

SHORTER COMMUNICATIONS

Journal of Herpetology, Vol. 43, No. 4, pp. 685–687, 2009
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Pseudopaludicola mirandae Mercadal de Barrio and Barrio, 1994 (Anura, Leiuperidae) Is a Junior Synonym of *Pseudopaludicola boliviana* Parker, 1927

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ABSTRACT.—*Pseudopaludicola* are small diurnal leiuperid frogs that are recognized by a hemispherical tubercle on their forearms. Members of this genus are broadly distributed over northern and central South America with 12 species currently recognized. *Pseudopaludicola mirandae* was described from six individuals and discriminated from *Pseudopaludicola boliviana* based solely on putative differences in head width. We reexamined the type series of *P. mirandae* and a large series (including topotypes) of *P. boliviana*. We show broadly overlapping ranges in the ratio of head length/width between *P. boliviana* and *P. mirandae*. Also, both taxa share a character state (a tubercle on the heel) that was previously considered autapomorphic for *P. boliviana*. Additionally, we document a number of omissions and errors in the original description of *P. mirandae* including comparisons with *P. boliviana*. Our analyses provide evidence suggesting that *P. mirandae* is a junior synonym of *P. boliviana*.

RESUMEN.—*Pseudopaludicola* comprende pequeñas ranas Leiuperidae que se reconocen por la presencia de un tubérculo en los antebrazos. Los miembros de este género están ampliamente distribuidos en el Norte y Centro de Sudamérica con 12 especies actualmente reconocidas. *Pseudopaludicola mirandae* fue descrita a partir de seis individuos y discriminada de *Pseudopaludicola boliviana* en base a presuntas diferencias en el ancho de la cabeza. Nosotros reexaminamos la serie tipo de *P. mirandae* junto a una gran muestra de *P. boliviana* (incluyendo material topotípico). Notamos que a diferencia de lo descrito para *P. mirandae*, encontramos rangos ampliamente solapados en la relación largo : ancho de la cabeza entre ésta y *P. boliviana*. Además, *P. mirandae* y *P. boliviana* muestran el mismo estado de carácter (un tubérculo del talón) el cuál fue previamente considerado como autopomórfico para *P. boliviana*. Adicionalmente se listan errores y omisiones durante la descripción original de *P. mirandae* y en su comparación con *P. boliviana*. Nuestro análisis provee evidencia de que *P. mirandae* es un sinónimo junior de *P. boliviana*.

Pseudopaludicola is a genus of small bodied (<25 mm snout-vent length), diurnal leiuperid frogs with an undivided sternum, no vomerine teeth, and one or more hemispherical tubercles on each forearm (Miranda-Ribeiro, 1926). Members of this genus are widely distributed over northern and central South America (Colombia, Venezuela, Guyana, Surinam, Perú, Bolivia, Paraguay, Brazil, Argentina and Uruguay) with 12 species currently recognized (Frost, 2008).

Pseudopaludicola mirandae was described by Mercadal de Barrio and Barrio (1994) based on six individuals collected in Itá Ibaté, Corrientes province, Argentina. This taxon was discriminated from *Pseudopaludicola boliviana* by quantitatively comparing 10 specimens of *P. boliviana* from two Argentine provinces, with the six specimens of the type series. The diagnosis of *P. mirandae* was supported by a statistical difference between the two species in the cephalic index; CI: head length/width, Mercadal de Barrio and Barrio (1994).

The purpose of our study was to reexamine the type material of *P. mirandae* and, using data from a large sample of specimens, to reassess the status of this species based on the single character used to discriminate it from *P. boliviana*.

MATERIALS AND METHODS

We examined 114 preserved adults and nine freshly captured specimens of *P. boliviana* including samples from Santa Cruz de la Sierra, Bolivia (type locality of *P. boliviana*), and Itá Ibaté, Corrientes Province, Argentina (type locality of *P. mirandae*), held in five collections to document the morphological variation of *P. boliviana* across its known distribution and the six exemplars assigned to *P. mirandae* from the type locality (Appendix 1). Specimens were examined under a dissecting microscope (10–40 ×), and measurements were taken with digital calipers (± 0.01 mm). Included in our analyses are measurements of the same characters studied in the original description of *P. mirandae*. For comparative purposes, head measurements were taken following Mercadal de Barrio and Barrio (1994), from the corner of jaw to tip of snout. We measured 108 *P. boliviana* specimens and recorded their cephalic index. We show frequency distribution of CIs for both species (creating CIs ranges from the minimal 0.71–1.00 superimposing the CI-values of the type series of *P. mirandae*). We also made two, two-day fieldtrips in austral spring and early fall (29 September 2006 and 30 March 2007, respectively) to the type locality of *P. mirandae*.

RESULTS AND DISCUSSION

Although *P. mirandae* has not been previously assigned to a species group, the presence of terminally expanded toe discs are mentioned in the diagnosis (Mercadal de Barrio and Barrio, 1994). This character

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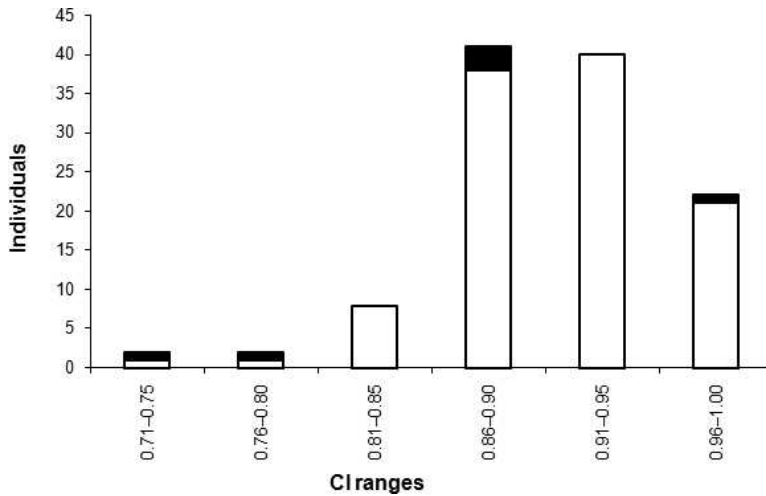


FIG. 1. CIs frequency distribution of *Pseudopaludicola boliviana* versus *Pseudopaludicola mirandae*. White: *P. boliviana*; Black: *P. mirandae*.

state is shared by members of the *Pseudopaludicola pusilla* species group (Parker, 1927; Lynch, 1989; Lobo, 1995). The only species belonging to the *P. pusilla* group in southern South America is *P. boliviana* (Lynch, 1989; Lobo, 1995; Frost, 2008). Lobo (1995) described a tubercle on the heel of *P. boliviana*, which he considered an autapomorphy for this species. This tubercle is also present on the holotype (CENAI 6043) and all the paratypes of *P. mirandae*.

The cephalic indices that Mercadal de Barrio and Barrio (1994) used to differentiate *P. mirandae* from *P. boliviana* were based on their comparison of the type series of *P. mirandae* ($N = 6$) and of *P. boliviana* ($N = 10$). First, we compared Mercadal de Barrio and Barrio's (1994) original measurements of the holotype (CENAI 6043) of *P. mirandae* to data we collected on the same specimen to demonstrate that their measurements are reproducible (our data are in parentheses following their data), except for the length of the head: total length 13.8 mm (13.87 mm); length of foot: 10.8 mm (10.86 mm); length of tibia 7.4 mm (7.41 mm); width of the head 4.7 mm (4.66 mm); length of the head 2.9 mm (3.51 mm). To ensure that our measurement of the head length of the holotype was not in error, we let another investigator take the same measurement, resulting nearly identical ($\pm 1\%$) to the one taken by us. Thus, the head length of the holotype of *P. mirandae* is approximately 21% longer than reported by Mercadal de Barrio and Barrio (1994).

Mercadal de Barrio and Barrio's (1994) cephalic index (CI) data are presented as means and standard deviations for the samples of *P. mirandae* and *P. boliviana* that they studied (raw data are reported only for the holotype). Unfortunately, we were unable to remeasure all the specimens of *P. boliviana* studied by Mercadal de Barrio and Barrio (1994), because MACN 31453–31463 are considered lost. Nevertheless, we examined more than 100 specimens of *P. boliviana*, including CENAI 9241–9243, which were used in the comparison between *P. mirandae* and *P. boliviana*. Our CI values (means \pm SD) average 34% larger than the

data in the type description of *P. mirandae*: 0.86 ± 0.08 versus 0.57 ± 0.0075 .

As demonstrated above, the cephalic index is not useful for diagnosing *P. mirandae* from *P. boliviana*. Not only are the original comparisons based on small sample sizes ($N = 6$ for *P. mirandae* vs. $N = 10$ for *P. boliviana*), but we show that the ranges of the CIs are overlapping for *P. mirandae* and *P. boliviana* (Fig. 1). Mercadal de Barrio and Barrio (1994) note that they used only 10 *P. boliviana* in their comparisons because no other specimens were available to them. However, in the "Specimens Examined" section, Mercadal de Barrio and Barrio (1994) list 13 *P. boliviana*, yet three *P. boliviana* specimens are not included in the comparison with *P. mirandae*, although the vouchers CENAI 9244–9246 are in the same lot as CENAI 9241–9243. We also note that MACN 27153 and 27162 were misidentified as *Pseudopaludicola falcipes* by Mercadal de Barrio and Barrio (1994) and are here assigned to *P. boliviana*, as are two other specimens (CENAI 6019, 6030), which were collected at the type locality of *P. mirandae* on the same date and by the same collector, but not mentioned in the diagnosis or in Mercadal de Barrio and Barrio's (1994) comparisons with *P. boliviana*.

Collectively, based on our morphological comparisons (in particular CI ratio and the presence of a tubercle on the heel shared by all samples) and field evidence, we conclude that *P. mirandae* is a junior synonym of *P. boliviana*.

Acknowledgments.—We thank J. Faivovich (MACN), who allowed us to examine the types of *P. mirandae*; B. Blotto for his assistance during our lab work at the MACN; and D. Baldo, M. Pereyra, E. Castillo, L. Cotichelli, S. Valdecantos, S. Quinteros, and J. Boris for their help during our field and lab research. J. Williams and D. Ferraro (MLP), R. Heyer (USNM), D. Frost, and L. Ford (AMNH) allowed us to study collections under their care. We are grateful to R. Espinoza for help with statistics, reviewing the manuscript, and correcting our English.

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- Accepted: 15 January 2009.

APPENDIX 1

Specimens Examined

Institutional abbreviations follow Leviton et al. (1985) with the addition of 25 vouchers from CENAI (not in Leviton et al., 1985), which are deposited in MACN, and nine vouchers at Museo de La Plata

(MLP-DB). Some specimen numbers represent lots of more than one specimen. In those cases, the number of specimens examined in the lot is indicated with a number in brackets.

Pseudopaludicola boliviana: ARGENTINA: Chaco Province: Departamento Bermejo, Gral. Vedia CENAI 9241–9246, Isla del Cerrito MACN 38522–38527; Departamento San Fernando, Antequera, Resistencia MLP-DB 1258, 4617, 5614, Reserva Benitez, Resistencia FML 2665; Departamento Comandante Fernandez, Roque Saenz Peña FML 4307 [23], 4316, 4337; Departamento General Güemes, J. J. Castelli proximidades de Puerto Lavalle FML 367. Corrientes Province: Departamento Ituzaingó: Itá Ibaté MLP-DB 5186–5189, 5633, 5646, CENAI 6019, 6030. Formosa Province: Departamento Laishi, Reserva El Bagual FML 648, 2205, 2665, 3670, 4316 [2], 4317 [5], 4337, 4876, 10608, 10660, 11656–11657, 12291, 12294, 12374, 13278, 13778, 13937, 13957, 14004, 15220, 15237, 15242, 15263, 15265, 15415, 15445, 15580, 15593. Departamento Pilcomayo, Alrededores de Clorinda MACN 38528. Santa Fé Province: Departamento De Garay, Cayastá, MACN 4999 (27153–27162); Departamento General Obligado, entre Reconquista and Puerto Reconquista FML 4876. BOLIVIA: Departamento La Paz: Ixiamas USNM 11860. Departamento Santa Cruz de la Sierra: Nueva Moka CENAI 9353–9362; Reyes CENAI 10841–10847. Departamento El Beni: Estancia San Miguel, 200 km north of Trinidad MACN 5142 (28061–28065). Reserva Biosfera Beni, entre El Porvenir and El Trapiche, Yacuma USNM 306623–306625. GUYANA: Isheartun AMNH-A 70116, 149051–149054, Southern Rupununi Savanna Aishalton, on Kubanawau Creek AMNH-A 139182–139185. VENEZUELA: Amazonas, Santa Bárbara, intersection of Río Orinoco and Río Ventuari AMNH-A 100615, 100617–100618, 100622.

Pseudopaludicola mirandae (junior synonym of *P. boliviana*): ARGENTINA: Corrientes Province: Departamento Ituzaingó: Itá Ibaté CENAI 6043 (holotype), 6020, 6036, 6061, 6195, 6456 (paratypes).