

## ***Australoheros perdi*, new species (Teleostei: Labroidei: Cichlidae) from the lacustrine region of the Doce River Valley, southeastern Brazil, with biological information**

FELIPE P. OTTONI<sup>1</sup>, ANTÔNIO Q. LEZAMA<sup>2</sup>, MAURO L. TRIQUES<sup>2</sup>,  
EVELISE N. FRAGOSO-MOURA<sup>3</sup>, CÍNTIA C. T. LUCAS<sup>3</sup> &  
FRANCISCO A. R. BARBOSA<sup>3</sup>

<sup>1</sup> Laboratório de Sistemática e Evolução de Peixes Teleósteos, Departamento de Zoologia, Universidade Federal do Rio de Janeiro, Cidade Universitária, Caixa Postal 68049, CEP 21994-970, Rio de Janeiro, RJ, Brasil; fpottoni(at)yahoo.com.br

<sup>2</sup> Laboratório de Ictiologia Sistemática, Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Av. Antônio Carlos 6627, Caixa Postal 486, CEP 31.270-901, Belo Horizonte, MG, Brasil; anlezama(at)yahoo.com.br, triques(at)icb.ufmg.br

<sup>3</sup> Laboratório de Ecologia de Processos e Qualidade de Água, Departamento de Biologia Geral, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Av. Antônio Carlos 6627, Caixa Postal 486, CEP 31.270-901, Belo Horizonte, MG, Brasil; evelisefragoso(at)yahoo.com.br, cinthia.tavares(at)yahoo.com.br, barbosa(at)icb.ufmg.br

Accepted on March 26, 2011.

Published online at [www.vertebrate-zoology.de](http://www.vertebrate-zoology.de) on June 22, 2011.

### > Abstract

*Australoheros perdi* is a new species herein described from the lacustrine region of the middle Doce River basin, Doce River Valley, southeastern Brazil. The new species is distinguished from all its congeners by having only 25 vertebrae and by a combination of characters states listed below: three abdominal bars in all stages of life, a conspicuous, rounded caudal-fin base spot, a conspicuous wide longitudinal stripe, head with depression in the region above the eyes, tip of pelvic fin reaching vertical through third to sixth anal fin spine base, fewer dorsal-fin spines, fewer pectoral-fin rays, fewer caudal vertebrae, fewer proximal radials on dorsal-fin base, more proximal radials on anal-fin base, more pleural ribs, a longer caudal peduncle, a deeper caudal peduncle, a wide ectopterygoid, a longer last anal-fin spine and a longer lower jaw. The available phylogenetic tree of the genus does not include the species from southeastern Brazil, thus impeding any discussion of the phylogeny of these species.

### > Resumo

*Australoheros perdi* é uma nova espécie aqui descrita para a região de lagos da bacia do médio Rio Doce, Vale do Rio Doce, sudeste do Brasil. A nova espécie difere de todos os seus congêneres por possuir apenas 25 vértebras e por uma combinação estados de caracteres listados abaixo: três barras abdominais em qualquer estágio de vida, uma mácula na base da nadadeira caudal conspícua e arredondada, uma faixa longitudinal larga e conspícua, cabeça com depressão na região acima dos olhos, ponta da nadadeira pélvica alcançando a vertical do terceiro ao sexto espinho da nadadeira anal, menos espinhos na nadadeira dorsal, mais raios na nadadeira peitoral, menos vértebras caudais, menos radiais proximais na base da nadadeira dorsal, mais proximais radiais na base da nadadeira anal, mais costelas pleurais, um pedúnculo caudal mais longo e mais alto, um ectopterygóide mais largo, último espinha da nadadeira anal mais longo e mandíbula inferior mais longa. A árvore filogenética do gênero disponível não inclui as espécies do sudeste do Brasil e sul da Bahia, impossibilitando discussões sobre a filogenia dessas espécies.

### > Key words

Cichlinae, Heroini, middle Doce River basin, Minas Gerais state, Parque Estadual do Rio Doce, Pisces, South-American cichlids, Taxonomy, biology, diet.

## Introduction

*Australoheros* RÍCAN & KULLANDER, 2006 was erected to include "*Cichlasoma*" *facetum* JENYNS, 1842 and its related species ("*C.*" *tembe* CASCIOGTA, GÓMEZ & TORESANI, 1995 and "*C.*" *scitulus* RÍCAN & KULLANDER, 2003), which were excluded from the genus *Cichlasoma* SWAINSON, 1839 in the revision proposed by KULLANDER (1983).

The genus *Australoheros* is distributed along the coastal basins from the south of Bahia state to southern Brazil, Uruguay and northeastern Argentina, also including the basins of the rivers São Francisco, Paraná, Paraguay and Uruguay (CASCIOGTA ET AL., 1995, 2006; RÍCAN & KULLANDER, 2006, 2008; and OTTONI & COSTA, 2008; OTTONI, 2010).

Since the description of the genus, several species have been described and currently the genus comprises 21 valid species: *Australoheros acaroides* (HENSEL, 1870), *A. charrua* RÍCAN & KULLANDER, 2008, *A. facetus*, *A. forquilha* RÍCAN & KULLANDER, 2008, *A. guarani* RÍCAN & KULLANDER, 2008, *A. kaaygua* CACIOGTA, ALMIRÓN & GÓMEZ, 2006, *A. minuano* RÍCAN & KULLANDER, 2008, *A. scitulus* RÍCAN & KULLANDER, 2003, *A. taura* OTTONI & CHEFFE, 2009 and *A. tembe*; which all occur in southern Brazil (but some of them are also distributed in Argentina and Uruguay), and *A. austrani* OTTONI & COSTA, 2008, *A. barbosa* OTTONI & COSTA, 2008, *A. capixaba* OTTONI 2010, *A. ipatinguensis* OTTONI & COSTA, 2008, *A. macacuensis* OTTONI & COSTA, 2008, *A. macaensis* OTTONI & COSTA, 2008, *A. muriae* OTTONI & COSTA, 2008, *A. paraibae* OTTONI & COSTA, 2008, *A. robustus* OTTONI & COSTA, 2008, *A. ribeirae* OTTONI, OYAKAWA & COSTA, 2008, *A. saquarema* OTTONI & COSTA, 2008; which occur in coastal basins of southeastern Brazil. Two of these species were described for the Doce River basin: *A. ipatinguensis* and *A. capixaba*.

Recently collected specimens from the lagoa Gambazinho (Fig. 1) in the Parque Estadual do Rio Doce (PERD) differ from all known species. Thus a new species is herein described for the middle Doce River basin, Doce River Valley, southeastern Brazil (Fig. 1).

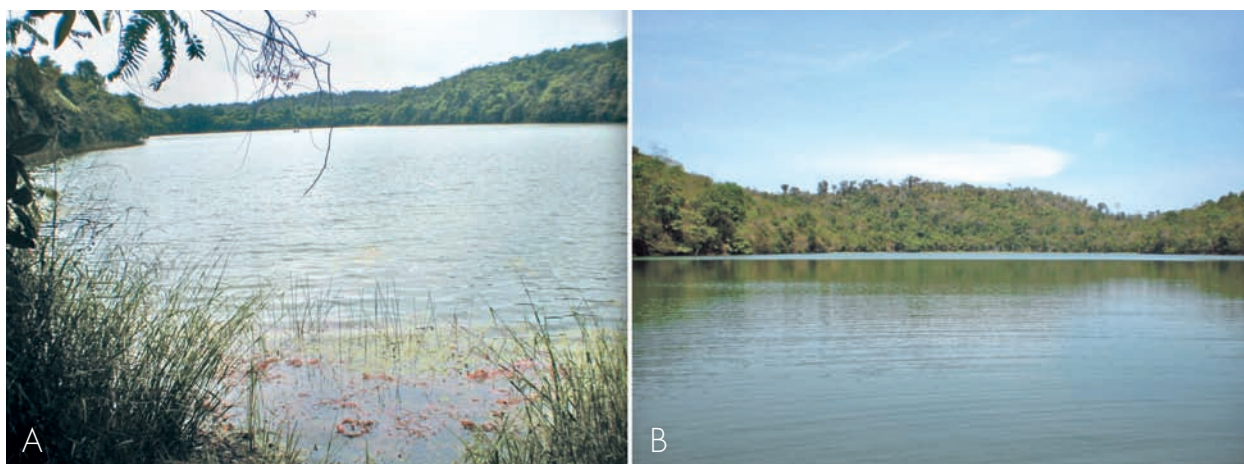
The PERD is located in the eastern region of Minas Gerais (19° 29' 24"–19° 48' 18" S; 42° 28' 18"–42° 38' 30" W) and has an area of 36,000 hectares with altitudes ranging from 230 to 515 m inserted in the largest remnant of the Atlantic Forest in Minas Gerais state. The human impacts from mining, farming activities, steel plants and cultivation of *Eucalyptus* sp. can be seen on its surroundings. The region has a tropical climate, warm and semi-humid, with 4 to 5

months of dry season (GODINHO, 1996; TUNDISI, 1997; BARBOSA & MORENO, 2002).

## Methods

Measurements and counts follow KULLANDER (1986) and OTTONI (2010): Measurements were made point-to-point with a caliper and are (1) standard length, from the upper jaw symphysis to base of middle caudal peduncle; (2) head length, from the upper jaw symphysis to posteriormost bony margin of opercle; (3) head width, measured in the wider part of head, usually the opercular region; (4) preorbital depth, measured in an imaginary vertical through anteriormost eye margin; (5) snout length, from the upper jaw symphysis to bony anteriormost eye margin; (6) horizontal orbital diameter; (7) upper jaw length, from symphysis of premaxillary bone to posterior end of maxillary bone; (8) lower jaw length, from symphysis of dentary bone to the posterior edge of lower jaw; (9) interorbital width, between osseous upper margins of orbits; (10) head depth, taken on an imaginary vertical line passing by the posteriormost eye margin; (11) body depth, taken on an imaginary vertical line passing by the pelvic-fin origin; (12) pectoral-fin length, from base of first ray to tip of longest ray; (13) length of last dorsal-fin spine; (14) length of last anal-fin spine; (15) pelvic-fin spine length; (16) pelvic-fin length, from its origin to tip of longest ray; (17) dorsal-fin base length, from origin to end of fin base; (18) anal-fin base length, from origin to end of fin base; (19) predorsal length, from the upper jaw symphysis to dorsal-fin origin; (20) prepelvic length, from the upper jaw symphysis to pelvic-fin origin; (21) depth of caudal peduncle, at approximately the middle of peduncle; (22) length of caudal peduncle, from the end of anal-fin base to the base of caudal-fin rays; (23) caudal-fin length, from the end of caudal peduncle to the end of the caudal-fin.

Auto-explicative counts are (1) dorsal-fin spines; (2) dorsal-fin rays; (3) anal-fin spines; (4) anal-fin rays; (5) pelvic-fin spines; (6) pelvic-fin rays; (7) pectoral-fin rays; (8) total vertebrae; (9) rib pairs; (10) precaudal vertebrae; (11) caudal vertebrae (vertebrae counts include the hypural complex); (12) scales of upper lateral line series; (13) scales of lower lateral line series; (14) proximal radials on dorsal-fin base; (15) proximal radials on anal-fin base; (16) scales between lateral lines; (17); scales of caudal-peduncle depth; The (18) caudal-fin rays are split into dorsal and ventral rays and are counted respectively upside-downward and downside-upward, following the for-



**Fig. 1.** Lagoa Gambazinho, Parque Estadual do rio Doce (type locality), Minas Gerais state, Brazil. (A), rainy season and (B), dry season. Photograph by EVELISE N. FRAGOSO-MOURA.

mula minuscule roman numerals (for undivided rays) + Arabic numerals (for divided rays) to the dorsal rays, “;” and another, equal formula, to the ventral rays of the fin. The (19) “scales of dorsal-fin origin serie” is the vertical count of scales from the upper lateral line to the dorsal-fin base origin (not counting the lateral line scale). The (20) “scales of the end of superior lateral line to dorsal fin series” is the number of series of scales above the last scale of the upper lateral line series (not counting the lateral line scales). The (21) scales of anal fin origin series is the vertical count of scales from anal-fin origin to lower lateral line (not counting this). The (22) longitudinal series of scales from the posterior bony margin of opercle through the inferior lateral line to the end of caudal peduncle is herein called “E0”. The (23) longitudinal series of scales from the posterior bony margin of opercle through the superior lateral line to the end of the series is herein called “E2”. The (24) longitudinal series of scales between the upper and lower lateral line series is herein called “E1” and includes the series of scales from the posterior bony opercle margin to the end of caudal peduncle, including the smallest caudal peduncle scales (as in E0 and E2). Gill rakers (25) from the first gill arch are in two series, one in the inner side and the other in the outer side, all of whom may fall out of the specimen easily under manipulation and can only be correctly studied in cleared, stained and dissected specimens; the count is expressed as a formula ( $x + y$ ; where  $x$  refers to the ceratobranchial rakers and  $y$  those from the epibranchial together with possible rakers from the intermediary cartilage); inner and outer rakers from each bone are added and expressed by a single number.

Osteological studies were made on cleared and stained (C&S) specimens, prepared according to TAYLOR & VAN DYKE (1995) and dissected as in

WEITZMAN (1974). The nomenclature of osteological characters follows COSTA (2006). Bars are grouped in head and trunk bars, numbered from the caudal-fin to the snout, following KULLANDER (1983). Spots are numbered as well as bars. Midlateral stripe sensu KULLANDER (1983) is here called as longitudinal stripe. All specimens of DZUFMG 073 were sexed, with male and females present, as well as some specimens of DZUFMG 074-077, for sexual dimorphism evaluation. For species delimitation we adopted here the method described by DAVIS & NIXON (1992) for practical reasons and discriminate species on divergent diagnostic character states (or on a specific combination of different character states).

The biological analysis used the chi square test to determine the sex ratio (ZAR, 1999), followed LE CREN (1951) in determining the length-weight relationship and qualitative and quantitative methods (HYNES, 1950) and the food index (IAi) (KAWAKAMI-VAZZOLER, 1980) to assess the diet species.

## Materials

Specimens were collected in the Lagoa Gambazinho (PERD) (Fig. 1) bimonthly from September 2006 to September 2007 with traps and batteries of gillnets (mesh size: 3.0 to 12.0 cm) with 10 m length and traps during 24 h, and trawls and sieves in January and September 2008.

The material is deposited in: DZUFMG, Departamento de Zoologia da Universidade Federal de Minas Gerais; MZUSP, Museu de Zoologia, Universidade de São Paulo, São Paulo, Brasil and UFRJ, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brasil.



**Fig. 2.** *Australoheros perdi* sp.n.: Brazil, Minas Gerais state: Marliéria municipality: lacustrine region of the middle Doce River basin, Doce River Valley, Parque Estadual do Rio Doce, Lagoa Gambazinho, 19° 47' 10,6" S, 42° 34' 48,3" W. A, UFRJ 7912, 88.4 mm SL (paratype) and B, UFRJ 7911, 44.5 mm SL (paratype).

Comparative material is listed in OTTONI (2010), OTTONI & CHEFFE (2009), OTTONI & COSTA (2008), OTTONI *et al.* (2008) and SCHINDLER *et al.* (2010). Comparisons with *Chromys oblonga* CASTELNAU, 1855 and *Heros autochthon* GÜNTHER, 1862 were based on CASTELNAU (1855) and GÜNTHER (1862).

## *Australoheros perdi* sp. n.

Figs. 2A and 2B

**Holotype.** DZUFMG 071, 93 mm SL, Brazil, Minas Gerais state, Marliéria municipality, lacustrine region of the middle Doce River basin, Doce River Valley, Parque Estadual do Rio Doce, Lagoa Gambazinho, 19°47' 10,6" S, 42° 34' 48,3" W; Evelise Nunes Fragoso-Moura and col., March 2007.

**Paratypes.** All paratypes were collected in the same site of holotype (Lagoa Gambazinho), by the same collectors. DZUFMG 072, (2, one partially digested) 47.7 mm SL, November 2006; DZUFMG 073, (11) 30.7–121.3 mm SL, January 2007; DZUFMG 074, (4) 81.7–120.2 mm SL, May 2007; UFRJ 7912, (1) 88.4 mm SL, May 2007; MZUSP 108138, (1) 99.1 mm SL, March 2007; MZUSP 108139, (1) 106.7 mm SL, July 2007; DZUFMG 075, (5 and 2 heads) 40.4–122.0 mm SL, September 2007; DZUFMG 076, (10) 15.4–31.0 mm SL, January 2008; DZUFMG 077, (73) 9.5–49.1 mm SL, September 2008; DZUFMG 078, (2) 10.3–65.3 mm SL, September 2006; DZUFMG 079, (4, C&S) 39.3–45.0 mm SL, collected with DZUFMG 077; DZUFMG 080, (1 and one head, C&S)

45–46 mm SL, collected with DZUFMG 075. UFRJ 7911, 5, 24.5–44.5 mm SL, September 2008; MZUSP 108140, (4) 24.6–37.0 mm SL, September 2008.

**Diagnosis.** *Australoheros perdi* is distinguished from all its congeners by having only 25 vertebrae (*vs.* 26 or more); from *A. facetus* group, *A. forquilha* group, *A. scitulus* group, *A. kaaygua* group, *A. taura* and *A. acaroides* by having fewer caudal vertebrae (12 *vs.* 13 or more); from *A. facetus* group, *A. forquilha* group and the species *A. minuano* by having three abdominal bars in all stages of life (*vs.* always four bars in juveniles and in 50% of adults); from *A. scitulus* group, *A. forquilha* group, *A. kaaygua* and *A. taura* by having a conspicuous, rounded and visible caudal-fin base spot (*vs.* not conspicuous and visible, mostly only a clear narrow bar at the caudal-fin base or absent); from *A. facetus* group and the species *A. minuano* by having a conspicuous and wide longitudinal stripe (*vs.* longitudinal stripe not conspicuous and straight); from *A. acaroides* by having fewer proximal radials on dorsal-fin base (22–24 *vs.* 26); and from *A. tembe* by having more proximal radials on anal-fin base (13 *vs.* 11–12). *Australoheros perdi* differs from *A. autrani*, *A. barbosa*, *A. capixaba*, *A. ipatinguensis*, *A. macacuensis*, *A. macaensis*, *A. muriae*, *A. paraibae*, *A. robustus*, *A. ribeirae* and *A. saquarema*; and from *A. autrani*, *A. barbosa*, *A. capixaba*, *A. ipatinguensis*, *A. macacuensis*, *A. muriae*, *A. paraibae*, *A. robustus*, *A. ribeirae* and *A. ribeirae* by having head with depression in the region above the eyes (*vs.* head without depression). Also, the new species presents 14–16 dorsal-fin spines (*vs.* 17 in *A. robustus*); 11–13 pectoral-fin rays (*vs.* 14–15 in *A. barbosa*, *A. muriae*; 14 em *A. autrani*, *A. capixaba*, *A. macaensis*, *A. macacuensis*, *A. ipatinguensis* and *A. saquarema*); and 11 pleural ribs (*vs.* 9–10 in *A. robustus*; 10 in *A. autrani*, *A. paraibae*, *A. ipatinguensis* and *A. saquarema*). *Australoheros perdi* differs from *A. barbosa*, *A. ipatinguensis*, *A. macacuensis*, *A. muriae*, *A. paraibae*, *A. robustus*, *A. ribeirae* and *A. saquarema* by having a longer caudal peduncle (caudal peduncle length 9.3–13.4 % SL in *A. perdi* *vs.* 5.5–8.7 % SL in *A. barbosa*; 6.6–8.0 % SL in *A. ipatinguensis*; 5.1–7.9 % SL in *A. macacuensis*; 7.1–8.9 % SL in *A. muriae*; 6.4–8.1 % SL in *A. paraibae*; 7.4–9.2 % SL in *A. robustus*; 66.6–9.1 % SL in *A. ribeirae*; 6.7–9.0 % SL in *A. saquarema*); from *A. ipatinguensis* and *A. ribeirae* by having a wide ectopterygoid (OTTONI & COSTA, 2008; fig. 3B) (*vs.* narrow in *A. ipatinguensis* (OTTONI & COSTA, 2008; fig. 3A)); from *A. capixaba* by having tip of pelvic fin reaching vertical through third to sixth anal-fin spine (*vs.* second anal-fin spine in *A. capixaba*); *A. macacuensis* by having a deeper peduncle (caudal peduncle depth 16.5–22.7 % SL *vs.* 14.2–15.9 % SL); from *A. paraibae* by having a

**Table 1.** Morphometric data of *Australoheros perdi*. H = holotype, R = range, M = mean and SD = standard deviation.

	H	R n = 20	M	SD
Standard length (mm)	93.0	39.8–121.1	78.6	29.5
Percents, standard length (SL)				
Body depth	51.9	40.0–56.0	50.3	4.1
Predorsal length	43.4	41.1–49.1	43.8	1.8
Prepelvic length	44.9	42.9–48.3	45.8	1.3
Caudal peduncle depth	19.4	16.5–22.7	19.7	1.6
Caudal peduncle length	11.9	9.3–13.4	11.6	1.3
Dorsal-fin base length	64.1	54.2–66.4	60.9	3.8
Anal-fin base length	31.2	25.7–31.9	29.0	1.6
Pelvic-fin spine length	20.4	14.5–20.4	17.5	1.4
Pelvic-fin length	40.4	26.1–49.9	39.0	7.0
Last dorsal-fin spine length	19.4	13.3–20.4	18.4	2.0
Last anal-fin spine length	16.1	14.4–20.8	17.6	1.7
Pectoral-fin length	30.9	27.5–35.3	32.0	1.9
Caudal-fin length	29.3	26.8–36.1	30.9	2.1
Head depth	38.4	32.1–45.7	39.4	3.5
Orbital diameter	8.9	7.4–14.3	10.6	1.8
Snout length	12.8	10.6–14.5	12.5	0.9
Head width	21.4	17.3–23.5	20.8	1.7
Interorbital width	12.7	10.9–15.4	12.9	1.2
Preorbital depth	27.8	17.7–30.3	23.9	3.8
Upper jaw length	11.6	9.8–13.0	11.5	0.7
Lower jaw length	7.8	7.8–10.2	8.5	0.6
Head length (mm)	35.9	34.1–40.7	36.6	1.7
Percents, head length (HL)				
Head depth	107.1	85.5–129.5	108.0	12.9
Orbital diameter	24.9	20.9–36.2	28.8	4.0
Snout length	35.7	29.1–40.7	34.1	2.9
Head width	59.5	46.7–66.6	57.0	6.4
Interorbital width	35.3	28.7–43.5	35.3	4.4
Preorbital depth	69.6	61.8–84.0	65.7	6.1
Upper jaw length	32.3	24.1–37.0	31.5	2.9
Lower jaw length	21.8	19.6–28.4	23.4	2.1

longer last anal-fin spine (last anal-fin spine length 14.4–20.8 % SL vs. 12.2–13.3 % SL); and from *A. ipatinguensis* by having a longer lower jaw (lower jaw length 19.6–28.4 % SL vs. 17.0–19.2 % SL).

**Description.** Morphometric data are in Table 1 and meristic ones in Table 2. Sexual dimorphism was not found. Body elongated and laterally compressed. Dorsal head profile sloping straight upward and backward in small specimens, with a depression on the level of eye; larger specimens also with depression in the region above eyes, however progressively with more convex profile from this point backward to form a hump (already present in specimens with 63 mm SL). Ventral profile slightly convex from snout to caudal peduncle origin. Caudal peduncle approximately straight and horizontal ventrally and dorsally. Mouth

terminal, distal tip of maxilla not reaching vertical tangent to anterior margin of orbit. Lower lip fold covering portion of upper lip. Lower jaw slightly shorter than upper one. Jaw teeth caniniform. Teeth hyaline, red at tip. Outer row teeth increasing in size symphysiad, anteriormost teeth longer in upper jaw than in lower jaw. Nostrils in the middle between the tip of snout and anterior margin of orbit. Opercle not serrated.

Body scales ctenoid, except those underlying the dorsal-fin base and just in front of it; at least some of the smallest scales underlying anal-fin base and gular region (including ventral region), which are cycloid. Trunk and caudal peduncle covered with ctenoid scales. Head and ventral region of body covered with cycloid scales. Scales on head and chest slightly smaller than on flanks. Two scale rows between the lateral lines. Number of cheek scales series 2–4 (above those of preopercle and below eye; 12 specimens). Dorsal-fin base scaled from 13–14° dorsal-fin spine. Anal-fin base scaled from 6° anal-fin spine.

Dorsal fin origin placed at level of posterior margin of opercle. Dorsal fin rounded, pointed on posterior region. Tip of dorsal fin reaching vertical through half of caudal fin. Dorsal fin basal half scaled from about last dorsal-fin spine to end. Anal fin rounded anteriorly, pointed posteriorly. Anal-fin basal third scaled from about last anal-fin spine. Tip of anal fin reaching vertical between half and posterior border of caudal fin.

Caudal fin long with distal margin rounded. Caudal fin with smaller ctenoid scales covering the basal half of the fin. Pectoral fin with a rounded tip, extending to about first anal-fin spine or vertical trunk bar 4. Pectoral-fin base on vertical through second or third spine of dorsal fin. Pelvic fin pointed. Pelvic-fin base on vertical through or slightly posterior to pectoral fin origin. Tip of pelvic fin reaching vertical through third or sixth anal fin spine.

**Osteology.** Epibranchial 2 with two long tubular processes (OTTONI & COSTA, 2008; fig. 4C), and anterior arm of epibranchial 1 long (OTTONI & COSTA, fig. 4A); a wide ectopterygoid (OTTONI & COSTA, 2008; fig. 3B). Ceratobranchial 4 with microbranchiospines only on its caudal side. Ceratobranchial 5 partially sutured medially, relatively robust, dorsally toothed; triangle-shaped in dorsal view, with slender lateral tips (which are not toothed) each with a minute cartilage laterally; midline teeth series 4–6; posterior border teeth 10–12+10–12; teeth bicuspid, sickle-shaped, usually directed forward (those anteriorly on bone, curved backward); posterior and medial teeth larger than lateral and anterior teeth and tend to be laterally compressed.

**Table 2.** Meristic variation data of *Australoheros perdi*.

	Holotype	Range
Dorsal-fin spines	16	14(2)–15(16)–16(2)
Dorsal-fin rays	10	9(8)–10(8)–11(4)
Anal-fin spines	7	6(4)–7(15)–8(1)
Anal-fin rays	10	8(8)–9(8)–10(4)
Pelvic-fin spines	1	1(20)
Pelvic-fin rays	5	5(20)
Caudal-fin rays	16	3+8+8+3(5)
Pectoral-fin rays	12	11(2)–12(15)–13(3)
Gill-rakers on first ceratobranchial	–	15(2)–16(3)+5(1)–6(2)–7(2)
Total vertebrae	–	25(5)
Rib pairs	–	11(5)
Precaudal vertebrae	–	13(5)
Caudal vertebrae	–	12(5)
Scales of upper lateral line serie	14	13(2)–14(1)–15(1)–16(11)–17(4)–18(1)
Scales of lower lateral line serie	8	6(1)–7(2)–8(3)–9(7)–10(7)
E0 serie	25	24(6)–25(12)–26(2)
E1 serie	27	25(1)–26(9)–27(10)
E2 serie	23	22(2)–23(10)–24(8)
Scales of dorsal fin origin serie	4	3(1)–4(19)
Scales of the end of superior lateral line to dorsal fin serie	3	2(2)–3(18)
Scales of anal fin origin serie	8	8(20)
Scales between lateral lines	2	1(1)–2(19)
Scales of peduncle depth	7	7(18)–8(2)
Proximal radial on dorsal-fin base	–	22(1)–23(1)–24(3)
Proximal radial on anal-fin base	–	13(5)

**Coloration in alcohol** (Fig. 2A and 2B) (also see a schematic illustration of the color pattern in OTTONI *et al.* (2008); fig. 2B). Body and head ground color cream (brown in large specimens). Side of body with seven dark brown trunk bars, between caudal peduncle and posterior margin of opercle, herein numbered in this direction.

All vertical trunk bars continuous, except vertical trunk bars 6–7 which are interrupted above longitudinal stripe. Three abdominal bars. Trunk bar 1 somewhat arched. Trunk bars 2–4 curved with concavity posteriorly. Trunk bar 5 vertically horizontally connected to trunk bar 6, just above upper lateral line. Trunk bar 5 dorsally forked in some specimens. Vertical trunk bar 7 forked, y-shaped, dorsally. Vertical trunk bar 7 its posterior arm with same width as the anterior one. Trunk bars not forked ventrally, except very rarely. A horizontal conspicuous and wide dark brown longitudinal stripe may be present slightly above middle of flank, uniting all vertical trunk bars in small specimens and at least 5–7 in adults; sometimes prolonging through upper region of opercle.

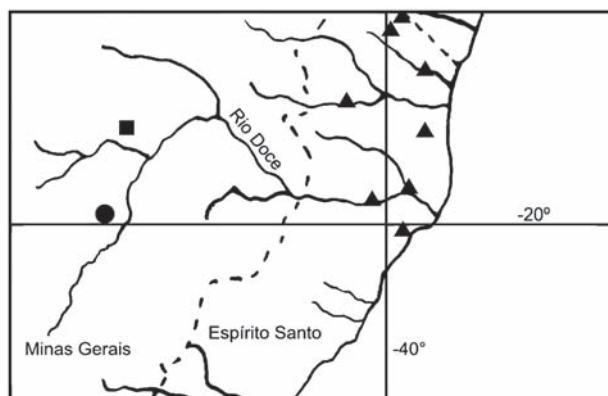
Three dark spots: first spot conspicuous, rounded and visible on caudal-fin peduncle (caudal-fin base spot), and on lower vertically elongated and passing by lateral line (a well developed round spot roundish

in very small specimens) and a second spot on junction between longitudinal stripe and trunk bar 4; and a third spot on posterior margin of opercle and longitudinal stripe. An interrupted brown longitudinal stripe running from trunk bar 1 to anterior margin of opercle, lighter and in conspicuous between trunk bars 1–5, darker between trunk bar 4 and vertical head bar 1.

Dorsal side of head with three brown bars: head bar 1 on post-orbital region close to the eye, extending to an horizontal tangent to dorsal margin of the eye; head bar 2 on supra-orbital zone between the eyes, head bar 2 extending to posterior orbital margin touching the ventral margin of head bar; head bar 3 slightly anterior to the eye and extending to an horizontal tangent to its ventral margin.

Dorsal fin hyaline in small specimens and brown in large ones, slightly invaded by dark brown trunk bars. Anal and caudal fins color pattern similar to dorsal fin. Pectoral fin hyaline. Pelvic fin hyaline in small specimens, darkening in large ones, specially at its distal portion.

**Distribution.** So far only know from the type locality (Fig. 1), Parque Estadual do Rio Doce (PERD), lacustrine region of the middle Doce River basin, Doce River Valley, southeastern Brazil (Fig. 3).



**Fig. 3.** Distribution of *Australoheros capixaba* (▲), *Australoheros ipatinguensis* (■), and *Australoheros perdi* (●).

**Etymology.** *perdi* refers to the Parque Estadual do Rio Doce (PERD), the locality where the new species was collected.

**Habitat notes.** The Lagoa Gambazinho (Fig. 1) (19° 47' 10.6" S, 42° 34' 48.3" W) is a small and elongated oligotrophic lake located within the PERD. It covers an area of 10.4 ha and has a maximum depth of 10.3 m without occurrence of thermal stratification (PELD, 2008). In the dry and rainy seasons the average water temperatures are respectively 25.4 °C and 29.4 °C (BRITO & MAIA-BARBOSA, 2009). Other species that occur in the Lagoa Gambazinho (Fig. 1) are: *Astyanax cf. taeniatus*, *Moenkhausia doceana* (STEINDACHNER, 1877), *Oligosarcus solitarius* MENEZES, 1987, *Hoplias gr. malabaricus*, *Leporinus cf. steindachneri*, and *Geophagus brasiliensis* (QUOY & GAIMARD, 1824).

**Biology and Ecology.** A total of 150 specimens were collected, 87 immature with undetermined sex. The range of total length was 1.3 to 16.7 cm. The sex ratio for this population was significantly equal to 1:1 ( $p > 0.05$ ) for the entire study period. The macroscopic analysis of gonads revealed that adults with mature gonads were collected in the rainy season. The smallest females and males captured with gonads in maturation were respectively 5.0 and 7.2 cm in total length. According to length–weight relationship, the species showed positive allometric growth with values of  $b = 3.082$  for females and  $b = 3.292$  to males.

For diet analysis the stomach contents of 80 specimens (33 adult and 47 immature ones) was examined. Most of the immature fishes had empty stomachs. In addition several intestines were analyzed in order to supplement the list of items ingested by this species. There was a wide variety of items ingested, but a large amount of sediment suggests an omnivorous-benthophagous feeding habit. The main

ingested item was shrimp (*Macrobrachium jelskii*) (IAi = 0.85) followed by fish scales and fish remains (IAi = 0.12), sediment (IAi = 0.02) and aquatic (Chironomidae larvae, Odonata nymph) and terrestrial (Hymenoptera, Coleoptera) insects (IAi = 0.01), plant material and other invertebrates. In addition, in the intestines of immature specimens zooplankton, mainly cladocerans, was also found.

## Discussion

A new species of the genus *Australoheros* is herein described from the lacustrine region of the middle Doce River basin, Doce River Valley, southeastern Brazil. The lacustrine system is located in the interplanaltic depression of the Doce River Valley. The origin of these lakes is associated with the ancient tributaries whose mouths have been closed through several mechanisms and due to their origins, exhibiting a typical dendritic configuration (SUGUIO & KOHLER, 1992). This system has about 140 lakes of which 42 of them are located within the PERD (LATINI *et al.*, 2004). One of the most serious problems in the Parque Estadual do Rio Doce is biological invasion. According to LATINI *et al.* (2004), only three lakes of the PERD do not contain introduced species. One of the lakes without introduced species is the Lagoa Gambazinho (Fig. 1), habitat of *Australoheros perdi* and some species that have who disappeared in other lakes in the system that contain invasive species as peacock bass (*Cichla kelberi* KULLANDER & FERREIRA, 2006) and the red piranha (*Pygocentrus nattereri* KNER, 1858). Thus, species of small and medium size, like the species of this paper, are seriously threatened in this system invaded by alien fish species.

The new species was described as a member of *Australoheros* because it fits perfectly with the color pattern (presence of interruptions on trunk bar 6–7, above longitudinal stripe) described as the main diagnostic character state of the genus (RÍCAN & KULLANDER, 2006). It also has a color pattern similar to that described for *A. ribeirae*, characterized by having seven trunk bars, trunk bar seven dorsally forked, trunk bar 5 not dorsally forked, a conspicuous and rounded caudal-fin base spot and a wide and conspicuous longitudinal stripe (OTTONI *et al.*, 2008), as well as mostly of its congeners from southeastern Brazil, however some specimens presented the trunk bar 5 dorsally forked.

*Australoheros perdi* possesses a unique character state distinguishing it from all the other congeners: 25 total vertebrae. Among the 21 valid species of

the genus, two are described from the same river basin of the new species (Doce River basin): *A. capixaba*, occurring in the lower rio Doce basin, and *A. ipatinguensis*, occurring in the upper rio Doce basin. Both are distinguished from the new species by several character states described above in the diagnosis.

There are three other valid names for the genus *Australoheros*, placed as junior synonyms of *A. facetus*: *Chromys oblonga*, from the rio Tocantins, in Goiás state, Brazil; *Heros jenynsii* Steindachner, 1869, from Montevideo, Uruguay; and *Heros autochthon*, from Brazil without any precise locality (RÍCAN & KULLANDER, 2003; KULLANDER, 2003; RÍCAN & KULLANDER, 2008; OTTONI & COSTA, 2008; SCHINDLER *et al.*, 2010).

The description of *Heros jenynsii* was based on characters seen as individual differences and not as diagnostic between *A. facetus* and *H. jenynsii*. Thus it is a synonym of *A. facetus* (RÍCAN & KULLANDER, 2003; RÍCAN & KULLANDER, 2008). The others two nominal valid taxa remain taxonomically undetermined. *Australoheros perdi* differs from *H. autochthon* by the absence of dark cross bands on body (*vs.* presence) and cycloid scales on chest (*vs.* ctenoid); and from *Chromys oblonga* by having more dorsal-fin rays (9–11 *vs.* 8) and more anal-fin rays (8–10 *vs.* 7).

RÍCAN & KULLANDER (2006, 2008) proposed a new species (*A. sp.* “*jacui*”) and observed that one population of *A. facetus* is also a new species (*A. cf. facetus*), but did not present a formal description of both species. *Australoheros perdi* is not only distinguished from both *A. sp.* “*jacui*” and *A. cf. facetus*, but also from all its congeners in the rio Paraguay–Paraná–Uruguay system by having fewer caudal vertebrae (12 *vs.* 13 or more), a conspicuous, visible and wide longitudinal stripe (*vs.* inconspicuous and straight) and three abdominal bars in all stages of life (*vs.* four abdominal bars in juveniles and in more than 50% of adults). It also differs from *A. sp.* “*jacui*” by having a conspicuous and rounded caudal-fin base spot (*vs.* absence).

The phylogenetic tree proposed by RÍCAN & KULLANDER (2006, 2008) does not include the species from southeastern Brazil, thus impeding any discussion of the phylogeny of these species (OTTONI, 2010).

## Acknowledgements

Thanks are due to Cyro Luna-Dias, from UFRJ, for providing the photograph of the paratypes, to Parque Estadual do Rio

Doce/ Instituto Estadual de Florestas (MG) for logistic support, to the staff the Laboratories of Limnology and Zooplankton Ecology of the Institute of Biological Sciences of the Federal University of Minas Gerais (UFMG) for field and laboratory support. We are indebted to FAPEMIG (CRA 2146/97 and APQ-00566-08) for optic and computational equipments. This study was supported by Long Term Ecological Research Program (PELD–CNPq) (520031/98–9), CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico – Ministério da Ciência e Tecnologia) and FAPERJ (Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro).

## References

- BARBOSA, F.A.R. & MORENO, P. (2002): Mata Atlântica e sistema lacustre do Rio Doce Site 4. Pp. 69–81 *In*: SEELIGER, U.; CORDAZZO, C.; BARBOSA, F. (Eds). – Os Sites e o Programa Brasileiro de Pesquisas Ecológicas de Longa Duração. Belo Horizonte, 184 pp.
- BRITO, S.L. & MAIA-BARBOSA, P.M. (2009): Differences in body size of *Thermocyclops minutus* (Lowndes, 1934) in two tropical lakes. – *Acta Limnologica Brasiliensia*, **21**(4): 409–414.
- CASCIOTTA, J.R., ALMIRÓN, A.E. & GÓMEZ, S.E. (2006): A new species of *Australoheros* (Teleostei: Perciformes: Cichlidae) from the río Iguazú basin, Argentina. – *Zoologische Abhandlungen*, **55**: 77–83.
- CASCIOTTA, J.R., GÓMEZ, S.E. & TORESANI, N.L. (1995): “*Cichlasoma*” *tembe*, a new cichlid species from the rio Paraná basin, Argentina (Osteichthyes: Labroidei). – *Ichthyological Exploration of Freshwaters*, **6**: 193–200.
- CASTENLAU, F. (1855): Animaux nouveaux ou rares recueillis pendant l’expédition dans les parties centrales de l’Amérique du sud, de Rio de Janeiro a Lima, et de Lima au Pará; exécutée par ordre du gouvernement français pendant les années 1843 a 1847, sous la direction du Comte Francis de Castelnau. Poissons. Paris.
- COSTA, W.E.M. (2006): Descriptive morphology and phylogenetic relationships among species of the Neotropical annual killifish genera *Nematolebias* and *Simpsonichthys* (Cyprinodontiformes: Aplocheiloidei: Rivulidae). – *Neotropical Ichthyology*, **4**(1): 1–26.
- DAVIS, J.I. & NIXON, K.C. (1992): Populations, genetic variation, and the delimitation of phylogenetic species. – *Systematic Biology*, **41**: 421–435.
- GODINHO, A.L. (1996): Peixes do Parque Estadual do Rio Doce. Instituto Estadual de Florestas – Universidade Federal de Minas Gerais, Belo Horizonte, Brasil, 48 pp.
- GÜNTHER, A. (1862): Catalogue of the fishes in the British Museum. Catalogue of the Acanthopterygii, Pharyngognathi and Anacanthini in the collection of the British Museum. Vol. 4. London: British Museum (Natural History). 534p.



- HYNES, H.B.N. (1950): The food of fresh-water sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*), with a review of methods used in studies of the food of fishes. – *Journal of Animal Ecology*, **19**: 36–57.
- KAWAKAMI, E. & VAZZOLER, G. (1980): Método gráfico e estimativa de índice alimentar aplicado no estudo de alimentação de peixes. – *Boletim do Instituto Oceanográfico*, **29**(2): 205–207.
- KULLANDER, S.O. (1983): A Revision of the South American Cichlid genus *Cichlasoma* (Teleostei: Cichlidae). The Swedish Museum of Natural History, Stockholm, Sweden, 296 pp.
- KULLANDER, S.O. (1986): Cichlid Fishes of the Amazon River Drainage of Peru. Stockholm: Swedish Museum of Natural History, 431 pp.
- KULLANDER, S.O. (2003): Family Cichlidae. Pp. 605–654 *In*: R. E. Reis, S.O. Kullander, C.J. Ferraris, JR (Eds), Check List Of The Freshwater Fishes Of South And Central America. Editora Universitária – EDIPUCRS, Porto Alegre, Brasil, x + 603 pp.
- LATINI, A.O.; LIMA–JUNIOR, D.P.; GIACOMINI, H.C.; LATINI, R.O.; RESENDE, D.C.; ESPÍRITO–SANTO, H.M.V.; BARROS, D.F. & PEREIRA, T.L. (2004): Alien fishes in lakes of the Doce river basin (Brazil): range, new occurrences and conservation of native communities. – *Lundiana*, **5**(2): 135–142.
- LE CREN, E.D. (1951): The length–weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). – *Journal of Animal Ecology*, **20**(2): 201–209.
- OTTONI, F.P. (2010): *Australoheros capixaba*, a new species of *Australoheros* from south–eastern Brazil (Labroidei: Cichlidae: Cichlasomatinae). – *Vertebrate Zoology*, **60**(1): 19–25.
- OTTONI, F.P. & CHEFFE, M. M. (2009): A new species of *Australoheros* from the upper rio das Antas, laguna dos Patos System, southern Brazil (Labroidei, Cichlidae, Cichlasomatinae). – *Spixiana*, **32** (1): 153–159.
- OTTONI, F.P.; OYAKAWA O.T. & COSTA, W.J.E.M. (2008): A new species of the genus *Australoheros* from the rio Ribeira do Iguape basin, São Paulo, Brazil (Labroidei: Cichlidae: Cichlasomatinae). – *Vertebrate Zoology*, **58**(1): 75–81.
- OTTONI, F.P. & COSTA, W.J.E.M. (2008): Taxonomic revision of the genus *Australoheros* Rícan & Kullander, 2006 (Teleostei: Cichlidae) with descriptions of nine new species from southeastern Brazil. – *Vertebrate Zoology*, **58**(2): 207–232.
- PELD (Programa Brasileiro de Pesquisas Ecológicas de Longa Duração). (2008): Dinâmica biológica e a conservação da biodiversidade da Mata Atlântica do Médio Rio Doce – MG. Belo Horizonte, Universidade Federal de Minas Gerais, 501 p. (site 4, Mata Atlântica e Sistema Lacustre do Médio Rio Doce – MG).
- RÍCAN, O. & KULLANDER, S.O. (2003): “*Cichlasoma*” *scitulum*: A new species of Cichlid fish from the río de La Plata region in Argentina, Brazil, and Uruguay. – *Copeia*, 2003: 794–802.
- RÍCAN, O. & KULLANDER, S.O. (2006): Character- and tree-based delimitation of species in the “*Cichlasoma*” *facetum* group (Teleostei, Cichlidae) with the description of a new genus. Swedish Museum of Natural History, Stockholm, Sweden, PO box 50007.
- RÍCAN, O. & KULLANDER, S.O. (2008): The *Australoheros* (Teleostei: Cichlidae) species of the Uruguay and Paraná River drainages. – *Zootaxa*, 1724: 1–51.
- SCHINDLER, I.; OTTONI, F. P. & CHEFFE, M. M. (2010): *Heros acaroides* HENSEL, 1870, a valid species of *Australoheros* (Teleostei: Cichlidae) from Laguna dos Patos system, south Brazil. – *Vertebrate Zoology*, **60**(2): 139–146.
- SUGUIO, K. & KOHLER, H.C. (1992): Quaternary Barred Lake Systems of the Doce River (Brazil). – *Anais da Academia Brasileira de Ciências*, **64**(2): 183–191.
- TAYLOR, W.R. & VAN DYKE, G.C. (1985): Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. – *Cybium*, **9**: 107–109.
- TUNDISI, J.G. (1997): Climate. Pp. 7–11 *In*: TUNDISI, J.G.; SAIO, Y. (Eds), Limnological studies on the Rio Doce Valley Lakes, Brazil. Brazilian Academy of Sciences. University of São Paulo. School of Engineering at São Carlos. Center for Water Resources and Applied Ecology. 528 pp.
- WEITZMAN, S.H. (1974). Osteology and evolutionary relationships of the Sternopytychidae, with a new classification of stomioid families. – *Bulletin of the American Museum of natural History*, **153**(3): 327–478.
- ZAR, J.H. (1999): Biostatistical analysis. 4 ed. New Jersey: Prentice Hall, 663 pp.