



## On the identity of *Bufo diptychus* Cope, 1862 (Anura: Bufonidae)

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### Abstract

The enigmatic toad *Bufo diptychus* was described by Cope (1862) based on a single individual (USNM 5841, now lost) of about 25 mm of SVL, collected during the expedition to La Plata River and tributaries, conducted by Captain Page between 1853 and 1856. As no dwarf species of toad was ever recorded in the surveyed area, and based on some tips that arise from Page's narrative, we postulate that the description was based on a toadlet. With this hypothesis in mind, we compared Cope's characterization of *B. diptychus* with juveniles of all species of *Rhinella* present in the region, finding an exact match in almost all characters shown by the juveniles of the common "cururú" or "rococo" toad, *Rhinella schneideri* (Werner 1894). Henceforth, we postulate that *R. schneideri* is a junior synonym of *B. diptychus*, under the combination *Rhinella diptycha* (Cope 1862).

**Key words:** Bufonidae, *Rhinella diptycha*, *Rhinella schneideri*, synonymy

### Introduction

On August 28, 1852, only five months after the Battle of Caseros, Justo José de Urquiza, then the Provisional Director of the Argentina Confederation, promulgated a Decree that freed the navigation of the rivers of the country to all the flags of the world, and on October 3 of the same year enacted a second one, in which the tonnage limit established in the preceding was removed (Muñoz Moraleda 1983). This threw away the long history of nationalism and protectionism supported by Juan Manuel de Rosas, and opened the doors of the Rio de la Plata to the imperial and neo-imperial powers. On May 24, 1853, it arrived at the harbor of Buenos Aires the first foreign warship that would use the franchise offered by the decrees. This was the Water Witch, a side-wheel steamer of 400 tons, which under the orders of the government of the United States would explore, between 1853 and 1856, the La Plata river basin from Buenos Aires (Argentina) to Corumbá. (Brazil), plus neighboring regions of Argentina, Brazil, Paraguay and Uruguay (Page 1856; 1859).

The Water Witch was commanded by Captain Thomas J. Page, and officially had the task of making the general hydrographic survey of the vast La Plata basin, which until then was all but ignored, since the only positive data were from the colonial era and few information raised from the Parana and Paraguay rivers by British and French sailors during the blockade of 1841. As stated in the documents available (*i.a.* Page 1856; 1859), on the ship there were no scientists, but zoological and botanical collections were made, in addition to the hydrographic and astronomical observations. Back in the United States, Page drafted a preliminary report of the findings, which was released in 1856, including an annex drafted on November 25, 1856 by Charles Girard, which mentions that in the samples he had not seen any frog but other "tree frogs and tree-toads", as well as "toads properly so called", of which there were "several kinds" (Page 1856: 38; reprinted as Appendix K in Page 1859: 603). Later, the material collected during the survey was formally described by Cope (1862), including *Bufo diptychus* among the new species.

*Bufo diptychus* Cope, 1862 is one of the most intriguing toads from southern South America. The species was described based on one individual, "Nº 5841", without an explicit mention of its depository collection, although at some-time in the past it was housed at the United States National Museum (USNM), according to catalogue records

(the same that indicates that this individual is currently lost). In the original description there is no indication of the type locality, and as the material was collected during the expedition commanded by Thomas Page to southern South America (see Page, 1859 for the itinerary), subsequent authors attributed this taxon to the faunas of Paraguay, Argentina, Brazil, Uruguay, and even Peru and Surinam (see Discussion).

Furthermore, Cope's (1862) description of *Bufo diptychus* was based on one specimen of one inch length, "from the muzzle to the vent". This information clearly indicates that the voucher specimen was a juvenile, because, to our knowledge, there are no species of dwarf toads in the territory covered by Page's expedition. Therefore, the purpose of this contribution is to attribute, in a reliable way, the name *Bufo diptychus* Cope, 1862 to an extant species of the area covered by the U.S.S. Water Witch survey.

## Material and methods

The main collection points of the expedition were identified based on Page's (1856, 1859) publications, and the original description of *Rhinella diptycha* (Cope 1862: 353) was compared with juvenile specimens of comparable body size (snout-vent length of one inch; Cope 1862) of all *Rhinella* species known from the collection points.

Morphological comparisons included the structures cited by Cope in the original description, in terms of presence/absence, position, shape, size relative to other structures, and color pattern. Terminology for cephalic ridges follows Gallardo (1965) and Narvaes & Trefaut (2009). The studied material is housed in the herpetological collections of the Museo Nacional de Historia Natural del Paraguay (MNHNP), the Instituto de Investigación Biológica del Paraguay (IIBP-H), and Naturhistorisches Museum, Basel, Switzerland (NHMB; see the type-catalog at <https://www.nmbs.ch/home/museum/sammlungen/biowissenschaftlich/typenkataloge/amphibien.html>). We measured the snout-vent length (SVL) using a digital caliper (0.1 mm). Examined material with locality details and SVL are in Table 1.

## Results

### 1. The type locality

Capt. Page's expedition covered an immense territory (about 3600 miles by river and 4400 miles by land (Page 1859; Spence Robertson 1923), exploring the Paraná and Paraguay rivers up to Corumbá, in Brazil. The most important collection points were La Paz, Corrientes, Albuquerque and Fort Coimbra, in the Argentine Confederation, and Asunción and Salvador in Paraguay. On the return, an expedition ascended 120 miles the Bermejo River, and other, by land, explored the Iquibe Island in Paraguay. Subsequently, Page went to Santiago del Estero and Tucumán, and also ascended the Uruguay river, up to Salto Grande. Of these set of collection points mentioned by Cope (1862), the locality of "Salvador", Paraguay, is of paramount importance. In fact, Page (1856) wrote in the entrance corresponding to November 16<sup>th</sup> of his narrative (p. 143): "*Salvador, in latitude 22°48'45" south, longitude 57° 54'33" west, has about one thousand inhabitants, and is, by the course of the river, seventy miles from Concepción...*", and on p. 146 stated: "*...Although little accustomed to trade, we found the people quite ready to dispose of any article for cash. I employed a boy to procure reptiles, and for this purpose gave him two large specimen-jars half filled with caña, charging him to omit no species, however common in the country. He soon returned with a quantity of diminutive toads, enough to have stocked every collection in the United States...*" This is the only mention of a toad in Page narrative, and we postulate that this anecdote testifies the day and place where the toadlet later described as *B. diptychus* by Cope was collected.

The locality, known today as San Salvador, on the Concepción bank of the Paraguay River, is located about 75 km NW in straight line from Concepción city, the departmental capital, and about 240 km N from Asunción. Available information (i.e., Brusquetti & Lavilla 2006; Weiler *et al.* 2013) indicates the presence of six species of the genus *Rhinella* in Concepción and Presidente Hayes Departments, near the Paraguay River: *Rhinella azarai* (Gallardo 1965), *R. bergi* (Céspedes 2000), *R. fernandezae* (Gallardo 1957), *R. major* (Müller & Hellmich 1936), *R. schneideri* (Werner 1894), and *R. scitula* (Caramaschi & Niemeyer 2003) that could be present in the area of San Salvador.

**TABLE 1.** Specimens analyzed with their respective localities and snout-vent length (SVL). Abbreviations: P. N., Parque Nacional (National Park); R. N., Reserva Natural (Natural Reserve).

Species	ID	Locality	SVL (mm)
<i>Rhinella azarai</i>	MNHNP 8782	Paraguay, Itapúa, P. N. San Rafael, San Pedro-mi.	33.9
<i>Rhinella bergi</i>	MNHNP 3256	Paraguay, Alto Paraguay, Potrerito.	27.0
<i>Rhinella bergi</i>	MNHNP 9072	Paraguay, Presidente Hayes, General Briguez.	30.2
<i>Rhinella bergi</i>	MNHNP 9075	Paraguay, Presidente Hayes, General Briguez.	25.4
<i>Rhinella bergi</i>	MNHNP 9076	Paraguay, Presidente Hayes, General Briguez.	28.1
<i>Rhinella bergi</i>	MNHNP 9078	Paraguay, Presidente Hayes, General Briguez.	23.4
<i>Rhinella bergi</i>	MNHNP 9081	Paraguay, Presidente Hayes, General Briguez.	25.1
<i>Rhinella bergi</i>	MNHNP 9082	Paraguay, Presidente Hayes, General Briguez.	21.9
<i>Rhinella bergi</i>	MNHNP 9765	Paraguay, Presidente Hayes, General Briguez.	24.3
<i>Rhinella fernandezae</i>	MNHNP 9058	Paraguay, Presidente Hayes, General Briguez.	25.6
<i>Rhinella fernandezae</i>	IIBP-H 212	Paraguay, Itapúa, 10 km NE from General Delgado city.	21.3
<i>Rhinella fernandezae</i>	IIBP-H 213	Paraguay, Itapúa, 10 km NE from General Delgado city.	24.2
<i>Rhinella fernandezae</i>	IIBP-H 216	Paraguay, Itapúa, 10 km NE from General Delgado city.	27.8
<i>Rhinella fernandezae</i>	IIBP-H 222	Paraguay, Itapúa, 10 km NE from General Delgado city.	22.3
<i>Rhinella fernandezae</i>	IIBP-H 223	Paraguay, Itapúa, 10 km NE from General Delgado city.	24.0
<i>Rhinella fernandezae</i>	IIBP-H 224	Paraguay, Itapúa, 10 km NE from General Delgado city.	26.7
<i>Rhinella fernandezae</i>	IIBP-H 225	Paraguay, Itapúa, 10 km NE from General Delgado city.	19.5
<i>Rhinella fernandezae</i>	IIBP-H 229	Paraguay, Itapúa, 10 km NE from General Delgado city.	25.4
<i>Rhinella fernandezae</i>	IIBP-H 230	Paraguay, Itapúa, 10 km NE from General Delgado city.	24.4
<i>Rhinella fernandezae</i>	IIBP-H 232	Paraguay, Itapúa, 10 km NE from General Delgado city.	21.9
<i>Rhinella fernandezae</i>	IIBP-H 233	Paraguay, Itapúa, 10 km NE from General Delgado city.	21.0
<i>Rhinella fernandezae</i>	IIBP-H 234	Paraguay, Itapúa, 10 km NE from General Delgado city.	22.1
<i>Rhinella fernandezae</i>	IIBP-H 379	Paraguay, Itapúa, 10 km NE from General Delgado city.	18.2
<i>Rhinella fernandezae</i>	IIBP-H 384	Paraguay, Itapúa, 10 km NE from General Delgado city.	17.4
<i>Rhinella fernandezae</i>	IIBP-H 654	Paraguay, Itapúa, 10 km NE from General Delgado city.	24.3
<i>Rhinella fernandezae</i>	IIBP-H 1273	Paraguay, Itapúa, 10 km NE from General Delgado city.	24.7
<i>Rhinella major</i>	MNHNP 1546	Paraguay, Boquerón, Filadelfia.	30.6
<i>Rhinella major</i>	MNHNP 5353	Paraguay, San Pedro, Villa del Rosario.	27.5
<i>Rhinella major</i>	MNHNP 7143	Paraguay, Alto Paraguay, P. N. Defensores del Chaco.	23.1
<i>Rhinella major</i>	MNHNP 7439	Paraguay, Alto Paraguay, P. N. Defensores del Chaco.	26.0
<i>Rhinella major</i>	MNHNP 7659	Paraguay, Presidente Hayes, Rancho Karandá.	20.9
<i>Rhinella major</i>	MNHNP 9747	Paraguay, Presidente Hayes, Estancia Isla Bella de Palosanto.	23.2
<i>Rhinella scitula</i>	MNHNP 6990	Paraguay, Amambay, P. N. Cerro Corá.	27.6
<i>Rhinella scitula</i>	MNHNP 9874	Paraguay, Concepción, P. N. Serranía San Luis.	25.1
<i>Rhinella scitula</i>	MNHNP 9875	Paraguay, Concepción, P. N. Serranía San Luis.	27.4
<i>Rhinella scitula</i>	IIBP-H 2137	Paraguay, Amambay, P. N. Cerro Corá.	20.0
<i>Rhinella scitula</i>	IIBP-H 2138	Paraguay, Amambay, P. N. Cerro Corá.	17.8
<i>Rhinella scitula</i>	IIBP-H 2575	Paraguay, Concepción, R. N. Cerrados del Tagatiya.	18.9
<i>Rhinella scitula</i>	IIBP-H 2576	Paraguay, Concepción, R. N. Cerrados del Tagatiya.	27.5
<i>Rhinella schneideri</i>	MNHNP 1570	Paraguay, Central, Villeta.	23.1
<i>Rhinella schneideri</i>	MNHNP 1571	Paraguay, Central, Villeta.	22.3

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TABLE 1. (Continued)

Species	ID	Locality	SVL (mm)
<i>Rhinella schneideri</i>	MNHNP 1572	Paraguay, Central, Villeta.	21.9
<i>Rhinella schneideri</i>	MNHNP 1573	Paraguay, Central, Villeta.	24.7
<i>Rhinella schneideri</i>	MNHNP 1575	Paraguay, Central, Villeta.	24.9
<i>Rhinella schneideri</i>	MNHNP 1578	Paraguay, Alto Paraguay, P. N. Defensores del Chaco.	27.9
<i>Rhinella schneideri</i>	MNHNP 1579	Paraguay, Alto Paraguay, P. N. Defensores del Chaco.	22.2
<i>Rhinella schneideri</i>	MNHNP 1580	Paraguay, Alto Paraguay, P. N. Defensores del Chaco.	25.6
<i>Rhinella schneideri</i>	MNHNP 1590	Paraguay, Presidente Hayes, Km 347 Transchaco Road.	20.3
<i>Rhinella schneideri</i>	MNHNP 1592	Paraguay, Presidente Hayes, Transchaco Road, Km. 97.	26.9
<i>Rhinella schneideri</i>	MNHNP 1597	Paraguay, Alto Paraguay, P. N. Defensores del Chaco.	22.8

## 2. Identification of *Bufo diptychus*

This description matches, almost word by word, with the features present in juveniles of the species currently known as *R. schneideri*. In fact, the specimen MNHNP 1573, used to illustrate the character states of the original description (Fig. 1), proves this asseveration.

Cope (1862) indicates that *Bufo diptychus* has "Cranium without longitudinal ridges (Fig. 1A, C). Canthus rostralis concave rounded; muzzle elevated, not protruding (Fig. 1C). Orbit as wide as length of muzzle anterior to it (Fig. 1C). Tympanum small, scarcely perceptible (Fig. 1C). Internal finger slightly longer than second, shorter than third (Fig. 1D); toes one-third palmate, third longer than fifth (Fig. 1E). A tarsal cutaneous fold continuous with the inner metatarsal tubercle; outer tubercle subconical (Fig. 1E). Paratoids (sic) beginning behind upper margin of tympanum, divergent, trilateral, extending posterior to the axilla, and continuous with a lateral dermal fold (Fig. 1A, C). Skin above smooth, with a few scattered tubercles (Fig. 1A). Femora, sides and abdomen rugulose; the first partly bound by the integument of the sides (Fig. 1B). The extended limbs reach, the anterior to the femur, the posterior to the end of the muzzle. Muzzle to vent one inch (see Table 1). Above light brown, with a whitish vertebral line; there are four deep brown spots on each side of this, and a broad chevron-shaped band of the same from border to border of the upper eyelids (Fig. 1A). A brown band on canthus rostralis, and two from orbit to lip (Fig. 1C). One from orbit to shoulder on outer edge of paratoid, continuous with a blackish shade beneath the lateral fold. Abdomen brownish white, with a median series of blackish spots from sternum to abdomen (Fig. 1B)".

## 3. Comparison with juveniles of other *Rhinella* species present in the area

As noted above, other five species of the genus *Rhinella* (*R. azarai*, *R. bergi*, *R. fernandezae*, *R. major*, and *R. scitula*), could be present in the area of San Salvador (aside from *R. schneideri*). Following the main morphological characters indicated by Cope (1862) in the description of *Bufo diptychus*, juveniles of these species show (see SVL range in Table 1):

*Rhinella azarai* (N = 1; Fig. 2A, B): Cranium with longitudinal ridges, including parietal, supraorbital, canthal, supratympanic, postorbital, infraorbital, and maxillar cranial crests. Canthus rostralis marked by the canthal crest; snout rounded in dorsal and lateral views, markedly elongated. Orbit narrower than the length of muzzle anterior to it. Tympanum large, evident. Internal finger as long as the second, shorter than third. Toes only basally palmate, third longer than fifth. A tarsal cutaneous fold absent; outer metatarsal tubercle rounded. Parotoids scarcely visible, subtriangular, and without a lateral dermal fold. Skin above tuberculate. Femora, sides and abdomen rugulose; the first partly bound by the integument of the sides. Above dark brown, with a whitish vertebral line and without darker spots. No bands on canthus rostralis or from orbit to lip. No bands from orbit to shoulder. Abdomen brownish white, with a median series of blackish spots from sternum to abdomen.

*Rhinella bergi* (N = 8; Fig. 2C, D): Cranium with longitudinal ridges, including parietal, supraorbital, canthal, and supratympanic cranial crests. Canthus rostralis marked by the canthal crest; snout quadrangular in dorsal and lateral views. Orbit as wide as the length of muzzle anterior to it. Tympanum small, scarcely perceptible. Internal finger as long as the second, shorter than third. Toes only basally palmate, third longer than fifth. A tarsal cutaneous fold absent; outer metatarsal tubercle rounded. Parotoids rounded to subtriangular, and without a lateral

dermal fold. Skin above tuberculate. Femora, and sides tuberculate; abdomen granulose; the first partly bound by the integument of the sides. Above light brown, with a barely noticeable vertebral line, and with elongate darker spots forming a reticulate. No bands on *canthus rostralis* or from orbit to lip. No bands from orbit to shoulder. Abdomen brownish white, with a median series of blackish spots from sternum to abdomen.

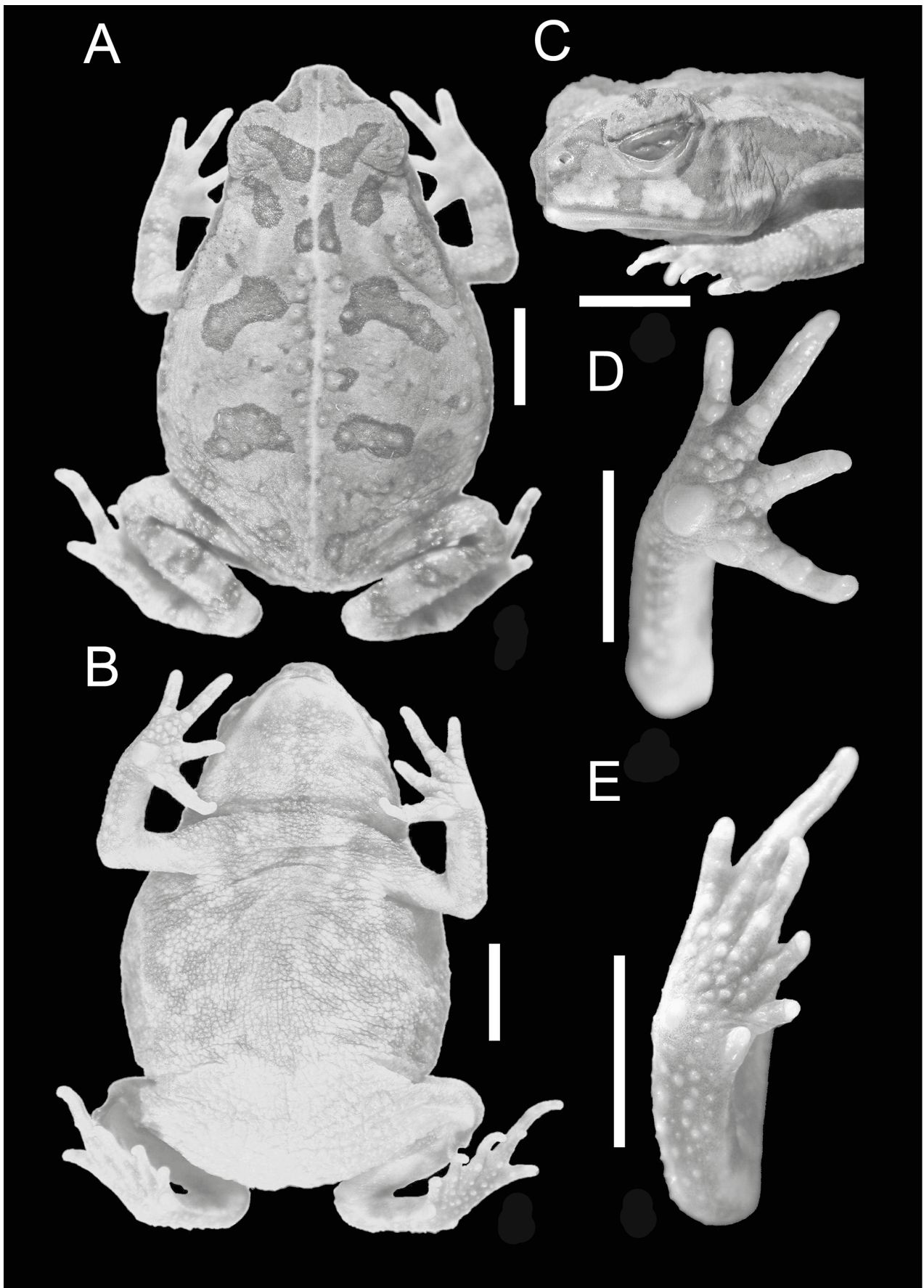
*Rhinella fernandezae* (N = 16; Fig. 2E, F): Cranium with longitudinal ridges, including parietal, supraorbital, canthal, supratympanic, postorbital, and infraorbital cranial crests. *Canthus rostralis* straight, marked by the canthal crest; snout rounded in lateral view. Orbit as wide as length of muzzle anterior to it. Tympanum small, scarcely perceptible. Internal finger longer than the second, shorter than third. Toes one half palmate, third longer than fifth. A tarsal cutaneous fold absent; outer metatarsal tubercle subconical. Parotoids scarcely visible, ovoid, and without a lateral dermal fold. Skin above tuberculate. Femora, sides and abdomen rugulose; the first partly bound by the integument of the sides. The extended limbs reach, the anterior to the femur, the posterior to the end of the muzzle. Muzzle to vent one inch. Above brown, with or without a vertebral line, and with elongate darker spots forming a reticulate; with a dark band (not as chevron) from border to border of the upper eyelids. No bands or spots on *canthus rostralis* or from orbit to lip. No bands from orbit to shoulder. Abdomen brownish white, with a median series of blackish spots from sternum to abdomen.

*Rhinella major* (N = 5; Fig. 2G, H): Cranium with longitudinal ridges, including parietal, supraorbital, canthal, supratympanic, preorbital, subnasal, infraorbital, maxillar and postorbital cranial crests. *Canthus rostralis* concave, marked by the canthal crest; snout quadrangular in dorsal and lateral views. Orbit as wide as length of muzzle anterior to it. Tympanum small, scarcely perceptible. Internal finger slightly longer than second, shorter than third. Toes only basally palmate, third longer than fifth. A tarsal cutaneous fold absent; outer metatarsal tubercle subconical. Parotoids triangular, without a lateral dermal fold. Skin above tuberculate. Femora, sides and abdomen rugulose; the first partly bound by the integument of the sides. The extended limbs reach, the anterior to the femur, the posterior to the end of the muzzle. Muzzle to vent one inch. Above light brown, without vertebral line, and four darker spots arranged in pairs along the dorsum. Some individuals show a X-shaped mark instead the four spots or two spots in the scapula and one patch in the sacral region. A brown band on *canthus rostralis*, and two from orbit to lip. No bands from orbit to shoulder. Abdomen brownish white, with a median series of blackish spots from sternum to abdomen.

*Rhinella scitula* (N = 8; Fig. 2I, J): Cranium with proportionally expanded longitudinal ridges, including supraorbital, and supratympanic cranial crests. *Canthus rostralis* rounded; snout quadrangular dorsally and rounded in lateral view, with a small, but evident, apical apophysis. Orbit as wide as length of muzzle anterior to it. Tympanum small, scarcely perceptible. Internal finger slightly longer than second, shorter than third. Toes almost completely palmate, third longer than fifth. A tarsal cutaneous fold absent; outer metatarsal tubercle rounded. Parotoids subtriangular to rounded, continuous with a lateral dermal fold. Skin above smooth, with a few scattered tubercles. Femora shagreen, sides and abdomen granulose; the first partly bound by the integument of the sides. The extended limbs reach, the anterior to the femur, the posterior to the end of the muzzle. Muzzle to vent one inch. Above light brown, with vertebral line and with darker, irregular margins. Both vertebral line and margin with variable width. A chevron-shaped band from border to border of the upper eyelids is present in some individuals. Smaller individuals are generally darker. A brown band on *canthus rostralis*, and two from orbit to lip. One from orbit to shoulder on outer edge of paratoid, continuous with a blackish shade beneath the lateral fold. Abdomen light brown, densely spotted in dark brown.

## Discussion

In spite of its citation for the montane forests of Puno Department by Rodríguez *et al.* (1993), *Rhinella diptycha* must be excluded from the Peruvian fauna; this record is most likely due to the comment by Cope (1863) on the identity of the supposed *Bufo poeppigii* reported from the dry coast of Peru by Girard (1858). The citation for Argentina derives from Aquino *et al.* (1996), without other precisions, while the records for Brazil were provided by Miranda-Ribeiro (1937), based on individuals from Rio Cumana and Solimões. Those from Paraguay are due to several authors (i.e., Aquino *et al.* 1996; Bertoni 1914; 1939; Boettger 1885; Boulenger 1882; Frost 1985; IUCN *et al.* 2004; Méhely 1904; Nieden 1923; Vaucher 1986); all these papers do not refer to voucher specimens, while the localities are almost always ambiguously cited as "Paraguay". Exceptions are Méhely (1904) (surroundings of



**FIGURE 1.** *Rhinella diptycha* juvenis (MNHNP 1573; SVL = 24.7 mm). Dorsal view (A), ventral view (B), lateral view of the head (C), palmar view of the right hand (D), plantar view of the right foot (E). Scale 5 mm.





**FIGURE 2.** Dorsal and lateral views of juvenile individuals of *Rhinella azarai* (A–B, MNHNP 8782, SVL = 33.9 mm), *Rhinella bergi* (C–D, MNHNP 9078, SVL = 23.4 mm), *Rhinella fernandezae* (E–F, IIBP-H 229, SVL = 25.4 mm), *Rhinella major* (G–H, MNHNP 5353, SVL = 27.4 mm), and *Rhinella scitula* (I–J, MNHNP 9874, SVL = 25.1 mm). Scale 10 mm.

Asunción and Villa Sana), and Bertoni (1936) (Puerto Bertoni). The references for Uruguay and Surinam are due to van Lidth de Jeude (1904), who reported three individuals from Montevideo and two, with doubts, collected by the Saramacca-expedition.

As already noted, the character states mentioned by Cope (1862) in the original description of *Bufo diptychus* coincide, almost point by point, with those showed by the juveniles of *Rhinella schneideri* (Fig. 1A–E). Conversely, the individuals of *Rhinella azarai* (Fig. 2A, B), *R. bergi* (Fig. 2C, D), *R. fernandezae* (Fig. 2E, F), *R. major* (Fig. 2G, H), and *R. scitula* (Fig. 2I, J) are excluded due to the presence of evident cranial crests, the *canthus rostralis* remarked by a canthal crest, the presence of parotoid glands, and the skin texture and the general coloration patterns. Consequently, *Rhinella schneideri* (Werner 1894) is a junior synonym of *Bufo diptychus* Cope, 1862, under the combination *Rhinella diptycha*.

Unfortunately, the reversal of precedence provided in art. 23.9 of the International Code of Zoological Nomenclature (ICZN 1999) is not applicable because the requirement in 23.9.1.1 is not met. In fact, Cope's species was mentioned, in diverse generic combinations, at last by Aquino *et al.* (1996), Bertoni (1914; 1939), Boettger (1885), Boulenger (1882), Dubois (1947), Frost (1985), Girard (1858), Méhely (1904), Miranda-Ribeiro (1937), Nieden (1923), Stohler (1931), Vaucher (1986), and Vellard (1959). Finally, confronted with this fact, in order to preserve the correct application of the name, we propose as the neotype for *Rhinella diptycha* the specimen NHMB 1916 as described by Werner (1894: 411), which in turn, is also the holotype of the junior synonym *Rhinella schneideri*.

### ***Rhinella diptycha* (Cope, 1862)**

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