



## Healing nomenclature: making the names *Australoheros mboapari* and *Australoheros ricani* available (Teleostei: Cichlidae)

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A close analysis of a publication effort by the authors of the present paper suggests that they need to issue a clarification to avoid confusion about the nomenclatural status of two species in the genus *Australoheros*, also known as chanchitos ('piglets').

Zoological nomenclature, as is clear from successive editions of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999) as amended in 2012: hereafter, the Code), and its antecedent conventions, has traditionally relied on evidence of printing and distribution of publications on paper to establish zoological names (i.e., to make them 'available'). This changed with amendments to the Code, which allowed for electronic publishing from 1 January 2012 (International Commission on Zoological Nomenclature 2012). The amendments allow journals and individuals to validly publish descriptions of new taxa without the need for paper copies but with specific requirements for archiving and registration. In practice, this allows the paperless ('electronic') publication of papers, usually issued in the Portable Document Format (PDF), specifically the standard for archiving (PDF/A). This option comes with requirements to ensure that publications are properly archived and also registered in the Official Registry of Zoological Nomenclature (ZooBank; [zoobank.org](http://zoobank.org)).

Most biological journals that publish systematics papers have developed routines for compliance with the amendments; those specialised in descriptive zoological taxonomy also published the amendments themselves, e.g., *Zootaxa* (Zhang, Z.-Q. 2012) and *Zookeys* (International Commission on Zoological Nomenclature 2012). From the requirements of the amendments, it follows that periodicals can in practice produce electronic publications that fulfill the requirements, particularly that of an archival repository. Thus, Code-compliant journals have developed streamlined procedures for publications containing nomenclatural acts.

Our initially 200-page long manuscript 'Conjectures and refutations: species diversity and phylogeny of *Australoheros* from coastal rivers of southern South America', which included two new-species descriptions, was published as Lucena *et al.* (2022), but without ZooBank registration. These two new zoological species names are thus unavailable. The relevant Code articles violated are:

'8.5. Works issued and distributed electronically. To be considered published, a work issued and distributed electronically must—' ...

'8.5.2. state the date of publication in the work itself, and

'8.5.3. be registered in the *Official Register of Zoological Nomenclature* (ZooBank) (see Article 78.2.4) and contain evidence in the work itself that such registration has occurred.'

'8.5.3.1. The entry in the *Official Register of Zoological Nomenclature* must give the name and Internet address of an organization other than the publisher that is intended to permanently archive the work in a manner that preserves the content and layout and is capable of doing so. This information is not required to appear in the work itself.'

We communicated the issue of non-registration to the publisher of Lucena *et al.* (2022) on 16 December 2022 with a request for action. There has, however, been no response from the publisher. Therefore, we here publish these two names in conformity with the Code, especially Recommendation 8D: ‘Content immutable. The content of a work is immutable once it is published. Corrections should be made through notices of errata or other separate publications. Second or other additional printings of a work should be clearly labelled as such, with date of publication stated in the work’.

We also take this opportunity to correct some errors relating to the two names, though excluding corrections of formatting and other items that are the responsibility of the original publisher. For the mentioned reasons, nomenclatural acts in Lucena *et al.* (2022) fail availability. There are only two such acts covered by the Code: the names ‘*Australoheros mboapari*’ and ‘*Australoheros ricani*’. Below we provide Code-compliant definitions of those two species, which then become their original descriptions. The discriminating morphological characters and detailed type series of each species are those given here. The detailed descriptive and genetic data for each are as published under the respective name in Lucena *et al.* (2022). The species concept and the group of authors too, remain the same as in Lucena *et al.* (2022). The type series are deposited in the fish collections of the Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP) and Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS), Brazil.

### **Australoheros mboapari, new species**

‘*Australoheros mboapari*’, Lucena, Kullander, Norén & Calegari, 2022:97; also as mbapoari; name unavailable owing to Lucena *et al.* (2022) having not been registered in ZooBank.

**Definition.** Based on the morphology of adult specimens in the type series, including unique concealed or absent cheek squamation and the combination of character states in colouration, squamation, fin shape, and vertebrae count shared only with *A. tembe*, *A. forquilha*, and *A. ricani*, *Australoheros mboapari* is hypothesised to be a distinct evolutionary lineage.

*Australoheros mboapari* can be distinguished from all other species of *Australoheros* by absence of scales from all or lower half of cheek, or present deeply embedded (vs exposed in thin skin layer or with free margins and covering cheek). *Australoheros mbapoari* shares with *A. forquilha*, *A. ricani*, *A. tembe*, and *A. ykeregua* a row of minute scales along base of dorsal fin reaching anteriorly to or almost to anterior insertion of dorsal fin (vs scale layer ending at middle or more posterior position along dorsal-fin base); with *A. ricani* black soft dorsal fin in adult females (vs soft dorsal fin light). *Australoheros mboapari* differs from all other species of *Australoheros* except for *A. forquilha*, *A. tembe*, and *A. ykeregua* by absence of abbreviated dorsal portions of bars 5–6 anterodorsally on flank; prepelvic scales deeply embedded (vs with free margins); caudal fin subtruncate (vs rounded); broad pelvic-fin tip with first and second rays subequal in length (vs first ray longest) (first may be longer also in *A. ykeregua*); from all except for *A. forquilha*, *A. kaaygua*, *A. tembe*, and *A. ykeregua* by deep lachrymal bone).

**Holotype.** MCP 49000, adult male, 101.7 mm SL; Brazil: Rio Grande do Sul: Antônio Prado: Rio Taquari drainage, Quaresma, close to the Rio das Antas, 28°52'46"S 51°19'12"W; J.D. Latini *et al.*, Oct. 2003.

**Paratypes.** All from Brazil, Rio Grande do Sul, Rio Taquari drainage: MCP 23044,47, 17.2–90.4 mm SL; Antônio Prado: Rio Toro, on the road from Vila Flores to Antônio Prado, 28°52'19"S 51°26'57"W; R.E. Reis, J.F. Pezzi and E.H.L. Pereira, 21 Jan. 1999.—MCP 33554, 4, 81.1–95.6 mm SL; Nova Roma do Sul: Arroio do Carma, near mouth in Rio das Antas, 28°58'93"S 51°23'12"W; J.D. Latini *et al.*, 2003.—MCP 33639, 1, 97.3 mm SL; Santa Bárbara: Rio das Antas close to mouth of Rio Carreiro, 29°5'29"S. 51°42'42"W; J.D. Latini *et al.*, 28 Sept. 2002. —MCP 33659, 7, 65.7–84.8 mm SL; Same data as holotype.—MCP 34988, 4, 62.1–77.5 mm SL; Brazil: Antônio Prado: Rio Ituim at Cachoeira do Saltinho, tributary of the Rio Turvo, 28°37'S 51°23"W; A.R. Cardoso and V.A. Bertaco, 6 Mar. 2004.—MCP 40953, 3, 56.0–97.3 mm SL; Veranópolis: Rio da Prata, tributary of the Rio das Antas, 28°58'16"S 51°27'20"W; J.D. Latini, V.A. Capatti, and S. Rodrigues, Nov 2005.—MCP 44382. 2, 78.5–87.2 mm SL. Veranópolis: mouth of the Rio Pratinha, 28°56'00"S 51°27'59"W; J.F. Pezzi, 14 Jan. 2007.—MCP 47552, 1, 106.2 mm SL; Nova Roma do Sul: Rio da Prata, tributary of the Rio das Antas, 28°58'15"S 51°27'20"W; J. D. Latini *et al.*, Oct 2011. – UFRGS 9688, 23 (3, 92.5–107.9 mm SL; 20, 21.3–36.1 mm SL); Dois Lajeados: Rio Carreiro above PCH Linha Emília, 28°56'24"S 51°46'47"W; J. Ferrer and G. Frainer, 17 Jan 2008.—UFRGS 13184. 2, 46.5–48.1 mm SL; Muitos Capões: Rio Taquari drainage: Rio Ituim at PCH Saltinho, 28°37'09"S 51°21'14"W; J. Anza and G. Frainer, 22 Mar. 2010.

**Explanation of name.** The specific name is a noun in apposition, referring to the geographical distribution of the species, the Rio das Antas, which was previously known as Mboapari.

### *Australoheros ricani*, new species

'*Australoheros ricani*', Lucena, Kullander, Norén & Calegari, 2022:103; name unavailable owing to Lucena *et al.* (2022) having not been registered in ZooBank.

**Definition.** Based on observation of the morphology of adults in the type series, the position in the phylogenetic trees based on *mt-cyb* and *mt-coI*, and more than 3% divergence in minimum uncorrected *p*-distance from other species of *Australoheros* (Lucena *et al.* 2022), *A. ricani* is a distinct evolutionary lineage. No morphological autapomorphy is registered. Specimens of *A. ricani* share with *A. mboapari*, *A. forquilha*, and *A. ykeregua* a row of minute scales along the dorsal-fin base extending cephalad to close to anterior insertion of dorsal fin (fourth dorsal-fin spine), and with *A. mboapari* a black soft dorsal fin in females (vs dorsal fin black throughout, or with black blotches at intervals). It is distinguished from *A. mboapari* by 3–5 rows of scales on cheek, exposed or discernible beneath skin cover.

**Holotype.** UFRGS 28500, adult female, 75.5 mm SL; Brazil: Rio Grande do Sul, Rio Jacuí drainage: Espumoso: Rio Morcego, tributary of the Rio Jaquí-mirim; 28°53'55"S 52°49'0.5"W; K. Bonato and R. Dala-Corte, 18 Dec. 2012.

**Paratypes.** All from Brazil: Rio Grande do Sul, upper Rio Jacuí drainage. Rio Jacuí-mirim: MCP 22779, 1, 109.9 mm SL; Santa Bárbara do Sul: Arroio das Figueiras, on road from Cruz Alta to Saldanha, 28°26'39"S 53°12'37"W; R.E. Reis, E.H.L. Pereira and V.A. Bertaco, 2 Apr. 1999.—Espumoso: Rio Morcego, MCP 50427, 2, DNA only, Rio Morcego, local road between Espumoso and Soledade, 28° 53'55.0"S 52° 49'05.0"W; T. Carvalho, R. Angrizani, and J. Chuctaya, 12 Oct. 2016.—Mormaço: Rio Quati, 28°38'52"S 52°37'11"W: UFRGS 22015, 1 juv.; K.O. Bonato, P.C. Silva, C. Hartmann, and A. Langoni, 26 Aug. 2012—UFRGS 22016, 4 juvs; K.O. Bonato, J. Wingert, L.G. Artioli, 27 Aug. 2012.—UFRGS 22020, 3, 20.9–56.9 mm SL; K.O. Bonato, A. Hirschmann, A. Hartmann and A. Langoni, 20 Apr. 2013.—UFRGS 22026, 4, 27.4–90.7 mm SL; UFRGS 22028, 4, 39.8–77.3 mm SL; K. Bonato, N. Bertier, A. Hirschmann, 21 June 2012.—UFRGS 22036, 4, 22.6–92.0 mm SL; K. Bonato, N. Bertier, A. Hirschmann, 19 Oct. 2012.—UFRGS 22037, 4: 41.1–76.6 mm SL; K. Bonato, N. Bertier, A. Hirschmann, 19 Dec. 2012.—Espumoso: Rio Morcego, 28°53'55"S 52°49'0.5"W: UFRGS 19968, 11, 4 measured, 22.4–84.9 mm SL; K.O. Bonato, J. Ferrer, C. Voguel and L. Cavalheiro, 19 June 2012.—UFRGS 22027, 8, 14.0–81.6 mm SL, K. Bonato, A. Hirschmann, C. Hartmann and S. Langoni, 20 Apr. 2013.—UFRGS 22029, 9, 19.5–100.9 mm SL; K.O. Bonato, P.C. Silva, C. Hartmann and A. Langoni, 27 June 2013.—UFRGS 22033, 4, 24.1–29.8 mm SL; K.O. Bonato, J. Wingert, and L.G. Artioli, 24 Aug. 2012—UFRGS 22038, 3, 29.2–72.5 mm SL; K.O. Bonato, N. Bertier and A. Hirschmann, 18 Oct. 2012.—UFRGS 22039, 4, 37.3–73.2 mm SL; K. Bonato, and R. Dala-Corte, 18 Dec. 2012—UFRGS 22040, 15, 13.7–64.9 mm SL; K.O. Bonato and J. Ferrer, 22 Feb 2013.—Espumoso, Rio Turvo, 28°43'47"S 52°47'40.4"W: UFRGS 22017, 54.7–63.7 mm SL; K.O. Bonato, and R. Dala-Corte, 17 Dec. 2012.—UFRGS 22019, 1, 51.0 mm SL; K.O. Bonato, A. Hirschmann, A. Hartmann, and A. Langoni, 19 Apr. 2013.—UFRGS 22025, 3, 57.8–68.3 mm SL; K.O. Bonato, J. Ferrer, N. Bertier and A. Hirschmann, 29 Oct. 2012.—UFRGS 22032, 1 juv.; K.O. Bonato, J. Wingert and L.G. Artioli, 26 Aug. 2012.—UFRGS 22034, 2 juvs; K.O. Bonato, N. Bertier, and A. Hirschmann, 29 Oct. 2012.—Espumoso, Rio Turvo, 28°43'S 52°47"W: UFRGS 22021, 2 juvs; K.O. Bonato, J. Ferrer and C. Voguel, 29 June 2012.

**Explanation of specific name.** Oldřich Říčan, University of South Bohemia, was the first to recognise *Australoheros* species richness, and made the pioneering analyses, discovering and highlighting the phylogeny and species richness of inland species of *Australoheros*. The specific name is a noun in the genitive case.

**Comparative data for *Australoheros mboapari* and *Australoheros ricani*.** In the Rio Jacuí drainage, *Australoheros mboapari* is most similar to the geographically adjacent *A. ricani*, e.g., in the long row of minute scales along the dorsal-fin base, and absent or indistinct caudal spot. The rare number of five anal-fin spines is recorded from both species. Non-parametric comparison of counts showed that they are distinct (Mann-Whitney U test,  $p=0.000–0.001$ ) in overlapping number of anal-fin spines (modally five in *A. ricani*, six in *A. mboapari*), dorsal-fin spines (modally 15 in *A. ricani*, 16 in *A. mboapari*), E1 scales, upper and lower lateral line scales, but not in number of soft dorsal- and anal-fin rays, or pectoral-fin rays (Lucena *et al.* 2022). *Australoheros mboapari* has the highest number of E1 scales recorded in the genus, modally 26, occasionally 27. Twenty-six E1 scales are frequent also in *A. forquilha* and *A. ricani*. *Australoheros mboapari* differs from *A. ricani* in slopes on SL of preorbital depth, lower jaw length, head width, pectoral-fin length, and length of last dorsal-fin spine (ANOVA  $p < 0.05$ ), and on intercept on head length, snout length, orbital diameter, interorbital width, and upper jaw length (ANCOVA,  $p < 0.05$ ) (Lucena *et al.* 2022). The slight difference in jaw lengths shows in the proportional measurements, (Lucena *et al.* 2022: figs 13–16, where the size ranges are reasonably comparable), *A. mboapari* has slightly shorter upper jaw (8.8–10.9 %SL (vs 10.2–11.5 in *A. ricani*), and lower jaw (11.7–14.2%SL vs 13.1–15.7% in *A. ricani*). *Australoheros mboapari* has deeper preorbital than the other coastal *Australoheros* except for *A. acaroides* (Lucena *et al.* 2022: tables 3–16). This character, however, is positively allometric, and only extremely large specimens of *A. acaroides* have a deep lachrymal bone (Lucena *et al.* 2022).

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