A new mouth brooder species of Gymnogeophagus with hypertrophied lips (Cichliformes: Cichlidae)

Andréia Turcati¹, Wilson Sebastián Serra-Alanis² and Luiz R. Malabarba¹

A new mouth breeder species of Gymnogeophagus is described from a tributary of the río Uruguay. It is distinguished from most species of the genus by the presence of hypertrophied lips, and from G. labiatus and G. pseudolabius by the color pattern. The presence of successive allopatric species of the Gymnogeophagus gymnogenys clade inhabiting the tributaries of the río Uruguay is discussed.

Keywords: Distribution, Endemism, Gymnogeophagus gymnogenys clade, New species, Río Uruguay.

Original article

Introduction

Cichlidae constitutes one of the major vertebrate families, with more than 1,700 species (Fricke et al., 2018). The genus Gymnogeophagus Ribeiro is included in the tribe Geophagini (López-Fernández et al., 2005a, 2005b, 2010) along with approximately 14 other genera of the Neotropical subfamily Cichlinae. Species belonging to Gymnogeophagus are easily recognized by sharing two synapomorphies (Reis, Malabarba, 1988): the absence of supraneurals, and the presence of a forward-directed spine in the first pterygiophore of the dorsal fin (Fig. 1). Gymnogeophagus includes one extinct species, G. eocenicus (Hensel, 1870), known from fossil records of the Eocene.

A new mouth breeder species, whose females deposit adhesive eggs on a surface and one or both parents guard and tend them, and another that includes mouth breeder species, where one or both parents brood orally the eggs and young (Reis, Malabarba, 1988; Wimberger et al., 1998). The substrate breeder clade has been treated as the G. rhabdotus clade, G. rhabdotus species group or G. rhabdotus group (Malabarba et al., 2010; Loureiro et al., 2016; Říčan et al., 2018, respectively) and includes G. rhabdotus (Hensel, 1870), G. che Casciotta, Casciotta, Gómez & Toresanni, 2000, G. meridionalis Reis & Malabarba, 1988, G. setequedas Reis, Malabarba & Paravelli, 1992, G. taroba Casciotta, Almirón, Pálek & Říčan, 2017, and G. terrapurpura Loureiro, Zarucki, Malabarba & González-Bergonzoni, 2016. The mouth breeder clade has been treated as the G. gymnogenys clade and G. gymnogenys group (Malabarba et al., 2010; Říčan et al., 2018, respectively), and includes G. gymnogenys (Hensel, 1870), G. australis (Eigenmann, 1907), G. balzani (Perugia 1891), G. caaguazuensis Staeck, 2006, G. constellatus Malabarba, Malabarba & Reis, 2015, G. labiatus (Hensel, 1870), G. lacustris Reis & Malabarba, 1988, G. lipokarenos Malabarba, Malabarba & Reis, 2015, G. mekinos Malabarba, Malabarba & Reis, 2015, G. missioneiro Malabarba, Malabarba & Reis, 2015, G. pseudolabius Malabarba, Malabarba & Reis,

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New Gymnogeophagus from lower río Uruguay

2015, and *G. tiraparae* González-Bergonzoni, Loureiro & Oviedo, 2009. In this paper we describe a new species of the *G. gymnogenys* clade from a tributary of the lower río Uruguay, the río Arapey Grande.

**Material and Methods**

Examined material of *Gymnogeophagus* belong to the fish collections of the Museu de Ciências e Tecnologia, Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP), Museo Nacional de Historia Natural, Montevideo (MHNM), Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS), and Facultad de Ciencias de la Universidad de la República, Montevideo (ZVC-P). Additional comparisons were done using data or specimens listed by Reis, Malabarba (1988), González-Bergonzoni et al. (2009), Malabarba et al. (2015) and Loureiro et al. (2016). Counts and measurements were taken according to Malabarba et al. (2015) and asterisks represents counts from the holotype. Specimens listed as non-types are referred for geographical distribution record, and were not counted or measured for species description. The localities of collection of specimens listed under Comparative material session are also given for distributional purposes.

*Gymnogeophagus* *peliochelynion*, new species

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**Figs. 1-5**

**Holotype.** ZVC-P 12493, male, 101.9 mm SL, Uruguay, Salto, arroyo de las Tunas on Ruta 31, tributary to río Arapey Grande, 31°20’4.87”S 57°19’36.42”W, 8 Sep 2005, V. Bertaco, F. Cantera, J. Ferrer & L. R. Malabarba.

**Paratypes. Uruguay, Departamento de Salto. Río Arapey drainage:** MHNM 3711, 4, 1 male 79.9 mm SL, 3 females or juveniles 50.0-69.5 mm SL, río Arapey Chico on Ruta 4, 31°02’7.44”S 56°53’50.21”W, 22 Nov 2005, F. Teixeira, A. D’Anatro, I. González, S. Oviedo & M. Loureiro. UFRGS 8042, 7, 2 males 93.1-106.1 mm SL and 5 unsexed juveniles 19.7-64.1 mm SL, tributary stream to río Arapey Grande on Ruta 4, 31°07’44.0”S 56°59’57.0”W, 8 Sep 2005, V. Bertaco, F. Cantera, J. Ferrer & L. R. Malabarba.


**Fig. 1.** Anterior portion of dorsal-fin skeleton of *Gymnogeophagus peliochelynion* (anterior towards left), UFRGS 8076, paratype, 74.2 mm SL. Arrow indicates the anterior spine in the first dorsal pterygiophore. Note the lack of supraneurals between supraoccipital and first dorsal pterygiophore.
**Diagnosis.** The new species can be distinguished from the species of the *Gymnogeophagus rhabdотus* group and from *G. balzanii* by the shape of the caudal peduncle longer than deep (vs. deeper than long). It is distinguished from all congeneres, except *G. labiatus* and *G. pseudolabiatus*, by the possession of thick lips. It differs from *G. labiatus* and *G. lacustris* by the lack of an oblique bar from the eye to the dorsal-fin origin (vs. oblique bar present), and by the color pattern of the caudal, dorsal and anal fins with dots (vs. caudal fin and posterior portion of anal fin with longitudinal hyaline stripes). It differs from *G. pseudolabiatus* and *G. mekinos* by the hump entirely black in males (Fig. 2; vs.

**Fig. 2.** Head of *Gymnogeophagus peliochelynion* (first column), *G. pseudolabiatus* (second column) and *G. mekinos* (third column) showing the entirely black hump in males in *G. peliochelynion* (vs. yellow with black margin), and upper lip not folded dorsally over anterior margin of snout (vs. upper lip folded dorsally in *G. pseudolabiatus* and undeveloped in *G. mekinos*). *G. peliochelynion* from top to bottom, paratype, ZVC-P 13210, paratype, 76.3 mm SL; ZVC-P 7016, 89.9 mm SL; ZVC-P 13057, 90.2 mm SL. *G. pseudolabiatus* from top to bottom, paratype, UFRGS 7754, 102.0 mm SL; MHNM 4010, 88.8 mm SL; MHNM 4010, 95.3 mm SL. *G. mekinos* from top to bottom, MHNM 3511, 105.1 mm SL; MHNM 3511, 97.2 mm SL; MHNM 4009, 121.3 mm SL.
yellow with black margin), and upper lip not folded dorsally over anterior margin of snout (vs. upper lip folded dorsally, usually with a well-developed medial lobe dorsally projected in *G. pseudolabiatus*).

**Description.** Standard length of specimens examined 19.2 to 106.1 mm. Morphometric data summarized in Tab. 1. Body elongated, laterally compressed. Dorsal profile of head slightly convex between mouth and interorbital area in young and females, slightly straight in males; slightly convex from interorbital region to dorsal-fin origin. Reproductive males with adipose hump from interorbital region to dorsal-fin origin; dorsal-fin base gently convex. Caudal peduncle rectangular, longer than deep, with slightly concave dorsal and ventral profiles. Prepelvic contour straight to slightly convex; abdominal contour straight and base of anal fin straight to slightly convex.

**Tab. 1.** Morphometric data of *Gymnogeophagus peliochelynion*, new species. Standard length is expressed in mm. Range includes measurements of holotype and 22 paratypes, except individuals smaller than 45 mm SL.

<table>
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<th>Character</th>
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<th>Max</th>
<th>Mean</th>
<th>SD</th>
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<td>35.0</td>
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<td>34.4</td>
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<td>7.64</td>
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Head depth larger than head length. Snout triangular in lateral aspect; slightly rounded anteriorly, pointed in dorsal aspect. Eyes small, close to dorsal profile of head in juveniles and progressively farther from it in larger specimens (about eye diameter in specimens up to 80 mm); eyes near middle of head length. Interorbital area slightly convex in young and female, and deeply convex in large males; interorbital width larger than eye diameter, except in individuals smaller than 25 mm. Mouth terminal. Posterior tip of maxilla not reaching vertical line across anterior margin of eyes. Upper jaw slightly longer than lower jaw; lips developed, lower lip thicker than upper lip; margin of lower lip convex, deeper in middle length of each dentary, deeply notched medially at symphysis. Snout longer than postorbital length, except in individuals up to 48 mm SL.


Dorsal-fin spines 12(1), 13(2), 14*(11); dorsal-fin soft rays 9(1), 10*(11), 11(2). First dorsal-fin spine inserted right above vertical line across posterior bony margin of opercle. Soft dorsal fin slightly pointed in young and adult females, reaching or almost reaching caudal-fin base. Fourth or fifth dorsal-fin soft ray longest in mature males, reaching proximal two third to half of caudal-fin length. Three anal-fin spines; anal-fin soft rays 8*(11), 9(3); anal-fin profile rounded in young and females, reaching or almost reaching caudal-fin base; slightly pointed in reproductive males, surpassing caudal-fin base. Pectoral fin with pointed tip, reaching or almost reaching anal-fin origin in juveniles and females and surpassing anal-fin origin in reproductive males. Pelvic fin slightly pointed; second soft ray longest, reaching anal-fin base in mature males. Caudal-fin margin concave.

Jaw teeth small, conical, with recurved tips. Upper jaw with outer regular row of 16-26 teeth in each premaxilla (number increasing with specimen size) and two irregular internal rows of slightly smaller teeth. Lower jaw with 3-5 irregular rows of small conical teeth; outer hemiseries with 20-28 teeth. Lower limb of first gill arch with 6-10 gill rakers; upper limb lobed with 3-4 gill rakers in its margin. Lower pharyngeal tooth plate wide; teeth covering whole occlusion surface. Teeth on medial rows larger than remaining ones. Posterolateral teeth elongated; posteromedial teeth larger, cylindrical with medial, blunt cusps of molariform aspect (Fig. 3).

**Coloration after fixation in formalin.** (Fig. 4) Mature males: ground color of body dark brown above longitudinal series of scales of posterior lateral line and light yellowish brown below. Series of double vertical bars clearly discernible along midventral lateral surface of flanks, distributed between pectoral-fin base and end of caudal peduncle, anterior to caudal-fin base. Number of vertical double dark bars 5-6. Midlateral spot without defined borders. Hump entirely black in males making dark band in front of dorsal-fin origin hardly detectable. Head dark brown with some black spots on cheek and near posterior margin of opercle; dark band covering cheek hardly distinct. Isthmus and branchiostegal membranes dark brown. Pectoral fin hyaline. Pelvic fin dark gray. Spinous dorsal fin dark brown; soft dorsal fin light brown with circular dots. Distal one third of anal-fin rays and spines dark brown, without additional marks. Two proximal thirds of anal-fin rays covered with small circular dots. Caudal fin covered with white dots, except near upper and lower borders.
Color in alcohol of preserved females and young not distinct from that described for males. Main differences are: isthmus and branchiostegal membrane yellow; clearly distinct dark band covering cheek, below eye; distinct dark band on dorsal-fin origin; and larger size of white spots on dorsal, anal, and caudal fins.

Coloration in life. (Fig. 5) Ground color of dorsal profile golden or dark olivaceous with longitudinal series of light blue spots. Well defined black, circular midlateral spot, covering scales 9-11 of the anterior lateral line, scales 10-12 of the scale row just below anterior lateral line and scales 8-10 of the next scale row below. Large dark bar below eye, usually not reaching midline of mouth in larger individuals. Numerous small bright blue spots usually present on cheeks. Red marks on cheeks usually present in mature males, concentrated on upper portion of opercle and preopercle, region behind eye and above pectoral fin. Usually grayish blue lips in reproductive males and gray in females and young. Adipose hump, when present, black. Ventral portion of body light olivaceous to yellow pale in mature males with longitudinal series of

Fig. 3. Pharyngeal tooth plate of Gymnogeophagus peliochelynion, 74.2 mm SL, UFRGS 8076, paratype. Dorsal view; anterior to bottom.

Fig. 4. Gymnogeophagus peliochelynion: top, holotype, male, ZVC-P 12493, 101.9 SL; bottom, paratype, female, UFRGS 8076, 77.2 SL. Both from arroyo de las Tunas on road 31, tributary of rio Arapey Grande, Salto, Uruguay. Photographs taken just after collection and fixation in formalin.
light blue spots. Spinous dorsal fin and base of soft dorsal fin yellowish brown; most soft dorsal fin red with relatively large and numerous hyaline dots. Distal tip of dorsal fin hyaline. Pectoral fin hyaline and pelvic fin dark orange to dark gray with light blue spots at base. Anal fin yellowish orange proximally with numerous clear spots and hyaline on half distal portion with dark gray margin. Caudal fin yellowish brown with numerous light spots, extending along middle of caudal fin; dorsal and ventral portions of fin hyaline.

Geographic distribution. This species is known from the río Arapey Grande drainage, a tributary of the lower río Uruguay basin, Uruguay (Fig. 6).

Ecological notes. The new species was collected in rivers with clear water, usually with rocky or muddy bottom and little vegetation.

Etymology. The name *peliochelynion* is from the Greek *pelios*, meaning black and blue, and *chelyne*, meaning lip, in reference to the color of the lips of the new species. A name in apposition.

Conservation status. *Gymnogeophagus peliochelynion* is relatively frequent and abundant in the río Arapey Grande drainage. No specific threats were detected, and the species can be categorized as Least Concern (LC) according to IUCN criteria (IUCN, 2016).

Discussion

*Gymnogeophagus peliochelynion* shares the two synapomorphies that diagnoses the genus (Reis, Malabarba, 1988): the lack of supraneurals and the presence of a forward-directed spine on anterodorsal margin of the first...
dorsal-fin pterygiophore (Fig. 1). The new species also belong to a clade that includes _G. gymnogenys_. Species in this clade are easily recognized by sharing two synapomorphies (more easily observed in females and juveniles; Fig. 5): the absence of an oblique bar between the dorsal border of the eye and the nape, and the possession of a black bar originating in the dorsal contour near the dorsal-fin origin and directed downward and backward on the dorsum (Reis, Malabarba, 1988; Malabarba _et al._, 2015). The conspicuous secondary sexual dimorphism (including development of a nuchal hump in reproductive males), mouthbrooding reproductive strategy, and elongated caudal peduncle, longer than deep (Wimberger _et al._, 1998), which are not observed in the _G. rhabdotus_ group, further support the inclusion of _G. peliochelynion_ in the _G. gymnogenys_ clade.

Species of the _Gymnogeophagus gymnogenys_ clade have an allopatric distribution (Fig. 6) along several tributaries of the rio Uruguay (Malabarba _et al._, 2015; Casciotta _et al._, 2017b; Říčan _et al._, 2017). _Gymnogeophagus lipokarenos_ is endemic to the upper portion of the rio Uruguay, upstream to San Javier (Argentina)/Porto Xavier (Brazil). _Gymnogeophagus constellatus_ and _G. missioneiro_ occur in tributaries immediately downstream of San Javier and Porto Xavier, the first occurring mainly in the rio Ijuí (Brazil), arroyo Itacaruaré and arroyo Chimiray-Mini (Misiones) drainages, and the second occurring in rio Piratini (Brazil) drainage, all draining a basaltic rock bed of the Serra Geral Formation (Batezelli _et al._, 2005). The next main tributary of the Río Uruguay, in a downstream direction, is the rio Ibicuí, with a fine grain sedimentary substrate, corresponding to the unique tributary of the middle Río Uruguay where _G. tiraparae_ and _G. mekinos_ are found. These two species are present too in lower tributaries of Uruguay and La Plata river basins in Uruguay and Brazil. In the next downstream drainage, the rio Quaraí, with basaltic rock bed, we find _G. pseudolabiatus_. The next downstream tributary, the rio Arapay, is occupied by the new species described herein, _G. peliochelynion_. This successive substitution of allopatric
species of the Gymnogeophagus gymnogenys clade along rio Uruguay tributaries suggests the main channel act as a physical or ecological barrier to dispersal of these species, all of which are adapted to small affluent's. Similar patterns have been observed in the tributaries of the river Amazonas for other groups of fish (Junk et al., 2001; Hubert, Renno 2006) and for Atlantic coastal rivers connected through freshwater lakes (Hirschmann et al., 2015).

Populations from río Queguay and río Dayman located downstream from the rio Arapey are tentatively identified herein as G. cf. peliochelynion. Although they do not show hypertrophied lips, they show similar color pattern to that described for G. peliochelynion. Further investigation is needed in order to determine whether these populations constitute a separate species.

Comparative material examined (In addition to those listed by Malabarba et al., 2015). Gymnogeophagus cf. peliochelynion.


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References


