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## A new *Corydoras* from floodplain swamps of the São Francisco river basin, northeastern Brazil

(Teleostei, Siluriformes, Callichthyidae)

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*Corydoras costai* is a new species described from seasonal swamps adjacent to the upper Rãs river of the Caatinga, tributary of the São Francisco river basin, northeastern Brazil. The new species, as well as *C. difluviatilis*, differ from all other Corydoradinae by having parapophyses of fourth free vertebra reduced and separated from each other, not fused into a haemal arch. *Corydoras costai* shares a unique colour pattern with *C. garbei* and *C. difluviatilis*, differing from both *C. garbei* and *C. difluviatilis* by having fewer rib pairs; from *C. garbei* by having odontodes present on infraorbitals and opercle, and nuchal plate not in contact with supraoccipital plate; and differing from *C. difluviatilis* by having five well delimited large dark brown blotches from the caudal fin base to the posterior margin of opercle, along the junction of dorsal and ventral plates on the midline of body, lower region of cleithrum dark brown, first haemal arch present on sixth free vertebra, fewer precaudal vertebra, fewer not segmented rays on anal fin, a shorter head and a deeper head. The new species shares with *Corydoras difluviatilis* the lack of contact between the supraoccipital and nuchal plate, small degree of ossification of the second hypobranchial and large mesial expansions on the first and second infraorbitals; which suggest a basal position within the Corydoradinae. The serrations on posterior margin of pectoral-fin spine revealed to be a polymorphic character in *C. costai*.

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### Introduction

*Corydoras* Lacépède, 1803 is an armored corydoradine catfish genus characterized by two longitudinal series of dermal plates and small size (25–120 mm SL) (Reis 2003, Axenrot & Kullander 2003). Among the more than 200 valid species of the Callichthyidae (Eschmeyer, 2014), *Corydoras* currently includes over

170 (Reis 2003, Ferraris 2007, Fuller & Evers 2005, Eschmeyer 2014), being the most speciose catfish genus. It is distributed along the Cis-Andean river basins of South America, occurring in a variety of habitats, such as shallow ponds, marshes, rivers, streams and associated flooded areas (Axenrot & Kullander 2003, Britto & Lima 2003, Britto et al. 2007).

Despite the great number of species described

in recent years, few taxonomic revisions were performed (Nijssen 1970, Nijssen & Isbrücker 1976) establishing species groups in *Corydoras*. Consequently, the phylogenetic relationships of its congeners are still not fully understood, as well as the monophyly of the genus and some species groups (Britto & Castro 2002, Britto 2003, Britto & Lima 2003, Britto et al. 2007).

The new species herein described was collected in seasonal swamps adjacent to the upper Rãs river of the Caatinga, tributary of the São Francisco river basin, northeastern Brazil.

## Materials and methods

Material is deposited in the following institutions: MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Pontifícia Universidade Católica do Rio Grande do Sul, Brazil; and UFRJ, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil. Morphometric and meristic data were taken according to Reis (1997) and Britto & Castro (2002) for anal fin spine length and vertebral counts. SL means standard length and HL head length.

Measurements were taken on the left side of each specimen with digital calipers under a stereomicroscope. Nomenclature for latero-sensory canals follows Schaefer & Aquino (2000). Osteological studies were made on cleared and counterstained (c&s) specimens prepared according to Taylor & Van Dyke (1985); osteological terminology follows Reis (1998). Tooth and vertebra counts were only based on cleared and counterstained specimens.

The species concept herein adopted follow De Queiroz (2007), and for the species delimitation we use the Population Aggregation Analysis method (PAA) proposed by Davis & Nixon (1992).

## Comparative material

*Aspidoras belenos* Britto, 1998: UFRJ 1206, 2 (paratypes), 23.2–25.5 mm SL; rio Suspiro, tributary from the rio das Mortes, 57 km south from Paranatinga, Mato Grosso state; W. Costa et al.; 09 Feb. 1993. UFRJ 4419, 2 c&s (paratypes); stream on the road Primavera do Leste-Paranatinga, 82 km north from Primavera do Leste, rio das Mortes basin, Mato Grosso do Sul state; W. Costa et al., 1996.

*Aspidoras fuscoguttatus* Nijssen & Isbrücker, 1976: UFRJ 4544, 1 c&s; aquarium material.

*Aspidoras microgalaeus* Britto, 1998: UFRJ 1247, 1 (paratype), 24.3 mm SL; tributary from the rio Culuene, km 86 from the road Paranatinga-Canarana, Mato Grosso state; W. Costa et al., 12 Feb. 1993. UFRJ 1385, 2 (paratypes), 26.6–34.7 mm SL; stream 67 km north from Paranatinga, rio Xingú basin; W. Costa et al., 10 Feb. 1993. UFRJ 4539, 2 c&s (paratypes); tributary from the rio Culuene, km 86 from the road Paranatinga-Canarana, Mato Grosso state; W. Costa et al., 12 Feb. 1993.

*Corydoras acutus* Cope, 1872: UFRJ 4645, 2 c&s, 29.9–33.3 mm SL; rio Curibara, Ballivia province, Beni, Bolivia; C. Starnes et al., 31 Aug. 1987.

*Corydoras aeneus* (Gill, 1858): UFRJ 4546, 1 c&s; aquarium material. UFRJ 3847, 15, 28.2–57.4 mm SL; Plaisance village, Gunupia, Trinidad, South America; no data about collector, 03 Dec. 1952. UFRJ 3017, 5, 34.9–36.8 mm SL, Buriti palms 15 km from Aparecida do Taboado, Mato Grosso do Sul state; W. Costa et al., 18 Sept. 1994.

*Corydoras arcuatus* Elwin, 1938: UFRJ 4644, 2 c&s, 34.3–38.5 mm SL; rio Negro, Peru; no data about collector, Mar. 1963.

*Corydoras baderi* Geisler, 1969: UFRJ 4640, 2 c&s, 23.8–26.4 mm SL; tributary of the stream Palbara, Nickerie, Surinme; Vari et al., 16 Sep. 1980. UFRJ 4620, 2, 25.2–25.5 mm SL; tributary of the stream Palbara, Nickerie, Surinme; Vari et al., 16 Sep. 1980.

*Corydoras blochi* Nijssen, 1971: UFRJ 3781, 6, 28.1–35.4 mm SL; Igarapé Puraquequara, Ourém, Belém municipality, Pará state; A. Sarraf et al., 07–08 Aug. 1996. UFRJ 4527, 2 c&s, 29.3–37.4 mm SL; Igarapé Puraquequara, Pará state, A. Sarraf et al., 08 Aug. 1996.

*Corydoras difluviatilis* Britto & Castro, 2002: MNRJ 19739, 1 (Paratype), 41.8 mm SL; Rio Paranaíba basin, Catalão municipality, Minas Gerais state, F. Bockmann et al., 17 Sept. 1999; MNRJ 19910, 13 (Paratypes), 3 c&s, 29.0–38.9 mm SL; Catalão municipality, Minas Gerais state, F. Bockmann et al., 20 Nov. 1999. MNRJ 19913, 1 (Paratype), 36.9 mm SL, Catalão municipality, Minas Gerais state, F. Bockmann et al., 21 Nov. 1999. MNRJ 19912, 2 (Paratypes), 23.3–28.9 mm SL, Catalão municipality, Minas Gerais state, F. Bockmann et al., 21 Nov. 1999. MNRJ 19737, 12 (Paratypes), 3 c&s, 30.1–38.8 mm SL; Campo Alegre de Goiás, rio Paranaíba basin Catalão municipality, Minas Gerais state, C. Figueiredo et al., 26 Sept. 1999. MNRJ 19735, 1 (Paratype), 37.7 mm SL, rio Paranaíba basin, Catalão municipality, Minas Gerais State, C. Figueiredo & F. Bockmann, 24 September 1999. MNRJ 19736, 2 (Partypes), 13.2–19.3 mm SL, rio Paranaíba basin, Catalão municipality, Minas Gerais State, C. Figueiredo & F. Bockmann, 24 September 1999. MNRJ 19909, 6 (Paratypes), 18.4–39.9 mm SL, rio Paranaíba basin, Catalão municipality, Minas Gerais State, F. Bockmann et al., 20 Nov. 1999. MNRJ 19911, 1 (Paratype), 35.5 mm SL, rio Paranaíba basin, Catalão municipality, Minas Gerais State, F. Bockmann et al., 21 Nov. 1999.

*Corydoras ehrhardti* Steindachner, 1910: UFRJ 2251, 3, 38.4–42.8 mm SL; dam of Vassouras, Curitiba municipality, Paraná state; R. Castro, 12 Feb. 1977. UFRJ 4423, 1 c&s; Campo Alegre, Santa Catarina state; S. Potch et al., 1996.

*Corydoras elegans* Steindachner, 1876: UFRJ 3782, 1, 36.5 mm SL; Igarapé Puraquequara, Ourém, Belém municipality, Pará state; A. Sarraf et al., 07–08 Aug. 1996. UFRJ 4425, 2 c&s; Igarapé Puraquequara, Ourém, Belém municipality, Pará state; A. Sarraf et al., 07–08 Aug. 1996.

*Corydoras garbei* Ihering, 1911: MNRJ 15778, 6, 22.9–36.9 mm SL, rio Verde Grande, Janauba municipality, Minas Gerais state, D. Moraes et al., 24–30 Sept. 1990.

MNRJ 15823, 8, 25.3–43.0 mm SL, rio Peruaçu, Itacarambi municipality, Minas Gerais state, D. Moraes et al., 24–30 Sept. 1990.

*Corydoras hastatus* Eigenmann & Eigenmann, 1888: UFRJ 3654, 5, 16.3–22.0 mm SL; rio Miranda, road between Miranda and Bodoquena, Mato Grosso do Sul state; W. Costa et al., 21 Apr. 1996. UFRJ 3659, 3, 11.3–17.0 mm SL; pool between km 23 and 29 of the road between Casal Vasco and Vila Bela, Mato Grosso state; W. Costa et al., 29 Apr. 1996. UFRJ 4529, 1 c&s, 14.7 mm SL; rio Miranda, road between Miranda and Bodoquena, Mato Grosso do Sul state; W. Costa et al., 21 Apr. 1996.

*Corydoras julii* Steindachner, 1906: UFRJ 3779, 59, 20.4–38.0 mm SL; Iguarapé Puraquequara, Ourém, Belém municipality, Pará state; A. Sarraf et al., 07–08 Aug. 1996. UFRJ 4433, 2 c&s, 24.1–27.6 mm SL; Iguarapé Puraquequara, Ourém, Belém municipality, Pará state; A. Sarraf et al., 1996.

*Corydoras melanistius* Regan, 1912: UFRJ 4434, 1 c&s; upper rio Jatapú, São João da Baliza, Roraima state; Pinishi, 1994.

*Corydoras nanus* Nijssen & Isbrücker, 1967: UFRJ 4641, 2 c&s, 5 miles west from Telefe, Capavara vilage, Amazonas state; H. Axelrod, Mar. 1974.

*Corydoras napoensis* Nijssen & Isbrücker, 1986: UFRJ 4622, 2, 34.3–35.7 mm SL; Camp. Trapiche La Pescana, Beni, Bolívia; H. Ortega et al., 30 Jul. 1988.

*Corydoras nattereri* Steindachner, 1876: UFRJ 0025, 8, 27.3–34.0 mm SL; rio Regamé, Araruama municipality, Rio de Janeiro state; W. Costa, 12 Oct. 1984. UFRJ 0031, 8, 31.7–45.1 mm SL; tributary of rio Piloto (UFRJ), Itaguaí municipality, Rio de Janeiro state; W. Costa, 06 Aug. 1981. UFRJ 0928, 2, 35.0–37.7 mm SL; Tupinambás farm, Itaguaí municipality, Rio de Janeiro state; M. Melgaço & E. Vicente, 08 Apr. 1992.

*Corydoras paleatus* (Jenyns, 1842): UFRJ 4213, 9, 16.4–26.6 mm SL; temporary lagoon on the road to lagoa Mirim, near arroio Grande, 10 km east from BR-114; W. Costa et al., 19 Jul. 1997.

*Corydoras polystictus* Regan, 1912: UFRJ 3849, 20, 25.0–26.9 mm SL; rio Itenez, 10 km of Costa Marques, Mamoré, Beni, Bolívia; R. Bailey & R. Ramos, 10 Sep. 1964. UFRJ 0440, 14, 24.0–32.5 mm SL; tributary of the rio Aripuanã (BR-174), Mato Grosso state; S. Kullander & K. Tånizaki, 15 Oct. 1989.

*Corydoras schwartzi* Rössel, 1963: UFRJ 4542, 1 c&s, aquarium material. *Corydoras sterbai* Knaack, 1962: UFRJ 4424, 1, 42.8 mm SL; tributary of the rio Aripuanã, Suina municipality, Mato Grosso state; K. Tanizaki et al., 15 Oct. 1989.

*Corydoras zigatus* Eigenmann & Allen, 1942: UFRJ 4643, 2 c&s, 33.1–37.2 mm SL; rio Negro, Peru; N. Chirichigno, Mar. 1963.

*Scleromystax barbatus* (Quoy & Gaimard, 1824): UFRJ 3204, 2, 44.6–50.6 mm SL; Cachoeiras de Macacu municipality, Rio de Janeiro state; no data about collector, 7 Dec. 1976. UFRJ 2268, 2, 55.0–55.3 mm SL; rio Guapiaçu, Cachoeiras de Macacu municipality, Rio de Janeiro state; M. Pompeu, 7 Dec. 1976.

*Scleromystax macropterus* (Regan, 1913): UFRJ 7228,

6, 31.2–58.4 mm SL, stream 28 km north of BR-101, Itanhaém municipality, São Paulo state; W. Costa et al., 14 Oct. 2005.

## Results

### *Corydoras costai* spec. nov.

Figs 1A–C and 2A–D

**Holotype.** UFRJ 7790, 44.7 mm SL; Brazil, Estado da Bahia. Município de Guanambi, swamp on BR-030, 3 km east from Guanambi (14°11'08"S 42°44'20"W / altitude 522 m); W. Costa, M. A. Barbosa, B. Costa, C. P. Bove, J. Ferreira & A. M. Katz, 7 Feb. 2010.

**Paratypes.** UFRJ 7789, 10, 21.8–37.3 mm SL; collected with holotype. UFRJ 7791, 6 (c&s), 21.8–37.3 mm SL; collected with holotype. MCP 48169, 2, 24.3–24.4 mm SL; collected with holotype.

**Diagnosis.** *Corydoras costai* is distinguished from all its congeners, except to *C. garbei* Ihering, 1911 and *C. difluviatilis* Britto & Castro, 2002, by having an unique colour pattern characterized by the presence of series of large irregular dark brown blotches on dorsal and lateral surfaces of body from anterior-most lateral plates to caudal peduncle (Figs 1, 2, 3 and 4) (vs. absence of blotches or presence of small blotches or dots). The new species is distinguished from all its congeners, except to *C. difluviatilis*, by having parapophyses of fourth free vertebra reduced (Fig. 5) (vs. well developed in other species of *Corydoras*) and separated from each other, not fused into a haemal arch (vs. contacting each other and fused into a haemal arch in all the other species of *Corydoras*). *Corydoras costai* differs from *C. garbei* and *C. difluviatilis* by having fewer pairs of ribs (5 in *C. costai* vs. 6–7 in *C. difluviatilis* and 8 in *C. garbei*); and from *C. garbei* by having odontodes present on infraorbitals and opercle (vs. absent) and nuchal plate not in contact with supraoccipital plate (Fig. 6) (vs. plates in contact). The new species differs from *C. difluviatilis* having five well delimited large dark brown blotches from the caudal fin base to the posterior margin of opercle, along the junction of dorsal and ventral plates on the midline of body (vs. large spots of flank diffused, randomly distributed), lower region of cleithrum dark brown (vs. with a large round patch of orange pigmentation), first haemal arch present on sixth free vertebra (vs. first haemal arch present on fifth free vertebra), fewer precaudal vertebra (7–9 vs. 10), fewer not segmented rays on anal fin (i vs. ii), a shorter head (head length 32.0–35.8 % mm SL vs. 38.2–46.0 % mm SL) and a deeper head (head depth 90.7–96.6 % mm HL vs. 77.4–88.8 % mm HL).



**Fig. 1.** *Corydoras costai* spec. nov.: UFRJ 7790, 44.7 mm SL (holotype), Brazil, Bahia state, Guanambi municipality, 14°11'8.8" S 42°44'20.4" W/altitude 522 m. **A.** Lateral view; **B.** dorsal view; **C.** ventral view.

### Description

Morphometric data are presented in Table 1. Head compressed with slightly convex dorsal profile

(Fig. 1A); roughly triangular in dorsal view (Fig. 1B). Dorsal profile of body convex from tip of supraoccipital process to origin of dorsal fin; slightly straight from this point to posterior-most dorsal fin ray.



Fig. 2. Lateral view of *Corydoras costai* spec. nov., UFRJ 7789. A. 32.7 mm SL; B. 25.2 mm SL; C. 25.0 mm SL; D. 24.2 mm SL.

Post-dorsal fin body profile slightly concave. Ventral profile of body nearly straight from isthmus to anal fin origin, slightly convex along region of pectoral and pelvic fin bases. Profile from anal fin origin to caudal fin base markedly concave. Body cylindrical



Fig. 3. Lateral view of *Corydoras difluviatilis*. A. MNRJ 19913, 36.9 mm SL; B. MNRJ 19739, 41.8 mm SL; C. MNRJ 19910, 39.3 mm SL; D. MNRJ 15823, 36.2 mm SL.

in cross section at pectoral fin, gradually becoming compressed toward caudal fin. Snout rounded or slightly pointed (Figs 1 and 2).

Eye round, located laterally on head; orbit delimited dorsally by frontal and sphenotic, ventrally by

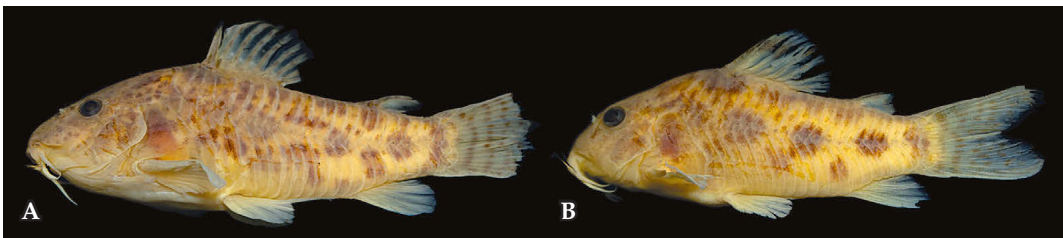


Fig. 4. Lateral view of *Corydoras garbei*. A. MNRJ 15823, 41.3 mm SL; B. MNRJ 15778, 36.9 mm SL.

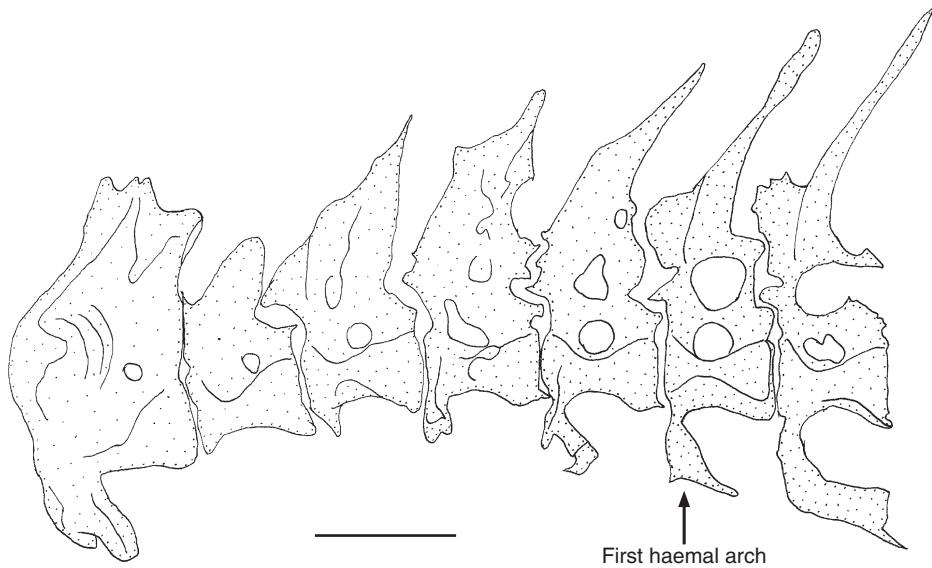


Fig. 5. Lateral view of the first precaudal vertebrae of *Corydoras costai* spec. nov., UFRJ 7791. Scale bar = 1 mm.

infraorbitals. Anterior and posterior nares proximal, only separated by flap of skin. Anterior nares tubular. Posterior nares close to anterodorsal margin of orbit, separated from it by distance equal than nares diameter. Mouth small, sub-terminal, width nearly

equal to orbit diameter. Maxillary barbel, usually reaching anteroventral limit of gill opening. Outer mental barbel slightly longer than maxillary barbel. Inner mental barbel fleshy. Small rounded papillae covering entire surface of all barbels, upper and

Table 1. Morphometric data of *Corydoras costai* spec. nov. Abbreviations: H, holotype; R, range; M, mean; SD, standard deviation. N=19.

	H	R	M	SD
SL	44.7	21.8-44.7	26.1	5.6
<b>Percentages of SL</b>				
Depth of body	35.3	35.3-40.6	38.8	1.2
Predorsal distance	49.2	48.3-52.8	51.5	1.1
Prepelvic distance	45.9	45.9-52.0	50.2	1.4
Preanal distance	79.0	79.0-82.3	80.9	0.9
Length of dorsal-fin spine	12.5	12.5-18.6	17.3	1.5
Length of pectoral-fin spine	18.6	18.6-24.9	23.5	1.3
Length of adipose fin spine	9.0	9.0-11.5	10.6	0.6
Caudal peduncle depth	14.5	14.5-17.9	16.9	0.8
Dorsal fin to adipose fin distance	19.0	14.0-19.0	15.4	1.2
Length of dorsal-fin base	19.5	19.5-21.5	20.7	0.5
Head length	32.0	32.0-35.8	34.5	1.1
Length of the longer barbel	17.4	17.5-21.3	20.5	0.8
<b>Percentages of HL</b>				
Head depth	94.4	90.7-96.6	94.1	1.6
Least interorbital distance	39.9	38.3-41.4	39.6	0.8
Horizontal orbit diameter	20.3	20.3-27.1	25.7	1.8
Snout length	51.7	44.0-51.7	48.6	1.6
Least internareal distance	21.0	15.9-21.0	17.9	1.7

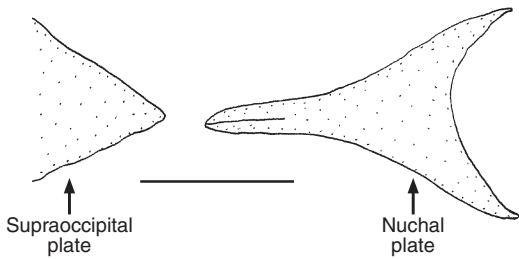


Fig. 6. Dorsal view of nuchal and supraoccipital plates of *Corydoras costai* spec. nov., UFRJ 7791. Scale bar = 1 mm.

lower lips, and isthmus. Gill membranes united to isthmus. Four branchiostegal rays covered by thick layer of skin; distal two rays united at their tips by branchiostegal cartilage. Teeth on upper pharyngeal tooth plate 33. Teeth on fifth ceratobranchial 30. Nasal, frontal, sphenotic, pterotic-supracleithrum, and supraoccipital visible externally, all covered by thin layer of skin and bearing minute scattered odontodes. Frontal fontanel elongate, ellipsoid in shape; posterior tip extending into supraoccipital anteriorly, covered by thin layer of skin. Nasal slender, slightly curved laterally, mesial border contacting frontal. Frontal quadrangular; anterior expansion in contact with nasal bone, posterior portion contacting sphenotic and supraoccipital. Sphenotic trapezoid, contacting supraoccipital dorsally, compound pterotic posteriorly, second infraorbital ventrally. Pterotic-supracleithrum approximately rectangular, with posterior expansion contacting first dorsal body plate and first lateral line ossicle. Ventral margin of pterotic-supracleithrum contacting infraorbital 2 and cleithrum. Supraoccipital approximately quadrangular with pointed posterior process, separated from nuchal plate by narrow space bridged by integument (Fig. 6).

Two infraorbital bones, externally visible, covered by thin layer of skin bearing minute odontodes directly attached to infraorbitals. First infraorbital with anterior expansion (Fig. 7); second infra-orbital with small, conspicuous posterior process contacting pterotic-supracleithrum. Opercle exposed, compact in shape, with angular free border. Preopercle, externally visible, slender and covered by thin layer of skin. Opercle and preopercle with minute odontodes. Interopercle triangular, covered by thin layer of skin.

Trunk lateral line with 3(6)–4(9) laterosensory canals; two anteriormost canals reduced to small ossicles, remaining canals encased in dorsolateral body plates. Lateral line canal entering neurocranium through compound pterotic, splitting into two branches before entering sphenotic: pterotic and preoperculomandibular, each with single pore. Sensory canal continuing through compound pter-

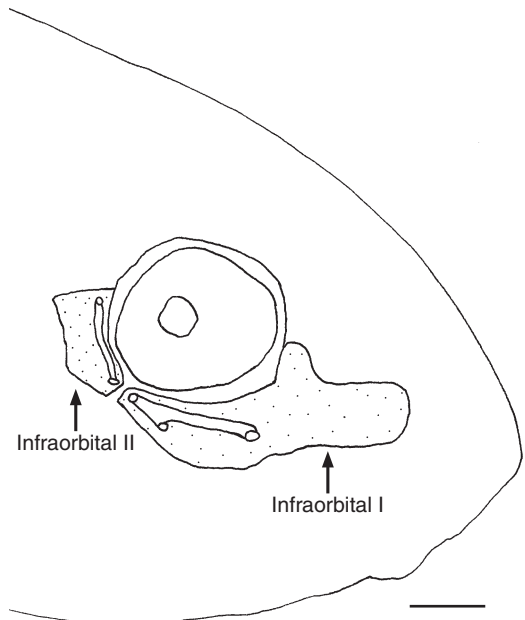
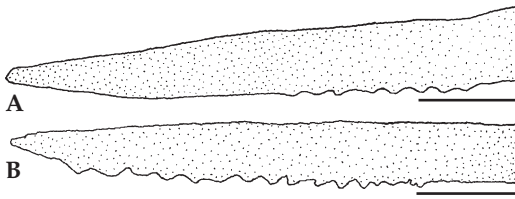


Fig. 7. Lateral view of infraorbital bones of *Corydoras costai* spec. nov., UFR 7791. Scale bar = 1 mm.

otic, entering sphenotic as temporal canal, which splits into two branches. One branch giving rise to infraorbital canal, and other branch entering frontal through supraorbital canal. Supraorbital canal with two branches: epiphyseal, which opens in frontal bone, and nasal canal. Nasal canal with single opening at each end. Infraorbital canal running through entire second infraorbital, extending to infraorbital 1 and opening into two pores. Preoperculomandibular branch gives rise to preoperculomandibular canal, which runs through entire preopercle with three openings, leading to pores 3, 4, and 5, respectively.

Body plates with minute odontodes restricted to posterior margins. Nuchal plate partially covered by skin anteriorly. Cleithrum and medial process of coracoid exposed. Dorsolateral body plates 22(12), 23(2) and 24(1); ventrolateral body plates 20(14)–21(15); dorsolateral body plates along dorsal fin base 5–7(7); dorsolateral body plates from adipose fin to caudal fin base 7(15); preadipose platelets 2(12)–3(3). Parapophyses of fourth and fifth free vertebra reduced, separate from each other, and not fused into haemal arch. Parapophyses fused into haemal arch only from sixth free vertebrae. Precaudal vertebrae 7(1)–8(2)–9(2); caudal vertebrae 12(2)–13(3); 5(6) pairs of ribs, all similar in size, except smaller last one.

Dorsal fin rounded, its origin just posterior to third dorsolateral body plate. Dorsal spine shorter



**Fig. 8.** Pectoral fin serrations of *Corydoras costai* spec. nov., UFRJ 7791. **A.** Restricted to the base of the spine (less than  $\frac{1}{3}$  of the spine); **B.** composed by weak serrations along the entire posterior margin of the pectoral fin spine. Scale bar = 1 mm.

than first 1–4 branched rays. Anterior and posterior borders of dorsal spine smooth. Dorsal-fin rays I(15), 7(1), 8(13) and 9(1). Adipose fin rounded, its origin separated from base of last dorsal-fin ray by 6(12)–7(3) dorsolateral body plates. Anal fin ovoid, its origin located just posterior to 11<sup>th</sup> to 12<sup>th</sup> ventrolateral body plates, coinciding with vertical through posterior margin of preadipose platelets. Anal fin rays i(15), 5(1)–6(14). Pectoral fin triangular, its origin located just posterior to gill opening. Ossified portion of pectoral spine shorter than first three branched rays. Distal tip of spine without small-segmented unossified portion. Posterior border of pectoral spine with serrations variable, restricted to proximal third to one-half in two specimens, and with serrations on entire posterior border in two specimens (Fig. 8A–B). Pectoral fin rays I, 8(6). Pelvic fin rays i, 5(15). Caudal fin bilobed, upper lobe slightly longer. Principal caudal fin rays 7/7(6); upper procurrent caudal fin rays 4(6); lower procurrent caudal fin rays 4(5)–5(1). All fins with minute odontodes scattered over all rays.

**Colour in alcohol** (Figs 1 and 2). Ground colouration of head light brown to yellowish. Small dark brown blotches scattered over dorsal and lateral surface of head and snout forming reticulate pattern. Anterior nares with series of minute brown chromatophores more concentrated at margin. Thin dark brown ring surrounding orbit. Dorsal maxillary barbel light brown, with minute scattered dark brown dots on dorsal surface. Ventral maxillary and mental barbels unpigmented. Opercle and preopercle regions almost dark brown, with few scattered yellowish areas. Ventral and lower sides of head yellowish. Head sides with some scattered chromatophores, mainly on snout tip. Ventral regions without chromatophores. Dark brown blotch on middle of snout, below nares.

Ground colour of trunk light brown or yellowish. Large dark brown blotch on dorsal limit of cleithrum and posterior region of pterotic-supracleithrum. Se-

ries of large irregular dark brown blotches on dorsal and lateral surfaces of body from anteriormost lateral plates to caudal peduncle. Ventrolateral blotches more elongate than remaining marks. Five well delimited large dark brown blotches from caudal fin base to posterior margin of opercle, along the junction of dorsal and ventral plates on the midline of body. Minute dark brown dots scattered over entire surface of trunk, more concentrated on anterior border of each lateral body plate. Ventral surface of body yellowish. Ground colour of all dorsal-fin elements light brown; interradiial membranes hyaline. Ground colour of anal fin rays light brown. Interradiial anal-fin membranes with scattered dark brown chromatophores on base of fin; remainder of fin membranes hyaline. Adipose-fin spine dark brown. Adipose fin membrane with dark brown blotch. Pectoral fin ground yellowish, with dark brown spine. Pelvic fin yellowish. Caudal fin yellowish, with 5–7 dark brown bars on entire fin.

**Colour in life.** Body side intense metallic green. Trunk blotches almost invisible because of intense brightness of metallic green ground colour.

**Distribution.** Only known from the type locality: floodplain swamps adjacent of the upper Rãs river, tributary of the São Francisco river basin, northeastern Brazil (Fig. 9).

**Etymology.** Named *costai* in honour to the ichthyologist Wilson Costa, who first collected and identified the species as new, in 1999.

## Discussion

*Corydoras costai* is a new species occurring in seasonal swamps adjacent to the upper Rãs river, tributary of the São Francisco river basin, northeastern Brazil. The new species shares a unique colour pattern with *C. garbei* and *C. difluviatilis* characterized by the presence of series of large irregular dark brown blotches on dorsal and lateral surfaces of body from anteriormost lateral plates to caudal peduncle (Figs 1, 2, 3 and 4). This unique colour pattern differ them from two other congeners from the São Francisco river basin: *C. lymnades* Tencatt, Vera-Alcaraz, Britto & Pavanelli, 2013 and *C. multimaculatus* Steindachner, 1907, which have small scattered dark brown blotches on dorsal and lateral surfaces of body (see Tencatt et al. 2013).

*Corydoras costai*, as well as *C. difluviatilis*, differ from all other corydoradines by having parapophyses of the fourth free vertebra reduced (Fig. 5), and separated from each other, not fused into a haemal arch, while other corydoradines have parapophyses



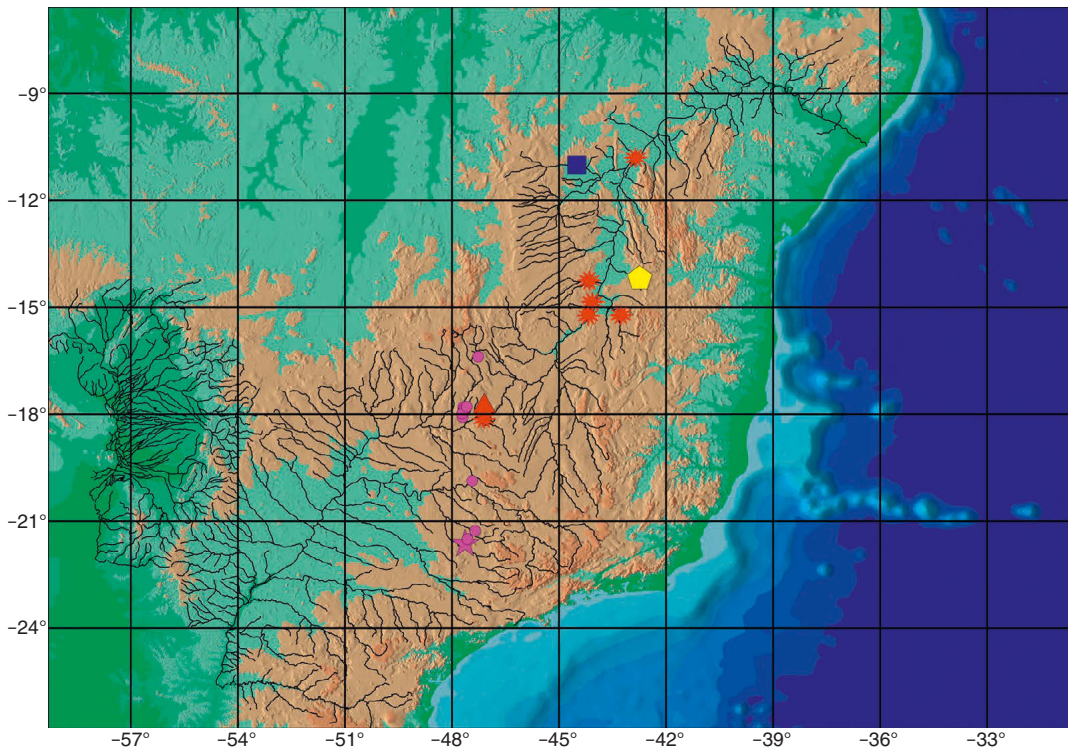


Fig. 9. Distribution of *Corydoradinae costai* (◆, type location), *C. difluviatilis* (★, type location; ●, paratypes), *C. multicaulatus* (■, type location) and *C. limnades* (▲, type location; ✨, paratypes). The type location of *C. garbei* was not located.

well developed, and contacting each other fused into a haemal arch. These character states were also observed by Britto & Castro (2002). Among members of the Corydoradinae, the first haemal arch, formed by fusion of parapophyses, is present on the third or fourth free vertebra (Britto & Castro 2002), while in *C. difluviatilis* and *C. costai* the first haemal arch is present only on the fifth or sixth, respectively. These character states related to the parapophyses and haemal arch, as well as the colour pattern, possibly indicates a closer relationship among these two species.

*Corydoradinae costai* and *C. difluviatilis* have some plesiomorphic character states compared to the group comprising *Brochis* Cope, 1871 and *Corydoradinae*, previously cited in Britto & Castro (2002) and Britto (2003): lack of contact between the supraoccipital and nuchal plate (Fig. 6), small degree of ossification of the second hypobranchial and large mesial expansion on second infraorbital (Fig. 7). These character states and implicated relationships are detailed and discussed in Britto & Castro (2002) and Britto (2003).

The degree of development of the pectoral-fin spine serrations is an informative character to di-

agnose corydoradine species. According to Britto & Castro (2002), some members of *Corydoradinae* have weakly developed serrations on the pectoral fin spine or serrations are absent, whereas some members of the genus show well-developed serrations on the pectoral fin spine. In all members of *Aspidoras* Ihering, 1907 the pectoral fin spines have well developed serrations. In the new species herein described, the character related to the serrations of the pectoral fin spine is polymorphic, possessing two distinguish states: one composed by weak serrations on posterior margin of pectoral fin spine, restricted to the base of the spine (less than 1/3 of the spine) (Fig. 8A); and second composed by weak serrations along the entire posterior margin of the pectoral fin spine (Fig. 8B).

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