

# A new species of *Microglanis* (Siluriformes: Pseudopimelodidae) from the Pacific slope of Ecuador



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A new species of catfish is described from the Esmeraldas River Basin, Pacific slope, northern Ecuador. Tentatively included in *Microglanis*, represents the second species of the genus inhabiting the Trans-Andean region. The new species is distinguished from known congeners by a unique combination of external characteristics: head and body color pattern, uniform, pale brown, yellowish or grayish, without any kind of blotches, bands or dots, only a lunate transverse band, dark or black, at caudal-fin origin; adipose-fin origin and forward without lighter or luminous areas. Compared with *M. variegatus*, the new species has morphometric differences, such as the distances between dorsal and pelvic fins, and between posterior nostrils. Some osteological characteristics are compared with those observed in species of Pseudopimelodidae inhabiting the Pacific versant of Colombia and Ecuador and with some other species of *Microglanis*.

**Keywords:** Diversity, Richness, Systematic, Taxonomy, Trans-Andean region.

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Se describe una nueva especie de bagre para la cuenca del río Esmeraldas, vertiente del Pacífico, en el norte de Ecuador. Incluida tentativamente en *Microglanis*, representa la segunda especie del género que habita en la región transandina. La nueva especie se distingue de los congéneres conocidos por una combinación única de características externas, que incluyen: patrón de color de la cabeza y el cuerpo, uniforme, marrón pálido, amarillento o grisáceo, sin ningún tipo de manchas, bandas o puntos, excepto una banda transversal alunada, oscura o negra, en el origen de la aleta caudal; origen de la aleta adiposa y región anterior sin áreas más claras o luminosas. En comparación con *M. variegatus*, la nueva especie tiene diferencias morfométricas, como las distancias entre las aletas dorsal y pélvica, y entre las narinas posteriores. Algunas características osteológicas se comparan con las observadas en especies de Pseudopimelodidae que habitan en la vertiente del Pacífico de Colombia y Ecuador, y en algunas otras especies de *Microglanis*.

**Palabras clave:** Diversidad, Región Transandina, Riqueza, Sistemática, Taxonomía.

## INTRODUCTION

*Microglanis* Eigenmann, 1912 is the most diverse and geographically widespread genus of family Pseudopimelodidae. Currently, includes 29 described species, all exclusive to South America, that range from Venezuela and Guyana to Argentina, and in the Trans-Andean region of Ecuador, being the SE Brazil the richest area (Ruiz, 2016; Shibatta, 2016; Fricke *et al.*, 2020). Usually, species of the genus inhabit small creeks with crystal clear waters and slow currents, in holes or where submerged leaves, branches, and tree trunks accumulate, with pebbles and stones (Ruiz, 2016).

Diagnostic characteristics for the genus include: small-sized (standard length up to 80 mm); variable color pattern, always includes dark brown blotches, bands, or dots; premaxillary tooth plate without evident projections backward; short or incomplete lateral line (anteriorly, a canal with pores followed posteriorly by free neuromasts, in longitudinal midline); eyes covered by skin; pectoral-fin with five to six branched rays; spines of dorsal and pectoral fins well-developed; and absence of axillary pores (Eigenmann, 1912; Mees, 1974; Shibatta, 2003, 2016; Ruiz, Shibatta, 2010; Ruiz, 2016). Some osteological characteristics of the genus include: mesethmoid bifurcated anteriorly; anterior fontanel large, oval-shaped, extends slightly beyond posterior border of eyes; posterior fontanel, on the supraoccipital, circular and small; frontal with lateral margin long and concave, at eyes level; cleithrum with posterior process slender and pointed; mesocoracoid arch filamentous; and gill rakers, elongated and conical (Ruiz, Shibata, 2010; Ruiz, 2016).

*Microglanis poecilus* Eigenmann, 1912 is the type species, described for Packeoo Falls, Essequibo River, Guyana. Three species are present in northern South America: *M. poecilus* Eigenmann, 1912, in Guyana; *M. secundus* Mees, 1974, in Suriname; and *M. iheringi* Gomes, 1946, in Venezuela. Three species have been described for Andes region of Ecuador and Peru: one Trans-Andean, *M. variegatus* Eigenmann, Henn, 1914,

in the Guayas River of Ecuador; and two Cis-Andeans, *M. pellopterygius* Mees, 1978, in the Aguarico River of Ecuador, and *M. zonatus* Eigenmann, Allen, 1942, in the Morona River of Peru. Remainder species are Cis-Andean: from Argentina, Brazil (mostly southeast), Paraguay, and Uruguay (Steindachner, 1880; Boulenger, 1891; Ahl, 1936; Bizerril, Perez-Neto, 1992; Malabarba, Mahler, 1998; Bertaco, Cardoso, 2005; Shibatta, Benine, 2005; Sarmiento-Soares *et al.*, 2006; Alcaraz *et al.*, 2008; Ottoni *et al.*, 2010; Ruiz, Shibatta, 2010, 2011; Jarduli, Shibatta, 2013; Shibatta, 2014, 2016; Ruiz, 2016; Terán *et al.*, 2016). *Microglanis variegatus* is sited only in the Guayas River basin, Pacific slope of Ecuador (Barriga, 2012; Jiménez-Prado *et al.*, 2015).

Despite the number of described species, there is not a phylogenetic approach for the genus to date. Some species-groups have been described based, only on external morphological characteristics (Ruiz, 2016). Osteological data of the species of *Microglanis* are scarce, some are provided in the original descriptions of species (Ortega-Lara, Lehmann, 2006; Sarmiento-Soares *et al.*, 2006; Mattos *et al.*, 2013). Ruiz (2016) evaluated the diagnostic characters commonly used to identify *Microglanis* and highlighted the need for osteological studies and phylogenetic analysis to accurately establish genus status and the relationship between species.

During a research project for the study of river ecology and fish diversity at the Pachijal River basin, NW Quito, 18 specimens tentatively identified as a new *Microglanis* were captured; herein the description of this new species is presented.

## MATERIAL AND METHODS

Fish sampling was conducted by electrofishing (Hans Grassl model IG200/2D, 300–600 V, 0.2–2 A). Specimens were anesthetized using lidocaine, fixed with formalin (10%) and preserved in ethanol (70%). Specimens were separated into types and non-types according to their condition after fixation. For description and comparative analyses, the holotype and 12 paratypes were used. For comparison with *Batrochoglanis transmontanus* (Regan, 1913), *Cruciglanis pacifici* Ortega-Lara, Lehmann, 2006 and the species of *Microglanis*, original descriptions and figures were used, as well as other available references (Eigenmann, Henn, 1914; Gomes, 1946; Sarmiento-Soares *et al.*, 2006; Mattos *et al.*, 2013; Shibatta, 2014, 2016; Ruiz, 2016). Additionally, direct comparisons were done with specimens of *Batrochoglanis transmontanus* and *Microglanis variegatus*, listed on the examined material.

Body measurements, meristics and observations on external morphology were made using a stereomicroscope. Measurements were taken on the left side, whenever as possible, point-to-point with a digital caliper with an accuracy of 0.1 mm. Twenty-two morphometric measurements were taken, following Shibatta (2016) and Shibatta, Vari (2017). Measurements are expressed as percentage of standard length (SL) or head length (HL). Meristic data included counts of dorsal, pectoral, pelvic, anal, and caudal-fin rays as well as lateral line pores. The frequency of counts obtained is shown throughout text in parentheses and the asterisk denotes holotype values. Twenty-eight morphometric measurements were taken for the new species and compared with identical measures taken on 12 newly captured specimens of *Microglanis variegatus* (Tabs. 1–2).

Analyses of some osteological characteristics were conducted using two specimens

(MECN-DP-3762, 39.5 and 51.4 mm SL) prepared, stained (C, S) and adapted from Taylor, Van Dyke (1985). Osteological nomenclature follows literature (Ortega-Lara, Lehmann, 2006; Sarmento-Soares *et al.*, 2006; Mattos *et al.*, 2013). Observations on osteology include neurocranium components, the premaxillary tooth plate, the Weberian apparatus complex, counts of vertebral centra (free centra and the caudal compound as a single element), pleural ribs, branchiostegal rays, and pectoral-fin spine serrations. Museum acronyms from examined comparative material follow Sabaj (2016).

## RESULTS

### *Microglanis berbixae*, new species

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(Fig. 1, 3–7, Tab. 1)

**Holotype.** MECN-DP-3944, 54.2 mm SL, male, Ecuador, Pichincha Province, Parroquia de Pacto, Quebrada Sune, a tributary of Pachijal River, Esmeraldas River Basin, Pacific slope, 0°05'28.56"N 78°53'53.04"W, 960 masl, 3 Jul 2017, I. Tobes, A. Falconí-López, J. Valdiviezo-Rivera, and F. Provenzano-Rizzi.

**Paratypes.** MECN-DP-3765, 4, 34.9–53.5 mm SL, same data as holotype. FMNH 135030, 2, 36.5–52.1 mm SL, same subsequent data as holotype. MZUSP 123411, 2, 34.9–40.0 mm SL, same subsequent data as holotype. MEPN 19262, 2, 42.2–47.8 mm SL, same subsequent data as holotype. MECN-DP-3762, 4 (2 C, S), 39.5–51.4 mm SL, same subsequent data as holotype except for the collection date of 19 Aug 2016.

**Non-types.** MECN-DP-3763, 2, 41.3–43.3 mm SL, same subsequent data as holotype except for the collection date of 19 Aug 2016. MECN-DP-3764, 1, 48.4 mm SL, Ecuador, Pichincha Province, Parroquia de Pacto, Mashpi Community, a tributary of Mashpi River, Pachijal River Basin, Esmeraldas River Basin, Pacific slope, 0°10'52.20"N 78°54'42.24"W, 539 masl, 14 Aug 2015, I. Tobes, R. Miranda, B. Ríos-Touma and A. Morabowen.

**Diagnosis.** *Microglanis berbixae* is distinguished from congeners by its color pattern. Head and body uniform, pale brown, yellowish or grayish, without any kind of blotches, bands, or dots, except a transverse lunate band, dark brown or black, at caudal-fin origin *vs.* head and body mottled or marbled brown with whitish or cream blotches, bands, or dots in other species (Figs. 1–3). *Microglanis berbixae* is further distinguished from *M. variegatus*, its geographically closest species, by belly pigmentation; in *M. berbixae* the belly color is uniform, yellowish or grayish brown, without aggregates of small black dots (melanophores), while *M. variegatus* usually possesses a whitish or creamy belly with randomly arranged aggregates of melanophores (Figs. 2–3).

In *M. berbixae*, fin-rays have very thin stripes, parallel, black or dark, while in *M. variegatus*, fin-rays have random patterns of dark spots. In *M. berbixae*, the adipose-fin



**FIGURE 1** | *Microglanis berbixae* new species, MECN-DP-3944, holotype, male 54.2 mm SL.

origin and anterior area are normal, while in *M. variegatus*, these areas are notably lighter or luminous (Figs. 1–3). Specimens of *M. berbixae* may have two or three black spots on adipose-fin, not observed in specimens of *M. variegatus*. Additionally, *M. berbixae* have higher values of distance between dorsal and pelvic fins than *M. variegatus* (24.4%–28.8% SL and 22.0%–24.1% SL, respectively) and between posterior nostrils (40.5%–52.3% HL and 24.4%–30.6% HL, respectively).

**Description.** Morphometric data are summarized in Tab. 1. Small-sized species, maximum size recorded 54.2 mm SL. Body depressed from snout tip to dorsal-fin origin, progressively compressed to caudal-fin base. Highest body depth at dorsal-fin origin and largest body width at pectoral-fin origin. Lateral line short, reach pelvic-fin origin, with 8 or 9(\*) pores. Contour of ventral surface of head and body almost





**FIGURE 2** | *Microglanis variegatus*, MECN-DP 4259, male, 37.9 mm SL.-

flat or slightly convex until anal-fin origin, and then slightly concave posteriorly (Fig. 1). Anus and urogenital papilla are differentiable. Papilla located behind the anus as a thickened fleshy tube, with variable shape between sexes (see “Sexual dimorphism” section).

Head depressed, anteriorly rounded in dorsal view. Eyes small, more dorsal than lateral, closer to mouth than to distal margin of operculum, located near the first third of head length, covered by skin, and without free orbital margin. Snout short. Anterior nostril tubular, closer to upper lip than to eye; posterior nostril near anterior margin of eye, possess an anterior flap (Fig. 1).

Mouth wide, terminal. Teeth villiform, curved backward. Gill membrane free from isthmus, with nine branchiostegal rays. All barbels thin, flattened in cross-section. One maxillary pair, two mental pairs. Maxillary barbel medium-sized, reaching or slightly



**FIGURE 3** | Color pattern in live specimens. **A.** *Microglanis berbixae*, MECN-DP-3764, 48.4 mm SL. **B.** *Microglanis variegatus*, MZUTI-P-000626, 35.66 mm SL.

surpassing pectoral-fin base. Outer mental barbel not reaching pectoral-fin base; inner mental barbel shorter, reaching almost half-length of outer mental barbel (Fig. 1).

Dorsal-fin 1,6 rays (13\*), located anterior to half of body length, posterior margin rounded, spinelet present. Dorsal-fin spine straight, strong and without hooks, shorter than first four branched rays. Adipose-fin fleshy and elongated, with free posterior margin, its origin opposite to anal-fin origin and its base a little longer than anal-fin base. Pectoral-fin 1,6 rays (12\*), 1,5 (1), slightly triangular, when adpressed, not reaching pelvic-fin origin. Pectoral-fin spine strong, slightly flattened and curved, shorter than first two branched rays, with serrations on both margins, anterior serrations partially or weakly developed compared with posterior ones. Pelvic-fin rounded, i,5 rays (13\*). Pelvic-fin origin at vertical line posterior to base of last branched dorsal-fin ray, when adpressed not reaching anal-fin origin. Anal-fin short with rounded margin, its base shorter than adipose-fin base and not confluent posteriorly with caudal-fin, ii,10 (13\*). Caudal-fin truncate, 9,10 (1) or 10,10 (12\*) principal rays and 7/4 procurrent rays (13\*).

**Osteological characters.** In dorsal and ventral views of mesethmoid, the anterior edge bifurcates and forms conspicuous cornuas (Fig 4). In dorsal view, central area of posterior edge constitutes the anterior margin of anterior cranial fontanelle; laterally, the posterior edge articulates with frontals (Fig. 4A). In ventral view, behind cornuas, bone widens and shows lateral projections smaller than cornuas, with a slightly concave anterior border (Fig. 4B). These projections are visible in both views (Fig. 4). Ventrally, the articulation between mesethmoid and vomer is not visible, both bones are firmly united or fused, cannot be separated. Thus, the presence of a mesethmoid-vomer complex is possible (Fig. 4B). In ventral view, the posterior edge shows elongated and pointed middle projection, which is part of the articulation between vomer and parasphenoid (Fig. 4B). Anterior cranial fontanelle is large, oval or elliptical, and nearly 33% of its length is located on the mesethmoid (Fig. 4A).

Premaxillary tooth plate trapezoidal-shaped, its distal border wide, truncate and

**TABLE 1** | Morphometric data of best-preserved specimens of *Microglanis berbixae*, expressed as percentages of standard length and percentages of head length, n = 13 (SD: standard deviation) (range and SD include holotype).

	Characters	Holotype	Min	Max	Mean	±SD
SL	Standard Length (mm)	54.2	34.9	54.2		
<b>Percents of Standard Length</b>						
HL	Head length	26.7	23.8	30.0	26.8	1.9
PL	Pelvic fin length	15.4	14.6	18.9	16.3	1.5
DBL	Dorsal-fin spine length	9.7	9.6	12.3	10.9	0.9
PSL	Pectoral-fin spine length	13.8	11.7	15.4	13.6	1.3
LPCP	Length of postcleithral process	9.1	7.8	10.8	9.0	0.9
PDD	Predorsal distance	37.7	35.0	41.9	38.0	1.8
PPL	Prepelvic length	52.8	50.0	53.8	51.9	1.2
AAnD	Anus to anal fin distance	11.9	9.9	17.4	13.9	2.0
CPL	Caudal peduncle length	15.2	13.1	18.5	15.6	1.4
CPD	Caudal peduncle depth	12.7	11.2	14.2	13.1	1.0
BD	Body depth	20.1	18.6	25.7	22.0	2.1
DBL	Dorsal-fin base length	9.7	9.6	12.3	10.9	0.9
AdBL	Adipose-fin base length	17.2	15.6	20.1	18.1	1.4
AnBL	Anal-fin base length	12.4	11.9	15.6	13.2	1.0
DP	Distance between pelvic fins	11.9	8.9	12.0	10.7	0.9
DPA	Distance from pelvic fin to anus	10.0	7.9	10.7	9.2	0.7
PAD	Pelvic to anal fin distance	19.8	18.0	23.6	20.6	1.7
DDP	Distance between the dorsal and pelvic fins	24.7	24.4	28.3	26.2	1.5
PGW	Pectoral girdle width	28.8	26.7	29.3	28.1	0.9
<b>Percents of Head Length</b>						
IOD	Interorbital distance	55.4	44.1	56.0	51.4	3.6
OD	Orbital diameter	8.2	8.2	12.2	10.5	1.4
SnL	Snout length	35.8	27.9	36.5	31.4	2.8
MW	Mouth width	92.2	70.5	94.6	85.7	9.3
MBL	Maxillary barbel length	75.5	65.9	102.3	87.5	12.4
APND	Anterior to posterior nostril distance	20.8	13.7	21.3	18.6	2.4
DPN	Distance between posterior nostrils	46.3	40.5	52.3	46.3	3.7
DPNO	Posterior nostril to orbit distance	11.6	8.8	12.6	10.7	1.1

without posterior projection (Fig. 4C). Dentary tooth plate elongated, larger, and narrower than premaxillary plate.

Frontal bone between mesethmoid and parieto-supraoccipital, defines lateral and posterior margin of anterior cranial fontanelle. Frontals narrow anteriorly and widened from center to back.

Parieto-supraoccipital is pentagon-shaped, in dorsal view, articulates anteriorly with frontals, and continues posterior as a process elongated and pointed, not bifurcate. Parieto-supraoccipital articulates anteriorly with sphenotic, in the center with pterotic and posterior with epiotic.

In ventral view, Weberian apparatus (complex centra) shows the transverse processes



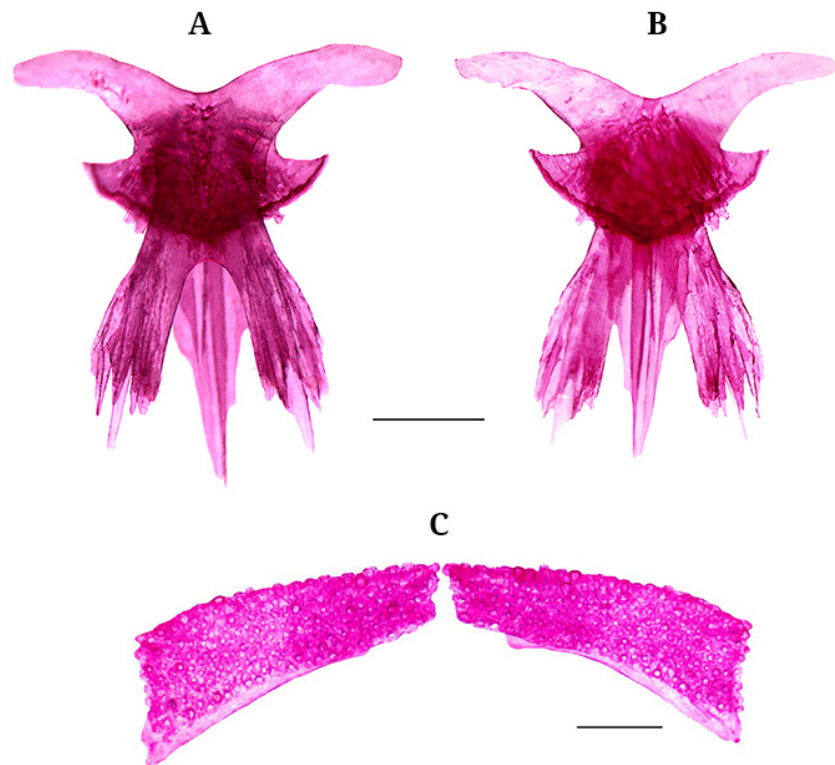
**TABLE 2** | Morphometric data of newly captured specimens of *Microglanis variegatus*, expressed as percentages of standard length and percentages of head length, n = 12 (SD: standard deviation).

	Characters	Min	Max	Mean	±SD
SL	Standard Length (mm)	25.8	37.9		
<b>Percents of Standard Length</b>					
HL	Head length	24.0	31.8	29.2	2.2
PL	Pelvic fin length	16.5	18.7	17.7	0.6
DBL	Dorsal-fin spine length	10.8	14.9	12.9	1.3
PSL	Pectoral-fin spine length	14.2	17.8	15.9	1.1
LPCP	Length of postcleithral process	10.3	12.8	11.4	0.7
PDD	Predorsal distance	36.1	39.3	37.9	1.0
PPL	Prepelvic length	47.3	53.0	50.2	1.6
AAnD	Anus to anal fin distance	10.9	14.5	13.2	1.1
CPL	Caudal peduncle length	13.3	16.7	15.2	1.1
CPD	Caudal peduncle depth	11.4	15.3	13.5	1.3
BD	Body depth	18.0	22.9	20.9	1.3
DBL	Dorsal-fin base length	10.8	14.9	12.9	1.3
AdBL	Adipose-fin base length	16.9	25.5	21.4	3.0
AnBL	Anal-fin base length	11.8	15.9	13.1	1.2
DP	Distance between pelvic fins	8.9	12.4	11.6	1.2
DPA	Distance from pelvic fin to anus	9.0	12.7	10.5	1.1
PAD	Pelvic to anal fin distance	20.4	24.2	22.9	1.0
DDP	Distance between the dorsal and pelvic fins	22.0	24.1	23.1	0.7
PGW	Pectoral girdle width	25.9	29.6	27.3	1.1
<b>Percents of Head Length</b>					
IOD	Interorbital distance	38.0	49.5	41.1	3.2
OD	Orbital diameter	10.9	15.8	13.0	1.5
SnL	Snout length	30.6	45.0	35.6	4.1
MW	Mouth width	68.4	94.3	75.1	8.3
MBL	Maxillary barbel length	38.7	72.4	53.6	10.8
APND	Anterior to posterior nostril distance	11.1	18.0	14.1	1.8
DPN	Distance between posterior nostrils	24.4	30.6	27.4	1.6
DPNO	Posterior nostril to orbit distance	4.7	9.2	6.5	1.3

of 4th centra, expanded as anterior and posterior projections, with a concave margin at the center, anterior and posterior projections not branched, pointed. Frontal region of anterior projection flat or somewhat deflected ventrally. Transverse processes of 5th centra elongated, curved and pointed (Fig. 5). Thirty vertebrae (six precaudal + 24 caudal). Six pairs of pleural ribs.

Branchial apparatus with two basibranchial and two hypobranchial elements ossified, visible. Gill rakers small and conical, first branchial arch with 2, 1, 4–5. Branchiostegal rays, 9.

On pectoral girdle, cleitrum with two projections on distal region, one dorsal, pointed, articulates with posttemporosupracleitrum and a posterior projection (cleithral spine), slender and pointed (Fig. 6A). On dorsal view of escapulo-coracoid bone, filamentous mesocoracoid arch is present (Fig. 6A). Tip of pectoral-fin spine not ossified.



**FIGURE 4** | *Microglanis berbixae*, MECN-DP 3762, paratype, 39.6 mm SL. Mesethmoid-Vomer complex. **A.** Dorsal view. **B.** Ventral view. **C.** Premaxillary tooth plate, ventral view. Scale bars = 1 mm.

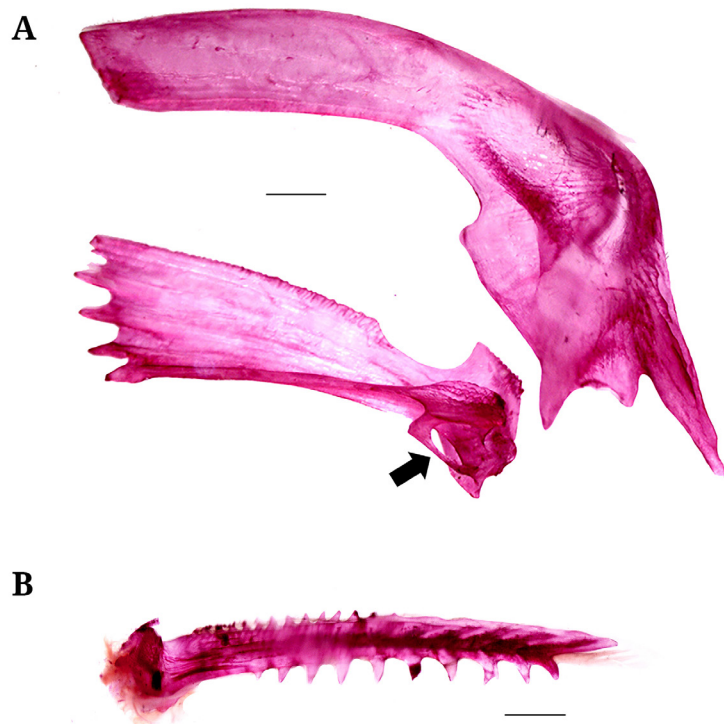
Anterior and posterior surfaces of pectoral-fin spine, dentate. Anterior surface with 10–12 small or weakly developed prickles, on the central and proximal sectors, distal sector without prickles. Posterior surface of pectoral-fin spine with 10 prickles well-developed (Fig. 6B).

**Coloration in alcohol.** Color pattern on specimens preserved in 70% ethanol: head and body color, uniform, pale brown, yellowish or grayish, without bands, dots, blotches, or patches, except transverse lunate band, dark brown, or black at the caudal-fin base (Fig. 1). Belly color uniform, pale brown, whitish or grayish, without groups of melanophores. Fins without dots, blotches, or bands; rays with very narrow dark brown or black bands or stripes, proximally and medially. Interradial membrane is hyaline, except on dorsal-fin. Dorsal-fin has dark brown interraddial membrane, anterior and proximally, becoming paler or hyaline posterior and distally. Adipose-fin similarly colored as head and body, but the border is hyaline, its origin and forward without lighter or luminous areas. Three specimens with two or three dark brown or black dots, usually horizontally aligned.

**Sexual dimorphism.** Specimens analyzed have urogenital papilla easily detected behind anus. The papilla is a short tube, thick and fleshy, with cylindrical or triangular shape. Cylindrical-shaped papilla ending truncate with a small pointed flap is associated with females (Fig. 7A). Two of them were dissected, showing well-developed



**FIGURE 5** | *Microglanis berbixae*, MECN-DP 3762, paratype, 39.6 mm SL. Ventral view Weberian apparatus. Scale bar = 1 mm.



**FIGURE 6** | *Microglanis berbixae*, MECN-DP 3762, paratype, 39.6 mm SL. **A.** Dorsal view right pectoral girdle. The arrow shows the filamentous mesocoracoid arch. **B.** Dorsal view right pectoral-fin spine. Scale bars = 1 mm.

ovaries, with yellow ovules visible by the naked eye. Ovaries occupy important volume on posterior region of abdominal cavity. Elongate and triangular papilla, ending in point tip associated with male specimens (Fig. 7B). One dissected male specimen showed developed testicles as ramified bands, white, attached to the dorsal region of abdominal cavity.

**Geographical distribution.** Specimens were captured in two small rivers of the Pachijal River system, the Sune and Mashpi Rivers (Fig. 8). These rivers belong to the Esmeraldas River Basin, Pacific Ocean versant, northwestern Ecuador, Pichincha province.

**Ecological notes.** Specimens were captured from two different localities. Microhabitat preferences: capture zone around the central area of the stream, characterized by shallow rapids ( $< 20$  cm;  $< 0.3$  m s<sup>-1</sup>) with pebbles and small scattered boulders. Sampling area at the Sune River located at 960 masl with a water temperature of 20.3°C, a conductivity of 46.5  $\mu$ S cm<sup>-1</sup>, dissolved oxygen with a saturation of 74.9%, and a pH of 7.8. River stretch with a mean width of 4.2 m and a mean depth of 33.1 cm. Rapids with slow velocities ( $< 0.3$  m s<sup>-1</sup>). Substrate composed as follows: sand ( $< 2$  mm) 19%; gravel (2–64 mm) 23.3%; pebbles (64–256 mm) 21.7%; boulders ( $> 256$  mm) 22.7%; and bedrock 13.3%. Riparian forest almost intact, shading 90% of the stream (Fig. 9). In one sample from the Sune River, the fish community dominated by *Rhoadsia altipinna* (26 specimens) and *Andinoacara blombergi* (12). The fish assemblage also included *Astroblepus cyclopus* (1), *Astroblepus* sp. (3), *Trichomycterus* sp. (2), *Pseudopoecilia festae* (2), and *Microglanis berbixae* (12).

At the Mashpi River, specimens were captured from the mouth of a small stream draining to the main channel, at 562 masl. Pphysicochemical variables were: water temperature of 23.2°C, a conductivity of 78.7  $\mu$ S cm<sup>-1</sup>, dissolved oxygen with a saturation of 89.4%, and a pH of 7.8. River stretch with a mean width of 1.9 m and a mean depth of 13.1 cm, mainly dominated by shallow rapids with slow velocities ( $< 0.3$  m s<sup>-1</sup>). Substrate composed by: sand ( $< 2$  mm) 55%; gravel (2–64 mm) 13%; pebbles



**FIGURE 7 |** *Microglanis berbixae*, close up urogenital papillae. **A.** Female, MECN-DP-3765, 53.5 mm SL. **B.** Male, MECN-DP-3765, 52.6 mm SL.





**FIGURE 8 |** Map of Ecuador showing capture localities of *Microglanis berbixae* (red dots) and *Microglanis variegatus* (black triangles).



**FIGURE 9 |** Quebrada Sune, tributary of Pachijal River, Pichincha. Type locality of *Microglanis berbixae*.

(64–256 mm) 7%; and boulders (> 256 mm) 25%. The stretch totally shaded by a well-preserved riparian forest. In one sample, the fish community composed by: *Rhoadsia altipinna* (15 specimens), *Andinoacara blombergi* (1), *Bryconamericus dahli* (3), *Astroblepus* sp. (2), *Trichomycterus* sp. (1), *Pimelodella modesta* (2) and *Microglanis berbixae* (1).

**Etymology.** The specific name “berbixae”, honor María Resurrección Sesma Lizari, “Berbixe”, mother of Ibon Tobes Sesma, for its unconditional support and infinite love. A genitive.

**Conservation status.** *Microglanis berbixae* inhabits the Tropical Andes at the Pacific slope of Ecuador. This area belongs to the Tumbes–Chocó–Magdalena hotspot (Myers *et al.*, 2000). The Pachijal River system drains to the Esmeraldas River basin, coastal slope of northwestern Ecuador. In the area, river systems are poorly known and *Microglanis berbixae* has been reported for only two localities. Consequently, the conservation status of *Microglanis berbixae* may be classified as Data Deficient (DD), according to the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN, 2019).

**Morphometric comparison.** After comparing the 28 morphometric characteristics between *M. berbixae* and *M. variegatus*, only two variables show intervals without overlap: the distance between dorsal and pelvic fins and the distance between posterior nostrils (see Tabs. 1–2).

## DISCUSSION

*Microglanis berbixae* belongs to the family Pseudopimelodidae without any doubt. The external characteristics of the specimens determine this conclusion. However, the generic allocation of the species is controversial, therefore, is included tentatively in the genus *Microglanis* based on the results of the comparative analyses. First, we compared it with the three species and three genera of Pseudopimelodidae that inhabit the Pacific slope of Colombia and Ecuador (Fricke *et al.*, 2020): *Batrochoglanis transmontanus*, *Cruciglanis pacifici* and *Microglanis variegatus*. *Microglanis berbixae* has uniform color pattern of head and body, while the color pattern of head and body of the other three species presents spots, bands or dots. The caudal-fin of *M. berbixae* is truncated, in *B. transmontanus* and *C. pacifici* is emarginated, and in *M. variegatus* the caudal-fin is emarginated or truncated with slightly rounded tips. The lateral line is incomplete and short in all species; in *M. berbixae* and *M. variegatus* it only reaches the origin of the pelvic-fin, while in *B. transmontanus* and *C. pacifici*, lateral line surpasses the base of the pelvic-fin (Regan, 1913; Eigenmann *et al.*, 1914; Ortega-Lara, Lehmann, 2006). These results indicate that specimens of *M. berbixae* are more like *M. variegatus*, but present some significant differences.

When some osteological characters of *M. berbixae* are compare with those reported for species of *Microglanis*, *B. transmontanus* and *C. pacifici*, the results show: In *M. berbixae* the vomer is fused with the mesethmoides. Lundberg *et al.* (1991) indicate that the vomer is absent in *Lophiosilurus*, *Microglanis* and *Batrochoglanis*, probably due to



fusion with the mesethmoid. Sarmiento-Soares *et al.* (2006) point out that the vomer is ovoid and wide in *M. pataxo* and located between the cartilaginous wings of the lateral ethmoid, in contact with the mesethmoid dorsally. Ortega-Lara, Lehmann (2006) indicate a T-shaped vomer present in *C. pacifici*, but do not show or indicate the presence of the vomer in *B. transmontanus* and *M. iheringi*. The condition observed in *M. berbixae* supports the conclusion of Lundberg *et al.* (1991), but conditions reported in other species of *Microglanis* indicate that the fusion of mesethmoid and vomer may be variable. In *M. berbixae* and *C. pacifici* the distal margin of premaxillary tooth plate is wide and without a posterior projection; in *B. transmontanus* the distal margin is curved and projecting backwards, while in species of *Microglanis* the premaxillary tooth plate is rectangular (Ortega-Lara, Lehmann, 2006; Ruiz, 2016; Shibatta, 2016). In *M. berbixae* and species of *Microglanis*, the anterior cranial fontanelle is elliptical and wide, while in *B. transmontanus* is short and narrow, and in *C. pacifici* is elongated and narrow (Ortega-Lara, Lehmann, 2006; Ruiz, 2016; Shibatta, 2016). In *M. berbixae* the posterior region or the posterior process of parieto-supraoccipital is elongated and pointed, not forked. A similar condition is indicated for *M. iheringi* (Ortega-Lara, Lehmann, 2006); but in *M. pataxo* and *M. pleriqueater* the posterior process of parieto-supraoccipital is short and bifurcated (Sarmiento-Soares *et al.*, 2006; Mattos *et al.*, 2013). Ruiz, Shibatta (2010) point out that a short posterior process on the parieto-supraoccipital is diagnostic for species of *Microglanis*. At the pectoral girdle, *M. berbixae* has a filamentous mesocoracoid arch; this condition is diagnostic for the species of *Microglanis* (Ruiz, Shibatta, 2010; Ruiz, 2016).

The evaluation of the external and osteological characteristics of *M. berbixae* suggests its inclusion in *Microglanis*, tentatively, waiting further analyses to determine its appropriate generic status. On the other hand, observed variability on bone components determines the need to improve studies on the osteology to know the variation interval between species of the genus *Microglanis*.

Among the species included in the genus *Microglanis*, *M. berbixae* can be easily recognized. Unlike its congeners, *M. berbixae* has a uniform body color pattern, making inappropriate the name bumblebee catfish for them, while other species traditionally included in *Microglanis* have a variable body color pattern, with colored transverse bands or bars and blotches. Shibatta (2014, 2016) and Ruiz (2016) point out that this color pattern is one of the diagnostic characteristics for *Microglanis*. *Microglanis berbixae* and *M. variegatus* have evident differences in terms of external morphology, but among morphometric variables differences are small and the majority of measurements overlap. A comparative analysis on osteology is ongoing between *M. berbixae* and *M. variegatus*, to establish the relationships between them and with other species of *Microglanis*.

*Microglanis berbixae* and *M. variegatus* inhabit the Pacific slope of Ecuador and could be phylogenetically related species. Provenzano, Barriga (2017) provide a similar example with two species of *Hemiancistrus* that inhabit the same region. Phylogenetic analyses for the species inhabiting the cis-Andean region are required to establish hypotheses of these relationships. These hypotheses and the available knowledge on the geological, climatic or other environmental events (*e.g.* river capture) could explain the speciation processes that took place in the area, throwing some light to the species diversity and distribution patterns observed nowadays in the Pacific slope of Ecuador.

**Comparative material examined.** *Batrochoglanis transmontanus*: Ecuador, Esmeraldas Province: MEPN 3817, 5, 25.4–37.8 mm SL, Parroquia Selva Alegre, Santiago River system. *Microglanis variegatus*: Ecuador, Guayas Province: MECN-DP-1489, 7, 16.6–26.3 mm SL, Río Vinces; MECN-DP-3942, 1, 31.3 mm SL, Río Chimbo. Los Ríos Province: MECN-DP-4259, 12, 25.8–37.9 mm SL, Río Baba. Cotopaxi Province: MZUTI-P-626, 1, 35.66 mm SL, Tontomalo River.

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#### ETHICAL STATEMENT

Samplings were approved by the Ministerio del Ambiente by the permit NO. 008-2016-IC-FAU-DPAP-MA.



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