



## A new species of *Rhinella* (Anura: Bufonidae) from Ischigualasto Provincial Park, San Juan, Argentina

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### Abstract

A new species of bufonid frog, *Rhinella bernardoi* sp. nov., belonging to the *granulosa* group, is described from moderately high elevation (1400 m) at Ischigualasto Provincial Park, San Juan, Argentina. The morphology of the new species is compared to and diagnosed from other closely related species of the same group (*R. bergi*, *R. fernandezae*, and *R. granulosa*). We also describe the osteology of the skull and the vertebral column of the new species and present data on its geographic distribution and natural history.

**Key words:** Argentina, Bufonidae, Ischigualasto, *Rhinella* sp. nov., San Juan

### Introduction

The frog family Bufonidae has a cosmopolitan distribution, except for Australia, Madagascar, and the Oceanic region, although several species have been widely introduced even into non-native areas (Frost 2009). Cei (1980) assigned most Argentine bufonids into seven species groups or genera. The *arenarum* group is composed of *Rhinella arenarum* (formerly *Bufo arenarum*) and *R. rufus* (*B. rufus*); the *marina* group includes *R. icterica* (*B. ictericus*) and *R. schneideri* (*B. paracnemis*); the monotypic *crucifer* group includes *R. crucifer*, and the *okendeni* group including *R. gnustae* (*B. gnustae*). Along the Andes mountain range in western Argentina, a series of species comprising the *spinulosa* group occur at different elevations, including *R. spinulosa* (*B. spinulosus*), *R. rubropunctata* (*B. rubropunctatus*), and one endemic species from Córdoba and San Luis: *R. achalensis* (*B. achalensis*) (Cei 1980; Gallardo 1986; Cei 1987; Lavilla & Cei 2001). The first taxonomic revision of the *granulosa* group was carried out by Gallardo (1965), who recognized nine species (*Bufo azarai*, *B. barbouri*, *B. beebei*, *B. goeldii*, *B. humboldti*, *B. lutzi*, *B. merianae*, *B. mini*, *B. mirandaribeiroi*) and also the subspecies *B. granulosa fernandezae*, *B. g. dorbignyi*, *B. g. major*, and *B. g. pygmaeus*, which were later elevated to species (Cei 1968; Cei 1972).

Frost *et al.* (2006) reorganized the Neotropical *Bufo* into several new genera, including *Chaunus*, which was the name attributed to a South American clade within *Bufo* sensu lato. Chaparro *et al.* (2007) transferred all *Chaunus* to *Rhinella* because the former was not found to be monophyletic in their analysis. Currently, the *granulosa* group is composed of six species: *Rhinella bergi*, *R. dorbignyi*, *R. fernandezae*, *R. granulosa*, *R. beebei*, *R. pygmaea* (Frost, 2009). In Argentina, the *granulosa* group is represented by *R. bergi*, *R. dorbignyi*, *R. fernandezae*, *R. granulosa*, and *R. pygmaea*; the latter species has been observed in Argentina by Cei (1980) in the provinces of Corrientes, Chaco, and Santa Fé. In her taxonomic review of the *granulosa* group, Narváez (2003) considered the geographic distribution of *R. pygmaea* to be restricted to Río de Janeiro, Brazil. All *Rhinella* in the *granulosa* group are small, have rugose skin covered with keratinized tubercles, and have digging habits (Narváez 2003). Morphological synapomorphies of this group include the prenasal

bone located anterior to the premaxillary bone, which forms an elongated snout and dorsally directed nostrils (Pramuk 2000). Here we describe a new species of *Rhinella* belonging to the *R. granulosa* group endemic to the Ischigualasto Provincial Park, San Juan, Argentina.

## Material and methods

On 24 January 2006, five adult males of an undescribed *Rhinella* species were collected from Ischigualasto Provincial Park, San Juan, Argentina. The specimens were fixed in 10% buffered formalin and preserved in 70% ethanol.

We measured 27 morphometric variables (modified from Narváez 2003): SVL= snout vent length; HW= head width; HeL= head length; IND= internostril distance; SW= snout width; END= eye-nostril distance; ESD= eye snout distance; IOD= inter orbital distance (measured at three different points, at the inner eye limit, at the middle of the eye and at the outer eye limit, and identified respectively as IOD1, IOD2, IOD3); ED= eye diameter; TDI= maximum tympanum diameter; TD2= minimum tympanum diameter; EW= eyelid width; PGL= parotoid gland length; PGW= parotoid gland width; AbL= abdomen length; AL= arm length; RUL= Radioulna length; HL= hand length; FL= femur length; TL= tibia length; FtL= foot length; HH= head height; 4TL= fourth toe length; OMCTD= outer metacarpal tubercle diameter; IMCTD= inner metacarpal tubercle diameter; BW= body width (We measured the width of the body, half the length SVL).

Measurements were taken with digital calipers ( $\pm 0.05$  mm) and the aid of a stereomicroscope (10–40x). Additionally, qualitative features of the external morphology of the specimens were recorded including: head shape in lateral and dorsal views, extent of skin granulation, ventral and dorsal color and pattern, cephalic crests (supraorbital, infraorbital, preorbital, supratympanic, canthal, subnasal, and parietal), nostril shape, and position and shape of the parotoid gland. An adult male (IMCN-UNSJ-5045) was cleared and double-stained, following the protocol of Wassersug (1976). Skeletal terminology follows Lehr *et al.* (2005). To diagnose the new species, we examined 60 specimens (20 each of *R. bergi*, *R. fernandezae*, and *R. granulosa*) for comparison with the new species, from the Colección Herpetológica de la Fundación Miguel Lillo, Universidad Nacional de Tucumán (FML) and the Colección Herpetológica de la Universidad Nacional de San Juan (IMCN-UNSJ) (Appendix I).

We statistically compared the morphometry of three species (*Rhinella bernardoi* sp. nov. vs. *R. fernandezae* and *R. granulosa*), because these three species are similar in general morphology and size. For comparison, each morphometric variable was size-standardized through division by SVL. Morphometric ratios were compared with Mann-Whitney *U* tests.

## *Rhinella bernardoi* sp. nov.

**Holotype.** FML 18400, adult male. Ischigualasto Provincial Park, Valle Fértil Department, San Juan Province, Argentina (30° 10' 9" S; 67° 48' 37" W; 1400 m). 24 January 2006. Collectors; Florencia Cano, Lorena Quiroga, Viviana Orozco, Rodrigo López, and Eduardo Sanabria.

**Paratypes.** IMCN-UNSJ 5043–5046. Four adult males with same locality data as holotype.

**Etymology.** Dedicated to Bernardo de la Iglesia Sanabria, a man of exceptional reputation and a great friend, to whom we are greatly thankful for his wholehearted trust and patience.

**Diagnosis and comparisons.** *Rhinella bernardoi* sp. nov. is assigned to the *granulosa* group in the genus *Rhinella* because it shares synapomorphies of the group (Pramuk 2002) including dorsally oriented nostrils and prenasal bones located anterior to the premaxillary bone.

*Rhinella bernardoi* sp. nov. (male SVL = 57.3 mm,  $n = 5$ ) differs from all members of the “*granulosa*” group by combination of the following characters: *Rhinella granulosa* average SVL of males is 53.8 mm ( $n = 21$ ); very large conical keratinized tubercles covering its skin; granulose cephalic crests, an expanded maxillary crest visible both dorsally and ventrally; snout with angular edges and square-shaped in ventral and lateral

views; large, divided subarticular tubercle on Finger III, covered with keratinized conical tubercles; subtriangular parotid gland; short hind legs, with end of Toe IV reaching the nostril when the legs is adpressed anteriorly along the body. In contrast, *R. bernardoii* **sp. nov.** has a low density of dorsal granulations, continuous cephalic crests, lacking a maxillary extension, prominent snout, square-shaped from a ventral view but round from a lateral view, long hind legs, with end of toe IV surpassing the snout when adpressed anteriorly along the body. Thirteen morphometric variables show significant differences (Table 1) between *R. granulosa* and *R. bernardoii* **sp. nov.**

**TABLE 1.** Comparison of *Rhinella bernardoii* **sp. nov.** (Rsp.nov.; N=5) with the similar *R. granulosa* (Rg; N=20). Morphometric variables and ratios (obtained dividing original measurements by SVL) of morphometric variables shown as mean  $\pm$  standard error (only variables showing significant differences shown). Significance values refer to Mann Whitney U-tests.

Morphometric variable	Mean $\pm$ SE <i>Rsp. nov.</i>	Ratios Mean $\pm$ SE <i>Rsp. nov.</i>	Mean $\pm$ SE Rg	Ratios Mean $\pm$ SE Rg	P<
Head length	16.5 $\pm$ 0.8	0.29 $\pm$ 0.002	15.8 $\pm$ 0.2	0.26 $\pm$ 0.002	0.0001
Internostril distance	3.1 $\pm$ 0.2	0.05 $\pm$ 0.001	2.7 $\pm$ 0.2	0.06 $\pm$ 0.001	0.001
Eye-nostril distance	4.08 $\pm$ 0.4	0.07 $\pm$ 0.003	3.6 $\pm$ 0.08	0.06 $\pm$ 0.001	0.009
Eye snout distance	6.6 $\pm$ 0.5	0.12 $\pm$ 0.003	5.9 $\pm$ 0.1	0.10 $\pm$ 0.001	0.00003
Inter orbital distance 1	7.32 $\pm$ 0.3	0.13 $\pm$ 0.003	6.9 $\pm$ 0.1	0.12 $\pm$ 0.001	0.004
Inter orbital distance 2	6.8 $\pm$ 0.5	0.12 $\pm$ 0.003	6.3 $\pm$ 0.1	0.11 $\pm$ 0.002	0.007
Maximum tympanum diameter	4.1 $\pm$ 0.2	0.10 $\pm$ 0.002	3.7 $\pm$ 0.09	0.12 $\pm$ 0.001	0.002
Parotid gland width	4.4 $\pm$ 0.2	0.14 $\pm$ 0.002	8.2 $\pm$ 0.2	0.17 $\pm$ 0.01	0.01
Arm length	13.6 $\pm$ 0.9	0.24 $\pm$ 0.01	10.5 $\pm$ 0.2	0.18 $\pm$ 0.04	0.001
Radioulna length	12.2 $\pm$ 0.8	0.47 $\pm$ 0.01	11.2 $\pm$ 0.4	0.56 $\pm$ 0.01	0.00007
Femur length	20.5 $\pm$ 0.8	0.24 $\pm$ 0.002	21.1 $\pm$ 0.5	0.23 $\pm$ 0.002	0.01
Head height	8.5 $\pm$ 0.6	0.57 $\pm$ 0.01	7.3 $\pm$ 0.09	0.47 $\pm$ 0.01	0.00003
Fourth toe length	11.7 $\pm$ 0.3	0.15 $\pm$ 0.004	10.3 $\pm$ 0.2	0.12 $\pm$ 0.013	0.0003

The average SVL of males of *Rhinella fernandezae* is 51.9 $\pm$ 1.4 mm ( $n = 20$ ). This species has a midvertebral line, continuous cephalic crests, a parietal crest, infraorbital crest surpasses postorbital and maxillary crests; and the body is completely covered by very conspicuous conical keratinized tubercles. In contrast, *R. bernardoii* lacks a midvertebral line, continuous cephalic crests but the parietal crest is absent, and infraorbital crests do not surpass postorbital and maxillary crests. In addition, there are fourteen statistically significant morphometric differences (Table 2).

The average SVL of males of *Rhinella beebei* is 51 mm and a very short parietal crest. Subnasal crests indistinct. Vertebral midline just visible. The ventral region may be light with small dark spots (Gallardo, 1965). In contrast, *R. bernardoii* does not have a visible vertebral midline; continuous cephalic crests but the parietal crest is absent, and subnasal crests are present. The average SVL of males of *Rhinella dorbignyi* is 48.2 mm and 55.6 mm for females (Narvaez 2003); reduced postorbital crest, infraorbital crest absent; tympanum barely visible, midvertebral line present (Narvez 2003). The average SVL size of *Rhinella bergi* males is 35.8  $\pm$  0.95 mm ( $n=15$ ); parietal crest present and infraorbital crest extends posteriorly over the postorbital crest, the dorsum has a appreciable vertebral line and small black points over abdominal skin; the infraorbital crest extends caudally over the postorbital crest; the parietal crest is present and the posterior end of the supraorbital crest extends over the postorbital crest (Narvez 2003). The average SVL of males of *Rhinella pygmaea* is 31.4 mm (Narvaez 2003); parietal crest present and infraorbital crest extends posteriorly over the postorbital crest (Narvez 2003). *Rhinella bernardoii* **sp. nov.** is larger than *R. dorbignyi*, *R. bergi*, and *R. pygmaea* these species has an average snout-vent length (SVL) of less than 40 mm. Also, in *Rhinella*

*bernardoi* sp. nov. the infraorbital crest never surpasses the postorbital crest and the new species lacks a midvertebral line.

**TABLE 2.** Comparison of *Rhinella bernardoi* sp. nov. (Rsp.nov.; N=5) with the similar *R. fernandezae* (Rf; N=20). Morphometric variables and ratios (obtained dividing original measurements by SVL) of morphometric variables shown as mean  $\pm$  standard error (only variables showing significant differences shown). Significance values refer to Mann Whitney U-tests.

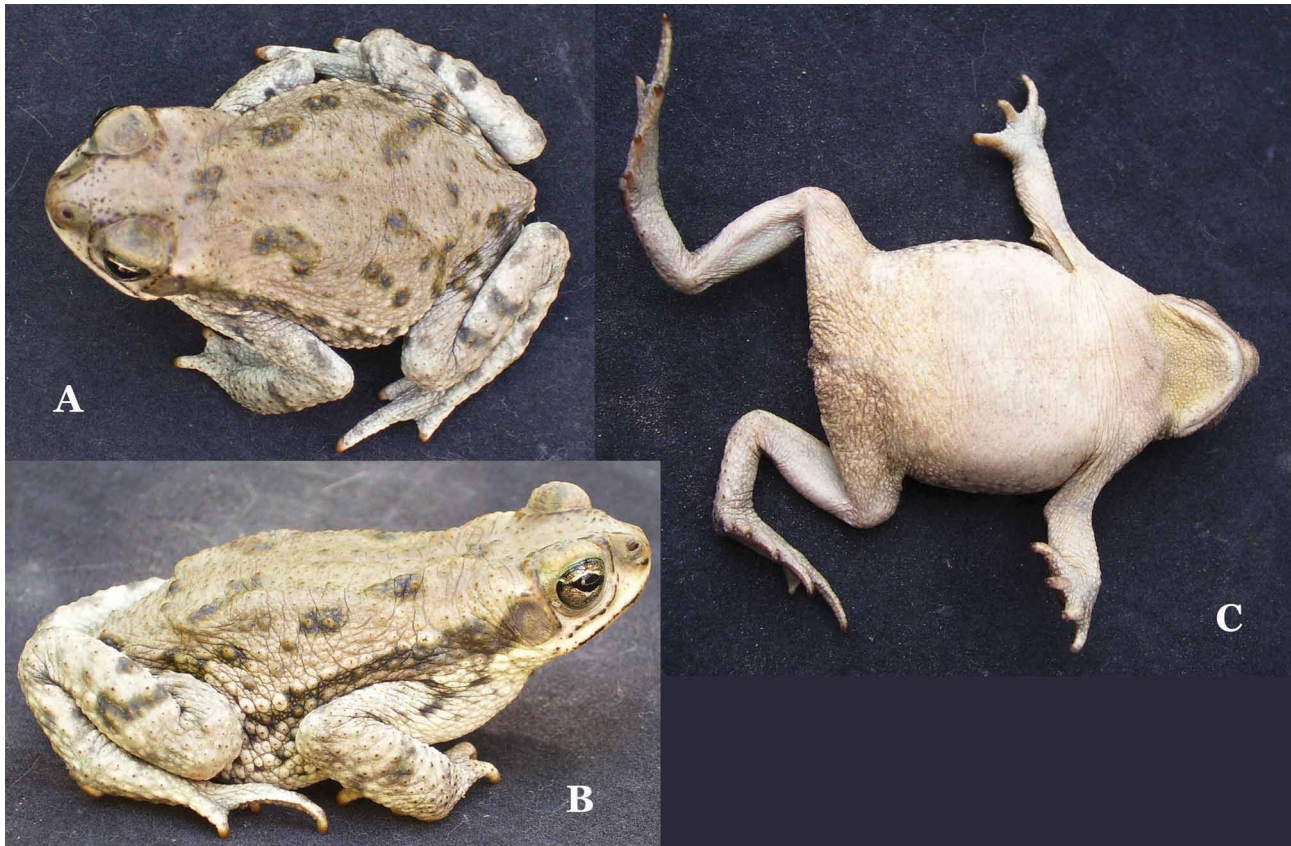
Morphometric variable	Mean $\pm$ SE	Ratios	Mean $\pm$ SE	Ratios	P<
	Rsp. nov.	Mean $\pm$ SE Rsp. nov	Rf	Mean $\pm$ SE Rf	
Head length	16.5 $\pm$ 0.8	0.29 $\pm$ 0.002	13.7 $\pm$ 0.3	0.26 $\pm$ 0.003	0.001
Eye-nostril distance	4.08 $\pm$ 0.4	0.07 $\pm$ 0.003	3.04 $\pm$ 0.06	0.06 $\pm$ 0.001	0.003
Eye-snout distance	6.6 $\pm$ 0.5	0.12 $\pm$ 0.003	5 $\pm$ 0.1	0.10 $\pm$ 0.001	0.00007
Inter orbital distance 1	7.3 $\pm$ 0.3	0.13 $\pm$ 0.003	5.6 $\pm$ 0.1	0.11 $\pm$ 0.002	0.0001
Inter orbital distance 2	6.8 $\pm$ 0.5	0.12 $\pm$ 0.003	5.5 $\pm$ 0.2	0.11 $\pm$ 0.002	0.03
Minimum tympanum diameter	3.1 $\pm$ 0.2	0.07 $\pm$ 0.002	2.1 $\pm$ 0.06	0.06 $\pm$ 0.001	0.001
Eyelid width	4.4 $\pm$ 0.1	0.06 $\pm$ 0.002	3.8 $\pm$ 0.1	0.04 $\pm$ 0.008	0.00003
Arm length	13.6 $\pm$ 0.9	0.24 $\pm$ 0.01	8.2 $\pm$ 0.2	0.16 $\pm$ 0.003	0.03
Radioulna length	12.2 $\pm$ 0.8	0.47 $\pm$ 0.01	6.1 $\pm$ 0.4	0.52 $\pm$ 0.01	0.00003
Hand length	13.9 $\pm$ 0.6	0.21 $\pm$ 0.003	12.4 $\pm$ 0.4	0.12 $\pm$ 0.01	0.00003
Tibia length	17.4 $\pm$ 1.1	0.36 $\pm$ 0.01	14.8 $\pm$ 0.5	0.3 $\pm$ 0.01	0.0001
Head height	8.5 $\pm$ 0.6	0.57 $\pm$ 0.01	7.1 $\pm$ 0.2	0.49 $\pm$ 0.01	0.0002
Fourth toe length	11.7 $\pm$ 0.3	0.15 $\pm$ 0.004	9.3 $\pm$ 0.3	0.14 $\pm$ 0.002	0.02
Inner metacarpal tubercle diameter	2.1 $\pm$ 0.1	0.06 $\pm$ 0.003	1.7 $\pm$ 0.3	0.05 $\pm$ 0.004	0.01

**Holotype description.** Adult male, snout–vent length (63.9 mm.). Head wider (33.8% SVL) than long (28.9% SVL) or tall (14.8% SVL), subtriangular in dorsal view. Snout truncated from dorsal view, rounded in profile. Upper jaw extends past margin of lower jaw. Eyes positioned laterally, not very prominent. Eye diameter 1.13 times eye–snout distance. Nostrils subelliptical and dorsally positioned, nearer to tip of snout than to eye. Prominent and continuous cranial crests. Supraorbital crests strongly curved, following line of eye. Canthal crest long and continuous but not extending over nostrils. Infraorbital crests straight, ending at postorbital crest forming a 90° angle. Preorbital crests straight, forming curve at juncture with infraorbital crests. Postorbital crests straight, continue with infraorbital crests. Supratympanic folds very short, joining postorbital crests and parotoid gland. No parietal crests, subnasal crests greatly reduced, similar size as nostrils. Maxillary crest located over the lip and continuing over length of maxillary, without visible lateral or dorsal expansion and appearing more like a well-defined line in the shape of a moustache. Oval-shaped tympanum, diameter 59.7% of eye diameter; green tympanic membrane between parotoid gland and postorbital crest, separated from latter by tympanic annulus. Parotoid gland oval shaped, longer (14% SVL) than wide (6.8% SVL), with poorly defined edges and covered by small, scarce, flat tubercles with a small keratinized spicule each.

Dorsum covered by scarce flattened tubercles with a keratinized spicule each; tubercles on flanks large, conical, keratinized. Interorbital area, area surrounding the nostrils, and region between parotoid gland and tympanum smooth. Dorsally light buff with long black blotches with green and yellow margins; markings joined from tympanum to vent forming an irregular line; dorsum markings scarce, lacking a regular pattern. Ventral region with small, flat, non-keratinized granules. Throat region yellow; otherwise ventrally cream with small black dots and a red patch on the lower abdomen and thighs.

Forelegs relatively long (forearm 23.1% of SVL; arm 21.4% of SVL), hands (23.7% of SVL). Fingers free with a relative length of  $3 > 1 < 4 > 2$ . Hands with a round outer metacarpal tubercle larger than inner ovoid

metacarpal tubercle. Subarticular tubercles fingers I and II divided. Nuptial pads on fingers I and II; Hind legs long (122.8% SVL), with webbed feet (57.5% SVL) except on toe 4 where webbing reaches middle toe and continues as a noticeable skin flap. Relative length of toes  $1 < 2 < 3 < 4 > 5$ . Inner and outer metatarsal tubercles similar, oval, and spade-shaped. Subarticular tubercles on toes III and IV divided.



**FIGURE 1.** *Rhinella bernardoii* sp. nov. (a) Dorsal, (b) lateral, and ventral (c) views of paratype IMCN-UNSJ 5044. Photo: Eduardo Sanabria.

**Holotype measurements.** SVL= 63.9 mm. HW= 21.6 mm. HL= 18.5 mm. IND= 3.8 mm. SW= 6.8 mm. END= 4.6 mm. ESD= 7.6 mm. IOD= 18.3 mm, IOD2= 7.7 mm, IOD3= 9.4 mm. ED= 6.7 mm. TD1= 4.4 mm. TD2= 4.0 mm. ELW= 4.7 mm. PGL= 9 mm. PGW= 4.4 mm. AbL= 14.8 mm. AL= 13.7 mm. HndL= 15.2 mm. FL= 22.2 mm. TL= 19.5 mm. FtL= 36.8 mm. HH= 9.5 mm. 4TL= 11.8 mm. OMCTD= 4.2 mm. IMCTD= 2.5 mm. BW= 29.3 mm.

**Color in life.** The dorsum is light buff with long black blotches surrounded by green and yellow edges; the pattern of blotches on the flanks is similar in the specimens examined. Lateral markings are joined from the tympanum to the vent, forming an irregular line; dorsum markings are scarce and lack a regular pattern (Fig. 1). Ventrally, males are cream with a reddish-red patch covering part of the abdomen, thighs, and pelvic patch. The throat is yellow. The ventral area has round black blotches small distributed randomly.

**Color in ethanol.** Buff background color remains, but the green blotches on the dorsum fade, becoming a pattern of dark blotches that are noticeable from the background. The throat remains yellow, but the red patch on the abdomen and thighs fades.

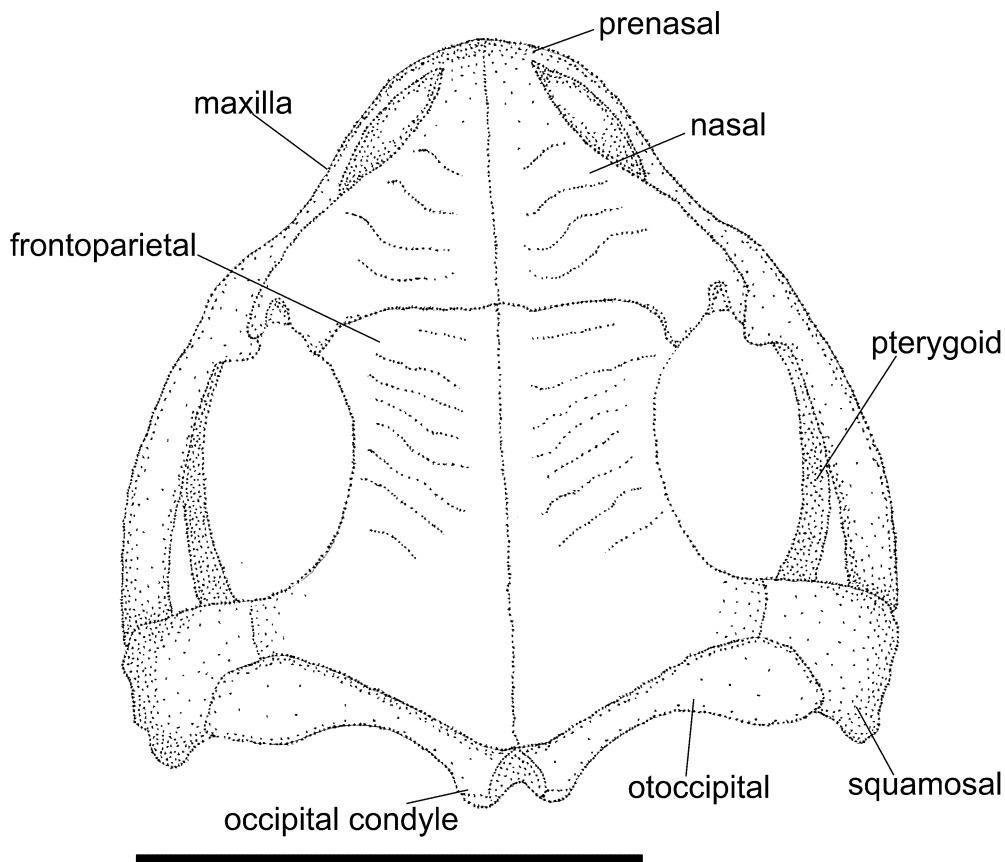
**Variation.** One paratype has black round blotches randomly located on the ventral area, other two paratypes are similar to the holotype. Variation in morphometric variables is summarized in Appendix II.

**Osteology.** Based on one adult male paratype (IMCN-UNSJ-5045). The skull of *Rhinella bernardoii* sp. nov. is wider than long with the greatest width at the level of the quadratojugals. It is heavily ossified with prominent dermal ornamentation on the dorsal surface of the nasals and frontoparietals. In dorsal view, the nasal is posterolaterally expanded and articulates with the frontoparietal covering the sphenethmoid

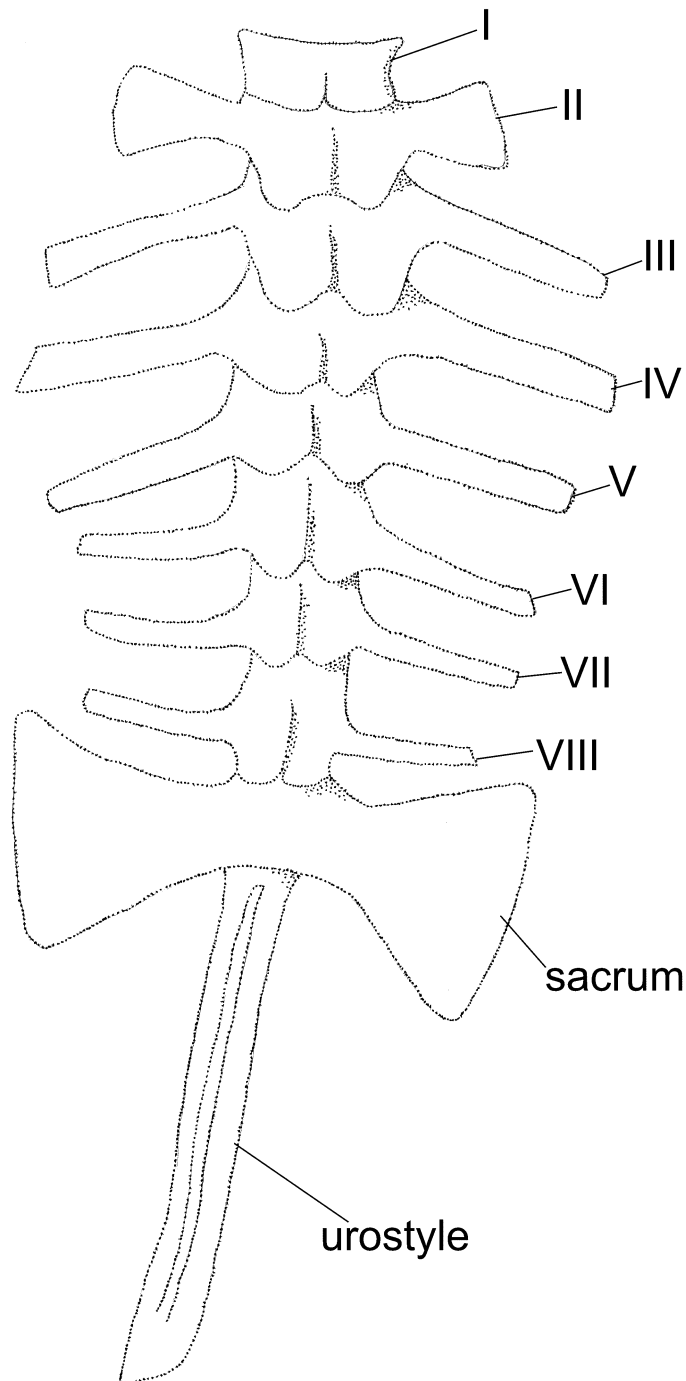
completely (Fig. 2). Prenasal bones are anterior to the premaxillary bone in the dorsal region of the skull (Pramuk 2000). These are dermal, paired, and ovoid and lie posterior to the nares, which is unique among members of the *granulosa* group. In lateral view, the orbit appears closed with the margin of the orbit being formed by the articulation of the zygomatic ramus of the squamosal, the dorsal surface of maxilla, and the confluence of preorbital and suborbital crests. The quadratojugals are poorly developed and located between the maxilla and the zygomatic ramus of the squamosal. The maxilla has a dorsal expansion in the facial region, which is in contact with the ventrolateral surface of the nasal. In ventral view, the prenasals lie at the anterior margin of the skull. The maxilla and premaxilla are thin. The vomers are slender with poorly developed postchoanal processes. The sphenethmoid covers the anterior region of the base of the skull. The anterior edge of the cultriform process of the parasphenoid is acuminate and the suture between parasphenoid and pterygoid is not visible.

The vertebral column (Fig. 3) of *Rhinella bernardoii* **sp. nov.** is formed by eight presacral vertebrae. The transverse process of vertebrae II, III, IV, V, VI, and VII are posterolaterally oriented in relation to the vertebral column, whereas the transverse process of vertebra VIII is oriented perpendicular to the axis of the column. The sacral diapophyses are broadly dilated and flat, and are wider than long.

**Distribution.** The *granulosa* group has a wide geographic distribution in almost all South American countries except Ecuador and Chile (Gallardo 1965, 1969). In Argentina, the group is distributed primarily in the northeast, with species occurring in the provinces of Buenos Aires, Santa Fé, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Jujuy, La Pampa, Misiones, Río Negro, Salta, and Santiago del Estero (Narváez 2003). *Rhinella bernardoii* **sp. nov.** is only known from Ischigualasto Provincial Park in San Juan province (Fig. 4). Here, the new species is syntopic with three other frogs: *Pleurodema nebulosum*, *P. tucumanum*, and *Rhinella arenarum*, whereas *R. spinulosa* uses permanent bodies of water to breed (Sanabria & Quiroga 2009).



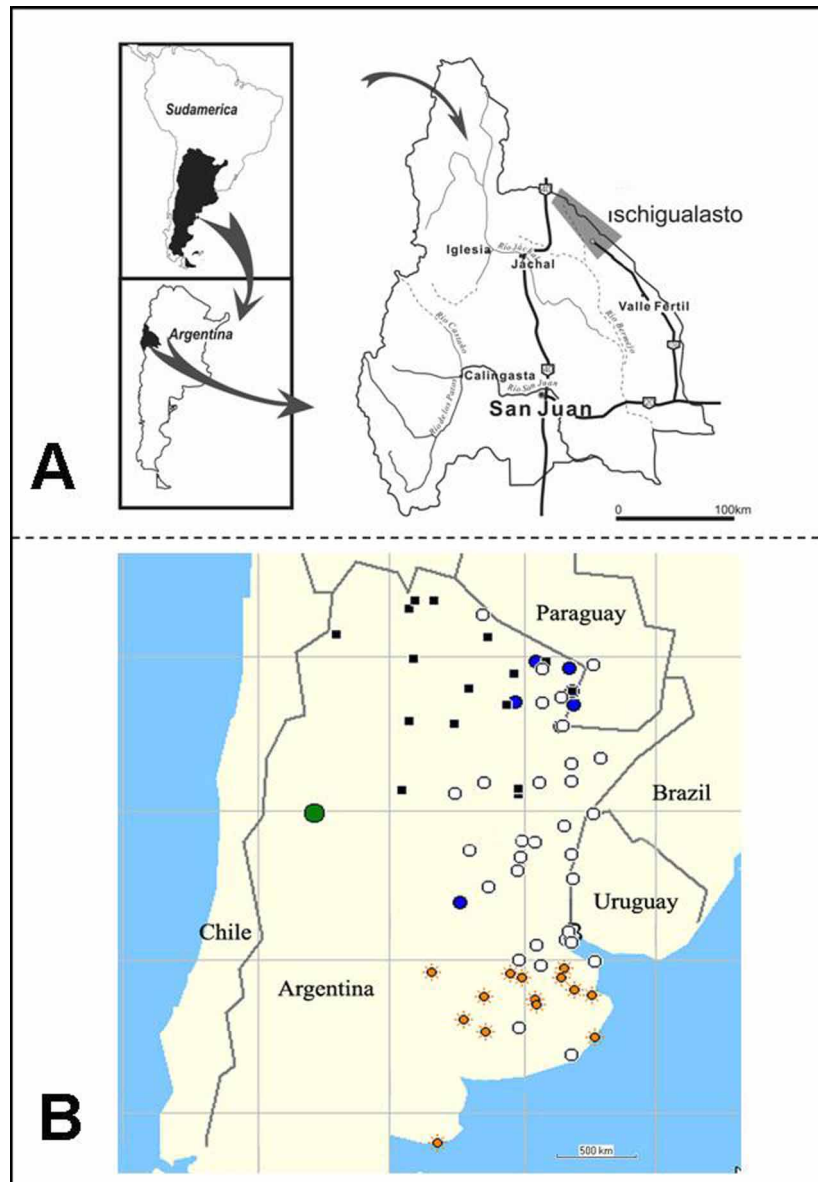
**FIGURE 2.** Dorsal view of the skull of *Rhinella bernardoii* **sp. nov.** (IMCN-UNSJ-5045), illustrating prenasal bone located anterior to the premaxillary bone, a synapomorphy of the *granulosa* group. Scale bar = 1 cm. Drawing: Federico Arias.



**FIGURE 3.** Vertebral column of the *Rhinella bernardoii* **sp. nov.** (IMCN-UNSJ-5045). Note that the sacral diapophysis is broadly dilated and flat, a character of the *granulosa* group. Scale bar = 1 cm. Drawing: Federico Arias.

**Natural history.** The new species occurs in habitat known as the Monte phytogeographic region, which has an arid climate with a mean annual temperature of 20 °C, a mean annual maximum temperature of 40 °C, a mean annual minimum temperature of 16 °C, and a mean annual rainfall of 84 mm concentrated in summer (Cabrera 1994). The most common shrubs are *Larrea* sp. (“jarillas”) and *Prosopis* sp. (“algarrobos”) and riparian species such as *Baccharis salicifolia* (mulefat) and *Grabowskia obtusa* (Márquez *et al.* 2005) (Fig. 5). Specimens were found in temporary pools following summer rains, which were used by the new species, *R. arenarum*, and *Pleurodema nebulosum* for reproduction. There are no data regarding other aspects of the biology of *R. bernardoii* **sp. nov.**, but other species in this group have an explosive, but brief (1–2 d) reproductive period following strong summer rains (Gallardo 1972; Yanosky *et al.* 1997; Langone 1999).

**Statistical analyses.** The results from the Mann-Whitney  $U$  tests show that *R. bernardoi* **sp. nov.** differs statistically from *R. granulosa* in 15 morphometric variables (Table 1) and from *R. fernandezae* (Table 2) in 14 morphometric variables.



**FIGURE 4.** (a) Type locality of *Rhinella bernardoi* **sp. nov.** at Ischigualasto Provincial Park. (b) Distribution of the *granulosa* group: *R. bergi* (blue), *R. granulosa* (black), *R. fernandezae* (white dots), *R. dorbignyi* (orange), *R. bernardoi* **sp. nov.** (green). Modified from Narváez (2003).

## Discussion

Following Chaparro *et al.* (2007), the new species described herein is assigned to the genus *Rhinella*. Based on external morphology, we place *R. bernardoi* **sp. nov.** into the *granulosa* group, because it shares features such as rugose skin covered by granules or keratinized tubercles, developed cephalic crests, dark and keratinized fingertips, and palmar tubercles (Narváez, 2003). Likewise, the skull of *R. bernardoi* **sp. nov.** has character states of the *granulosa* group as proposed by Pramuk (2006) including the presence of prenasals in the dorsal region of the skull (Fig. 2).

Species of the *granulosa* group are typical inhabitants of variable open area habitats; they use ephemeral



lagoons of short duration (1–2 days) formed by rains for reproduction. During this period, breeding aggregations can be observed in the field (Gallardo 1972; Yanosky *et al.* 1997, and Langone 1999). These species are well adapted to arid regions where they dig burrows or use abandoned burrows of other animals. The presence of prenasals, which form the snout, may be used by these species to dig (Pramuk 2000). Argentine species in the *granulosa* group occur in the northeastern portion of the country, and more than 400 km (and many geographic barriers) separates the known distribution of the new species from others in the group.



**FIGURE 5.** Habitat of *Rhinella bernardoi* **sp. nov.** at the type locality, Ischigualasto Provincial Park, San Juan, Argentina. Photo: Eduardo Sanabria.

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## Appendix I: Specimens Examined

*Rhinella bergi*—**Chaco**: Departament of Comandante Fernández, Roque Saenz Peña, National Routes 16 and 95: FML 5529–1–3, 5, 8. **Formosa**: Departament of Laishi, El Bagual, Ecological Reserve: FML 12227, 12265, 12269, 12279, 12290, 12292, 13190, 13270, 13650, 1312, 14199, 14223, 14246, 14262, 14270.

*Rhinella bernardoi*—**San Juan**: Ischigualasto Provincial Park, Department of Valle Fértil: FML 18400 (holotype); IMCN-UNSJ 5043–46 (paratypes).

*Rhinella fernandezae* — **Buenos Aires**, Florencio Varela: FML: 00106–13, 00106–14; 00106–15; 00106–16 José C. Paz and FML 02047–3, 02047–4, 02047–5; 02047–6; 02047–7; 02047–8; 02047–9. **Santa Fé**, General Department, Obligado between Reconquista and Puerto Reconquista: FML: 04849–1; 04849–2; 04849–3; 04849–4; 04849–5; 04849–6; 04849–7; 04849–8; 04849–9, and Department of Santo Tomé: IMCN-UNSJ: 5133; 5134; 5135; 5136; 5137; 5138; 5139.

*Rhinella granulosa*—**Formosa**: Department of Matacos, Ingeniero Juárez: FML 1099–2, 8, 9, 13, 27, 32–34, 36; Department of Laishi, El Bagual, Ecological Reserve: FML 10690–91. **Salta**: Department of Anta, Finca Los Colorados, Campo Grande: FML 5266–3–5. **Santiago del Estero**: Department of Copo, Monte Quemado: FML 3586–1–5, 7, 9, 10.

**Appendix II.** Morphometric measurements (all in mm) of the paratypes of *Rhinella bernardoi* sp. nov. paratypes. See Materials and Methods for abbreviations of variables measured.

	UNSJ 5043	UNSJ 5044	UNSJ 5045	UNSJ 5046	Mean ± SE
SVL	57.2	64.4	49.0	52.4	57.38±3.0
HW	18.7	21.4	17.1	17.6	19.28±0.9
HeL	16.7	18	14.2	15.1	16.50±0.8
IND	2.8	3.3	2.8	2.8	3.10±0.2
SW	5.2	6.5	5.0	5.1	5.72±0.3
END	3.7	5.4	3.4	3.3	4.08±0.4
ESD	6.4	8.2	5.3	3.3	6.42±0.6
IOD1	7.2	7.8	6.8	6.5	7.32±0.3
IOD2	6.4	8.3	5.9	5.8	6.82±0.5
IOD3	8.1	10.5	7.1	7.2	8.46±0.6
ED	6.1	6.3	5.4	5.4	5.98±0.2
TD1	3.7	4.6	3.5	4.3	4.10±0.2
TD2	3.2	3.0	2.5	3.1	3.16±0.2
EW	4.4	4.7	4.2	4.0	4.40±0.1
PGL	8.7	9.5	6.9	7.3	8.28±0.5
PGW	4.7	5.2	3.5	4.2	4.40±0.2
AbL	13.8	16.5	11.7	11.2	13.60±0.9
AL	12.0	14.5	10.4	10.7	12.26±0.8
RUL	13.8	16.5	11.7	11.2	13.60±0.9
HL	13.7	15.8	12.4	12.8	13.98±0.6
FL	22.5	22.2	17.6	18.4	20.58±1.0
TL	17.2	20.4	15.2	14.7	17.40±1.1
FiL	31.1	36.4	29.9	29.7	32.78±1.5
HH	7.7	10.4	7.2	7.7	8.50±0.6
4TL	10.6	12.4	11.7	12.3	11.76±0.3
OMCTD	3.1	4.1	2.9	2.9	3.44±0.2
IMCTD	2.2	2.4	1.5	1.9	2.10±0.1
BW	26.5	31.0	21.8	25.3	26.78±1.6