VERTEBRATE ZOOLOGY
© Senckenberg Gesellschaft für Naturforschung, 2015.
65 (1): 65 – 79
4.5.2015

SENCKENBERG

Phylogenetic position and re-description of the endangered cichlid *Nannacara hoehnei*, and description of a new genus from Brazilian Cerrado (Teleostei, Cichlidae, Cichlasomatini)

Felipe P. Ottoni [1] & José Leonardo O. Mattos [1]

[1] Laboratório de Sistemática e Evolução de Peixes Teleósteos, Departamento de Zoologia, Universidade Federal do Rio de Janeiro, Cidade Universitária, CEP 21994-970, Caixa Postal 68049, Rio de Janeiro, RJ, Brazil — Corresponding author: F.P. Ottoni; fpottoni(at)gmail.com

Accepted 19.ii.2015.
Published online at www.senckenberg.de / vertebrate-zoology on 4.v.2015.

Abstract

Rondonacara, gen. nov. is herein described as a member of the tribe Cichlasomatini, being considered as the sister taxon of *Laetacara*. The new genus differs from all the other genera of Cichlasomatini by having transversal streaks originated at the insertion of spines and softs rays of dorsal fin. Additionally, the new genus differs from the other genera of the Cichlasomatini by its unique combination of character states: longitudinal stripe of the flank horizontally oriented, ending directed to caudal-fin base; conspicuous suborbital bar; caudal-fin base spot on the middle of the fin and not ocellated; preopercle without scales; two supra-neural; and uniserial predorsal squamation. *Rondonacara* is monotypic, including only *Rondonacara hoehnei*, re-described herein. This species was originally described from a tributary of the Araguaia River, Mato Grosso state, with unprecise locality. Currently, *Rondonacara hoehnei* is known only from a single locality, a tributary of the das Mortes River, Araguaia River basin, in the Brazilian Cerrado. The restrict distribution area, and the widespread and accelerated destruction of natural habitat strongly indicate that *Rondonacara hoehnei* is critically endangered.

Key words

Araguaia River basin, Biodiversity, Cichlidae, "Expedição Científica Rondon-Roosevelt", Labroidei, Perciformes, das Mortes River.

Resumo

Rondonacara, gen. nov., é descrito como membro da tribo Cichlasomatini, sendo considerada como táxon-irmão de *Laetacara*. O novo gênero diferencia-se de todos os outros gêneros de Cichlasomatini por possuir faixas transversais originadas na inserção dos espinhos e raios da nadadeira dorsal. Adicionalmente, o novo gênero diferencia-se dos demais gêneros de Cichlasomatini pela seguinte combinação de estados de caráter: faixa longitudinal do flanco horizontalmente orientada, terminando direcionada para a base da nadadeira caudal; barra suborbital conspícua; mácula da nadadeira caudal no meio da base da nadadeira e não oceolada; pre-opérculo sem escamas; dois supra-neurais; e escamação pré-dorsal unisserial. *Rondonacara* é monotípico, incluindo apenas *Rondonacara hoehnei*, redescrito no presente trabalho. Esta espécie foi descrita originalmente de um tributário do Rio Araguaia, Estado do Mato Grosso, com localidade imprecisa. Atualmente, *Rondonacara hoehnei* é conhecida apenas para uma única localidade, um tributário do Rio das Mortes, Bacia do Rio Araguaia, no Cerrado brasileiro. A área de distribuição restrita, e a generalizada difundida e acelerada destruição dos habitats naturais indicam fortemente que *Rondonacara hoehnei* é criticamente ameaçada.

Palavras-chaves

Bacia do Rio Araguaia, Biodiversidade, Cichlidae, "Expedição Científica Rondon-Roosevelt", Labroidei, Perciformes, Rio das Mortes.

Introduction

Cichlidae is the most species-rich non-Ostariophysyan freshwater fish family, including more than 1,670 valid species (Kullander, 1998; Eschmeyer & Fong, 2014). The family is distributed along the freshwater systems of Africa, Americas, and southeastern and eastern Asia (Kullander 1998, 2003). Currently, Cichlidae is divided in four subfamilies: Etroplinae, Ptychochrominae, Pseudocrenilabrinae and Cichlinae (Smith *et al*., 2008). Cichlinae, which comprises Neotropical taxa, together with Pseudocrenilabrinae, restricted to Africa, are the most species-rich subfamilies, comprising almost the diversity of the whole family (Kullander, 1998, 2003). According to Smith *et al*. (2008), Cichlinae is divided into seven tribes: Cichlini, Retroculini, Astronotini, Chaetobranchini, Geophagini, Cichlasomatini and Heroini.

Nannacara hoehnei Ribeiro, 1918 was firstly described on the basis of specimens collected during the "Expedição Científica Rondon-Roosevelt", an expedition led by Marechal Cândido Rondon and Theodore Roosevelt, between 1913 and 1914. The type material was collected by the Brazilian botanist Frederico Carlos Hoehne, who was honored with the name of the species. Kullander (1983), in his revision of the Neotropical cichlid genus *Cichlasoma* Swainson, 1839, provided a new arrangement for the taxa previously placed in *Cichlasoma* and *Aequidens* Eigenmann & Bray, 1894, and additionally *N. hoehnei* was transferred to the *incertae sedis* "*Aequidens*" *guianensis* group. Shortly after, Kullander & Nijssen (1989) erected the genus *Krobia* Kullander & Nijssen, 1989 to include species previously placed in the "*Aequidens*" *guianensis* group *sensu* Kullander, 1983 except "*Aequidens*" *hoehnei* and "*Aequidens*" *potaroensis* Eigenmann, 1912, which remained *incertae sedis*.

The first phylogenetic study including "*Aequidens*" *hoehnei* was published by Kullander (1998), which covered a variety of South American cichlid genera, playcing the species "*Aequidens*" *hoehnei* within the tribe Cichlasomatini. However, the precise relationships of "*Aequidens*" *hoehnei* among Cichlasomatines was quite controversial, appearing both as sister group of the clade including *Laetacara* Kullander, 1986 + *Nannacara* + *Cleithracara* Kullander & Nijssen, 1989, and sister group of the clade *Krobia* + *Bujurquina* Kullander, 1986 + *Tahuantisuyoa* Kullander, 1986 + "*A*". *latifrons* (Steindachner, 1878) + "*A*". *rivulatus* (Günther, 1860) (the two last species currently placed in the recently described genus *Andinoacara* Musilová, Rícan & Novák, 2009). More recently, Musilová *et al*. (2009) presented a phylogeny of the tribe Cichlasomatini based on both morphological and molecular characters, placing "*Aequidens*" *hoehnei* as sister taxon of the clade including *Laetacara* + *Nannacara* + *Cleithracara*. However, no DNA material of "*Aequidens*" *hoehnei* was used in that study.

The present paper aims to re-describe the poorly known species *Nannacara hoehnei* based both on types and recently collected material, as well as, to search for the phylogenetic position of *N. hoehnei* among Cichlasomatines using DNA sequences for the first time in order to evaluate its generic placement.

Material and methods

Material

Material for morphological analysis and voucher specimens utilized for DNA extraction are deposited in following institutions: ANSP, Academy of Natural Sciences of Philadelphia; BMNH, Natural History Museum, London; CBF, Colección Boliviana de Fauna, Instituto de Ecología, Museo Nacional de Historia Natural, La Paz; IEPA, Instituto de Pesquisas Científicas e Tecnológicas do Estado do Amapá, Macapá; MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre; MNRJ, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro; MTD F, Museum für Tierkunde Dresden Fish Collection, Dresden; MZUSP, Museu de Zoologia, Universidade de São Paulo, São Paulo; NMW, Naturhistorisches Museum Wien, Viena; UFRJ, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro; and ZMB, Museum für Naturkunde, Berlin.

Comparative material

Acaronia nassa (Heckel, 1840): Amazonas state: UFRJ 4120, 3, 30.0–91.6 mm SL; Máximo lake, Amazonas river basin, Parintins municipality; C. Figueiredo and C. Codeço, 14 Sep. 1996. UFRJ 4360, 1 (C&S), 59.1 mm SL; Parananema lake, Amazonas river basin, Parintins municipality; C. Figueiredo & C. Codeço, 11 Sep. 1996. UFRJ 9226, 1, 48.1 mm SL; Igarapé Salgado, beginning of the road to Caurés river, near Barcelos; F. Ottoni, P. Bragança and P. Amorim, 17 Nov. 2012. Pará state: UFRJ 4121, 7, 14.8–65.5 mm SL; Pauxis lake, Amazon river basin, Óbidos municipality; C. Figueiredo & C. Codeço, 07 Sep. 1996. Roraima state: UFRJ 8937, 5, 30.4–50.8 mm SL; flooded área about 10 km from the BR – 401, Bonfim municipality; E. Henschel, F. Ottoni and P. Bragança, 10 Sep. 2012.

Australoheros autrani Ottoni & Costa, 2008*:* Rio de Janeiro state: UFRJ 1071, 1 (C&S – paratype), 34.4 mm SL; São João river, near Gaviões; W. Costa, 10 Jul. 1991. UFRJ 6115, 1 (C&S – paratype), 44.9 mm SL; Aldeia Velha river, 23 km from Silva Jardim, W. Costa, 10 Jul. 1993. UFRJ 6133, 1 (C&S – paratype), 52.3 mm SL; tributary of the São João river; W. Costa, 10 Jul. 1991. UFRJ 7256, 1 (holotype), 57.0 mm SL; Aldeia Velha river, Silva Jardim municipality; W. Costa, 28 Aug. 2005.UFRJ 7201, 3 (paratypes), 59.3–71.7 mm SL; Aldeia Velha river; W. Costa, 16 Jul. 2005.

Bujurquina vittata (Heckel, 1840)*:* Mato grosso state: UFRJ 4932, 8, 23.8–68.3 mm SL; flooded área form the Cuiabá river, Estância do SESC Pantanal, Cuiabá; W. Costa, A. Barbosa and F. Autran, 09 Jun. 1999. UFRJ 8868, 3 (C&S), 42.5–63.7 mm SL; flooded área form the Cuiabá river, Estância do SESC Pantanal, Cuiabá; W. Costa, A. Barbosa and F. Autran, 09 Jun. 1999.

Cichlasoma araguaiense Kullander, 1983: Mato Grosso state: UFRJ 8759, 1 (C&S), 54.8 mm SL; buriti palon BR-154, 94 km South of Nova Xavantina; F. Ottoni and P. Bragança, 25 Apr. 2012. Tocantins state: UFRJ 5074, 1 (C&S), 50.8 mm SL; Araguaia river. D. Almeida, G. Brasil and R. D'Arrigo, Feb. 2009. UFRJ 4946, 21, 29.7–81.7 mm SL; Javés river, Araguaia river basin; R. D'Arrigo *et al*., 7 Oct. 1999. UFRJ 4936, 20, 28.2–65.5 mm SL; Javés river, Araguaia river basin; R. D'Arrigo *et al*., 7 Oct. 1999. Goiás state: UFRJ 1451, 10, 40.9–84.2 mm SL; buriti palm stream 21 km south from São Miguel do Araguaia; W. Costa *et al*., without informations about the date of the collect. UFRJ 8759, 1 (C&S), 59.2 mm SL; buriti palmo n Go-142, north of Montividiu do Norte; F. Ottoni and P. Bragança, 02 May. 2012.

Cichlasoma boliviense Kullander, 1983: Bolívia: CBF 02427, 1, 80.1 mm SL; Estación Biológica del Beni, Mamoré river, Beni; W. Starnes *et al*., 25 Aug. 1987. CBF 01078, 1, 61.1 mm SL; Nacional Park, Indigenan territory Isiboro-Sécure, Beni; S. Barrea, 17 May. 1992. CBF 01894, 1, 105.8 mm SL; Espiritú Estanque, Beni; J. Sarmiento and W. Hanagarth, 23 Apr. 1987.

Cichlasoma dimerus (Heckel, 1840): Mato Grosso state: UFRJ 5795, 2, 65.3–73.9 mm SL; SESC Pantanal; S. Lima *et al*., 19 Sep. 2002. UFRJ 5082, 14, 37.4–57.3 mm SL; swamp near SESC Pantanal; W. Costa *et al*., 10 Jun. 1999. Mato Grosso do Sul state: UFRJ 3713, 3 (C&S), 28.3–60.3 mm SL; flooded área of Miranda river, Paraguay river basin, Bodoquena; W. Costa *et al*., 21 Apr. 1996.

Cichlasoma orientale Kullander, 1983: Ceará state: MNRJ 1256, 17 (3 D&C), 21.8–101.0 mm SL; Grangueiro river, Crato; A. Carvalho, without informations about the date of the collect.

Cichlasoma paranaense Kullander, 1983: Mato grosso state: UFRJ 3019, 2, 48.3–74.3 mm SL; buriti palm 15 km from Aparecida do Taboado, Paraná river basin; W. Costa et al., 18 Sep. 1994. Mato Grosso do Sul state: UFRJ 2221, 15, 36.2–62.8 mm SL; stream on the road Chapadão do Sul-Paranaíba, 68 km north from Cassilândia; W. Costa et al., 17 Sep. 1994.

Cichlasoma sanctifranciscense Kullander, 1983: Bahia state: UFRJ 7797, 5, 64.2–87.9 mm SL; swamp on the road BR-394, Capim Grosso; W. Costa *et al*., 10 May. 2010. Pernambuco state: UFRJ 7788, 3, 30.2–53.0 mm SL; swamp on the Estrada do Vinho, São Francisco river basin, between Lagoa Grande and Santa Maria da Boa Vista; W. Costa *et al*., 11 May 2010. Minas Gerais state: UFRJ 0118, 1, 38.2 mm SL; Januária; G. Brasil, 12 Feb. 1990.

Cichlasoma zarskei Ottoni, 2011: Maranhão state: MNRJ 37576, 1, 76.6 mm SL (holotype); Malhada Grande lake, Maranhão river basin; G. Nunan et al., 22 Nov. 1985. MNRJ 14502, 56 (3 D&C – paratypes), 48.1–99.6 mm SL; Malhada Grande lake, Maranhão river basin; G. Nunan et al., 22 Nov. 1985. MNRJ 14504, 77 (3 D&C – paratypes), 43.1–86.0 mm SL; Igarapé Ariri, Ariri Municipality; G. Nunan et al., 22 Nov. 1985. MCP 45751, 4 (paratypes), 51.9–82.7 mm SL; Igarapé Ariri, Ariri Municipality; G. Nunan et al., 22 Nov. 1985.

Cleithracara maroni (Steindachner, 1881): Amapá state: IEPA 2338, 6 (1 C&S 36,1 mm SL), 30,7–46,8 mm SL; Parna Montanhas do Tumucumaque, Mapaoni river, Jari river basin; C. Souza-Gama, 10 Jan. 2005.

Krobia guianensis (Regan, 1905): Guiana: BMNH 1861.5.2.8, 1. (holotype). Brazil: Amapá state: UFRJ 9367, 82.1 mm SL; road BR-210 between Cupixi river and Porto Grande near Felicíssimo ranch, Porto Grande; P. Bragança and E. Henschel, 27 Jul. 2012; UFRJ 8842, 1, 72.3 mm SL, road BR-210 between Cupixi river and Porto Grande near Felicíssimo ranch, Porto Grande; P. Bragança and E. Henschel, 27 Jul. 2012; UFRJ 8870, 3 (C&S), 52.0–60.8 mm SL; road BR-210 between Cupixi river and Porto Grande near Felicíssimo ranch, Porto Grande; P. Bragança and E. Henschel, 27 Jul. 2012. UFRJ 8844, 2, 68.4–88.0 mm SL; small stream on Amapari river basin, Pedra Preta village, Serra do Navio municipality; P. Bragança and E. Henschel, 27 Jul. 2012.

Krobia xinguensis Kullader, 2012: Mato Grosso state: UFRJ 9371, 1, 55.8 mm SL; flooded area do Suia Miçu river on BR-158, Cascalheira municipality; P. Bragança and F. Ottoni, 07 Apr. 2013.

Laetacara araguaiae Ottoni & Costa, 2009: Goiás state: UFRJ 7557, 1 (holotype), 32.1 mm SL; buriti palm near rio Verde, 32 km north of São Miguel do Araguaia, Araguaia river basin; W. Costa *et al*., 25 Jul. 1993. UFRJ 1477, 14 (paratypes), 15.9–34.9 mm SL; buriti palm near rio Verde, 32 km north of São Miguel do Araguaia, Araguaia river basin; W. Costa *et al*., 25 Jul. 1993. MCP 42589, 2 (paratypes), 26.5–28.3 mm SL; buriti palm near rio Verde, 32 km east from São Miguel do Araguaia; W. Costa *et al*.,25 Jul. 1993. UFRJ 1447, 8 (paratypes), 19.0–34.0 mm SL; buriti palm 21 km South from São Miguel do Araguaia; W. Costa *et al*., 28 Jul. 1993. UFRJ 7552, 4 (C&S – paratypes), 24.3–34.2 mm SL; buriti palm 21 km south from São Miguel do Araguaia; W. Costa *et al*., 28 Jul. 1993.

Laetacara curviceps (Ahl, 1923): Amazonas state: ZMB 31324, 1 (holotype), 46.8 mm SL, Amazonenstrom. ZMB 32398, 3 (paratypes), 39.2–46.9 mm SL; Amazonenstrom. ZMB 32399, 2 (paratypes), 35.6–39.6 mm SL, Amazonenstrom. ZMB 32400, 1 (paratype), 40.4 mm SL, Amazonenstrom. UFRJ 4350, 6, 27.2–34.5 mm SL; Parananema lake, Amazonas river basin, Parintins municipality; C. Figueiredo & C. Codeço, 11 Sep. 1996. UFRJ 4358, 11, 20.3–27.3 mm SL; Parananema lake, Amazonas river basin, Parintins; C. Figueiredo & C. Codeço, 11 Sep. 1996. UFRJ 4361, 7, 23.3–29.4 mm SL; Parananema lake, Amazon basin, Parintins; C. Figueiredo & C. Codeço, 11 Sep. 1996. UFRJ 7522, 4 (C&S), 29.5–25.2 mm SL; Parananema lake, Amazonas river basin, Parintins; C. Figueiredo & C. Codeço, 11 Sep. 1996. UFRJ 4234, 1, 21.1 mm SL; Máximo lake, Amazonas river basin, Parintins; C. Figueiredo & C. Codeço, 14 Sep. 1996. Pará state: UFRJ 4225, 7, 14.2–32.9 mm SL; Óbidos, Paunis lake, Amazonas river basin, near mouth of igarapé Paunis; C. Figueiredo & C. Codeço, 07 Sep. 1996. UFRJ 7971, 22, 24.9–40.4 mm SL; Utinga lake, Belém municipality; D. O. Castro, 12 Oct. 2010. UFRJ 8058, 2 (C&S), 24.8– 38.1 mm SL; Utinga lake, Belém municipality; D. O. Castro, 12 Oct. 2010.

Laetacara dorsigera (Heckel, 1840): Paraguay: NMW 33669, 1 (holotype – photograph); Sümpfe in der Nähe desParaguay-Flusses bei Villa Maria. Brazil: Mato Grosso do Sul state: UFRJ 7541, 1, 31.8 mm SL: temporary pool in Estrada do Taboco, 80 km north from Aquidauana, Paraguai river basin; F. Costa *et. al.*, 23 Apr. 199. MCP 42590, 1, 28.2 mm SL; temporary pool in Estrada do Taboco, 80 km north from Aquidauana, Paraguai river basin; Costa *et. al.*, 23 Apr. 1996. UFRJ 3709, 5, 18.1–21.3 mm SL; temporary pool in Estrada do Taboco 80 km north from Aquidauana, Paraguai river basin; Costa *et al.*, 23 Apr. 1996. UFRJ 3710, 4, 22.3–25.6; stream on Estrada Boiadeiro, about 100 km north from Aquidauna; W. Costa *et al*., 22 Apr. 1996. UFRJ 1913, 5, 19.8–28.3 mm SL, Corumbá; W. Costa & K. Tanizaki, Sep. 1989. Mato Grosso state: UFRJ 3708, 10, 22.3–30.6 mm SL; temporary pool near Casal Vasco, Guaporé river basin; Costa *et. al.*, 29 Apr. 1996. UFRJ 7521, 4 (C&S), 23.3–36.9 mm SL; temporary pool near Casal Vasco, Guaporé river basin; Costa *et al.*, 29 Apr. 1996. UFRJ 3711, 5, 20.9–28.2 mm SL; temporary pool between km 23 and 29 from the street between Casal Vasco and Vila Bela, Guaporé river basin, Costa *et. al.*, 29 Apr. 1996. UFRJ 3714, 2, 23.3–29.3 mm SL; buriti palm 7.7 km from the street between Pontes e Lacerda and Vila Bela, Guaporé river basin; Costa *et. al.*, 28 Apr. 1996. UFRJ 5538, 1, 22.7 mm SL; temporary pool on the street from E.E. Sesc Pantanal, Costa *et. al.*, 12 Apr. 2002; UFRJ 3716, 1, 21.9 mm SL; temporary pool on km 16–19 from the street between Santo Antônio do Leverger and Barão de Melgaço, Paraguai river basin, Costa *et. al.*, 26 Apr. 1996. MNRJ 14868, 1, 30.8 mm SL; Cáceres, córrego Carrapato, farm Pantanalzinho; 22 Sep. 1984. MNRJ 14873, 2, 28.2–36.9 mm SL; córrego Sangradourozinho, Exp. Polonoroeste, 3 Jul. 1984. MNRJ 14874, 2, 33.3–36.8 mm SL; Vermelho river, Rio Branco municipality, Exp. Polo noroeste, 28 Nov. 1984. MNRJ 14885, 10, 28.2–40.0 mm SL; Cáceres, córrego

Carrapato, farm Pantanalzinho, Exp. Polonoroeste, 22 Nov. 1984; MNRJ 14938, 9, 23.7–33.6 mm SL; Cáceres, farm Pantanalzinho, Porto Esperidião, Exp. Polonoroeste, 24 Nov. 1984. MNRJ 17450, 2, 26.9–33.6 mm SL; farm Pantanalzinho, Porto Espiridião, Cáceres, Exp. Polonoroeste, 23 and 24 Nov. 1984; and MNRJ 17452, 11, 19.5–25.1 mm SL; lagoon near road Transpantarina, km 110; U. Caramaschi, 06 Out. 1987.

Laetacara flamannellus Ottoni, Bragança, Amorim & Gama, 2012: Amapá state: UFRJ 8060, 34.0 mm SL, 1 (holotype); Curiaú lake, following the road AP-70 to Santo Antônio da Pedreira, Macapá municipality; P. Bragança & P.F. Amorim, 10 Jan. 2011. UFRJ 8005, 16 (paratypes), 10.4–38.2 mm SL; Curiaú lake, following the road AP-70 to Santo Antônio da Pedreira, Macapá municipality; P. Bragança & P.F. Amorim, 10 Jan. 2011. UFRJ 8057, 3 (C&S – paratypes), 26.7–37.8 mm SL; Curiaú lake, following the road AP-70 to Santo Antônio da Pedreira, Macapá municipality; P. Bragança & P.F. Amorim, 10 Jan. 2011. UFRJ 8010, 4 (paratypes), 15.6–17.3 mm SL; flooded area at the road BR-156, in direction to Oiapoque, 4 km before Tartarugal, Tartarugalzinho municipality; P. Bragança & P.F. Amorim, 16 Jan. 2011. UFRJ 8056, 2 (C&S – paratypes), 21.4–29.1 mm SL; flooded area at the road BR-156, in direction to Oiapoque, 4 km before Tartarugal, Tartarugalzinho municipality; P. Bragança & P.F. Amorim, 16 Jan. 2011. UFRJ 8038, 1 (paratype), 35.8 mm SL; Igarapé do Davi, Amapá municipality; P. Bragança & P. Amorim, 16 Jan. 2011. MNRJ 14570, 1 (paratype), 20.4 mm SL; Igarapé de lago, tributary from the left side of rio Vila Nova or rio Anauerapucu, near Babolândia; G.W. Nunan & D.F. Moraes, Apr. 1987. IEPA 1090, 2 (paratypes), 22.3–31.9 mm SL; IEPA 1092, 2 (paratypes), 29.6–34.9 mm SL; IEPA 0199, 6 (paratypes), 32.8–37.0 mm SL; lago Pracuúba, Pracuúba municipality; M.A.S. Lima, 18 Jul. 1984. IEPA 1764, 4 (paratypes), 20.2–0.5 mm SL; rio Araguari, AMCEL area, Ferreira Gomes municipality; C.S. Gama & D.A. Halboth, 2 Jun 2002. IEPA 2751, 8 (paratypes), 21.2–33.1 mm SL; Córrego Areal near BR-156, Mazagão municipality; J.F.P da Silva *et al*., 15 Jul. 2008.

Laetacara flavilabris (Cope, 1870): Peru: ANSP 9156, 1 (holotype – photograph and radiograph); near Peabas, Ecuador (currently Peru). ANSP 9157, 1 (lectotype of *Acara freniferus* – photograph and radiograph); the Ambyiacu. MZUSP 26094, 11 (3 C&S), 29.8–61.3 mm SL; Ucayali, Ivita, Pucallpa, Província Coronel Portillo; H. Ortega, 17 Feb. 1976. MZUSP 16211, 9, 23.1–45.1 mm SL; Loreto, Requena, "Arboretum" Jenaro Herrera; H. Ortega, 4 Jul. 1979. Brazil: Amazonas state: MZUSP 42669, 6 (1 C&S), 32.2–55.9 mm SL; Fonte Boa; Expedição Permanente da Amazônia, 25 Oct. 1968.

Laetacara fulvipinnis Staeck & Schindler, 2007: Brazil: Amazonas state: MZUSP 59200, 3, 27.7–40.4 mm SL; Santa Isabel do Rio Negro, Igarapé in São João, near Santa Isabel (=Tapurucuara); Expedição Permanente da Amazônia, 23 Oct. 1972. MZUSP 84752, 1, 60.6 mm SL; Santa Isabel do Rio Negro, igarapé in São João, near Tapurucuara; Expedição Permanente da Amazônia, 26 Oct. 1972. MZUSP 58648, 13, (2 C&S), 28.7–45.8 mm SL; Rio Negro, lake on the Rio Aiuanã; Expedição Permanente da Amazônia, 29 Oct. 1972. MZUSP 95230, 2, 47.7–47.8 mm SL; Santa Isabel do Rio Negro, Paricatuba; Expedição Permanente da Amazônia, 11 Nov. 1972. MZUSP 55138, 5, 29.7–41.5 mm SL; igarapé on São João, near Tapurucuara; Expedição Permanente da Amazônia, 27 Oct. 1972. UFRJ 9076, 1, 42.7 mm SL; Igarapé do Cajarazinho, tributary of the rio Caurés, in the comunity of Balaio, Barcelos municipality; F. Ottoni, P. Bragança and P. Amorim, 17 Nov. 2012. UFRJ 9075, 1, 44.9 mm SL; island on tributary of the rio Daraã, Santa Isabel do Rio Negro municipality; F. Ottoni, P. Bragança and P. Amorim, 15 Nov. 2012.

Laetacara thayeri (Steindachner, 1875): Brazil: Estado do Amazonas: NMW 33726 (photograph of syntype); NMW 33727 (photograph of syntype); NMW 33729 (photograph of syntype); NMW 33734 (photograph of syntype); NMW 33737 (photograph of syntype); NMW 33733 (photograph of syntype); NMW 33740 (photograph of syntype); NMW 3374 (photograph of syntype); all from "Im Amazonenstrom und dessen Ausständen bei Cudajas, in den See Hyanuary bei Manaos und im Lago Maximo bei Alenquer". MNRJ 29470, 4, 34.6–57.5 mm SL; Igarapé do Ananás, Tefé lake; Mission Amazonie, 19 Nov. 1962. MNRJ 29471, 15 (1 C&S), 41.8–59.1 mm SL; Petit Igarapé, tributary of Jacitara river, Grande de Manacapuru lake; Mission Amazonie, 12 Nov 1962. MZUSP 6655, 1, 51.0 mm SL; igarapé tributary of Manacapuru lake; Expedição Permanente da Amazônia, 19 Nov. 1967. MZUSP 6845, 160, 3 (C&S), 25.7–60.3 mm SL; Manaus, tributary of Tarumazinho, north of Manaus; Expedição Permanente da Amazônia, 18 Nov. 1967. MZUSP 27206, 3, 28.3–33.8 mm SL; Moura, Negro river, Pedra do Gavião; L. Portugal, 14 Nov. 1982. MZUSP 47934, 1, 37.4 mm SL; Manacapuru, igarapé on the Manacapuru lake; Expedição Permanente da Amazônia, 13 Nov. 1967. MZUSP 58427, 1, 40.8 mm SL; Tapera; Expedição Permanente da Amazônia, 1 Nov. 1972. MZUSP 7365, 21, 31.0–56.2 mm SL; Maués, igarapé Limaozinho; Expedição Permanente da Amazônia, 4 Dec. 1967. MZUSP 7491, 63, 35.4–62.6 mm SL; Silves, tributary of the Sanabani river; Expedição Permanente da Amazônia, 07 Dec. 1967. MZUSP 101022, 1, 30 mm SL; Parana of the Amanã lake; R. Barthem, 1 Oct. 1979. MZUSP 87435, 1, 25.7 mm SL; Amanã lake, Paraná do Baré; 22 Sep. 1979. MZUSP 5834, 1, 18.2 mm SL; Silves, Saracá lake; Expedição Permanente da Amazônia, 17 and 18 Mar. 1967. MZUSP 42671, 8, 22.2–48.0 mm SL; Codajás, Miuá lake; Expedição Permanente da Amazônia, 25 Sep. 1968. MZUSP 35560, 2, 38.2–38.4 mm SL; Humaitá, Poço dos Tamboatazinhos, igarapé Banheiro (tributary of the middle Madeira river); U. Caramaschi, 29 Jul. 1975. MZUSP 59169, 8, 40.7–45.6 mm SL; Cantagalo, flooded áreas of Negro river; Expedição Permanente da Amazônia, 28 Jan. 1972. MZUSP 7418, 2, 32.5–45.1 mm SL; Silves, Igarapé on the Sacará lake; Expedição Permanente da Amazônia, 6 Dec. 1967. MZUSP 42670, 1, 28.9 mm SL; Coari, Solimões river; Expedição Permanente da Amazônia, 28 Sep. 1968. MZUSP 6934, 88, 34.7–65.3 mm SL; igarapé on the Puraquequara lake; Expedição Permanente da Amazônia, 23 Nov. 1967. UFRJ 9078, 1 (C&S), 64.9 mm SL; Igarapé do Cajarazinho tributary of Caurés river in the comunity of Balaio, Barcelos municipality; F. Ottoni, P. Bragança and P. Amorim, 17 Nov. 2012. UFRJ 9077, 1 (C&S), 62.9 mm SL; Tibarrá river, Santa Isabel do Rio Negro municipality; F. Ottoni, P. Bragança and P. Amorim, 14 Nov. 2012. Rondônia state: MZUSP 85529, 2, 33.6–47.6 mm SL; Calama, Madeira river drainage; Expedição Permanente da Amazônia, 20 Nov. 1975.

Mesonauta sp.: Amazonas state: UFRJ 6130, 1 (C&S), 33.9 mm SL; Zé-Açú lake, Amazonas river basin, near comunidade Bom Socorro, Parintins municipality; C. Figueiredo and C. Condeço, 13 Sep. 1996.

Nannacara aureocephalus Allgayer, 1983*:* Amapá state: UFRJ 8819, 13, 22.0–36.0 mm SL; igarapé Patauá, Oiapoke; P. Bragança and E. Henschel, 29 Jul. 2012. UFRJ 8869, 4 (C&S), 17.8–25.3 mm SL; igarapé Patauá, Oiapoke; P. Bragança and E. Henschel, 29 Jul. 2012. UFRJ 8820, 5, 23.4–30.9 mm SL; igarapé Patauá, Oiapoke; P. Bragança and E. Henschel, 29 Jul.

Petenia splendida Günther, 1862: Guatemala: UFRJ 6127, 1 (C&S), 72.2 mm SL; Petenalong lagoon on airfield, Peten; Hubbs and Vander Shalie, 08 Feb. 1935.

Pterophyllum sp.: Amazonas state: UFRJ 6100, 1 (C&S), 49.7 mm SL; Máximo lake, Amazonas river basin, Parintins; C. Figueiredo and C. Condeço, 14 Sep. 1996. UFRJ 6101, 1 (C&S), 54.6 mm SL; Máximo lake, Amazonas river basin, Parintins; C. Figueiredo and C. Condeço, 14 Sep 1998.

Symphysodon sp.: UFRJ 4845, 1 (C&S), 85.8 mm SL; aquarium material; 12 May 1999

Information about other species of the Cichlasomatini were based on Kullander (1983: 1986: 2012), Kullander & Nijssen (1989), Kullander & Prada-Pedreros (1993),

Römer (2006), Musilová *et al.* (2008: 2009 A and B), Staeck (2012), and Steele *et al.* (2013).

Comparative material not included as terminal taxa in the phylogenetic analyses were used to confirm the diagnostic character states of the genera and tribes.

Morphological inspection

Morphological data were obtained from specimens fixed in formalin 10% for a period of 15 days, and then transferred to 70 % ethanol.

Measurements and counts were made according to Ottoni *et al*. (2011) and Ottoni *et al.* (2012). Counts of gill-rakers of the first branchial arch are expressed following the formula: gill-rakers on the epibranchial 1 + gill-rakers on the cartilage between the epibranchial 1 and the ceratobranchial 1 + gill-rakers on the ceratobranchial 1. In the description and tables, the number of specimens exhibiting a character state is presented in parentheses. Description of the colouration in life was based on five photographed specimens and on observation of all the collected specimens during the field work.

Measurements are presented as percentages of standard length (SL), except for those related to head morphology, which are expressed as percentages of both standard length (SL) and head length (HL). Measurements were taken on the left side of each specimen with digital callipers under a binocular microscope. Osteological studies were made on five cleared and counterstained (c&s) specimens prepared according to Taylor & Van Dyke (1985); the osteological nomenclature follows Costa (2006). Nomenclature related to colour patterns follows Kullander (1983). The lateral band *sensu* Kullander (1983) is named "longitudinal stripe" here.

Euthanasia

The specimens were euthanized according to the guidelines of the Journal of the American Veterinary Medical Association (AVMA Guidelines), and European Commission DGXI consensus for fish euthanasia. Specimens were submerged in a buffered solution of ethyl-3-aminobenzoat-methansulfonat (MS-222) at a concentration of 250mg/l, for a period of 10 min. or more, till the complete cessation of opercular movement. This substance acts on the nervous system, interrupting sensory input or muscle contractions till deactivation of the central nervous system.

DNA extraction, amplification and sequencing

Specimens for molecular analysis were fixed and preserved in absolute ethanol just after collection. The complete genomic DNA was representatively extracted from muscular tissue of the right side of the caudal peduncle using the DNeasy Blood & Tissue Kit (Qiagen). Our target were fragments of four genes: two mitochondrial, 16S RNA (16S) with 607 pb. using primers mtD32 and mtD34 (Marescalchi, 2005) and Cytochrome b (CYTB) with 1,161 pb. using primers CytB-F (Palumbi *et al*., 1991) and TrucCytB-R (Martin & Berminghan, 1998); and two nuclear, Recombination activating gene 1 (RAG1) with 1,484 pb. using unnamed primers designed by Grande *et al*. (2004), and Ribosomal protein S7 (S7) with 646 pb. using primers S7RPE-X1F and S7RPE-X2R (Chow & Hazama, 1998).

Polymerase chain reaction (PCR) was performed in 30µl reaction mixtures containing 5 × Green GoTaq Reaction Buffer (Promega), 3.2 mM $MgCl_2$, 1 µM of each primer, 75 ng of total genomic DNA, 0.2 mM of each dNTP and 1 U of Taq polymerase. Thermocycling profile was: (1) 1 cycle of 4 minutes at 94°C; (2) 35 cycles of 1 minute at 92°C, 1 minute at 58 – 60°C and 1 minute at 72°C; and (3) 1 cycle of 4 minutes at 72° C. Negative controls were used to check DNA contamination in all PCR reactions. PCR results were visualized by means of agarose gel electrophoresis (1.8/1%) in TBE buffer. Amplified PCR products were purified using Wizard SV Gel and PCR Clean-Up System (Promega). Sequencing reactions were made using BigDye Terminator Cycle Sequencing Mix (Applied Biosystems). Cycle sequencing reactions were performed in 10 µl reaction volumes containing 1 µl BigDye 2.5, 1.55 µl 5 × sequencing buffer (Applied Biosystems), 2 µl of amplified products (10 – 40 ng), and 2µM of primer. Thermocycling profile was 35 cycles of 10 seconds at 96°C, 5 seconds at 54°C and 4 minutes at 60°C. The sequencing reactions were conducted directly from purified and denatured PCR reaction products. Those samples were run on an ABI 3130 Genetic Analyzer. List of species and respective Gen-Bank accession numbers are shown in Tables 1 and 2.

Phylogenetic analysis

Four character partitions were defined for this study: 16S, Cytb, Rag1 and S7. Each partition block was singly edited using MEGA 5 (Tamura *et al.*, 2011) and aligned using Muscle algorithm (Edgar, 2004) with following opening parameters G = – 500 and extension parameter W = 0 for all genes fragments. The alignment obtained was checked visually. The complete molecular partition includes all sequence data merged into a single data matrix with a total of 3.901pb.

Phylogenetic relationships were estimated by Maximum Parsimony (MP), Maximum Likelihood (ML) and Bayesian analysis methods. The same data matrix was submitted to all the analysis. It was composed by 2.799 constant, 350 variable but parsimony-uninformative, and 711 parsimony-informative characters. MP was performed with TNT 1.1 (Goloboff *et al*., 2008), using the 'traditional' search and setting random taxon-addition replicates to 10, tree bisection-reconnection branch swap-

Table 1. New material used in the DNA analyses of the current work.

Species	Catalog number	Accession codes				Locality	Coordinates
		16S	Cyt *b*	Rag1	S7		
Laetacara araguaiae	UFRJ 8631	KP308122	KP308098	KP308106	KP308114	Buriti palm flooded área oh the rio Araguaia basin, Município de São Miguel do Araguaia, Estado de Goiás.	13º27'17"S 50º17'12"W
Laetacara curviceps	UFRJ 9057	KP308123	KP308099	KP308107	KP308115	Lago Parananema, Município de Parintins, Estado do Amazonas.	02°40'51"S 56°47'14"W
Laetacara dorsigera	UFRJ 9360	KP308124	KP308100	KP308108	KP308116	Flooded área of rio Bento Gomes, Município de Poconé, Estado de Mato Grosso.	16°0'0"S 56°28'50"W
Laetacara flamannellus	UFRJ 8006	KP308125	KP308101	KP308109	KP308117	Lago Curiaú, Município de Macapá, Estado do Amapá.	0°0'54"N 51°2'26"W
Laetacara fulvipinnis	UFRJ 9056	KP308126	KP308102	KP308110	KP308118	Igarapé do Cajarazinho, tributary of the rio Caurés, Município de Barcelos, Estado do Amazonas.	01°06'17"S 062°58'42"W
Laetacara thayeri	UFRJ 9059	KP308127	KP308103	KP308111	KP308119	Igarapé do Cajarazinho, tributary of the rio Caurés, Município de Barcelos, Estado do Amazonas.	01°06'17"S 62°58'42"W
Rondonacara hoehnei	UFRJ 9364	KP308128 and KP308129	KP308104 and KP308105	KP308112 and KP308113	KP308120 and KP308121	Tributary of rio das Mortes, rio Araguaia basin, Estado de Mato Grosso.	14°52'31.07"S 54°05'00.26"W

Table 2. Accession codes from GeneBank sequences of the other species used in this work.

Species	16S	Cytb	Rag1	S7
Acaronia nassa	EF432897.1	EF432937.1	EU706390.1	GU736750.1
Aequidens tetramerus	GU737169.1	EF432949.1	EU706386.1	GU736733.1
Andinoacara pulcher	EF432889.1	EF432944.1	EF362595.1	GU736738.1
Bujurquina vittata	EF432892.1	EF432951.1	EU706385.1	EF432984.1
Cichlasoma dimerus	GU737177.1	EF432941.1	EU706366.1	GU736742.1
Cleithracara maronii	EF432901.1	AY050614.1	EU706394.1	EF432993.1
Krobia guianensis	EF432910.1	EF432933.1	EU706402.1	EF433002.1
Ivanacara adoketa	EF432903.1	EF432946.1	EU706396.1	EF432995.1
Nannacara anomala	EF432898.1	AY050618.1	EU706391.1	EF432990.1
Nannacara aureocephalus	EF432899.1	EF432939.1	EU706392.1	EF432991.1
Nannacara taenia	GU737182.1	GU736972.1	EU706393.1	GU736748.1
Tahuantinsuyoa macantzatza	EF432891.1	EF432915.1	EU706384.1	EF432983.1

ping, multi-trees in effect, collapsing branches of zero-length, characters equally weighted, and a maximum of 10,000 trees saved in each replicate. MP tree branch support was given by bootstrap analysis (Felsenstein, 1985), using a heuristic search with 1,000 replicates and the same settings used in the MP search, and saving a maximum of 1,000 trees in each random taxon-addition replicate; and them strict consensus tree was calculated. *Acaronia nassa* was defined as out-group.

The appropriated evolutionary model for each partition was estimated using JModelTest version 2.1.3 (Posada, 2008; Darriba *et al.*, 2012), through the Akaike criteria, AIC (Akaike, 1974). The best scored models found to each gene was: GTR+I+G for 16S and Cytb, GTR+I for RAG1, and HKY+G for S7. The ML analysis was performed in Garli 2.0 (Zwickl, 2006), which allow to apply different evolutionary models to each data partition. ML tree branch support was calculated with 1000 nonparametric bootstrap replicates using the same settings.

Bayesian analysis was performed in MrBayes v. 3.1.2 (Ronquist *et al*., 2012). The same evolutionary models for each partition utilized in ML analysis were applied. Two independent runs of 3 million generations using four Markov chains and saving one tree every five hundred generations were performed. The program Tracer v 1.5 (Rambaut, 2009; Rambaut *et al*., 2013) was utilized to verify and evaluate the effective sample size (ESS) for all parameters for the analysis. Posterior probabilities were calculated and evaluated as a majority-rule consensus of the saved trees.

Terminal taxa represent all genera of the tribe Cichlasomatini (Musilová *et al*., 2009). The data matrix included 19 terminal taxa. In-group comprised *Nannacara*

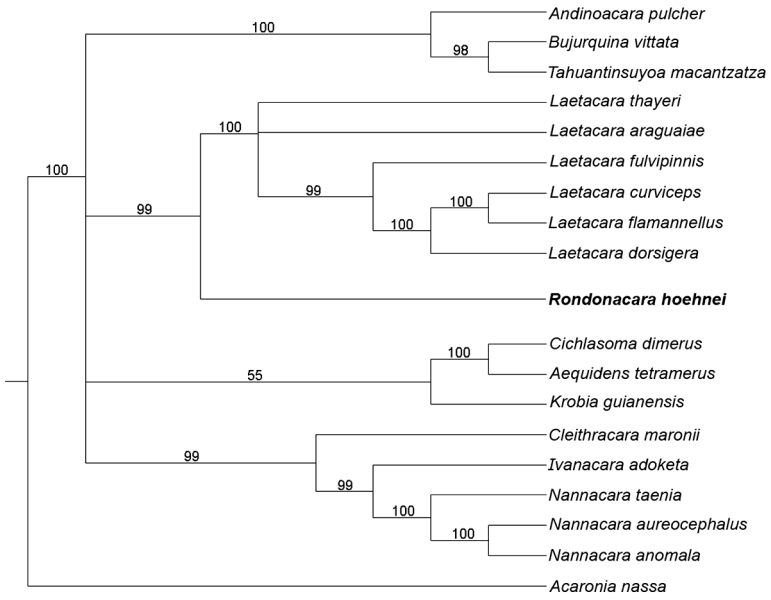


Fig. 1. Unique most parsimonious tree generated by Maximum Parsimony analysis (MP) with a concatenated data set of mitochondrial genes 16S (607 pb.) and Cytb (1,161 bp.), and nuclear genes Rag1 (1,484 pb.) and S7 (646 pb.). Numbers above branches are bootstrap values above 50%.

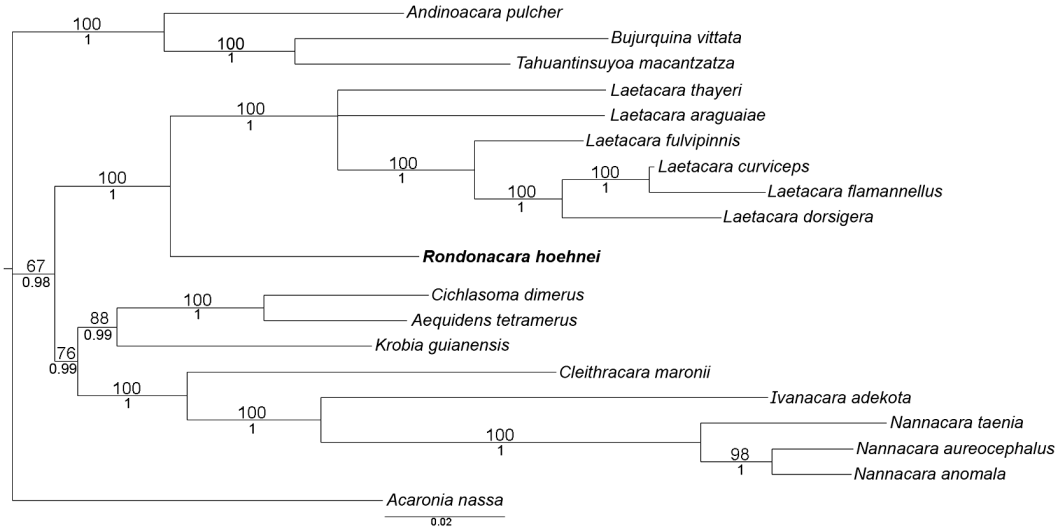


Fig. 2. Topology founded in Maximum Likelihood (ML) and Bayesian analysis through a combined data set. Numbers above branches are bootstrap values above 50% and below branches posterior probability <98.

hoehnei (two specimens), and all its close related genera according to previous phylogenetic analysis or relationships hypothesis (Kullander, 1983, 1998; Musilová *et al*., 2009): *Aequidens tetramerus*, *Bujurquina vittata*, *Cleithracara maronii*, *Krobia guianensis*, *Ivanacara adekota*, *Nannacara anomala*, *N. aureocephalus*, *N. taenia*, *Tahuantinsuyoa macantzatza*, *Laetacara araguaiae*, *L. curviceps*, *L. dorsigera*, *L. flamannellus*, *L. fulvipinnis*, and *L. thayeri*. Out-group comprised three species: *Acaronia nassa*, *Andinoacara pulcher* (Gill, 1858), and *Cichlasoma dimerus* (Tabs. 1 and 2).

Results

Phylogenetic analysis

Among the analysed characters, 2.799 were constant, 350 variable but parsimony-uninformative, and 711 parsimony-informative. The MP analysis generated one most parsimonious tree (total length 3014; consistency index 0.551; retention index 0.560; Fig. 1), which topology agreed with the results found for ML and Bayesian

(Figs. 1 and 2). All phylogenetic analyses recovered *Nannacara hoehnei* as the sister group of *Laetacara*, with bootstrap support value of 99 in MP, and maximum support values in ML and Bayesian analysis (Figs. 1 and 2). However, the remaining species of the genus *Nannacara*, including the type species *N. anomala*, clustered together, and it was recovered as the sister-group of *Ivanacara*, with 99 of bootstrap support value in MP, and maximum support values in ML and Bayesian analysis (Figs. 1 and 2).

Monophyly of *Laetacara* was corroborated by MP, ML and Bayesian analysis. The clade *L. fulvipinnis* + *L. dorsigera* + *L. curviceps* + *L. flamannellus* was recovered as the sister group of the remaining species of *Laetacara* with elevated support values (Figs. 1 and 2). Relationships between this group and *L. thayeri* and *L. araguaiae* showed no resolution, resulting in a polytomy. In addition, other two clades were recovered: *Andinoacara* + *Bujurquina* + *Tahuantinsuyoa*, with maximum or 99 bootstrap support value (Figs. 1 and 2); and *Cichlasoma* + *Aequidens* + *Krobia*, with lower bootstrap support value (55 in MP, 88 in ML) and posterior probability of 99 in the Bayesian analysis (Figs. 1 and 2).

Thus, the fact that *Nannacara hoehnei* failed to cluster with any historically allocated genera nor any available genus provided molecular evidence that it has been incorrectly allocated in *Nannacara* and that it belongs to a new separated genus. Therefore, we here propose the new genus *Rondonacara* (see below) to allocate the species *Nannacara hoehnei*.

Rondonacara gen. n.

Fig. 3

Type species. *Nannacara hoehnei* Ribeiro, 1918.

Diganosis. A typical cichlasomatine cichlid possessing only four pores on the dentary (vs. five in others tribe of the Cichlidae, except Heroini) and just three anal-fin spines (vs. more in Heroini). *Rondonacara* differs from all other genera of Cichlasomatini by presence of transversal streaks originated at the insertion of spines and softs rays of dorsal fin in live specimens, preserved ones retains just the proximal portion of the transversal streaks (Fig. 3) (vs. absence). Additionally, it differs from *Acaronia* (Myers, 1940), *Bujurquina*, *Krobia*, *Andinoacara* and *Tahuantinsuyoa* by having the longitudinal stripe of the flank horizontally oriented, ending directed to caudal-fin base (Fig. 3) (vs. dorsally displaced, ending directed to the end of dorsal-fin base); from "*Aequidens*" *paloemeuensis* Kullander & Nijssen, 1989, "*A*". *potaroensis, Cichlasoma* and *Aequidens* by having the caudal-fin base spot on the middle of the fin (Fig. 3) (vs. dorsally displaced with major part of spot occurring above lower lateral line); from *Cichlasoma* and *Aequidens* by presence of a conspicuous suborbital bar (Fig. 3) (vs. suborbital bar transformed into a spot located below orbits [cheek spot *sensu* Kullander (1983)], and caudal-fin base spot not ocellated (Fig. 3) (vs. ocellated); from *Ivanacara* Römer & Hahn 2007, *Laetacara* Kullander, 1986, *Nannacara* Regan, 1905 and *Cleithracara* Kullander & Nijssen 1989 by having unscaled preopercle (vs. with scaled); from *Cleithracara*, *Ivanacara*, and *Nannacara* by presence of two supraneuralia (vs. 1), and from *Laetacara* by having uniserial predorsal squamation (vs. triserial).

Etymology. *Rondonacara*, a contraction of *Rondon*, in honour to Marechal Cândido Rondon, leader of the "Expedição Científica Rondon-Roosevelt", expedition during which the type series of this species was collected; and *Acara*, a vernacular name for cichlid fishes in Brazil. The name is masculine gender.

Rondonacara hoehnei (Ribeiro, 1918)

Fig. 3

Nannacara hoehnei Ribeiro, 1918: p. 14 (rio Branco, afluente do Araguaya, e n' uma lagoa do Coxipo da Ponte, em Mato Grosso [MNRJ 1245]).

Material examined. Brazil: MNRJ 1245, 1 (holotype), 56.7 mm SL; tributary of Araguaia River; F. C. Hoehne. MNRJ 1255, 2 (paratypes), 63.4–72.2 mm SL; Mato Grosso State; F. C. Hoehne. UFRJ 9408, 14, 25.8–53.4 mm SL; flooded area from a tributary of the das Mortes River, Araguaia River basin, São Pedro farm on the road MT-130 between Primavera do Leste and Paranatinga, approximately 60 km south of Paranatinga (14°52'31.07"S 54°05'00.26"W, 650 m alt); F. Ottoni and P. Bragança, 06 Apr. 2013. UFRJ 9404, 5 (c&s), 27.9–46.3 mm SL; flooded area from a tributary of the das Mortes River, Araguaia River basin, São Pedro farm on the road MT-130 between Primavera do Leste and Paranatinga, approximately 60 km south of Paranatinga (14°52'31.07"S 54°05'00.26"W 650 m alt); F. Ottoni and P. Bragança, 06 Apr. 2013.

Diagnosis. Same diagnosis as given above for the genus.

Description. Morphometric data are summarized in Table 3, meristic data in Table 4. Dorsal profile slightly convex from snout to caudal-peduncle origin, more conspicuous between tip of snout and dorsal-fin origin. Ventral profile slightly convex from snout to caudal-peduncle origin. Caudal peduncle approximately straight ventrally and dorsally. Body profile oval, laterally compressed. Mouth isognath. Three rows of teeth on both upper and lower jaws. Jaw teeth caniniform, hyaline, reddish at tip. Opercle not serrated.

Anterior portion of dorsal fin rounded, posterior region pointed. Tip of dorsal fin reaching vertical through ⅓ to half of caudal fin. Anal fin rounded anteriorly, pointed posteriorly. Tip of anal fin reaching vertical through ⅓ to half of caudal fin. Caudal fin rounded, with anterior ⅓ covered by cycloid scales of half size of flank scales. Pectoral fin with posterior margin rounded. Pectoral-fin



Fig. 3. *Rondonacara hoehnei*: UFRJ 9408; tributary of the das Mortes River, Araguaia River basin, Central Brazil. A – life specimen with 53.4 mm SL (taken on April 6th 2013); B – preserved specimen with 53.4 mm SL; C – dorsal fin of preserved specimen with 53.4 mm SL; D – preserved juvenile specimen with 29.9 mm SL; E – dorsal fin of preserved juvenile specimen with 29.9 mm SL.

Table 3. Morphometric data of *Rondonacara hoehnei*. SL = standard length; HL = Head length; SD = standard deviation; H = holotype; Min = minimum value; Max = maximum value.

	Non types (n = 8)			
	Min	**Max**	**Mean**	**SD**
SL (mm)	36.2	53.4	45.0	—
in Percentages of SL				
Body depth	41.9	46.1	43.3	1.3
Predorsal length	43.3	45.1	44.1	0.7
Dorsal-fin base length	55.2	58.0	56.4	1.1
Last dorsal-fin spine length	13.2	15.0	14.0	0.6
Prepelvic length	44.3	46.7	45.3	0.8
Pelvic length	27.3	29.8	28.4	0.9
Pelvic-fin spine length	12.7	13.9	13.3	0.5
Anal-fin base length	18.7	21.4	20.0	0.9
Last anal-fin base length	12.4	13.5	13.0	0.4
Caudal peduncle length	9.1	10.8	9.8	0.7
Caudal peduncle depth	16.5	18.7	17.4	0.8
Caudal fin length	31.2	35.1	33.5	1.3
Pectoral-fin length	29.5	31.5	30.4	0.7
Head depth	31.5	33.1	32.6	0.5
Snout length	9.9	10.6	10.3	0.3
Preorbital depth	19.3	21.7	20.5	0.8
Head width	19.8	22.7	21.1	0.8
Orbital diameter	12.0	13.0	12.5	0.2
Interorbital width	13.2	15.1	13.8	0.7
Upper jaw length	10.8	11.5	11.2	0.2
HL (mm)	13.9	20.0	16.8	—
in Percentages of HL				
Head depth	82.0	89.2	87.3	2.6
Snout length	26.6	28.7	27.7	0.7
Preorbital depth	50.3	58.3	55.0	2.9
Head width	51.3	60.5	56.6	3.1
Orbital diameter	32.6	34.7	33.5	0.7
Interorbital width	34.6	41.0	36.9	2.3
Upper jaw length	28.1	31.1	30.0	1.2

base on vertical through about first and second dorsal-fin spine. Tip of pectoral-fin reaching vertical through middle of flank spot. Pelvic fin pointed. Pelvic-fin base on vertical through third or fourth spine of dorsal fin. Tip of pelvic fin approximately reaching vertical through first anal-fin spine or near it.

Trunk covered by ctenoid scales; scales above upper lateral line with few ctenii. Predorsal scales cycloids or with few ctenii; squamation pattern uniserial, composed by eight scales and occasionally more one smaller. Prepelvic scales cycloids. Region between dorsal and anal-fins spines and rays unscaled. Pectoral and pelvic fins without scales. Two scales between lateral lines, upper and lower lateral line scales not overlapping vertically, separated by one or two vertical scale rows. Three large scales between upper lateral line and dorsal-fin origin; one or two scales, upper with half of size of lower one, between end of upper lateral line and dorsal-fin base. Opercular, interopercular and subopercular scales cycloids. Three vertical rows of scales on opercle plate, and one row on subopercle and interopercle. Preopercle without scales. Cheek scales cycloid or with few ctenii, rarely typical ctenoid. Cheek with three scale rows on anterior portion (sometimes two), and two scale rows on posterior portion.

Ceratobranchial 4 with one or two tooth plates. Ceratobranchial 5 partly medially sutured and relatively robust, with 7 teeth along midline and 19 to 21 teeth along posterior margin. Posterior teeth usually more compressed. Posterior and medial teeth larger than lateral and anterior teeth. All teeth bicuspid, second cuspid more evident in larger teeth (Fig. 4). Presence of two supraneuralia, rectangular lacrimal (Fig. 5), infraorbitals with conspicuous laminar expansions (Fig. 5), and anterior ceratohyal without any depression on its margin or with depression very inconspicuous (Fig. 6).

Colour in alcohol (Fig. 3b–e). Side of body light brown; seven dark brown bars with two or three flank scales wide, between posterior limit of caudal peduncle and posterior margin of opercle. Bars from both sides of body not merging ventrally. First four bars located from end of caudal peduncle to beginning of anal fin. Trunk bar 7 only on region above mid-portion of trunk. Dorsal region of body darker than ventral region. Belly and chest pale brown, without bars. Two black spots; first spot not ocellated on middle of caudal fin, relatively elliptical in adults and sometimes rounded on juveniles, about one flank scale wide, crossed by lower lateral line on its half; second spot rounded, located on junction between longitudinal stripe and vertical trunk bar 5, about three flank scales wide. Interrupted longitudinal stripe dark brown between half of trunk bar 1 and posterior margin of opercle, lighter and inconspicuous between bars, as well as from bar 1 to bar 5.

Side of head of same ground colouration as trunk, darker on opercle and dorsal region. Dark brown blotch on nape. Suborbital bar from lower margin of orbit to posterior margin of preopercle, slightly inclined to posterior portion. No supraorbital bar. One black bar on head anterior of eyes. Three conspicuous black interorbital stripes; first positioned on half of eyes length, second on ⅔ of eyes length and third on anterior margin of orbits, colouring mid-dorsal region of upper jaw.

Dorsal fin without spot located on its base above trunk bar 5. Dorsal and anal fins grey-hyaline, with small light brown interrupted bars or dots on posterior portion of fins. Dorsal fin spines and sometimes rays with dark brown or black pigmentation on its insertion. Caudal fin grey-hyaline, without any dots or small interrupted bars. Pectoral fin grey-hyaline. Pelvic fin grey-hyaline, darker on rays.

Colouration in life (Fig. 3a). Body ground colouration light brown, darker on dorsal region. Ventral portion of trunk pale brown. Trunk bars dark brown; bars 2–4 reaching anal-fin base, bars 5–6 not reaching chest, bar 7 only above longitudinal stripe. Interrupted longitudinal stripe black, inconspicuous from trunk bar 1 to trunk

Table 4. Meristic data of *Rondonacara hoehnei*. Pc = procurrent rays.

	Type series	Non types
Dorsal-fin spines	14 (1)	13 (3)–14 (16)
Dorsal-fin rays	9 (1)–10 (1)	9 (1)–10 (8)–11 (10)
Proximal Radials on dorsal-fin base	—	22 (1)–23 (4)
Supra neurals	—	2 (5)
Anal-fin spines	3 (2)	3 (18)
Anal-fin rays	9 (1)–10 (1)	9 (11)–10 (8)
Proximal Radials on anal-fin base	—	9 (3)–10 (2)
Pectoral-fin rays	14 (2)	14 (19)
Pelvic-fin spines	1 (1)	1 (5)
Pelvic-fin rays	5 (1)	5 (5)
Caudal-fin rays	—	3 Pc + 8 + 8 + 3 Pc (5)
Precaudal vertebrae	—	12 (5)
Caudal vertebrae	—	12 (5)
Rib pairs	—	9 (2)–10 (3)
Gill-rakers on first ceratobranchial	—	2 (3) + 2 (3) + 10 (1)–11 (1)–12 (1)
Teeth on posterior margin of ceretobtanchial 5	—	19 (2)–21 (1)
Teeth on mid-line of ceretobtanchial 5	—	7 (3)
Scales of upper lateral line serie	14 (2)–15 (1)	13 (1)–14 (7)–15 (6)
E0	19 (3)	18 (2)–19 (11)–20 (1)
E1	—	22 (4)–23 (9)–24 (1)
Scales of lower lateral line serie	8 (2)–9 (1)	7 (4)–8 (8)–9 (2)
E2	—	21 (1)–22 (12)–23 (1)
Scales of dorsal-fin origin serie	—	3 (14)
Scales of the end of upper lateral line to dorsal fin serie	—	1 (5)–2 (9)
Scales of anal-fin origin serie	—	7 (8)–8 (5)
Scales between lateral lines	—	2 (13)
Scales of peduncle depth	7 (3)	7 (14)
Cheek scales rows	3(3)	2 (6)–3 (10)
Squ. op	—	6 (2)–8 (3)–9 (9)
Squ. io	—	3 (12)
Squ. sop	—	3 (12)
Squ. pop	—	0 (12)
Squ. prv	—	9 (8)–10 (6)

bar 5. Caudal- fin base spot and flank spot conspicuous and black.

Head ground colouration as body ground colour, darker at dorsal region. Opercle with golden iridescence. Head bar and interorbital stripes conspicuous with black or dark brown. Suborbital bar conspicuous and black. Iris varying from yellow to black.

Ground colour of dorsal-fin greyish hyaline, with yellow stripe on margin; posterior region of fin with yellow pigmentation. Few white dots present on yellow posterior portion of fin. Presence of transversal streaks originated at the insertion of spines and softs rays of dorsal fin. Anal-fin yellow, with few white dots on base and posterior portion. Caudal fin yellow without dots, with brown coloration near base. Inconspicuous blue stripe present on posterior margin of fin. Pectoral fin yellowish hyaline. Pelvic fin yellow, with pale yellow colouration near base.

Distribution. Upper das Mortes River basin, Araguaia River drainage, central Brazil.

Discussion

Taxonomic remarks

Herein *Rondonacara*, gen. nov. is described as a member of the tribe Cichlasomatini, considered to represent the sister group of *Laetacara* (Figs. 1 and 2). The new genus is a typical member of the Cichlasomatini, sharing the two most important diagnostic character states with the tribe: four pores on the dentary, instead of five in other Cichlidae tribes (except Heroini), and just three anal-fin spines, instead of more than three anal-fin spines in species of the Heroini (Kullander, 1998).

Morphologically, the clade *Laetacara* + *Rondonacara* shares with the clades *Cleithracara* + *Ivanacara* + *Nannacara* [also partially recovered by Musilová *et al*. (2009)], and *Cichlasoma* + *Aequidens* [also recovered by Musilová *et al*. (2009)] a unique colour pattern character state, in which there is a longitudinal stripe horizontally oriented, ending directed to caudal-fin base (*e.g.*: Fig. 3; Kullander, 1986, plates XXXV, XXXVI, XXXVII and XXXVIII; Kullander & Nijssen, 1989, Figs. 73, 122 and 123; Ottoni & Costa, 2009, Fig. 1; Ottoni *et al*., 2012, Figs. 1 and 2), whereas in the other Cichlasomatini, that stripe is dorsally displaced, ending directed to end of the dorsal-fin base (*e.g.*: Fig. 8; Kullander, 1986, plates VI, XXIX, XXXII and XXXIII; Kullander & Nijssen, 1989, Figs 80 and 81; Steele *et al*., 2013, Fig. 2). However, all phylogenetic analyses performed in this work recovered *Krobia* as the sister group to *Cichlasoma* and *Aequidens* (Figs. 1 and 2) [also recovered by Musilová *et al*. (2009)], despite *Krobia* showing the flank longitudinal stripe displaced in dorsal direction. Thus, the hypothesis that these three clades together form a monophyletic group is not supported here. In addition, a clade comprising these three clades, and *Krobia guianensis* as the sister group to *Cichlasoma dimerus* and *Aequidens tetramerus* was supported by lower bootstrap support value (67) in the ML tree, but had a high posterior probability value (98) in the Bayesian analysis. However, it is beyond the scope of the present work establish the relationship of the tribe Cichlasomatini.

The clade including *Laetacara* and *Rondonacara* is clearly morphologically distinguished from the clade including *Cichlasoma* and *Aequidens* by the caudal-fin

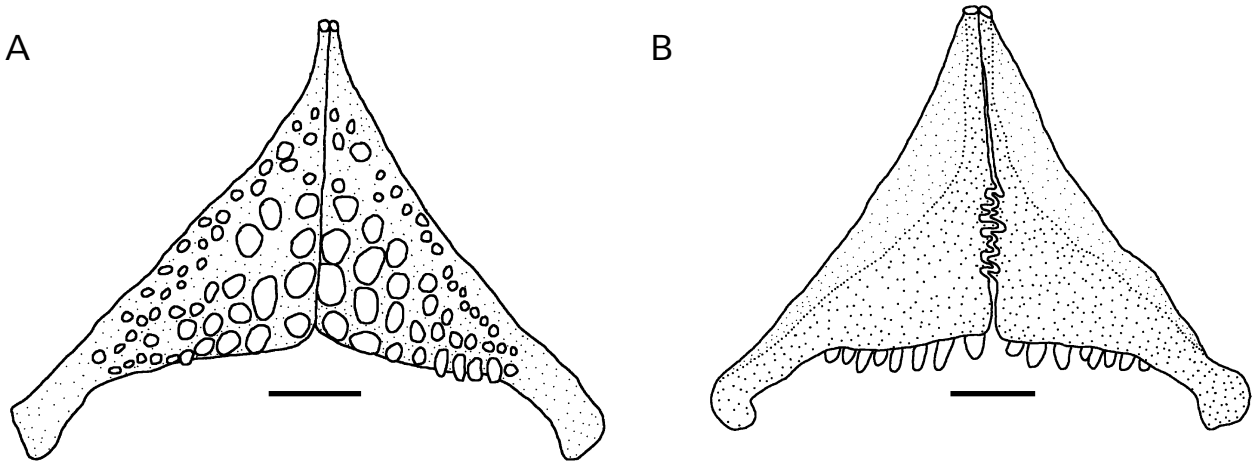


Fig. 4. Ceratobranchial 5 of *Rondonacara hoehnei*: UFRJ 9404, 46.3 mm SL. A – dorsal view; B – ventral view. Scale bar = 1 mm.

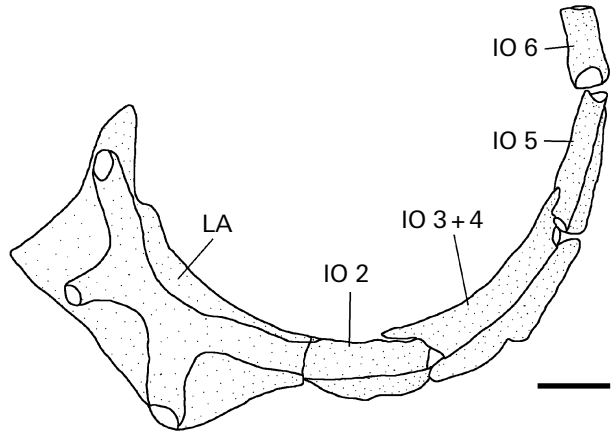


Fig. 5. Infraorbital series of *Rondonacara hoehnei*: UFRJ 9404, 46.3 mm SL. LA- lacrimal; and IO- infraorbitals. Scale bar = 1 mm.

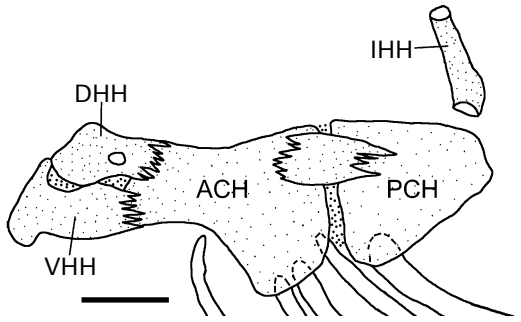


Fig. 6. Hyoid arch of *Rondonacara hoehnei*: UFRJ 9404, 46.3 mm SL. ACH-anterior ceratohyal; DHH-dorsal hypohyal; IHH-interhyal; PCH-posterior ceratohyal; and VHH-ventral hypohyal. Scale bar = 1 mm.

base spot on the middle of the fin (Fig. 3) (transformed in a complete bar in some species of *Laetacara*), whereas the caudal fin spot is dorsally displaced, with major part of spot occurring above lower lateral line in *Cichlasoma* and *Aequidens* (Fig. 7). In addition, *Cichlasoma* and *Aequidens* have the suborbital bar transformed into a spot below orbit [cheek spot sensu Kullander (1983)] (Fig. 7), whereas *Rondonacara* and *Laetacara thayeri* show a conspicuous suborbital bar (Fig. 3), while the others *Laetacara* have it lost. Moreover, the clade *Laetacara* + *Rondonacara* is also clearly distinguished from the clade *Cleithracara* + *Ivanacara* + *Nannacara* by species of the prior having two supraneuralia instead of one. *Rondonacara* possess a unique character state among species of Cichlasomatini: transversal streaks originated at the insertion of spines and softs rays of dorsal fin in live specimens, preserved ones retains just the proximal portion of the transversal streaks (Fig. 3). It also shares with *Laetacara fulvipinnis* a rare colour pattern characteristic among species of Cichlasomatini characterized by the absence of a pattern of dots on caudal fin (Fig. 3; Staeck & Schindler, 2007, figs. 1, 3, 4 and 5). In addition, *Rondonacara* easily differs from its closely related genus, *Laetacara*, by two additional character states: first by uniserial predorsal squamation, whereas *Laetacara* shows trisserial squamation; and second by unscaled preopercle, whereas *Laetacara* have scaly preopercle.

Conservation status

Rondonacara includes only *Rondonacara hoehnei*, described from a tributary of the Araguaia River, Mato Grosso state, with unprecise locality. Currently, *Rondonacara hoehnei* is known only from a single locality at a tributary of the das Mortes River, Araguaia River basin (Fig. 9). Despite recent field work efforts, this species was collected in this single locality only (Costa *pers. comm.*).

Natural habitats of the Brazilian Cerrado, one of the global hotspots according to Myers *et al.* (2000), under-



Fig. 7. *Cichlasoma araguaiense*: UFRJ 1241, 96.9 mm SL; Xingú river basin.



Fig. 8. *Krobia guianensis*: UFRJ 9367, 82.1 mm SL; Brazil: Amapá state.



Fig. 9. Locality of the recent collected material of *Rondonacara hoehnei*: flooded area from a tributary of the das Mortes River, Araguaia River basin, São Pedro farm on the road MT-130 between Primavera do Leste and Paranatinga, approximately 60 km south of Paranatinga (14°52'31.07"S 54°05'00.26" W 650 m alt.).



Fig. 10. Satellite image of the area where the recent material was collected, taken from Google Earth. Satellite image taken on August 17th 2004. Red circle represents the precise locality of the recent collected material.

go accelerated and severe destruction, as modern agriculture rapidly develops. The landscape is increasingly taken not only by extensive soya bean cultivation, but also by fields of maize and rice, and cattle pastures. Other activities such as charcoal production also add to the devastation suffered by the Cerrado. Evaluation of satellite photographs available from Google Earth (www.earth.google.com) allows the observation that large areas on both sides of the riverbed of the das Mortes River are engaged in agricultural plots (Fig. 10). Thus, the Brazilian Cerrado is currently reduced to about 50% of its original area (De Luca *et al*. 2009). The restricted distribution and the widespread and accelerated destruction of natural habitats strongly indicate, that *Rondonacara hoehnei* has to be stated to be a "*critically endangered*" species.

Acknowledgements

Thanks are due to Pedro Bragança (from UFRJ) for the help during field work; to Axel Katz (from UFRJ) for helping in edition of the figures; to Ana Galvão (from UFRJ) for assistance during phylogenetic analysis; to Marcelo Britto (from MNRJ) for enabling us to examine material in their care; and to Wilson Costa (from UFRJ) and to the anonymous reviewers for corrections and suggestions on the manuscript. This study was supported by 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

Akaike, H. (1974): A new look at the statistical model identification. – IEEE Transactions on Automatic Control, **19**: 716–723.

Chow, S. & Hazama, K. (1998): Universal PCR primers for S7 ribosomal protein gene introns in fish. – Molecular Ecology, **7**: 1255–1256.

Costa, W.J.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**: 1–26.

Darriba, D., Taboada, G.L., Doallo, R. & Posada, D. (2012): jModelTest 2: more models, new heuristics and parallel computing. – Nature Methods, **9**: 772.

De Luca, A.C., Bencke, G.A. & Develey, P.F. (2009): Bird Conservation in Brazil: Considerations for Amazonia, the Cerrado and Pantanal Biomes. – In: Áreas importantes para a conservação das aves no Brasil. Parte II – Amazônia, Cerrado e Pantanal (De Luca, A.C., Develey, P.F., Bencke, G.A. & Goerck, J.M. orgs.), pp 1 – 8. SAVE Brasil, São Paulo, Brazil.

Edgar, R.C. (2004): MUSCLE: a multiple sequence alignment method with reduced time and space complexity. – BMC Bioinformatics, **5**: 113.

Eschmeyer, W.N. & Fong, J.D. (2014). Species of fishes by family/subfamily. (http://research.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp). Electronic version accessed 18 December 2014)

Felsenstein, J. (1985): Confidence limits on phylogenies: an approach using the bootstrap. – Evolution, **39**: 783–791.

Goloboff, P.A., Farris, J.S. & Nixon, K.C. (2008): TNT, a free program for phylogenetic analysis. – Cladistics, **24**: 774–786.

Grande, T., Laten, H. & Lopez, J.A. (2004): Phylogenetic relationships of extant esocid species (Teleostei: Salmoniformes) based on morphological and molecular characters. – Copeia, **4**: 743–757.

Kullander, S.O. (1983): A revision of the South American cichlid genus *Cichlasoma*. Swedish Museum of Natural History, Stockholm, 296 pp.

Kullander, S.O. (1986): Cichlid fishes of the Amazon River drainage of Peru. Swedish Museum of Natural History, Stockholm, 431 pp.

Kullander, S.O. (1998): A phylogeny and classification of the South American Cichlidae (Teleostei: Perciformes), pp 461 – 498. – In: Phylogeny and Classification of Neotropical Fishes (Malabarba, L.R., Reis, R.E., Vari, R.P., Lucena, Z.M. & Lucena, C.A.S., eds.). Phylonegy and Classification of Neotropical Fishes. Editora Universitária – EDIPUCRS, Porto Alegre, Brazil, 603pp.

Kullander, S.O. (2003): Family Cichlidae. – In: Check List of the Freshwater Fishes of South and Central America (Reis, R.E., Kullander, S.O. & Ferraris, C.J.Jr., eds.). Editora Universitária – EDIPUCRS, Porto Alegre, Brazil, pp. 605 – 654.

Kullander, S.O. (2012): *Krobia xinguensis*, a new species of cichlid fish from the Xingu River drainage in Brazil (Teleostei: Cichlidae). – Zootaxa, **3197**: 43–54.

Kullander, S.O. & Nijssen, H. (1989). The cichlids of Surinam. E.J. Brill, Leiden, XXXIII: 256 p.

Kullander, S.O. & Prada-Pedreros, S. (1993): *Nannacara adoketa*, a new species of cichlid fish from the Rio Negro in Brazil. – Ichthyological Exploration of Freshwaters, **4 (4):** 357–366.

Myers, N.; Mittermeier, R.A.; Mittermeier, C.G.; Da Fonseca, G.A.B.; & Kent, J. (2000): Biodiversity hotspots for conservation priorities. – Nature, **403**: 853–858.

Marescalchi, O. (2005): Karyotype and mitochondrial 16S gene characterizations in seven South American Cichlasomatini species (Perciformes, Cichlidae). – Journal of Zoological Systematics and Evolutionary Research, **43**: 22–28.

Martin, A.P. & Bermingham, E. (1998): Systematics and evolution of lower Central American Cichlids inferred from analysis of cytochrome b gene sequences. – Molecular Phylogenetics and Evolution, **9**: 192–203.

Musilová, Z.; Říčan, O.; Janko, K.; & Novák, J. (2008) Molecular phylogeny and biogeography of the Neotropical cichlid fish tribe Cichlasomatini (Teleostei: Cichlidae: Cichlasomotinae). – Molecular Phylogenetics and Evolution, **46**: 659–672.

Musilová, Z., Schindler, I. & Staeck, W. (2009A): Description of *Andinoacara stalsbergi* sp.n. (Teleostei: Cichlidae: Cichlasomatini) from the Pacific coastal rivers in Peru, and annotations on the phylogeny of the genus. – Vertebrate Zoology, **59**: 131–141.

Musilová, Z., Říčan, O. & Novák, J. (2009B): Phylogeny of the Neotropical cichlid fish tribe Cichlasomatini (Teleostei: Cich-

lidae) based on morphological and molecular data, with the description of a new genus. – Journal of Zoological Systematics and Evolutionary Research, **47**: 234 – 247.

Ottoni, F.P., Bragança, P.H.N., Amorim, P.F. & Gama, C.S. (2012): A new species of *Laetacara* from the northern Brazil coastal floodplains (Teleostei: Cichlidae). – Vertebrate Zoology, **62**: 181 – 188.

Ottoni, F.P. & Costa, W.J.E.M. (2009): Description of a new species of *Laetacara* Kullander, 1986 from central Brazil and re-description of *Laetacara dorsigera* (Heckel, 1840). – Vertebrate Zoology, **59**: 41 – 48.

Ottoni, F.P., Lezama, A.Q., Triques, M.L., Fragoso-Moura, E.N., Lucas, C.C.T. & Barbosa, F.A.R. (2011): *Australoheros perdi*, new species (Teleostei: Labroidei: Cichlidae) from the lacustrine region of the Doce River Valley, southeastern Brazil, with biological informations. – Vertebrate Zoology, **61**: 137 – 145.

Palumbi, S., Martin, A.P., Romano, S., McMillan, W.O., Stice, L. & Grabowski, G. (1991): The Simple Fool's Guide to PCR: Version 2.0. University of Hawaii Press, Honolulu. 94 pp.

Posada, D. (2008): jModelTest: phylogenetic model averaging. – Molecular Biology and Evolution, **25**: 1253 – 1256.

Rambaut, A. (2009): FigTree: Tree figure drawing tool. Version 1.2.2.Institute of Evolutionary Biology, University of Edinburgh.

Rambaut, A., Suchard, M.A., Xie, D. & Drummond, A.J. (2013): Tracer v1.5, Available from http://beast.bio.ed.ac.uk/Trace.

Ribeiro, M.A. (1918): Historia Natural. Zoologia. Cichlidae. – In: Commissão de Linhas Telegraphicas e Estrategicas de Matto-Grosso ao Amazonas. Publ. 46 (Annexo 5): 1 – 8, Pls. 1 – 16.

Römer, U. (2006): Cichlid Atlas. Mergus, Melle, vol. 2, 1319 pp.

Ronquist, F., Teslenko, M., VanDermark, P., Ayres, D. & Sowford, D. (2002): PAUP* Phylogenetic Analysis Using Parsimony (* and other methods). Version 4. – Sinauer Associates, Sunderland, Massachusetts.

Smith, W.L., Chakrabarty, P. & Sparks, J.S. (2008): Phylogeny, Taxonomy and Evolution of Neotropical Cichlids (Teleostei: Cichlidae: Cichlinae). – Cladistics, **24**: 1 – 17.

Staeck, W. (2012): *Nannacara* of French Guiana. – Aquarium International, **2**: 13 – 24.

Staeck, W. & Schindler, I. (2007): Description of *Laetacara fulvipinnis* sp. n. (Teleostei: Perciformes: Cichlidae) from the upper drainages of the rio Orinoco and rio Negro in Venezuela. – Vertebrate Zoology, **57** (1): 63 – 71.

Steele, S.E., Liverpool, E. & López-Fernández, H. (2013): *Krobia petitella*, a new species of cichlid fish from the Berbice River in Guyana (Teleostei: Cichlidae). – Zootaxa, **3693**: 152 – 162.

Tamura, K., Peterson, D., Peterson, N., Stecher, G., Nei, M. & Kumar, S. (2011): MEGA5: Molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. – Molecular Biology and Evolution, **28**: 2731 – 2739.

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.

Zwickl, D.J. (2006): Genetic algorithm approaches for the phylogenetic analysis of large biological sequence datasets under the maximum likelihood criterion. – Ph.D. dissertation, The University of Texas, Austin.