

***Gymnogeophagus caaguazuensis* sp. n. - a new species of cichlid fish (Teleostei: Perciformes: Cichlidae) from the drainage of the lower río Paraguay in Paraguay**

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Abstract. *Gymnogeophagus caaguazuensis* sp. n. is described from the drainage of the upper río Tebicuary-mi in the province of Caaguazú in Paraguay. It can be distinguished from all other described *Gymnogeophagus* species by the following combination of characters: body deep, caudal peduncle short, caudal fin of males lyreate, 26–28 scales in a lateral line and small size.

Resumo. *Gymnogeophagus caaguazuensis*, espécie nova, é descrita da drenagem do alto rio Tebicuary-mi (província Caaguazú, Paraguai). *Gymnogeophagus caaguazuensis* é distinta das demais espécies descritas do gênero *Gymnogeophagus* pela combinação das seguintes características: corpo relativamente alto, pedúnculo caudal curto, nadadeira caudal dos machos em forma de lira, 26–28 escamas no linha lateral e tamanho pequeno.

Resumen. Se describe una nueva especie de cíclido, *Gymnogeophagus caaguazuensis*, de la cuenca del alto río Tebicuary-mi (provincia Caaguazú de Paraguay). La nueva especie se distingue de todas las demás especies del género *Gymnogeophagus* por la siguiente combinación de caracteres diagnósticos: cuerpo relativamente alto, pedúnculo caudal corto, aleta caudal de los machos en forma de lira, 26–28 escamas en la serie longitudinal y talla pequeña.

Kurzfassung. *Gymnogeophagus caaguazuensis* sp. n. wird aus dem oberen río Tebicuary-mi in der Provinz Caaguazú in Paraguay beschrieben. Die neue Art unterscheidet sich von allen anderen bisher beschriebenen *Gymnogeophagus*-Arten durch die Kombination folgender diagnostischer Merkmale: Körper hoch, Schwanzstiel kurz, Schwanzflosse der Männchen leierförmig, 26–28 Schuppen in der Längsreihe und geringe Größe.

Key words. Taxonomy, ichthyology, freshwater, ecology, Cichlidae, new species, Paraguay.

Introduction

The South American cichlid genus *Gymnogeophagus* was first erected by MIRANDA-RIBEIRO (1918) as a monotypic genus for *G. cyanopterus* (= *G. balzanii*). In 1976 it was reviewed and redescribed by GOSSE who included three additional species. Later REIS & MALABARBA (1988) and REIS *et al.* (1992) revised the genus again and rearranged the species. The genus, which contains medium-sized geophagine cichlids (maximum SL 90–169 mm), is distributed in the in the southern tropical or subtropical regions of Bolivia, Brazil, Paraguay, Uruguay and northern Argentina.

The majority of the *Gymnogeophagus* species is endemic to the drainages of both some coastal rivers in Uruguay and in the states of rio Grande do Sul and Santa Catarina in southern Brazil and to the river systems of the río Paraguay, río Paraná and río Uruguay. The only exception is *Gymnogeophagus balzanii* (PERUGIA, 1891), which is also known from the Amazon River basin, for there is a single record from the río Guaporé, a tributary to the río Madeira (REIS & MALABARBA, 1988).

The genus *Gymnogeophagus* MIRANDA-RIBEIRO, 1918 is diagnosed by two derived features, viz. (1) the possession of a forwards directed spine on the top of the first dorsal-fin pterygiophore, and (2) the loss of the bony supraneurals (REIS & MALABARBA, 1988). As currently recognized, it includes nine nominal species (REIS & MALABARBA, 1988; REIS *et al.*, 1992; CASCIOTTA *et al.*, 2000), but about a dozen others remain to be described (WIMBERGER *et al.*, 1998; STAECK, 2001). Some of them are well-known in the aquarium trade and in the popular literature and

provisionally referred to by popular names. The purpose of the present paper is to give a formal description of one of these species which brings the total number of described taxa in the genus to ten and elevates the number of species known from Paraguay to at least three.

Material and Methods

The holotype and paratypes were fixed in 75% ethanol. The type specimens are deposited in Staatliches Museum für Tierkunde Dresden (MTD F).

Measurements and counts were taken according to REIS & MALABARBA (1988). Measurements were made with a dial caliper reading to the nearest 0.1 mm. Numbers in brackets after counts indicate the number of specimens examined with that condition. Comparisons were made with specimens of *G. gymnogenys*. Data from the original species descriptions and redescrptions (HENSEL, 1870; GOSSE, 1976; REIS & MALABARBA, 1988) were also used.

Abbreviations. E1 = row of scales in the horizontal series directly above the longitudinal row including the lower lateral line; SL = standard length; TL = total length; MTD F = Staatliche Naturhistorische Sammlungen Dresden, Museum für Tierkunde, Fischeammlung; ZMB = Museum für Naturkunde, Berlin.

Gymnogeophagus caaguazuensis sp. n.

(Figs. 1–3)

Holotype. MTD F 30367, 84.8 mm SL, male, upper río Tebicuary-mi (approx. 25°28'S, 56°10'W), tributary to río Tebicuary (drainage of the lower río Paraguay), at ruta No. 7 approx. 25 km east of Cnel. Oviedo in the province of Caaguazú in Paraguay, *leg.* February 2005 by W. STAECK.

Paratypes. MTD F 30384–30393, 10 specimens (6 males, 4 females), 56.8–86.3 mm SL, collecting data like holotype.

Non-types. MTD F 30368–30383, 16 juveniles, 19.8–37.3 mm SL, collecting data like holotype. Priv. Coll. STAECK, 2 females, 70.5 and 58.4 mm SL, collecting data like holotype.

Comparative material. *Gymnogeophagus gymnogenys* (HENSEL 1870): ZMB 7465, 1 male, 125 mm SL, Brazil, rio Grande do Sul, rio Cadeia (Lectotype); ZMB 22299, 4 specimens, 81.6–153.6 mm, collecting data like holotype (Paralectotypes). Priv. Coll. STAECK, 1 male, 84.4 mm SL, Uruguay, rio Tacuari, 14.2.2000. Priv. Coll. STAECK, 1 male, 82.5 mm SL, Uruguay, arroyo Yerbal, 16.2.2000.

Diagnosis. A small mouthbrooding species of *Gymnogeophagus* with a conspicuous secondary sexual dimorphism. It differs from all the other described species in the genus in the following combination of characters: (1) body comparatively deep, (2) caudal peduncle short, (3) caudal fin of males lyreate, (4) 26 to 28 scales in E1 row and (5) small size (max. SL 86.3 mm).

Description.

Based on the holotype and 10 paratypes. See figs. 1–3 for general shape and colour patterns. Body proportions are summarized in table 1.

Gymnogeophagus caaguazuensis is a strikingly dimorphic, rather deep-bodied, robust species with males being considerably larger, more brightly coloured and developing pointed fins and a tumescent, adipose hump on top of their heads.

Body laterally compressed. In anterior view with keeled nape. Dorsal outline more arched than ventral outline. In adult males dorsal contour conspicuously divided into two segments with different degrees of arching: dorsal head contour from snout tip to top of adipose hump very



Fig. 1. *Gymnogeophagus caaguazuensis* sp. n., holotype, two months after fixation, MTD F 30367.

steep and straight (save for small concavity above anterior half of orbit); body contour at base of dorsal fin only slightly arched. Ventral head contour with slightly inclined straight lower jaw and straight sloping posterior section. In females dorsal and ventral outline evenly arched from snout to last dorsal fin ray, respectively to first anal fin ray.

Snout moderately long. Mouth terminal. In upper and lower jaw numerous small unisupid conical teeth, which are moderately recurved and not arranged into conspicuous series. Outer teeth slightly larger than inner ones. Orbit close to forehead contour, all in dorsal half of head.

Dorsal fin usually originating anterior to vertical line through posterior bony margin of operculum. Large individuals with pointed prolongation of the soft dorsal fin, usually reaching base of caudal fin. Soft anal fin of adult males pointed, usually reaching caudal-fin base. Pectorals long, usually reaching anal-fin base. Pelvic fins of females roundish, in males pointed, reaching slightly beyond anus. Caudal fin in females concave, in males lyrate, deeply emarginate and with a pointed prolongation of both lobes.

Body scales moderately large and ctenoid, except for cycloid and ctenoid small-scaled pre-ventral area. Operculum with cycloid and ctenoid scales, usually irregularly scattered. Cheeks naked or rarely with up to 3 scales. Dorsal fin, anal fin, pelvic and pectoral fins without scales. Caudal fin scaled only at its base.

Teeth of lower pharyngeal tooth plate conical and pointed, not numerous; a few postero-medial teeth much stronger and with blunt cusps (studied in 2 female non-types of 70.5 and 58.4 mm SL).

External gill rakers on first gill arch: 3–4 epibranchial and 6–7 ceratobranchial (studied in 2 female non-types of 70.5 and 58.4 mm SL).

Dorsal fin XIII.10 (2), XIII.11 (4), XIV.9 (3), XIV.10 (1) XIV.11 (1). Anal fin III.7 (1), III.8 (10). Scales in E1 row 26 (3), 27 (5), 28 (3). Scales on upper lateral line: 16 (4), 17 (6), 18 (2); on lower lateral line 9 (2), 11 (9), 12 (1).

Colouration in life. Body of adult males with greyish white ground colour. Ventral region yellowish to deep yellow, forehead and nape tan. Cheeks often with a few irregularly shaped metallic greenish to golden dots. Upper and frontal part of iris brown. Lips grey. Posterior part of gill cover often with a tinge of orange. On the body sides several longitudinal series of scales with a small golden or greenish dot, which form up to eight iridescent thin longitudinal lines.

Table 1. Morphometry of *Gymnogeophagus caaguazuensis*. Measurements of holotype and 10 paratypes in percent of SL (except SL in mm); min = lowest value, max = highest value, mean = arithmetic mean, sd = standard derivation.

Measurement	min	max	mean	sd
Standard length	56.8	86.3	70.71	
Head length	31.7	36.6	34.13	1.57
Snout length	10.7	15.0	12.84	1.47
Body depth	38.0	42.8	40.00	1.47
Eye diameter	8.9	11.4	10.01	0.83
Interorbital width	9.3	13.7	11.83	1.26
Preorbital depth	8.2	11.9	9.96	1.25
Caudal peduncle depth	13.3	14.9	13.97	0.59
Caudal peduncle length	13.9	17.4	15.92	0.99
Pectoral fin length	27.3	33.8	30.90	1.80
Last dorsal fin spine length	11.0	13.3	12.09	0.81

Frequently with a dark infraorbital stripe from the eye to the corner of the preopercle and a dark supraorbital stripe from eye to eye. In the middle of the flanks a large black rectangular lateral blotch extending dorso-ventrally from the upper lateral line to the scales 6 or 7 to 9 or 10 in E1 row. An irregular dark horizontal lateral band from gill cover to caudal spot is interrupted both behind the lateral blotch and in front on the caudal peduncle. In adult specimens vertical bars usually reduced to a large blotch in front of the origin of the dorsal fin and another above the lateral blotch.

In adult males caudal fin yellowish with broad red margins and irregularly arranged silvery or bright blue roundish dots. Soft portion of dorsal fin red with silvery to bright blue dots. Proximal portion of anal fin yellow, distal portion deep red with well-defined silvery to bright blue dots. Ventral fins reddish with several bluish longitudinal streaks. Pectoral fins hyaline. Colouration of female specimens similar but more pallid.

Colouration in alcohol. Dark markings well preserved, but general appearance of preserved specimens paler. Iridescent marks and bright blue dots become white, red pigmentation becomes pale brown. The ventral orange colouration becomes whitish.

Geographical distribution. At present *Gymnogeophagus caaguazuensis* is known only from the type locality in the drainage of the lower río Paraguay in the province of Caaguazú in Paraguay.

Ecological notes. Field observations at the type locality indicate that the habitats preferred by *Gymnogeophagus caaguazuensis* are bare sandy bottoms among rocky areas in small rivulets which may have a strong current during the rainy season. But during the dry season and the period of low water this species is found in pools and ponds with more or less stagnant water. Water data collected in February at the type locality: pH 7.9; electrical conductivity 240 μ S/cm; water temperature 24.2 °C. The associated fish fauna included *Phalloceros caudimaculatus* (Poeciliidae), *Rineloricaria* sp. (Loricariidae) and two small characid species.

Reproductive behaviour. *Gymnogeophagus* species display a variety of parental care and mating systems ranging from mouthbrooding and polygyny to substrate spawning and monogamy. Breeding was observed in aquarium: *Gymnogeophagus caaguazuensis* is a



Fig. 2. Live topotypic adult male of *Gymnogeophagus caaguazuensis* sp. n., approx. 10 cm TL, photographed in aquarium; not preserved.

Fig. 3. Live topotypic adult female of *Gymnogeophagus caaguazuensis* sp. n., approx. 8 cm TL, photographed in aquarium; not preserved.

delayed (larvophile) maternal mouthbrooder. Like several of its congeners this species starts reproduction like a substrate spawner, i. e. the parents initially spawn on a stone. But just prior to the hatching of the larvae the female picks up the eggs and then orally broods the larvae and young.

In front of ripe females courting males display a conspicuous quivering movement of their mouths caused by opening and closing the mouth with extremely high frequency. This peculiar behaviour during courtship seems to be a synapomorphy of the mouthbrooding *Gymnogeophagus* species, as it has been observed only within this species complex (STAECK, 2003).

Etymology. The specific epithet *caaguazuensis* refers to the province of Caaguazú in Paraguay,

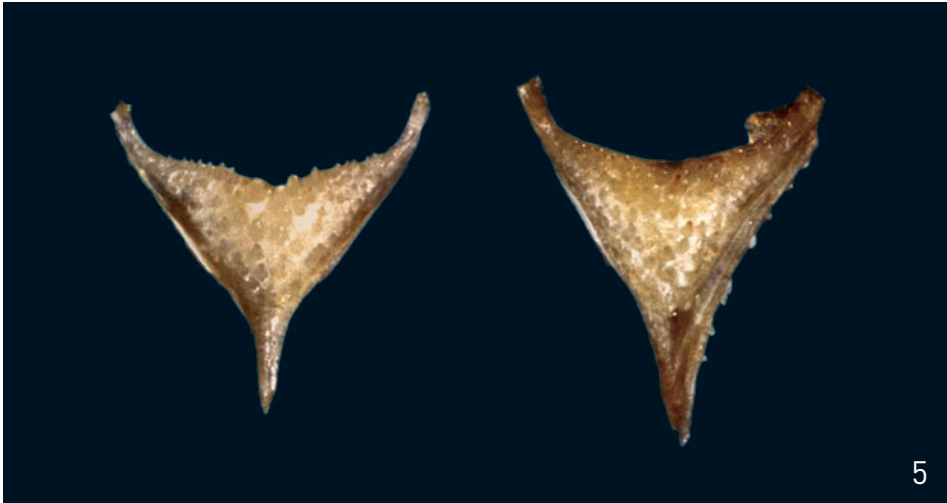


Fig. 4. Collecting site of *Gymnogeophagus caaguazuensis* sp. n. at the upper río Tebicuary-mi in the drainage of the lower río Paraguay in the province of Caaguazú in Paraguay.

Fig. 5. Lower pharyngeal toothplates of 2 females of 70.5 and 58.4 mm SL.

the area of occurrence of the new species. The word is regarded as an adjective, here in masculine form.

Discussion

WIMBERGER *et al.* (1998) published results of molecular analyses providing strong support for the monophyly of the genus *Gymnogeophagus*. They distinguish within the mouthbrooding group three clades: (1) *Gymnogeophagus labiatus* (HENSEL, 1870) and *Gymnogeophagus lacustris* REIS & MALABARBA, 1988, (2) *Gymnogeophagus balzanii* (PERUGIA, 1891) and (3) the “*gymnogenys*-like” group, the most derived lineage. All the species of the *Gymnogeophagus gymnogenys* species-group (REIS & MALABARBA, 1988) form a monophyletic complex within

the genus *Gymnogeophagus* (REIS *et al.*, 1992).

Gymnogeophagus caaguazuensis is a species of the “*gymnogenys*-like” group as diagnosed by WIMBERGER *et al.* (1998). It can be distinguished from all the described species outside the mouthbrooding group by the higher number of scales in E1 (26–28 vs. 22–25). Within the mouthbrooding *G. gymnogenys* species-group (REIS & MALABARBA, 1988) *Gymnogeophagus caaguazuensis* can be distinguished from all the other species by the lyreate caudal fin of the males.

The lack of a hypertrophy of the lips distinguishes *Gymnogeophagus caaguazuensis* from *Gymnogeophagus labiatus* (HENSEL, 1870). It differs from *Gymnogeophagus balzanii* by the lower number of soft rays in the dorsal fin (9–11 vs. 12–15) and from *Gymnogeophagus lacustris* by the lack of orange lips and the possession of well-defined circular roundish dots in the caudal, dorsal and anal fin (vs. small stripes).

Within the “*gymnogenys*-like” group (WIMBERGER *et al.*, 1998) it differs from *G. australis* by a supraorbital stripe, a pattern of conspicuous dark cloudy markings on the sides (versus vertical double bars), its longer caudal peduncle (length/depth 1.0–1.3 [mean 1.1] versus 0.9–1.1 [1.0]) and its more elongated body (body depth in SL 2.3–2.6 [mean 2.4] versus 2.0–2.2 [2.2]).

Gymnogeophagus caaguazuensis can be distinguished from *Gymnogeophagus gymnogenys* by its deeper body (body depth in SL 2.3–2.6 [mean 2.4] versus 2.3–2.9 [2.6]), the absence of a reddish to orange postorbital area in adult males and the smaller size (TL 86.3 versus > 160 mm).

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References

- CASCIOTTA, J.R.; GÓMEZ, S.E. & TORESANNI, N.I. (2000): *Gymnogeophagus che*, una nueva especie de la familia Cichlidae de la cuenca del río Paraná (Perciformes, Labroidei). – Rev. Mus. Argentino Cienc. Nat., n.s., **2**(1): 53–59.
- GOSSE, J.-P. (1976): Révision du genre *Geophagus* (Pisces Cichlidae). – Mem. Acad. R. Sci. Outre-Mer Cl. Sci. nat. méd., n.s., **19**(3): 1–172.
- HENSEL, R.F. (1870): Beiträge zur Kenntniss der Wirbelthiere Südbrasilens. Fische. – Archiv f. Naturgesch., **36**(1): 50–91.
- KULLANDER, S.O. (2003): Family Cichlidae (Cichlids). in: REIS, R.E.; KULLANDER, S.O. & FERRARIS Jr., C.J. (eds.): Check List of the Freshwater Fishes of South America and Central America. – EDIPUCRS, Porto Alegre, Brazil, 742 pp.
- REIS, R.E. & MALABARBA, L.R. (1988): Revision of the neotropical cichlid genus *Gymnogeophagus* Ribeiro, 1918, with description of two new species (Pisces, Perciformes). – Revta. Bras. Zool., **4**: 259–305.
- MALABARBA, L.R. & PAVANELLI, C.S. (1992): *Gymnogeophagus setequeadas*, a new cichlid species (Teleostei: Labroidei) from middle Rio Paraná system, Brazil and Paraguay. – Ichthyol. Expl. Freshwaters, **3**(3): 265–272.
- STAECK, W. (2001): Zwei neue Erdfrösser aus Uruguay. – D. Aqua. Terr. Z. (DATZ), **54**(12): 20–21.
- STAECK, W. (2003): Die maullbrütenden *Gymnogeophagus*-Arten. – D. Aqua. Terr. Z. (DATZ), **56**(5): 6–11.
- WIMBERGER, P.H.; REIS, R.E. & THORNTON, K.R. (1998): Mitochondrial Phylogenetics, Biogeography, and Evolution of Parental Care and Mating Systems in *Gymnogeophagus* (Teleostei: Cichlidae). In: MALABARBA, L.R.; REIS, R.E.; VARI, R.P.; LUCENA, Z.M.S. & LUCENA, C.A.S. (1998): Phylogeny and classification of neotropical fishes. Porto Alegre.