



## Rediscovery, resurrection and redescription of *Rhinella leptoscelis* (Boulenger, 1912) (Anura: Bufonidae)

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### Abstract

We resurrect *Rhinella leptoscelis* (Anura: Bufonidae) from the synonymy of *R. veraguensis* and redescribe it on the basis of the holotype, and recently collected specimens from Peru and Bolivia. *Rhinella leptoscelis* is well distinguished from all other species of the *R. veraguensis* group by its flat head with well developed orbitotympanic and postorbital crests, distinct tympanum, large parotoid glands, spiny tubercles on dorsal surfaces, long and slender extremities, dorsolateral row of conical, enlarged and elevated tubercles, webbing absent on fingers, basal and serrated webbing between toes, and first finger longer than second. This species is known from the humid forests of the Amazonian versant of the Andes from central Bolivia to southern Peru.

**Key words:** Amazon, Andes, Peru, Bolivia, *Rhinella veraguensis* group, *Rhinella margaritifera* group, taxonomy

### Introduction

The taxonomic status of the toad *Rhinella leptoscelis* (Boulenger, 1912) has remained uncertain. This species, described on the basis of a single specimen from the Andean slopes of southern Peru, has been considered either as a junior synonym of *R. veraguensis* (Schmidt, 1857) (Vellard 1959; Hoogmoed 1990) or as a valid species (Gallardo 1961; Cei 1968, 1972; Gorham 1974; Hoogmoed 1985; Duellman and Schulte 1992). Vellard (1959) considered *R. ockendeni* (Boulenger, 1902) and *R. leptoscelis* very similar, but recommended to gather more information to solve the taxonomic status of both species. Savage (1969) synonymized *R. ockendeni* under *R. veraguensis*. Hoogmoed (1990) placed *R. leptoscelis* in the synonymy of *R. veraguensis*, and attributed some differences between the single known specimen of *R. leptoscelis*, a female, and the lectotypes of *R. veraguensis*, all adult males, to sexual dimorphism. He furthermore removed *R. veraguensis* and all its junior synonyms from the *R. typhonius* species group and placed it in the *R. veraguensis* group. Duellman and Schulte (1992) did not follow this position and treated *R. leptoscelis* as a valid species without further discussion. But subsequent taxonomic studies of toads assigned to this group did not consider *R. leptoscelis* as a valid species (Harvey and Smith 1993, 1994; Lehr *et al.* 2001, 2005; Padial *et al.* 2006; Pramuk 2006; Chaparro *et al.* 2007; see account by Frost 2009).

Our comparisons of *Rhinella leptoscelis* with all type specimens of the *R. veraguensis* and *R. margaritifera* groups inhabiting the Andean slopes of Southern Peru and Bolivia (see De la Riva *et al.* 2000;

Köhler 2000; Padial *et al.* 2006; Chaparro *et al.* 2007), together with the finding of new specimens at the type locality (Santo Domingo de Carabaya, Puno, Peru) of *R. leptoscelis*, indicate that this is a valid species, which we redescribe and resurrect herein.

## Material and methods

For morphological and color characteristics used in the diagnosis and description we follow Duellman and Schulte (1992). Specimens examined are listed in the Appendix. Measurements were taken with a digital caliper to the nearest 0.01 mm, but following Hayek *et al.* (2001), for avoiding pseudo precision, we rounded all measurements to only one decimal. Abbreviations of measurements are as follows: snout–vent length, SVL; head length (from posterior margin of the lower jaw to tip of snout), HL; head width, HW; upper eyelid width, EW; eye diameter (measured horizontally), ED; eye to nostril distance, EN; distance between nostrils, IND; tibia length, TL; foot length (from proximal border of inner metatarsal tubercle to tip of fourth toe), FL. Museum acronyms refer to: Natural History Museum, London, U.K. (BM); Centro de Biodiversidad y Genética, Cochabamba, Bolivia (CBG); Colección Boliviana de Fauna, La Paz, Bolivia (CBF); Museo de Historia Natural Noel Kempff Mercado, Santa Cruz de la Sierra, Bolivia (MNK-A [Amphibian Collection]); Estación Biológica de Doñana, Sevilla, Spain (EBD); Museo Nacional de Ciencias Naturales, Madrid, Spain (MNCN); United States National Museum of Natural History, Smithsonian Institution, Washington, USA (USNM); and Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK).

We follow Chaparro *et al.* (2007) in that all South American bufonids assigned to *Chaunus* by Frost *et al.* (2006) should now be included in *Rhinella*, except *Rhaebo* for the former *Bufo guttatus* group, and *Nannophryne* for the former *Bufo variegatus* group. There seems to be no morphological synapomorphy for the *R. veraguensis* group (Pramuk 2006). Phylogenetic analyses (Pramuk 2006; Chaparro *et al.* 2007) place some members of the *R. veraguensis* group as the sister clade of the *R. margaritifera* group while other members are basal to it, also suggesting thus that the *R. veraguensis* group, as defined by Duellman and Schulte (1992), is paraphyletic. Thus, apart of the general morphological appearance, there is no objective criterion to definitively assign species to this group. *Rhinella leptoscelis* is most similar in external morphology to members of the *R. veraguensis* group (see below) and to a lesser extent to members of the *R. margaritifera* group. We therefore compare *R. leptoscelis* with members of the *R. veraguensis* group (listed by Padial *et al.* 2006) and with two members of the *R. margaritifera* group that potentially inhabit the same area (De la Riva *et al.* 2000). All those species share the following external characters: medium size; long and slender extremities; head flattened, wider than long; supraorbital and/or parietal crests prominent; skin on dorsum and extremities bearing tubercles; lateral row of enlarged tubercles; parotoid glands moderately developed.

## Results

### *Rhinella leptoscelis* (Boulenger, 1912)

*Bufo leptoscelis* Boulenger, 1912, Ann. Mag. Nat. Hist., Ser. 8, 10: 186. Holotype (Fig. 1A–B): BM 1907.5.7.32. Type locality: "Santo Domingo, Carabaya, S.E. Peru, 6500 feet".

**Diagnosis.** A medium-sized species of *Rhinella* (Figs. 1A–B, 2A–G) distinguished by the following unique combination of characteristics: (1) canthus rostralis concave in dorsal view, sharp in profile, orbitotympanic and postorbital crests prominent, not protruding; (2) tympanum distinct, oval; (3) parotoid glands large, oblong to subtriangular, protuberant, separated from eyelid and tympanum by the supratympanic crest; (4) body surfaces covered by spiny tubercles with keratinized tips; (5) extremities long and slender; (6) a

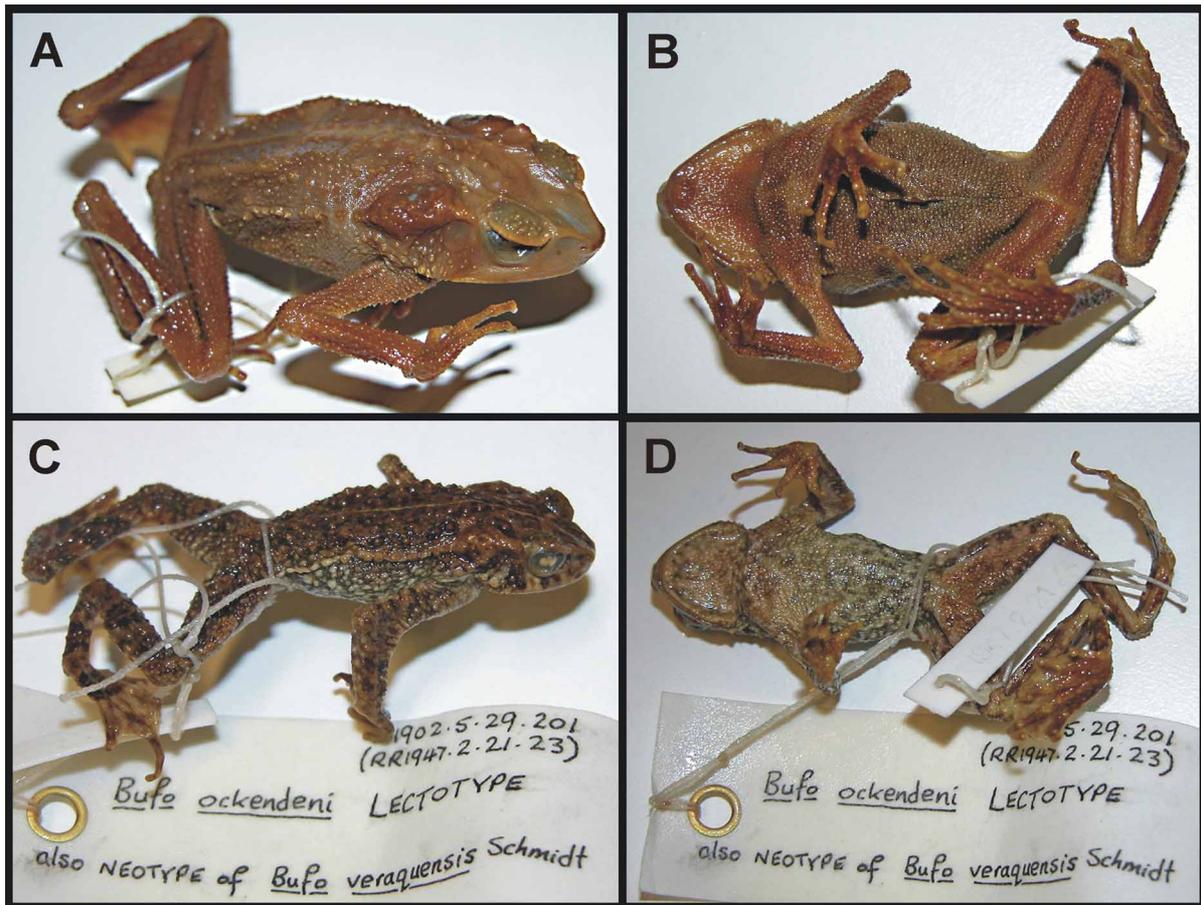
dorsolateral row of conical, enlarged, and elevated tubercles; (7) tarsal fold absent; (8) webbing absent on fingers, basal and serrated between toes; (9) first finger longer than second; (10) iris green in life.

From other species of the *Rhinella veraguensis* species group, *R. leptoscelis* can be distinguished as follows. From *R. amboroensis*, *R. arborescandens*, *R. justinianoi*, *R. quechua* and *R. veraguensis* (Fig. 1C–D) by having a conspicuous tympanic membrane and toe webbing basal and serrated. From *R. arborescandens*, *R. chavin*, *R. manu*, *R. multiverrucosus*, *R. nesiotas*, *R. rumbolli*, and *R. tacana* by lacking fleshy interdigital membranes, having fingers slender with first finger longer than second, and subtriangular parotoids. From *R. chavin* and *R. multiverrucosus* it can be distinguished by lacking glands on the forearms and hind legs. *Rhinella leptoscelis* shares with *R. fissipes* the slender fingers and serrated basal membrane on toes. However, *R. leptoscelis* can be distinguished from *R. fissipes* by having cranial crests, conspicuous tympanic membrane, and larger tubercles on dorsal skin. With *R. inca*, *R. leptoscelis* shares the presence of cranial crests, first finger longer than second, and the observable tympanic membrane, but *R. leptoscelis* has more spiny dorsal skin and serrated fringes, and prominent cranial crests anterior and posterior to eye (absent in *R. inca*). From *Rhinella margaritifera* and *R. stanlaidi*, two members of the *R. margaritifera* group inhabiting the Andean slopes from Southern Peru to Central Bolivia, *R. leptoscelis* can be distinguished by lacking a protruding cranial crest above the tympanic area.

**Redescription of the holotype.** An adult female (Fig. 1A–B) with long and slender extremities; large and flat head, wider than long, its width 36% of SVL, its length 29% of SVL; snout subacuminate in dorsal view, round in profile; cranial crests present, occipital and orbitotympanic crests well developed but not protruding; skin of head not co-ossified with underlying cranial bones; internarial area concave; nostrils not protuberant, very small, oriented laterally; canthus rostralis narrow and elevated in profile, concave in dorsal view; lips flat; eye-nostril distance smaller than eye length; tympanic membrane visible, conspicuous, oval, surrounded by tubercles, its diameter approximately half of eye length; tympanic annulus thin, overlapped with surrounding granules. Forelimbs long and slender; hand broad, with long and slender fingers; relative length of fingers II<III<IV; webbing absent, lateral fringes present, serrated; tips of digits round, not expanded; ulnar region covered by keratinized spines; palmar tubercle subtriangular, protruding; prepollical tubercle elongated, protruding, smaller than palmar tubercle; subarticular tubercles round, conspicuous; supernumerary tubercles conical, diffuse, smaller than subarticular tubercles. Hind limbs and feet long; tibia length 45% of SVL; foot length 44% of SVL; no tarsal fold, tarsus covered by spines; outer metatarsal tubercle round, prominent, 1/2 the size of inner; inner metatarsal tubercle small, prominent, elongate; relative length of toes I<II≤V<III<IV; webbing basal between toes I–II, II–III, and IV–V, slightly more developed between III–IV, reaching the basis of second subarticular tubercle of toe III; tip of toes rounded; subarticular tubercles prominent, round to ovoid, larger than supernumerary tubercles; supernumerary tubercles abundant, small, conical or rounded. Choanae, vomerine teeth, and tongue conditions were not examined in the holotype to avoid damaging of the specimen (but see below).

Skin of head, body, and extremities bearing abundant conical tubercles with keratinized tips; enlarged tubercles forming an irregular dorsolateral row on each side of dorsum; canthus rostralis, interorbital region, and snout with scarce or no tubercles; parotoid glands large (60% HL), subtriangular, more displaced to side of the head than to dorsum, almost in contact with tympanic membrane, and in contact with small, short orbitotympanic and postorbital crest; enlarged glands absent on limbs or forearms; skin on throat and other ventral surfaces granular to spiny. In preservative, dorsum and ventral surfaces mostly dark reddish-orange, head, belly and fingers paler.

Measurements (in mm) are only available for adult females. Measurements of the holotype (BM 1947.2.21.95) are followed in parentheses by those of additional specimens (MHNC 5976, 5989, and 5975, respectively): SVL, 53.5 (85.5, 56.8, 59.8); HL, 15.4 (23.3, 17.4, 19.1); HW, 19.2 (29.3, 20.8, 19.9); ED, 6.5 (6.9, 5.9, 6.9); END, not measured (5.8, 4.2, 5.6); EW, 3.8 (6.0, 4.8, 4.9); IND, not measured (5.2, 3.7, 3.8); IOD, not measured (10.9, 8.6, 7.0); TL, 24.0 (37.1, 30.4, 28.2); FL, 23.5 (34.5, 27.1, 27.2). These measurements indicate a large variation in adult female size, from 56.8–85.5 in SVL.

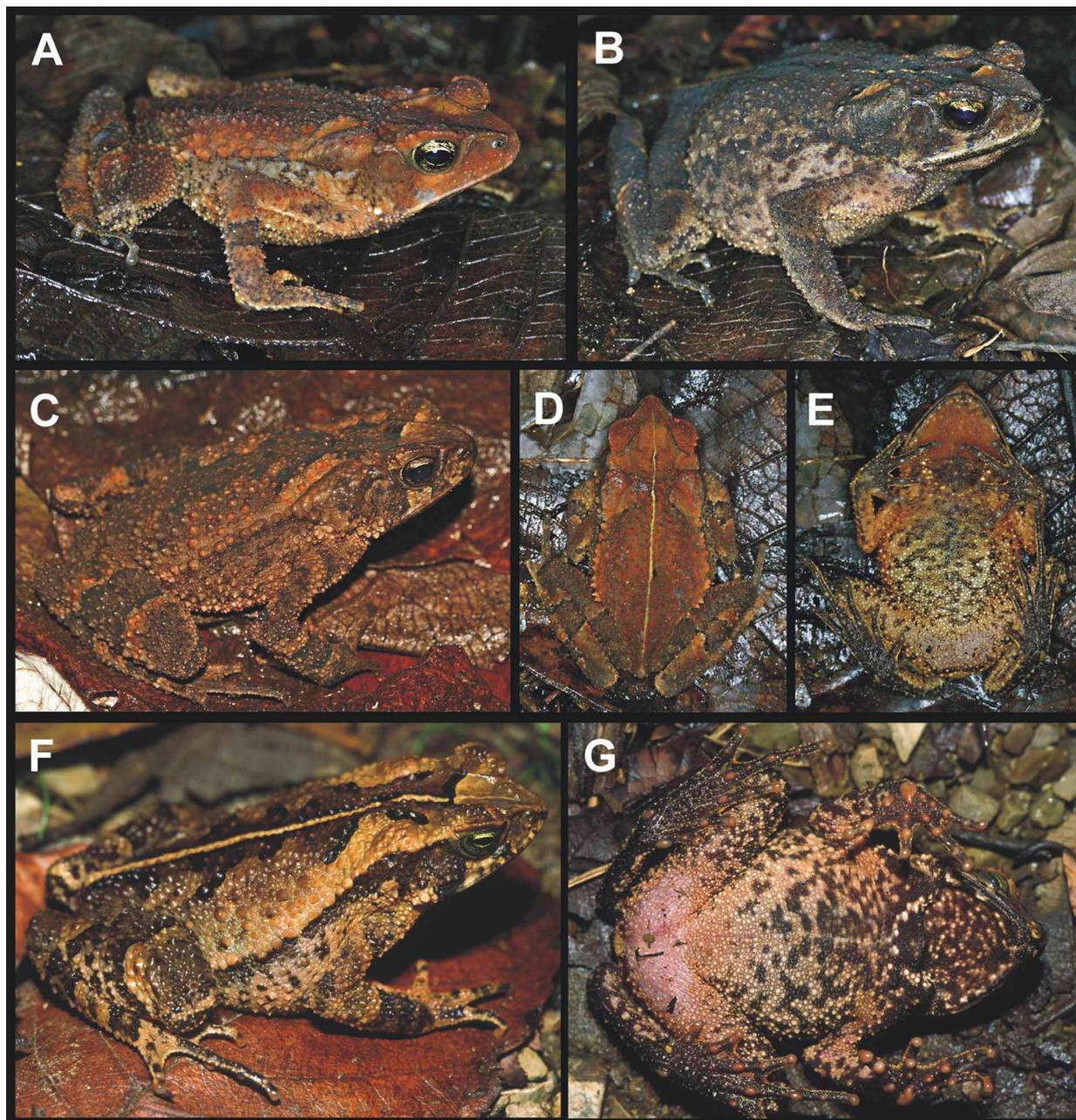


**FIGURE 1.** (A–B) Holotype of *Rhinella leptoscelis* (BM 1907.5.7.32, SVL= 53.5 mm) from Santo Domingo, Carabaya, Departamento Puno, Peru. (C–D) Neotype of *R. veraquensis* (BM 1947.2.21.23, SVL=41.0 mm; also lectotype of *Bufo ockendeni*) from Marcapata Valley, Departamento Cusco, Peru.

**Variation.** We describe variation in qualitative characters, measurements, and color in life on the basis of five newly collected specimens from the type locality (MHNC 5975–6, 5987–9; see associated data under remarks section). No male specimens of *R. leptoscelis* have been found to date. The holotype and the five new Peruvian specimens show few differences in qualitative characters (Fig. 1A–B and Fig. 2 A–G), mostly related to skin texture and coloration. The largest adult female (MHNC 5976; Fig. 2B) has spiny skin texture. The choanae and vomerine teeth were examined in an adult female with convoluted oviducts (MHNC 5975). The choanae are large, round, and anterolateral; between them are the odonthophores, which are no more than two tiny, almost indiscernible protuberances lacking vomerine teeth. Dorsal coloration is brownish-grey in MHNC 5976 and brownish-orange in MHNC 5975, with a longitudinal middorsal pale yellow stripe (this stripe is underlined with black in MHNC 5976). The dorsolateral row of tubercles is brownish-cream in MHNC 5976 and intense orange in MHNC 5975. The flanks are pale grey with darker spots in MHNC 5976, and orange and grey with tiny dark grey spots and white tubercles in MHNC 5975. In MHNC 5976, the lateral surfaces of head are overall dark brownish-grey, with pale lips; dorsally, the eyelids and the interorbital region are brownish-orange to cream, with two black spots posteriorly, and a longitudinal cream stripe; the occipital region has two large yellow and bold black spots. In MHNC 5975, the head is overall orange, with a middorsal longitudinal yellow stripe; the ventral regions have black, white, orange and grey flecks; the plantar surfaces are dark brownish-grey, with yellowish-cream fringes and membranes. The hind limbs are dark grey with two transversal cream to yellow narrow irregular stripes in MHNC 5976, and brownish-orange with grayish-brown transversal bars in MHNC 5975. The forelegs are dark grey with some darker and paler spots in MHNC 5976, and brownish-orange with grayish-brown transversal bars in MHNC 5975. Bolivian

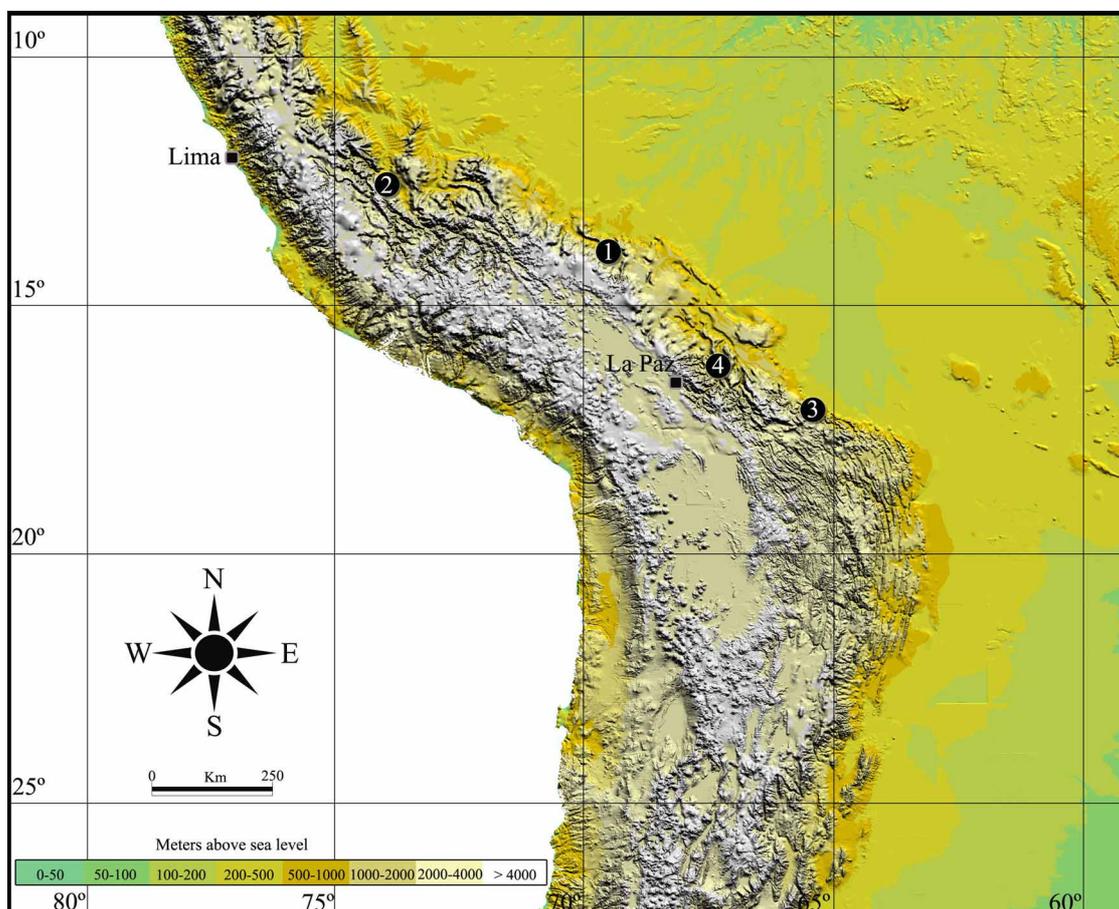
specimens (see below) are also all females, with a light vertebral stripe, bordered by dark brown lines, and cream lateral dorsum and flanks, contrasting with the darker mid-dorsum (Fig. 2F). Dark brown dorsal flecks and markings are present in all Bolivian specimens. The throat is dark brown with some scattered cream spots (Fig. 2G).

**Remarks.** Other specimens that we now consider to represent *R. leptoscelis* are those reported as *R. fissipes* by Köhler (2000) for Bolivia. The identity of these Bolivian populations was reinvestigated and some differences between the *R. fissipes* holotype and Bolivian specimens (i.e. tympanum condition) mentioned by Köhler (2000), and the lack of distinct cranial crests in *R. fissipes*, seem to be reliable characters to distinguish between both taxa. Consequently, *R. leptoscelis*, and not *R. fissipes* should now be listed for Bolivia, although the presence of the latter in the country is very likely.



**FIGURE 2.** (A, D–E) Adult female of *Rhinella leptoscelis* from Santo Domingo de Carabaya, Departamento Puno, Peru (MHNC 5975, SVL= 59.8 mm); (B) Adult female of *R. leptoscelis* from Santo Domingo de Carabaya, Departamento Puno, Peru (MHNC 5976, SVL=85.5 mm); (C) Adult female of *R. leptoscelis* from Kimbiri River, 1550 m a.s.l., Departamento Cusco, Peru (MNCN 44406; SVL=65.7); (F–G) Adult female of *R. leptoscelis* from Chapare, Bolivia (ZFMK 72670, SVL=65.6 mm).

**Distribution.** Since the discovery of *Rhinella leptoscelis* by Ockenden at the end of the Nineteenth Century at Santo Domingo de Carabaya, Puno, Peru (2000 m a.s.l.) (Fig. 3), no additional specimens were allocated to this species. One of the authors (JCC) rediscovered this species during an expedition to the type locality and the surrounded area in November 2006. He collected two specimens (MHNC 5975–6) at Santo Domingo de Carabaya, 1658 m a.s.l., and three specimens (MHNC 5987–9) at a lower altitude, 1400 m a.s.l. (see Appendix). More recently, we collected additional specimens of *R. leptoscelis* (Fig. 2C) in Kimbiri River, Vilcabamba Mountains, Cusco, Peru (Fig. 3; Appendix).



**FIGURE 3.** Map of the Central Andes depicting localities for *Rhinella leptoscelis*: (1) type locality at Santo Domingo de Carabaya, 2000 m a.s.l, Departamento Puno, Peru; (2) Kimbiri River, 1350–1550 m a.s.l., Departamento Cusco, Peru; (3) Chapare, 1300–1400 m a.s.l., Departamento Cochabamba, Bolivia; (4) Caranavi, Departamento La Paz, Bolivia.

Bolivian records of *R. leptoscelis* (see above) come from Chapare, 1300–1400 m a.s.l., Departamento Cochabamba, and from the surroundings of Caranavi, Departamento La Paz, Bolivia (the latter specimens, deposited at CBF, were erroneously reported as originating from Rurrenabaque, Departamento Beni, by Köhler 2000).

Thus, *Rhinella leptoscelis* occurs in well-preserved humid montane forests from the Chapare region in Bolivia to the Vilcabamba mountain range in southern Peru. All known specimens were found between 1300–1658 m. The species is known to occur in sympatry with *R. veraguensis* and *R. fissipes* at the type locality, with *R. inca* in Vilcabamba, and with *B. quechua*, *R. stanlaidi*, and *R. veraguensis* in the Bolivian Chapare region.

## Discussion

We have provided arguments for the recognition of *R. leptoscelis* as a valid species well distinguished from *R. veraguensis*. But the assignation of *Rhinella leptoscelis* to the *R. veraguensis* group is tentative. The *R. veraguensis* group is non-monophyletic, and some of its members are more closely related to members of the *R. margaritifera* group (Pramuk 2006; Chaparro *et al.* 2007). *Rhinella leptoscelis* shows a degree of development in the orbytotympanic crests that resembles that of some members of the *R. margaritifera* group (e.g. *R. margaritifera*, *R. stanlaidi*). But the crests do not project above the tympanic area in *R. leptoscelis*, as is typical in most members of the *R. margaritifera* group. Also, the morphological definitions of the *R. margaritifera* and *R. veraguensis* groups provided by Duellman & Schulte (1992) were similar enough to argue for a close relationship. Moreover, some of the species now assigned to the *R. veraguensis* group (*R. fissipes*, *R. inca*, *R. leptoscelis*, and *R. quechua*) were former members of the *R. margaritifera* group (Hoogmoed 1985). Thus, at least from the point of view of external characters, both groups are quite similar. There is, however, an osteological synapomorphy (expansion of the posterior ramus of the pterygoid) shared by some members of the *R. margaritifera* group (Pramuk 2006), which is not confirmed for current members of the *R. veraguensis* group. Future molecular approaches will allow to improve our knowledge about the phylogenetic relationships of all these species and to better define the limits, if any, between these species groups.

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## Appendix

### Specimens examined

- Rhinella amboroensis*. BOLIVIA: Departamento Cochabamba: 12.7 km by road E of El Empalme along road to Khara Huasi, MNK-A 953 (holotype).
- Rhinella fissipes*. PERU: Santo Domingo, Carabaya, S.E. Peru, 6000 feet, BM 1947.2.20.64 (holotype).
- Rhinella inca*. PERU: Departamento Cusco: Huadquinia, USNM 49557 (holotype); Kimbiri River, 1100 m a.s.l., 12°35'26.5"S, 73°41'36.8"W, MNCN 44405.
- Rhinella justinianoi*. BOLIVIA: Departamento Cochabamba: Karahuasi, 1800 m a.s.l., ZFMK 72657; Old Chapare road, 1650 m a.s.l., ZFMK 72600–02; Old Chapare road 2250 m a.s.l., ZFMK 72621; Saquisacha, CBG 168–176; Departamento Santa Cruz: El Chapé, MNK-A950 (holotype).
- Rhinella leptoscelis*. BOLIVIA: Departamento Cochabamba: Chapare 1300–1400 m a.s.l., ZFMK 66985, 72668–71, 80035–36; PERU: Departamento Puno: Santo Domingo, Carabaya, S.E. Peru, 6500 feet, BM 1907.5.7.32; Santo Domingo de Carabaya 1658 m a.s.l., 13°49'59.6"S, 69°38'31.8"W, MHNC 5975–76; Santo Domingo de Carabaya, 1400 m a.s.l., 13°46'14.3"S, 69°37'28.7"W, MHNC 5987–89; Departamento Cusco: Kimbiri River 1350–1550 m a.s.l., 12°34'12.4"S, 73°39'17.6"W, MHNC 6803, 6812, 6817, MNCN 44404, 44406.
- Rhinella manu*. PERU: Departamento Cusco: Tres Cruces, approx. 134 km NE of Cusco, 2750 m a.s.l., MHNC 3005 (holotype), MHNC 3003–4, 3006–11, MHNSM 24883 (paratypes).
- Rhinella quechua*. BOLIVIA: Departamento Cochabamba: Incachaca (type locality), 2300 m a.s.l., ZFMK 66939–41; Old Chapare Road, 2250 m a.s.l., EBD 30249–30252, ZFMK 72622; Sehuencas, 2200 m a.s.l., CBG 109–127, ZFMK 60255–74, 60276–82, 66835–36.
- Rhinella stanlaii*. BOLIVIA: Departamento Cochabamba: road Villa Tunari-Cochabamba, 1850 m a.s.l., ZFMK 60464 (paratype); road to San Onofre, 1900 m a.s.l., CBF 3346 (holotype); Old Chapare road, 1400 m a.s.l., ZFMK 67096 (paratype); Departamento Santa Cruz: La Hoyada, 1700 m a.s.l., ZSM 144/1999 (paratype).
- Rhinella tacana*. BOLIVIA: Departamento La Paz: Arroyo Huacataya, path from San José de Uchupiamonas to Apolo, Serranía Eslabón, Madidi National Park, MNCN 42073, MNK-A-7194 (paratypes); Huairuro path from San José de Uchupiamonas to Apolo, Serranía Eslabón, Madidi National Park, MNK-A 7188 (holotype), MNK-A 7187, MNCN 42072 (paratypes).
- Rhinella veraguensis* (= *Bufo ockendeni*). BOLIVIA: Departamento Beni: Río Yucumo, 5 km upstream from Yucumo, MNCN 43836–37; Departamento Cochabamba: Campamento Los Guácharos, Carrasco National Park, MNCN 42633, 43017; Charuplaya, BM 1947.2.21.26–27 (paralectotypes); Karahuasi, CBG 226–236, ZFMK 72658; Old Chapare road, 1250 m a.s.l., ZFMK 72555–58; La Siberia, road to Locotal, MNCN 43369; Old Chapare road, 1300–1500 m a.s.l., ZFMK 72574–75; Old Chapare road, 1650 m a.s.l., ZFMK 72590–92; Quebrada on the road Cochabamba-Villa Tunari, MNCN 43379; road Los Guácharos-El Palmar, 8 km from Los Guácharos, MNCN 43032; 120 km from Cochabamba on Cochabamba-Villa Tunari road, MNCN 43384; Departamento La Paz: Arroyo Huacataya, path between San José de Uchupiamonas and Apolo, MNCN 43414; Puesto Guardaparques-Arroyo Huabudahaida, Madidi National Park, MNCN 43011; Serranía de Bella Vista, MNK-A7270–71, MNCN 41991; Valle de Zongo, MNCN 43413; Departamento Santa Cruz: El Empalme, Serranía de la Siberia, MNCN 43736; El Fuerte, Samaipata, ZFMK 62832–33, 66884; 29 km SE of Guadalupe, 1600 m a.s.l., ZFMK 66850–51; La Yunga, 2300 m a.s.l., MNCN 43370–71, ZFMK 66880; 45 km W of Río Seco, ZFMK 67077–78; 120 km from Santa Cruz to Cochabamba, MNCN 43380–81; PERU: Departamento Cusco: Marcapata Valley, BM 1947.2.21.23 (lectotype).