

A new species of *Crenicichla* from the upper Rio das Antas basin, dos Patos lagoon system, southern Brazil (Teleostei: Cichlidae)

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Abstract

Crenicichla lucenai sp. n. from the upper Rio das Antas basin, dos Patos lagoon system, southern Brazil is here described. The new species is similar to *C. punctata* and *C. maculata*. It is distinguished from both these species by the conspicuous pattern of dark brown irregular lines extending from longitudinal stripe to ventral profile (versus irregular lines absent). In addition, *C. lucenai* can be distinguished from *C. punctata* by the absence of dots on the sides of its head.

Resumo

Crenicichla lucenai sp. n. da bacia do alto Rio das Antas, sistema da Laguna dos Patos, sul do Brasil, é aqui descrita. A nova espécie é similar a *C. punctata* e *C. maculata*. Está é distinguida de ambas as espécies pelo conspicuo padrão de linhas irregulares marrons que se estendem desde a faixa longitudinal até o perfil ventral (versus ausência de linhas irregulares). Adicionalmente, *C. lucenai* pode ser distinguida de *C. punctata* pela ausência de pintas nas laterais da cabeça.

Key words

Biodiversity, Cichlinae, *Crenicichla lucenai*, *Crenicichla maculata*, *Crenicichla punctata*, systematics, taxonomy.

Introduction

Crenicichla Heckel, 1840 is a Neotropical genus of predatory fish known as pike-cichlids. Currently, this genus comprises more than 85 valid taxa, being the most species rich genus of the family Cichlidae in the Neotropical region (KULLANDER, 2003; KULLANDER & LUCENA, 2006; MONTAÑA *et al.*, 2008; KULLANDER *et al.*, 2010; PIÁLEK *et al.*, 2012; VARELLA *et al.*, 2012; CASCIOTTA *et al.*, 2013). The species of *Crenicichla* occur in the cis-Andean region of South America from the coastal drainages of

Venezuela and the Guianas to the lower La Plata river basin in Argentina (KULLANDER, 2003; CASCIOTTA *et al.*, 2006; CASCIOTTA *et al.*, 2010; KULLANDER *et al.*, 2010). KULLANDER (1998), using morphological characters, considered *Crenicichla* to be the sister taxon of *Cichla* BLOCH & SCHNEIDER, 1801, and classified the entity *Cichla* + *Crenicichla* as a relatively basal clade of the Neotropical Cichlidae. However, molecular phylogeny studies strongly support *Crenicichla* as a member of the

derived geophagine cichlids (FARIAS *et al.*, 2000; LÓPEZ-FERNÁNDEZ *et al.*, 2005a, 2005b, 2010; SMITH *et al.*, 2008). Several species groups have been recognized within the genus *Crenicichla* based on morphological character states (e.g. KULLANDER, 1991; PLOEG, 1991; LUCENA & KULLANDER, 1992; KULLANDER & LUCENA, 2006). Recently published molecular phylogenies have questioned the monophyly and validity of some of these species groups, as well as their supposed relationships (KULLANDER *et al.*, 2010; PIÁLEK *et al.*, 2012).

KULLANDER & LUCENA (2006) provided a revision of the *Crenicichla* species from the coastal river basins of southeastern and southern Brazil. Formerly, these species were pooled in the *C. lacustris* group *sensu* KULLANDER (1982). However, the monophyly and validity of this species group has been put in question (LUCENA & KULLANDER, 1992; KULLANDER & LUCENA, 2006; KULLANDER *et al.*, 2010; PIÁLEK *et al.*, 2012). Following the revision by KULLANDER & LUCENA (2006), six species from this geographic region have been recognized as valid: *C. iguapina* KULLANDER & LUCENA, 2006, from the Ribeira do Iguape river drainage; *C. tingui* KULLANDER & LUCENA, 2006, from the Itapocu river drainage and the Babitonga and Paranaguá bays systems; *C. maculata* KULLANDER & LUCENA, 2006, from the coastal rivers' drainages and lake systems lying between north of dos Patos lagoon and the Itapocu river drainage; *C. lacustris* CASTELNAU, 1855, from Paraíba do Sul and São João river basins and lakes of the upper Doce river drainage; *C. punctata* HENSEL, 1870, from the dos Patos lagoon system, including the Mirim lagoon basin; and *C. mucuryna* IHERING, 1914, from the Mucuri river basin (KULLANDER & LUCENA, 2006). KULLANDER & LUCENA (2006) arranged these species into three distinct morphological groups: *C. punctata* and *C. maculata*, characterized by having E1 row scales counts in the range 56–75, a row of blotches along the side of the body and males being densely spotted on body and fins; *C. iguapina*, *C. tingui* and *C. lacustris* are characterized by having a wide longitudinal stripe along the side, males densely spotted on body and fins, and E1 row scales counts range 60–75. *Crenicichla mucuryna* can be distinguished from the previous morphological assemblages by having a trunk with narrow bars and an absence of dots.

The purpose of this paper is to describe a new *Crenicichla* species originating from the Atlantic coastal river basins of southern Brazil. The new species occurs in the upper Rio das Antas basin, Jacuí river drainage. Based on morphological character states, it is closely related to *C. maculata* and *C. punctata*.

Materials and Methods

Measurements and counts follow KULLANDER & LUCENA (2006) and OTTONI *et al.* (2011). Measurements were taken on the left side of each specimen with digital cali-

pers under a binocular microscope. Osteological studies were made on cleared and counterstained (C&S) specimens prepared according to TAYLOR & VAN DYKE (1985). Osteological nomenclature follows COSTA (2006). Nomenclature of the *Crenicichla* species groups follows PIÁLEK *et al.* (2012) and KULLANDER & LUCENA (2006).

For species delimitation we adopted the population aggregation analysis (DAVIS & NIXON, 1992), a character-based method in which species are delimited by a unique combination of stable morphological character states occurring in one or more populations.

Materials are deposited in CIMC, Divisão de Fauna, Grupo Especial de Estudo e Proteção do Ambiente Aquático do Rio Grande do Sul; DZUFMG, Departamento de Zoologia da Universidade Federal de Minas Gerais, Brasil; MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul; UFRJ, Universidade Federal do Rio de Janeiro; and ZMB, Museum für Naturkunde – Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu, Berlin.

Comparative material

Crenicichla lacustris: Rio de Janeiro State: UFRJ 6071, 4, 129.6–129.8 mm SL; São João River, near Gaviões; W. Costa, 31 Jan. 1992. UFRJ 7206, 4, 75.2–88.3 mm SL; Aldeia Velha River, near BR 101, Silva Jardim Municipality; W. Costa, 28 Aug. 2005. UFRJ 7281, 3, 81.9–97.7 mm SL; Aldeia Velha River, Silva Jardim Municipality; W. Costa, no date.

Crenicichla maculata: Santa Catarina State: MCP 14308, 1, 114.8 mm SL (paratype), Três forquilhas River, Torres Municipality; M. Lucena *et al.*, 12 Dec. 1989. ZMB 17214, 3, 117.7–150.9 mm SL; Humboldt River; Erhardt, 1910. MCP 23594, 1 (C&S), 95.6 mm SL; Itoupava River, 3 km W from Ermo, Pereira *et al.*, 22 Jul. 1999.

Crenicichla punctata: Rio Grande do Sul State: ZMB 7459, 1, 143.6 mm SL (lectotype of *C. punctata*); Guaíba River; Hensel, no date. ZMB 7461, 1, 221 mm SL (lectotype of *C. polysticta*); Cadea River; Hensel, no date. UFRJ 7929, 2, 61.9–87.3 mm SL; Jacuzinho River, Estrela Velha Municipality; L. Rosa, F. Silveira and Z. Correa, 22 Oct. 2006. UFRJ 7928, 3, 70.5–102.3 mm SL; Jacuzinho River, Estrela Velha Municipality; L. Rosa, F. Silveira and Z. Correa, 22 Oct. 2006. CIMC 31107, 5, 97.2–126.5 mm SL; Dona Francisca dam near the mouth of Jacuzinho River, Jacuí River drainage, Ibarama Municipality; L. Rosa, F. Silveira and Z. Correa, 19 Jan. 2005. CIMC 31208, 2, 115.8–145.0 mm SL; Dona Francisca dam, Lajeado do Gringo, Jacuí River drainage, Ibarama Municipality; L. Rosa, F. Silveira and Z. Correa, 21 Jan. 2005. CIMC 32057, 1, 185.4 mm SL; Jacuí River near the mouth of Soturno stream, Dona Francisca Municipality; L. Rosa, F. Silveira and Z. Correa, 22 Jan. 2005. CIMC 33630, 2, 98.5–126.8 mm SL; Jacuí River near the mouth of do Couto stream, Guaíba Lake drainage, Rio Pardo Municipality; M. Cheffe, R. Baltar and L. Rosa, 12 May. 2004. CIMC 32206, 3, 107.2–175.0 mm SL; Jacuí River, Guaíba Lake drainage, Cachoeira do Sul Municipality; M. Cheffe, R. Baltar and L. Rosa, 19 Oct. 2003. CIMC 31458,



Fig. 1. *Crenicichla lucenai* sp. n.: UFRJ 7930, 144.4 mm SL (holotype).

2, 118.6–129.8 mm SL; Piratini River, near the São Gonçalo canal, Mirim Lagoon drainage, Arroio Grande Municipality; M. Cheffe, G. Maurício and F. Silveira, 15 Feb. 2002. [CIMC 32852](#), 3 (1 C&S), 86.5–155.2 mm SL; Arroio Pelotas near Cordeiro de Farias bridge, Mirim Lagoon drainage, Pelotas Municipality; M. Cheffe and G. Maurício, 25 Apr. 2004. [CIMC 33722](#), 1, 172.5 mm SL; Jaguarão River near the mouth of Telho stream, Mirim Lagoon drainage, Jaguarão Municipality; M. Cheffe and L. Matheus, 08 Sept. 2003. [CIMC 33189](#), 4 (2 C&S), 106.3–198.4 mm SL; Camaquã River, near the mouth of Pantanosos stream, dos Patos Lagoon drainage, Canguçu Municipality; M. Cheffe and L. Matheus, 21 May 2002.

Information about other congeners are obtained from the respective descriptions and re-descriptions: KULLANDER (1991); PLOEG (1991); LUCENA & KULLANDER (1992); KULLANDER & LUCENA (2006); MONTAÑA *et al.* (2008); KULLANDER (2009); VARELLA *et al.* (2012); and KULLANDER & LUCENA (2013).

Crenicichla lucenai spec. nov.

Fig. 1

Holotype. UFRJ 7930, 144.4 mm SL; Rio das Antas, Passo do Gabriel, Bom Jesus Municipality, Rio Grande do Sul State, Brazil; M. Cheffe and L. Rosa, 09 Sep. 2004.

Paratypes. Brazil: Rio Grande do Sul State: UFRJ 7931, 6, 109.7–132.8 mm SL; Rio das Antas, Passo do Meio, São Francisco de Paula Municipality; M. Cheffe and L. Rosa, 18 Sep. 2002. [DZUFMG 133](#), 1, 116.2 mm SL; Rio das Antas, Passo do Meio, São Francisco de Paula Municipality; M. Cheffe and L. Rosa, 18 Sep. 2002. UFRJ 7932, 3 (C&S), 103.6–106.6 mm SL; collected with holotype. UFRJ 9746, 2, 106.9–112.5 mm SL; collected with holotype. [CIMC 35102](#), 18 (2 C&S), 115.5–145.9 mm SL; Rio das Antas near the mouth of Rio Tainhas, Jacuí River drainage, São Francisco de Paula Municipality; M. Cheffe, R. Baltar and L. Rosa, 23 Aug. 2002. [CIMC 35540](#), 2, 106.0–121.8 mm SL; lower Arroio Camisas tributary of Rio das Antas, Jacuí River drainage, Cambará Municipality; M. Cheffe, G. Maurício, F. Silveira and L. S. Rosa, 18 Nov. 2003.

Diagnosis. *Crenicichla lucenai* is a member of the *C. punctata* species group. This group differs from the *C. wallacii* group by having pterotic serrations absent (versus present in *C. wallacii* group); from the *C. lugubris* and *C. acutirostris* groups by having E1 row scales counts moderate, 47–76 (versus more than 100 and 76–111, respectively); from the *C. saxatilis* group by humeral ocellus absent (versus present); from the *C. reticulata* group by having higher number of depressible teeth rows, 3–5 (versus often with fewer and more firmly implanted teeth); from *C. macrophthalmia* HECKEL, 1840 by having predorsal scales cycloid (versus predorsal scales ctenoid), normal size eyes (versus extremely large eyes) and lateral line scales with same coloration as adjacent flank scales (versus lateral line scales differently colored than adjacent flank scales); from the *C. missioneira* group by having preopercle margin serrated (versus smooth); from the *C. scottii* group by having maxilla just reaching to the vertical anterior of orbit (versus beyond the same vertical); from *C. vittata* by having 47–76 E1 row scales (versus 78–85); from the species *C. mucuryna* and from the *C. mandelburgeri* species group by having wide bars on flank (versus narrow bars), and presence of spots on flank (versus absence); from *C. iguapina*, *C. tinguui* and *C. lacustris* by having a row of blotches on flank (versus a continuous lateral band).

Crenicichla lucenai is distinguished from both *C. punctata* and *C. maculata* by having a conspicuous pattern of dark brown irregular lines extending from longitudinal stripe to ventral profile (versus irregular lines absent). In addition, *C. lucenai* is distinguished from *C. punctata* by the absence of dots on sides of head (versus presence).

Description. Based on specimens larger than 103.0 mm SL. Measurements are given in table 1, counts in table 2; see Fig. 1 for habitus. Body elongate (mean of body depth 20.3 % SL). Caudal peduncle longer than deep. Snout moderately long, rounded in dorsal and ventral view, and moderately pointed in lateral view. Lower jaw prognathous. Maxilla reaching to vertical from anterior margin of orbit. Upper and lower lips of approximately the same width. Postlabial skin fold margin truncate. Orbit supralateral, not visible from below, chiefly in an-

Table 1. Morphometric data of *Crenicichla lucenai* sp.n.. Range=lowest and highest value; mean = arithmetic mean; SD = standard deviation.

	<i>Crenicichla lucenai</i> sp.n.			
	Holotype	Range (n=13)	Mean	SD
Standard length (mm)	144.4	103.6–144.4	115.9	—
<i>Per cents of standard length</i>				
Body depth	20.3	20.3–22.3	21.5	0.7
Caudal peduncle length	15.7	12.9–15.9	14.6	0.8
Caudal peduncle depth	11.7	11.0–11.9	11.6	0.3
Last D spine length	10	9.6–10.5	10	0.3
Pectoral fin length	17.3	16.4–19.3	17.6	0.9
Head length	31.9	29.7–32.7	31.4	0.7
Head depth	15.2	13.5–16.2	15.2	0.7
Snout length	12.1	10.0–12.2	11.4	0.6
Orbital diameter	5.8	5.4– 6.4	5.9	0.3
Interorbital width	8.4	7.2– 8.4	7.7	0.4
Upper jaw length	11.6	10.1–11.6	10.8	0.5
Lower jaw length	10	7.9–10.3	9.4	0.7

Table 2. Meristic data of *Crenicichla lucenai* sp.n. Pc = procurent rays.

	<i>Crenicichla lucenai</i> sp.n.	
	Holotype	Range
Dorsal-fin spines	22	21(4)–22 (5)
Dorsal-fin rays	12	11 (3)–12 (5)
Anal-fin spines	3	3 (13)
Anal-fin rays	9	9 (4)–10 (2)
Pelvic-fin spines	1	1 (13)
Pelvic-fin rays	5	5 (13)
Caudal-fin rays	—	6 (1)–7 (2) Pc + 8 (3) + 8 (3) + 6 (1)–7 (2) Pc
Pectoral-fin rays	17	16 (1)–17 (8)
Gill-rakers on first gill arch	—	9 + 4 (1)
Total vertebrae	—	36 (2)–37 (1)
Precaudal vertebrae	—	19 (3)
Caudal vertebrae	—	17 (2)–18 (1)
Proximal radial on dorsal-fin base	—	33 (2)–34 (1)
Proximal radial on anal-fin base	—	11 (2)–12 (1)
Scales of upper lateral line series	28	25 (6)–26 (4)–27 (1)–28 (1)–29 (1)
Scales of lower lateral line series	14	12 (2)–13 (1)–14 (5)–15 (3)–16 (2)
E0 series	59	55 (2)–56 (5)–57 (2)–58 (1)–59 (2)–60 (1)
E1 series	70	59 (1)–60 (1)–62 (1)–63 (2)–64 (1)–65 (2)–66 (1)–69 (2)–70 (2)
E2 series	53	44 (1)–46 (1)–47 (1)–49 (3)–50 (2)–51 (1)–53 (3)–54 (1)
Scales between the end of upper lateral line and dorsal fin base	4	4 (13)
Scales between lateral lines	3	3 (13)
Scales between upper lateral line and anal-fin origin	15	15 (8)–16 (5)
Transversal series of scales from the caudal peduncle	12	11 (1)–12 (8)–13 (4)
Cheek scales rows	7	6 (2)–7 (5)–8 (5)
Teeth rows on upper jaw	5	5 (11)
Teeth rows on lower jaw	3	3 (11)

terior half of head. Single dorsolateral nostrils (not tubular) between orbit and tip of snout, located at about ¼ of the distance from orbit. Vertical margin of preopercle serrated.

Flank scales strongly ctenoid. All scales on head, anteriorly on dorsum (above anterior ¼ of lateral line),

along dorsal fin base, chest, and on ventral parts of body from lower edge of pectoral axilla to anal fin origin, and along anal fin base cycloid. Predorsal scales small and cycloid, covered by skin. Predorsal scales with similar size as ventral and prepelvic scales (all cycloid). Cheek fully scaled (cycloid scales), with 6–8 (n=13) scale



Figure 3. *Crenicichla maculata*: MCP 14308, 114.8 mm SL (paratype). Photograph provided by Carlos Lucena.



Figure 4. *Crenicichla punctata*: ZMB 7459, 1, 143.6 mm SL (lectotype).



Figure 5. *Crenicichla punctata*: ZMB 7461, 1, 221 mm SL (lectotype of *Crenicichla polysticta*).

Etymology. The species name *lucenai* honours the ichthyologist CARLOS LUCENA for his contributions to the taxonomy and systematics of the genus *Crenicichla*.

Distribution. Upper Rio das Antas basin, Jacuí river drainage, dos Patos lagoon system, southern Brazil (Fig. 2).

Discussion

The most recent phylogenetic analyses (based on molecular data) revealed that *Crenicichla* is paraphyletic with respect to *Teleocichla* KULLANDER, 1988 (KULLANDER *et al.*, 2010; PIÁLEK *et al.*, 2012). Thus, distinct monophyletic lineages within *Crenicichla* may be recognized as

different genera (KULLANDER *et al.*, 2010). The type species of the genus (*C. macrophthalmus* HECKEL, 1840) was recovered at a more basal position in the phylogenetic trees (KULLANDER *et al.*, 2010; PIÁLEK *et al.*, 2012), and is not particularly closely related to the species examined and discussed here. Nevertheless, in accordance with the current use (e.g. LUCENA & KULLANDER, 1992; KULLANDER & LUCENA, 2006; MONTAÑA *et al.*, 2008; CASCIOTTA *et al.*, 2010; VARELLA *et al.*, 2012), we include the new species *C. lucenai* sp. n. and its relatives in the genus *Crenicichla*, until the generic classification of crenicichlins is revised.

The melanin elements within the colour pattern are an important source of character states for the taxonomical delimitation of Neotropical cichlids (KULLANDER & SILFVERGRIP, 1991; ŘÍČAN *et al.*, 2005; OTTONI & CHEFFE, 2009; OTTONI & COSTA, 2009; OTTONI, 2011; OTTONI, 2013), and are often used as diagnostic traits to sepa-

rate closely related *Crenicichla* species (e.g. & LUCENA & KULLANDER, 1992; KULLANDER & LUCENA, 2006; 2013; MONTAÑA *et al.*, 2008; PLOEG, 1991; VARELLA *et al.*, 2012). The new species herein described is a member of the species group proposed by KULLANDER & LUCENA (2006) including *C. maculata* and *C. punctata* for having 59–70 scales on E1 row, the presence of a row of blotches along the side of its body, and general colour pattern characters discussed in the diagnosis. The new species, *C. lucenai* sp. n., is clearly distinguishable from both *C. maculata* and *C. punctata* by its conspicuous pattern of dark brown irregular lines on body flanks (see diagnosis above). Such a pattern is unique within the genus. Hence, it may be treated as an apomorphic characteristic of the new species described here.

The area where these three species occur has undergone a complex tectonic history. It is associated with one of the six megadomes situated at the coastal area of eastern South America (RIBEIRO, 2006). Megadome uplifts and the erosive retreat of its margins had a significant influence in the drainages pattern and the development of the river basins (RIBEIRO, 2006). At present, *C. lucenai* sp. n. and *C. maculata* inhabit isolated hydrographic basins, separated by a mountain ridge. It is possible, however, that the upper Rio das Antas basin was once connected with the coastal rivers of the region where *C. maculata* is distributed. Therefore, it is not unlikely that *C. lucenai* sp. n. is more closely related to *C. maculata* than to *C. punctata*. In overall appearance, *C. lucenai* sp. n. (Fig. 1) looks more similar to *C. maculata* (Fig. 3) than to its closest geographic neighbour *C. punctata* (Figs. 4 and 5). The dark spots present on the sides of the head in *C. punctata* (Figs. 4 and 5) distinguish this species from both *C. maculata* (Fig. 3) and *C. lucenai* (Fig. 1).

The upper Antas river basin is apparently an area of endemism for cichlid and for catfish genera *Trichomycterus* and *Hisonotus* (see FERRER & MALABARBA, 2013; CARVALHO & REIS, 2011). It is also the type locality of *Australoheros taura* OTTONI & CHEFFE, 2009, a cichlid species known only (like *C. lucenai* sp. n.) from the upper Antas river basin (OTTONI & CHEFFE, 2009).

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