
Caudal peduncle depth	0.219993	-0.081367
Body width	0.220662	0.017422
Body depth at dorsal fin	0.140803	0.097062
Dorsal-fin base length	0.294262	-0.188299
Adipose-fin base length	0.323613	0.326230
Anal-fin base length	0.263716	-0.420258
Eigenvalue	0,1111	0,011
Percents of total variance	76.5%	7.83%

species (*e.g.*, in *M. zonatus* all hooks on anterior margin are retrorse; Eigenmann & Allen, 1942). This character however, should be used with caution in *M. maculatus* due to ontogenetic variation on the hook morphology. Small specimens of *M. maculatus* may present only retrorse hooks while large specimens have antrorse and retrorse hooks. The analysis of hook morphology on the anterior margin of the pectoral spine on large and small specimens of *M. maculatus*, evidenced that all hooks are retrorse until the ninth hook (counting from the base of spine), and beyond the ninth hook, antrorse hooks become more numerous. The single hooks, as present in *M. maculatus*, is a very common character in *Microglanis*, but forked hooks is not related to the ontogenetic development, and it seems to be characteristic of *M. robustus*.

Noteworthy is the restricted geographic distribution of *M. maculatus*. Some *Microglanis* species apparently has a wide geographic distribution (*e.g.*, *M. cottoides* in coastal rivers of Southern and South Brazil; Menezes *et al.*, 2007), which may indicate large dispersal ability of these species. However, despite the sampling efforts in different locations of the upper rio Tocantins basin, *M. maculatus* was found only in the rio dos Patos basin, in Barro Alto. The species was not found in another 20 sampling points on different streams of the rio dos Patos and rio Maranhão basins (Claro-García & Shibatta, 2013), and neither on the ichthyological survey conducted in the Serra da Mesa (Bartolette *et al.*, 2012), slightly on North of the type locality. The small number of specimens collected and the apparent restricted distribution of *M. maculatus* in the rio dos Patos basin, indicate that this species is rare.

Comparative material. *Microglanis carlae*: **Paraguay.** MHNHP 3667, holotype, 34.1 mm SL, rio Salado, río Paraguay basin, 26°39'S 58°05'W; MZUSP 98255, paratypes, 5, 23.4-29.1 mm SL. *Microglanis cibelae*: **Brazil.** Rio Grande do Sul. MCP 19822, paratypes, 3, 34.9-48.7 mm SL, arroio do Ouro, tributary of rio Maquiné, 29º34'00"S 50º16'00"W; MCP 21190, 9, 24.6-42.4 mm SL, Osório, rio Tramandaí basin, 29º57'57"S 50º13'45"W. *Microglanis cottoides*: **Brazil.** Rio Grande do Sul. MCP 10826, 5, 38.2-49.5 mm SL, rio Sanga das Águas Frias, rio Uruguai basin; MCP 17706, 4, 25.1-45.3mm SL, arroio Quarizinho, tributary of rio Buricá, rio Uruguai basin, 27º47'00''S 54º 14'00"W. *Microglanis eurystoma*: **Brazil.** Santa Catarina. MCP 13405, holotype, 77.6 mm SL, rio Uruguai, 27º18'00"S 52º20'00"W. **Brazil.** Rio Grande do Sul; MCP 12698, 10 paratypes, 26.3-41.1 mm SL, arroio do Passo Alto, rio Uruguai basin, 28º11'00"S 55º16'00"W. *Microglanis garavelloi*: **Brazil**. Paraná, MZUSP 88006, holotype, 31.7 mm SL, ribeirão Taquari, upper rio Paraná basin; MZUSP 1732, paratypes, 2, 23.7-30.8 mm SL, ribeirão Taquari, 23º12'24"S 50º56'50"W; MCP 1678, 4 paratypes (3c&s), 24.6-27.9 mm SL, ribeirão Taquari. *Microglanis iheringi*: **Venezuela.** Aragua. USNM 121985, 1 paratype, 31.3 mm SL, río Turmero, Portuguesa. CAS 64403, 3, 27.4-41.0 mm SL, río Orinoco. *Microglanis leptostriatus*: **Brazil.** Minas Gerais. MZUSP 47456, 2 paratypes, 28.4-28.7 mm SL, rio Verde, rio São Francisco basin; MZUEL 3733, 6 paratypes, 19.3-27.4 mm SL, rio Cruz, rio São Francisco basin. *Microglanis malabarbai*: **Brazil.** Rio Grande do Sul. MCP 37252, 1, 47.7 mm SL, arroio Alexandrino rio Ijuí basin, 28º10'25"S 54º48'05"W; MCP 37187, 1, 50.1 mm SL, arroio das Pedras rio Ijuí basin, 28º12'07"S 54º04'30"W. *Microglanis nigripinnis*: **Brazil.** Rio de Janeiro. MZUSP 80223, 1, 47.2 mm SL, tributary of rio São João, Eastern basin; MZUSP 80229, 2, 38.3-43.5 mm SL, tributary of rio São João. *Microglanis parahybae*: **Brazil.** Rio de Janeiro. MNRJ 15989, 5, 30.3-34.2 mm SL, rio Dois Rios, rio Paraíba do Sul basin; MNRJ 16047, 5, 28.6-38.9 mm SL, rio Muriaé, rio Paraíba do Sul basin.

Microglanis pataxo: **Brazil.** Bahia. MZUSP 54516, 10, 24.9-31.4 mm SL, rio Mucuri, East coast basin. *Microglanis pellopterygius*: **Ecuador.** Napo. ANSP 130437, holotype, 68.1 mm SL, rio Aguarico, 00°06'N 76°51'W; MEPN 88.4-12, 2, 22.4-23.1 mm SL, tributary of the río Aguarico. *Microglanis poecilus*: **Guiana.** Kurupukari. ROM 60738, 1, 22.5 mm SL, unknown stream of río Essequibo, 4° 46'20"S 58°45'W; ROM 62390, 1, 17.1 mm SL, Shimiri Stream,Yawiri, río Essequibo basin, 4°42'13"S 58°42'43"W; ROM 62391, 1, 17.1 mm SL, río Essequibo, 4°48'22"S 58°46'14"W. **Brazil.** Amazonas. INPA 28575, 3, 18.6-20.6 mm SL, rio Aripuanã, rio Madeira basin. **Brazil.** Roraima. INPA 28576, 3, 19.8-20.4 mm SL, igarapé Ano Bom, rio Branco basin; INPA 8052, 3, 24.8-26.2 mm SL, igarapé Maracá, rio Branco basin, Pará. INPA 6828, 3, 19.2-25.8 mm SL, rio Jamanxin, rio Tapajós basin, 5°27'11"S 55°52'40"W. *Microglanis robustus*: **Brazil.** Pará. INPA 8053, holotype, 20.3 mm SL, lower rio Tocantins, rio Tocantins-Araguaia basin; INPA 32885, 11 paratypes (2 c&s), 18.4-23.3 mm SL, same data as holotype; INPA 7943, 2 paratypes, 20.0-22.2 mm SL; INPA 7957, 3 paratypes, 19.2-21.7 mm SL, Jatobal, lower rio Tocantins. *Microglanis secundus*: **Suriname.** Brokopondo. MHNG 2621.038, 6, 18.9-27.1 mm SL, rio Mindrineti. **Brazil.** Pará. INPA 5730, 7, 18.5-31.1 mm SL, rio Trombetas, rio Amazonas basin; INPA 7950, 3 (2 c&s), 24.4-28.1 mm SL rio Trombetas, rio Amazonas basin. *Microglanis variegatus*: **Ecuador.** Vinces. USNM 083653, 1 paratype, 29.1 mm SL, pools in forests near Vinces. Los rios. MHNG 298.033, 2, 25.2-27.7 mm SL, río Palengue; MHNG 1232.11, 2, 23.6-26.2 mm SL, Hazienda Clementina.

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