



***Crenicichla mandelburgeri*, a new species of cichlid fish (Teleostei: Cichlidae) from the Paraná river drainage in Paraguay**

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Abstract

Crenicichla mandelburgeri, new species, is described from the streams Tembey, Pirayuy, Pirapó and Poromoco which are Paraguayan tributaries to the Paraná River. It is similar in particular to *Crenicichla niederleinii*, *C. mucuryna*, and *C. jaguarensis*, distinguished by relatively small size (114 mm SL), low scale counts, and details of the colour pattern.

Key words: PROVEPA, Arroyo Tembey, Arroyo Poromoco, *Crenicichla jaguarensis*, *Crenicichla niederleinii*

Resúmen

Se describe *Crenicichla mandelburgeri*, nueva especie, de los arroyos Tembey, Pirayuy, Pirapó y Poromoco, todos afluentes del río Paraná en el Paraguay. La nueva especie es particularmente similar a *Crenicichla niederleinii*, *C. mucuryna* y *C. jaguarensis*, y es distinguido por su tamaño relativamente pequeño (114 mm LS), bajo número de escamas y detalles del padrón de colorido.

Introduction

The South American cichlid genus *Crenicichla* Heckel is the most speciose genus of the family Cichlidae, with close to 80 valid species (Kullander, 2003; Casciotta *et al.*, 2006; Kullander & Lucena, 2006). Whereas South American cichlid species diversity is highest in the Amazon basin, recent studies have demonstrated a proportionally high number of species of *Crenicichla* in southern and southeastern South America. Lucena & Kullander (1992) reported on 11 species from the Uruguai river basin, of which nine endemic, to which Lucena (2007) added two species, also endemic. Kullander & Lucena (2006) distinguished six species, of which three new, from the coastal rivers of Brazil and eastern Uruguay. Seven endemic species are known from the upper Paraná river drainage (Kullander, 2003; Casciotta *et al.*, 2006).

Only four species of *Crenicichla* have been reported from Paraguay, all of them relatively widespread in the Paraguay-Paraná basin, viz. *Crenicichla vittata* Heckel, *C. lepidota* Heckel (including *C. edithae* Ploeg), and *C. semifasciata* Heckel, mainly distributed in the Río Paraguay drainage, and *C. niederleinii* (Holmberg), from the Paraná river drainage (Kullander, 2003). There are at least two undescribed species in the Paraguayan tributaries of the Paraná River, and this paper describes one of them.

Material and methods

Measurements and counts were taken as described by Kullander (1980, 1986). Specimen lengths are given as

standard length (SL), measured from the tip of the upper jaw to the middle of the base of the caudal fin. Scales in a longitudinal row (E1 row scales) are counted in the row immediately dorsal to that containing the lower lateral line. Colour marking terminology follows Kullander (1980; 1986). Vertebral counts include the last halfcentrum and were taken from X-radiographs made on Kodak X-omat V film using a Philips MG-105 low voltage X-ray unit. Morphometric data were managed and analysed using SPSS 15.

Paraguayan orthography varies with regard to the final *i* (Guarani word for water or small) in names of rivers and streams. Pirayuy could also be written Pirayui, Pirayu'i, or Pirayu-i. I chose here the more common -y ending.

Specimens are deposited in the following institutions: MNHNP, Museo Nacional de Historia Natural del Paraguay, San Lorenzo; MHNG, Muséum d'Histoire naturelle de Genève, Geneva; Museu de Zoologia da Universidade de São Paulo, São Paulo; NRM, Swedish Museum of Natural History, Stockholm; NUP, Coleção Ictiológica do Núcleo de Pesquisas em Limnologia, Ictiologia e Aqüicultura da Universidade Estadual de Maringá, Maringá.

Comparative material: *Crenicichla haroldoi* Luengo, MZUSP 16038 (43); *C. iguassuensis* Haseman, NUP 6079 (2), 6080 (2), 6081 (1), 6082 (1); *C. jaguarensis* Haseman, MZUSP 41182 (4); *C. jupiaensis* Britski & Luengo, MZUSP 16046 (21).

***Crenicichla mandelburgeri*, new species**

Figs 1–7, Tables 1–2

Holotype. MHNG 2691.043, adult female, 82.5 mm SL; Paraguay: Itapúa: Arroyo Tembey above falls; 1–3 November 1982, Expedition of MHNG.

Paratypes. All from Paraguay, Departamento Itapúa. — MHNG 2691.044, 1, 97.0 mm SL; Arroyo Tembey drainage: small tributary to Arroyo Tembey, 10 km S of CAICISA, San Rafael; 4 Nov 1982, Expedition of MHNG. — MHNG 2691.045, 14, 60.8–113.2 mm SL; NRM 55478, 5, 55.5–106.9 mm SL; Arroyo Tembey drainage: Arroyo Tembey, 4 km above rapids; 1–2 Nov 1982, Expedition of MHNG. — MHNG 2691.046, 4, 66.9–81.6 mm SL; Arroyo Poromoco, 10 km S of Santa María; 26 Oct 1982, Expedition of MHNG. — MHNG 2691.047, 12, 58.8–95.7 mm SL; Arroyo Poromoco; 26–27 Oct 1982, Expedition of MHNG. — NRM 42898, 1, 78.6 mm SL; Arroyo Pirapó drainage: Pirapó, Arroyo Pirapó, inundated area; 21 Feb 1998, S.O. Kullander, *et al.* — NRM 42475, 1, 98.2 mm SL; Arroyo Tembey drainage: Arroyo Guazúy, on side of road about 14 km before Naranjito; 24 Feb 1998, S.O. Kullander, *et al.* — NRM 22687, 1, 36.1 mm SL; NRM 25926, 1, 87.6 mm SL; Arroyo Tembey drainage: Balneario Yberá in stream ca 2 km from road Encarnación–Ciudad del Este, ca km 128; 24 May 1994, S.O. Kullander, *et al.* — NRM 41887, 3, 23.3–23.5 mm SL; Arroyo Pirayuy drainage: Natalio, Arroyo Pirayuy, in the Balneario Pirayuy; 22 Feb 1998, S.O. Kullander, *et al.* — MNHNP 3678, 2, 66.1–81.1 mm SL; NRM 27910, 3, 58.4–114.6 mm SL; NRM 27912, 2, 89.7–103.2 mm SL; Arroyo Tembey drainage: Arroyo Tembey at Km 141 on Ruta 6 Ciudad del Este–Encarnación; 23 May 1994, S.O. Kullander, *et al.*

Diagnosis. Similar to other species of *Crenicichla* from Brazil (*C. mucuryna* von Ihering) and the Paraná River (*C. niederleinii*) by presence in young specimens of numerous narrow vertical bars along the side, replaced in adults by an irregular dark horizontal band. Distinguished by low number of scales in a lateral row, 44–56 vs. 57–63 in *C. mucuryna* and 56–65 in *C. niederleinii*. Distinguished from *C. jaguarensis*, in the upper Paraná River, by presence of numerous narrow vertical bars in young specimens, lateral band in adults 2–3 scales wide and running close to upper lateral line vs. 1–1½ scales wide and distinctly separated from upper lateral line, and suborbital stripe usually short and narrow and individual spots making up the stripe recognizable vs. stripe wide, long and almost uniformly pigmented. Distinguished from *C. jupiaensis* in the upper Paraná River by lower jaw prognathous, vs. jaws isognathous, preopercular margin serrated vs. smooth, and by colour pattern, *C. jupiaensis* not developing a lateral band. Distinguished from *C. haroldoi*, in the upper Paraná River, by caudal blotch present and distinct, vs. absent or indistinct, preopercle serrated vs. not

serrated, and black dots marking lateral line scales absent vs. present. Distinguished from *C. yaha* and *C. iguassuensis* from the Urugua-í and Iguazú basins respectively, by dark lateral band along the side vs. a row of dark blotches along the middle of the side. Distinguished from coastal species *C. maculata*, *C. punctata*, *C. lacustris*, *C. tingui*, and *C. iguapina* by larger scales in the E1 row, 44–56 vs. 56–75.



FIGURE 1. *Crenicichla mandelburgeri*, holotype, adult female, 82.5 mm SL, MHNG 2691.043. Paraguay, Itapúa, Arroyo Tembey above falls.



FIGURE 2. *Crenicichla mandelburgeri*, paratype, adult male, 98.2 mm SL, NRM 42475. Paraguay, Itapúa, Arroyo Guazúy.



FIGURE 3. *Crenicichla mandelburgeri*, paratype, adult male, 78.6 mm SL, NRM 42898. Paraguay, Itapúa, Arroyo Pirapó.

Description. Largest male 114.6 mm SL, largest female 82.5 mm SL. Refer to Figures 1–5 for general aspect. Head about as wide as deep. Caudal peduncle slightly longer than deep. Snout moderately long, rounded from above, bluntly pointed in lateral view. Lower jaw slightly prognathous, its articulation below middle of orbit; ascending premaxillary processes reaching to 1/4 of orbit; maxilla reaching to or slightly surpassing vertical from anterior margin of orbit. Lips thick and wide, lower lip folds separate anteriorly; folds of upper lip not continuous but cutting into a symphyseal wide thickening. Postlabial skin fold margin truncate. Orbit supralateral, not visible from below, chiefly in anterior half of head. Interorbital area flat, narrower than mouth. Nostril dorsolateral, about halfway between orbit and margin of postlabial skin fold,

with low tubular margin but no anterior marginal membranaceous skin flap. Preopercle with regular serrations along vertical margin. Lateralis pores on head simple or with two small openings.

Flank scales strongly ctenoid. All scales cycloid on head, on dorsum above anterior 1/3 of upper lateral line, along dorsal-fin base, on chest, and on belly below line from lower edge of pectoral-fin base to anal-fin origin. Predorsal scales small, embedded in skin, extending forward to transverse frontal lateralis canal. Prepelvic scales very small, deeply embedded in skin. Cheek naked anteroventrally; below eye 5–7 scales, embedded in skin. Interopercle naked. Scales in E1 row in Tembey specimens 44 (1), 46 (2), 47 (4), 48 (2), 50 (7), 51 (3), 54 (1), 55 (1); in Poromoco specimens 48 (1), 50 (1), 51 (1), 52 (3), 53 (2), 55 (1), 56 (1). Transverse scale row 14–15+1+5. Circumpeduncular scale rows 10–11 dorsally, 11–12 ventrally (23–24 including lateral lines).



FIGURE 4. *Crenicichla mandelburgeri*, paratype, adult male, 88.5 mm SL, MHNG 2691.047. Paraguay, Itapúa, Arroyo Poromoco.



FIGURE 5. *Crenicichla mandelburgeri*, paratype, adult female, 88.9 mm SL, MHNG 2691.047. Paraguay, Itapúa, Arroyo Poromoco.

Lateral-line scales in Tembey specimens 24/10 (3), 25/10 (3), 25/11 (3), 26/9 (1); in Poromoco specimens 23/12 (2), 23/13 (1), 24/10 (1), 24/11 (2), 25/10 (1), 25/11 (2), 25/12 (1); 2 scales continuing lower line onto caudal fin; one tubed accessory lateral-line scale on caudal fin, between rays D3 and D4, in one specimen. Upper and lower lateral lines overlapping by one scale. Scales between upper lateral line and dorsal fin 11 anteriorly, 3½ posteriorly; scale rows between lateral lines 2. Anterior upper lateral-line scales larger and more elongate than adjacent scales, remaining lateral-line scales nearly same size as adjacent scales; three scales impinging on each scale of anterior part, two on each scale of posterior part of upper lateral line; 1–2 scales impinging on each scale of lower lateral line. Dorsal, anal, pectoral and pelvic fins without scales. Caudal-fin squamation extending to about 1/3 of fin, posterior margin of scaled area straight vertical.

First dorsal-fin spine about 1/4–1/3 length of last; spines subequal in length from 6th–9th. Soft part of dorsal fin with rounded or subacuminate tip, reaching to base of caudal fin or slightly beyond. Dorsal-fin count in Tembey specimens XXI.11(4), XXI.12 (2), XXII.10 (5), XXII.11 (4); in Poromoco specimens XX.11

(1), XXI.10 (2), XXI.11 (4), XXII.11 (2), XXIII.11 (1). Soft anal fin with rounded tip, reaching to or almost to base of caudal fin; anterior soft rays, lappets and margin of soft portion thickened. Anal fin count in Tembey specimens III.8 (6), III.9 (7), III.10 (1); in Poromoco specimens III.8 (7), III.9 (3). Caudal fin rounded. Pectoral fin rounded, 7th ray longest, reaching about halfway to spinous anal fin. Pectoral-fin rays in Tembey specimens 16 (12), 17 (1); in Poromoco specimens 15 (2), 16 (8). Pelvic fin inserted well posteriorly to vertical from pectoral axilla, with rounded or subacuminate tip, second ray longest, reaching about halfway to spinous anal fin; anterior rays and margin thickened.

TABLE 1. Standard length (in millimeters) and proportional measurements in percents of standard length of *Crenicichla mandelburgeri* from the Arroyo Tembey drainage. SD, standard deviation. Regression line parameters, a (intercept), b (slope), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimeters; shown when $p < 0.05$. Holotype (HT) values given separately and also included in group values.

| | HT | N | Min | Max | Mean | SD | a | b | r |
|------------------------------|------|----|------|-------|------|-------|-------|-------|-------|
| Standard length (mm) | 82.4 | 17 | 55.5 | 114.6 | 87.4 | 16.40 | | | |
| Head length | 30.8 | 17 | 29.7 | 32.3 | 31.0 | 0.63 | 4.847 | 0.271 | 0.996 |
| Snout length | 8.1 | 17 | 6.7 | 9.8 | 8.3 | 0.91 | | | |
| Head depth | 15.2 | 17 | 13.9 | 16.9 | 15.3 | 0.85 | | | |
| Body depth | 23.5 | 17 | 20.0 | 23.9 | 21.5 | 1.08 | 3.891 | 0.182 | 0.971 |
| Orbital diameter | 8.9 | 17 | 7.6 | 9.6 | 8.5 | 0.59 | 3.370 | 0.049 | 0.967 |
| Interorbital width | 4.6 | 17 | 4.6 | 5.9 | 5.0 | 0.54 | | | |
| Pectoral-fin length | 21.4 | 16 | 16.4 | 22.1 | 20.2 | 1.53 | 6.159 | 0.136 | 0.916 |
| Upper jaw length | 10.6 | 17 | 9.7 | 12.0 | 11.0 | 0.73 | | | |
| Lower jaw length | 14.7 | 17 | 13.5 | 15.6 | 14.8 | 0.67 | 0.949 | 0.147 | 0.997 |
| Caudal-peduncle depth | 12.0 | 17 | 10.6 | 12.0 | 11.1 | 0.38 | 2.407 | 0.089 | 0.982 |
| Caudal-peduncle length | 13.7 | 17 | 12.8 | 15.3 | 14.1 | 0.80 | 3.586 | 0.105 | 0.949 |
| Last dorsal-fin spine length | 13.5 | 17 | 10.7 | 14.8 | 12.8 | 1.08 | 4.246 | 0.083 | 0.893 |

TABLE 2. Standard length (in millimeter) and proportional measurements in percents of standard length of *Crenicichla mandelburgeri* from the Arroyo Poromoco drainage. SD, standard deviation. Regression line parameters, a (intercept), b (slope), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimeters; shown when $p < 0.05$.

| | N | Min | Max | Mean | SD | a | b | r |
|------------------------------|----|------|------|------|------|--------|-------|-------|
| Standard length (mm) | 10 | 66.9 | 95.7 | 81.7 | 9.59 | | | |
| Head length | 10 | 29.7 | 32.1 | 31.0 | 0.70 | | | |
| Snout length | 10 | 7.5 | 9.2 | 8.6 | 0.67 | -3.347 | 0.128 | 0.969 |
| Head depth | 10 | 13.0 | 15.9 | 14.1 | 0.88 | | | |
| Body depth | 10 | 18.4 | 22.9 | 20.6 | 1.33 | -7.084 | 0.294 | 0.976 |
| Orbital diameter | 10 | 7.7 | 8.8 | 8.2 | 0.37 | 2.163 | 0.056 | 0.956 |
| Interorbital width | 10 | 4.2 | 5.2 | 4.8 | 0.28 | -1.599 | 0.068 | 0.988 |
| Pectoral-fin length | 10 | 19.3 | 21.3 | 20.5 | 0.73 | | | |
| Upper jaw length | 10 | 9.9 | 11.7 | 10.8 | 0.61 | -2.921 | 0.144 | 0.973 |
| Lower jaw length | 10 | 14.0 | 15.8 | 15.0 | 0.62 | -3.34 | 0.192 | 0.990 |
| Caudal-peduncle depth | 10 | 9.7 | 11.7 | 11.3 | 0.63 | -2.992 | 0.15 | 0.983 |
| Caudal-peduncle length | 10 | 13.1 | 13.9 | 13.4 | 0.31 | | | |
| Last dorsal-fin spine length | 10 | 11.1 | 13.3 | 12.4 | 0.74 | | | |

All teeth pointed, slightly recurved, teeth in outer row fixed, teeth in inner rows inclinable, some depressible. Outer row teeth slightly larger than inner teeth. Outer row of teeth in upper jaw extending for nearly the length of the alveolar ramus of the premaxilla. Upper jaw with 3–4 inner rows anteriorly, one inner row continued almost as long as outer row. Outer row of teeth in lower jaw extending along 3/4 of length of jaw. Lower jaw with 2–3 inner rows anteriorly, one inner row continued posteriorly for half the length of the outer row.

Gill rakers externally on first gill arch 1–2 epibranchial, 1 in angle; ceratobranchial gill-rakers in Tembey specimens 8 (7), 9 (4), 10 (2), in Poromoco specimens 8 (7), 9 (2), 10 (1). Gill rakers on lower pharyngeal tooth-plate in Tembey specimens 11 (5), 12 (1), 13 (2), 14 (2); in Poromoco specimens 11 (6), 12 (2), 15 (1). Microbranchiospines present externally on 2nd–4th arches.

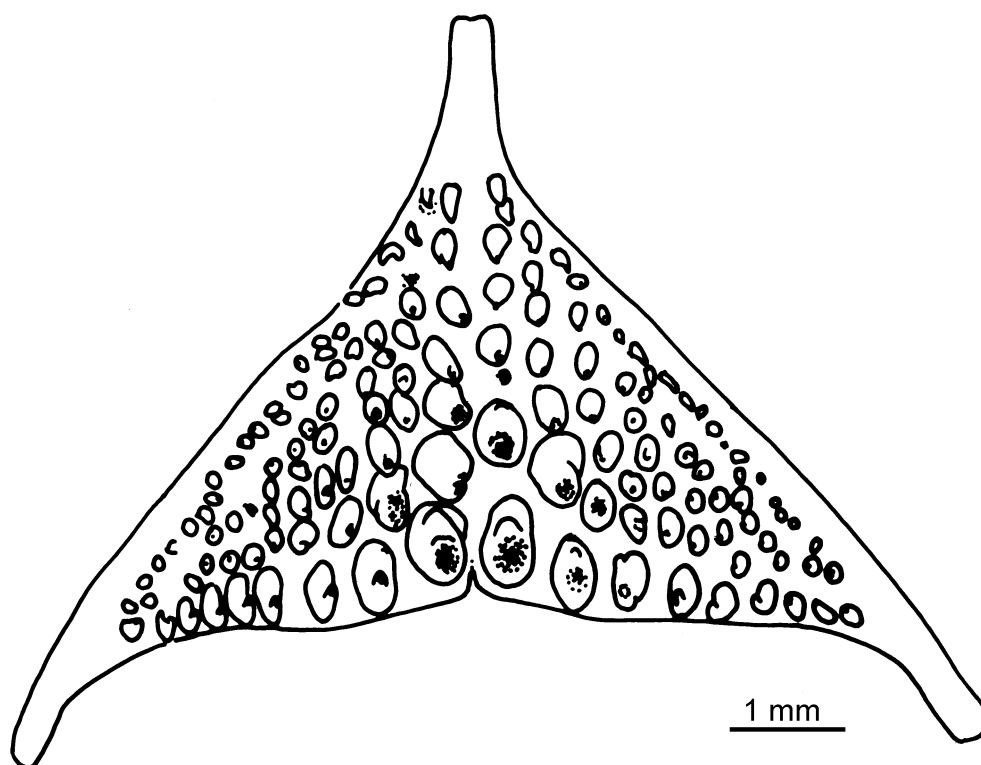


FIGURE 6. *Crenicichla mandelburgeri*, paratype, NRM 55478, 79.5 mm SL. Lower pharyngeal tooth plate in occlusal aspect.

Lower pharyngeal tooth-plate (Fig. 6) dissected from a 79.5 mm specimen, relatively compressed dorsoventrally, with moderately long posterior and anterior processes; tooth-plate length 85% of width; dentigerous area length 60% of width; 18 teeth in posterior row, 7 teeth in admedian row. Anterior teeth slender, subconical, slightly recurved, shape changing gradually to median and posterior teeth which slightly compressed, stout, with anterior shelf and posterior slightly antrorse cusp.

Vertebral counts in Tembey specimens 18+18=36 (1), 19+16=35 (3), 19+17=36 (4); in Poromoco specimens 19+16=35 (2), 19+17=36 (5), 20+17=37(2).

Coloration in alcohol. Chest, abdomen below level of pectoral-fin base, underside of head, and narrow zone along anal-fin base and ventral edge of caudal peduncle yellowish white. Cheek light brown, preopercle light grey. Snout dorsally and interorbital area dark grey. Sides and nape light brownish to yellowish; each scale with dark brown distal margin. Lateral-line scales light, each with a dark dot distally.

Dark brown stripe parallels postorbital stripe and turns transverse along anterior margin of predorsal squamation. Another dark brown stripe runs obliquely forward from gill cleft and along extrascapular row. Neither of these stripes crossing midline of nape. No spot at pectoral-fin base or any indication of a humeral blotch.

Preorbital stripe blackish, running from upper lip to orbit; more or less masked by dark snout

pigmentation. Postorbital stripe composed of dark blotch immediately posterior to orbit and two parallel, partly confluent stripes on opercle. Suborbital stripe running from infraorbital 3 obliquely caudoventrad toward preopercular margin, usually ending before reaching preopercular margin; uniformly pigmented proximally but distally breaking up into dots, one on each scale crossed by stripe; rarely confined to spot at orbital margin (Fig. 2).

Wide blackish lateral band with indistinct margins; three scales deep anteriorly, two scales deep posteriorly, lower margin running along lower lateral line tube row.

Five or six wide vertical blackish bars on dorsum below dorsal fin, and one indistinct dorsally on caudal peduncle. Bars incompletely divided vertically by lighter zone, and thus may appear as a variable number of pairs of bars. Light zone along upper lateral line separating bars from lateral band which, however, frequently showing dorsal expansions each opposed to a vertical bar division. Occasionally, anterior portion of lateral band reduced to row of continuous blotches corresponding in position to bars above.

Dorsal fin in females smoky with large black, slightly horizontally extended, ocellated blotch between spines 11–15, 12–17, 13–16, 14–16, or 14–17. Blotch narrowly margined by hyaline zone. In males dorsal fin grayish with 2–3 irregular rows of dark spots on spinous portion and one additional row of dark spots on soft portion.

Anal fin grayish with white lower margin and submarginal grey stripe; in males also a few dark spots on posterior membranes. Pelvic fin whitish, in females also dusked on anterior rays. Caudal fin dusky with scattered dark dots, dorsal and ventral margins black, posterodorsal and posteroventral margins white. Ocellated caudal blotch black, rounded, partially ringed with light.

Young specimens, up to 85 mm, usually with indistinct lateral band and its anterior to middle portion subdivided into about 5 narrow vertical double bars which extend down onto abdominal sides.

Distribution. Described from the Arroyo Tembey, with assigned samples from the Arroyo Poromoco, Arroyo Pirayuy, and Arroyo Pirapó, all right bank tributaries of the Paraná River in Paraguay (Fig. 7).

Habitats. NRM 27910, 27912, and MNHNP 3678 were collected with electrofishing from rapids in a large stream, 5–10 m wide, to 1 m deep, with turbid, brownish water. Rocks came from road building. The slope of rapids was about 10°. Associated fauna included *Crenicichla lepidota* Heckel (Cichlidae), *Ancistrus* sp. and *Rineloricaria* sp. (Loricariidae), *Bryconamericus* sp. (Characidae), *Heptapterus mustelinus* (Valenciennes) and *Rhamdia quelen* (Quoy & Gaimard) (Heptapteridae).

All other sites where NRM material was collected were small, shallow brown-water streams up to about 3 m wide, with varying velocity and transparency, with bottom of sand and stones, and generally absent vegetation, mostly sampled in unfavorable high water conditions in February. Associated species were generally typical forest stream species such as species of *Astyanax* and *Bryconamericus*, *H. mustelinus*, *Rineloricaria* sp., *Rhamdia quelen*, *Oligosarcus paranensis* Menezes & Géry (Characidae), *Apareiodon* sp. (Parodontidae), *C. lepidota*, and *Gymnogeophagus* cf. *caaguazuensis* (Cichlidae).

Etymology. Named for Paraguayan ichthyologist Darío Mandelburger, Paraguayan co-coordinator of the Proyecto Vertebrados del Paraguay 1992–1999, during which field work *C. mandelburgeri* was collected.

Discussion

Crenicichla mandelburgeri has been collected in four successive right bank tributaries to the Paraná River, viz. the Poromoco, Pirapó, Pirayuy and Tembey in upstreams order (Fig. 6). Since the Tembey and Poromoco streams, like most other tributaries of the Paraguayan portion of the Paraná River are widely separated at their mouths and also hold falls that separate their faunas from that of the Paraná River, it seems likely that there is genetic isolation between different rivers, but all morphometric and meristic characters overlap and there are no obvious differences in colour pattern between geographic samples. Principal component analysis of measurements fails to recover geographic groups. The samples from the Pirapó and Pirayuy streams are too small, or the specimens too small for analyses of morphological variation.

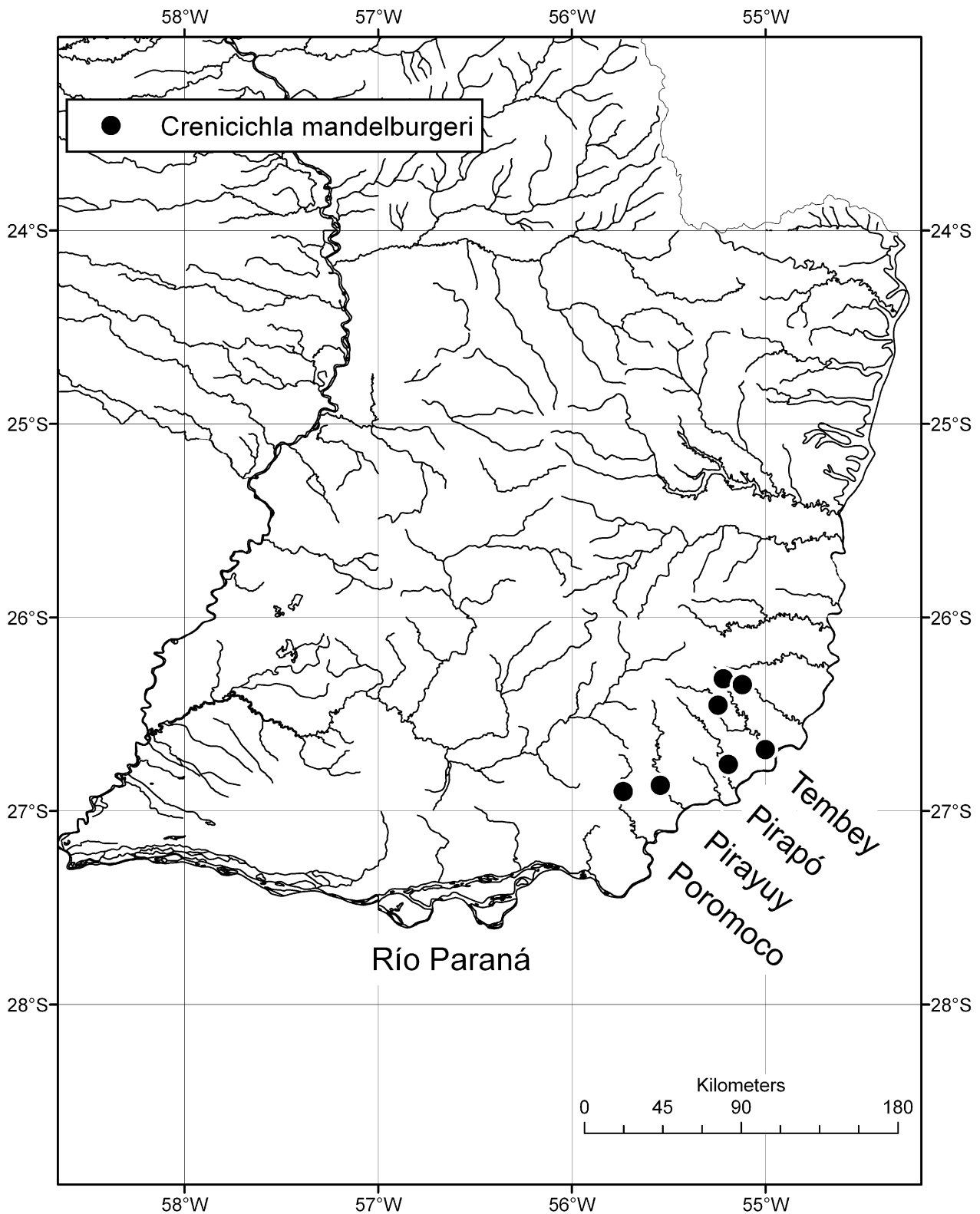


FIGURE 7. *Crenicichla mandelburgeri*, collecting localities in southern Paraguay, with names of rivers from which specimens collected.

The species most similar to *C. mandelburgeri* are *C. jaguarensis* and *C. niederleinii* sensu Kullander (1981). *Crenicichla jaguarensis* is the most widespread species of *Crenicichla* in the upper Paraná River,

occurring from Guaíra to the Corumbataí River, and has 44–54 E1 row scales. It possesses an irregular lateral band, but the band runs at a definite distance from the upper lateral line, and is 1–1½ scales wide, unlike in *C. mandelburgeri* in which it runs close to the upper lateral line and is 2–3 scales wide. The suborbital stripe is consistently developed, wide and long, and almost uniformly pigmented, unlike in *C. mandelburgeri* in which the shape is variable but usually a pattern of dark spots can be distinguished, and the stripe is usually short or narrow. The pattern of very thin vertical bars as in *C. mandelburgeri* or *C. niederleinii* is not recorded from *C. jaguarensis*. In the latter species, however, there are frequent short and narrow expansions of dark pigment dorsally and ventrally along the band, not unlike the colour pattern in *C. niederleinii* and *C. mandelburgeri*.

There are three additional species of *Crenicichla* in the Paraguayan portion of the Paraná river drainage. *Crenicichla lepidota*, member of the *C. saxatilis* (Linnaeus) species group and distinguished by presence of a humeral blotch and low scale count (E1 scales 34–52) (Kullander, 1982). It is recorded from several Paraná tributaries, including the Tembey (NRM 27913), and the Pirayuy (NRM 42302). Kullander (1981) reported a species identified as *C. niederleinii* from the Arroyo Pirapyta upstream from the mouth of the Acaray River. Several additional samples of that species were deposited meanwhile in the MHNG, with a Paraguayan distribution including the Monday and Limoy rivers, and the Itabó-Guazú and Pirapyta streams. That species grows to a much larger size (about 200 mm SL) than *C. mandelburgeri* and is distinguished by a higher scale count, 56–65 E1 scales. The colour pattern is similar to that of *C. mandelburgeri*, but the barred pattern is maintained past known maximum sizes for that species, and only a few large specimens with a horizontal lateral band are available.

Crenicichla jupiaensis, from the Paraná River in Guaíra and Ilha Solteira in Brazil, has 49–55 E1 scales. It is more deep-bodied than *C. mandelburgeri*, with smooth vs. serrated preopercular margin, suborbital stripe reduced to a few spots posterior to the orbit, and side with numerous narrow vertical bars only (lateral band absent). *Crenicichla haroldoi*, also occurring upstreams from Guaíra, has about 50–56 E1 scales. The caudal blotch is absent or indistinct (vs. present and distinct in *C. mandelburgeri*), the preopercle with irregular but not serrated margin (vs. serrated), and each scale in the lateral line is marked by a conspicuous contrasting black blotch (vs. absent in *C. mandelburgeri*).

Crenicichla mandelburgeri is similar in general aspect to species occurring along the coast of Brazil, which are characterized by a row of more or less contiguous blotches along the middle of the side (*C. punctata* Hensel and *C. maculata* Kullander & Lucena) or a wide lateral band (*C. lacustris* (Castelnau), *C. tingui* Kullander & Lucena, *C. iguapina* Kullander & Lucena). Those species, however, have smaller scales (56–75, usually between 60 and 70) than *C. mandelburgeri*, adult males are spotted to the extent that the lateral band may become obsolete, and neither young nor adults show a pattern of narrow vertical bars across the middle of the side (Kullander & Lucena, 2006). *Crenicichla mucuryna* is characterized by 9–12 narrow vertical stripes along the middle of the side, but does not develop a strong lateral band, and has more scales in the E1 row (57–63) than *C. mandelburgeri* (Kullander & Lucena, 2006).

Crenicichla yaha from the Urugua-í and Iguazú river basins in Argentina, is also a small species (to 146 mm SL) and has 48–51 E1 scales according to Casciotta *et al.* (2006), but differs in having isognathous jaws (vs. lower jaw prognathous in *C. mandelburgeri*) and, similar to *C. iguassuensis*, a colour pattern including a row of large blotches along the middle of the side (vs. large blotches along middle of side absent in *C. mandelburgeri*). *Crenicichla iguassuensis* grows to sizes over 200 mm SL, and is recorded only from the Iguazú River upstream from the Iguazú Falls. It has 53–59 E1 scales, and a colour pattern including a series of dark blotches close below the upper lateral line, which may merge to form a lateral band.

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