



Two new minute species of *Phrynopus* (Lissamphibia: Anura) from the Cordillera oriental in Peru

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Abstract

Two small new species of terrestrial frogs of the genus *Phrynopus* are described from the Andes in the Department of Pasco in central Peru. The presence of a tympanum in one species is shared with *P. peruanus*. The second species shares characters with the larger *P. dagmarae* from the Department of Huánuco. The new species are the smallest known members of the genus.

Key words: *Phrynopus*, new species, Andes, central Peru

Resumen

Describimos dos especies nuevas pertenecientes al género *Phrynopus* y distribuidas en el Departamento de Pasco, centro del Perú. Una de las especies presenta un tímpano similar al de *P. peruanus*. La segunda especie tiene características similares a las de *P. dagmarae*, una especie de mayor tamaño que se conoce del Departamento de Huánuco. Las dos especies nuevas son las más pequeñas hasta ahora conocidas del género.

Palabras claves: *Phrynopus*, especies nuevas, Andes, centro del Perú

Introduction

Exploration of regions previously poorly known biologically has shown the existence of great biodiversity. The small, terrestrial frogs of the genus *Phrynopus* Peters are an excellent example. Peters (1874) described *Phrynopus peruanus* from the high Andes in Departamento Junín, Peru. Nearly three quarters of a century passed until the descriptions of two new species of “*Syrrhophus*” from the same region by Shreve (1938); subsequently both of these were placed in *Phrynopus* (Cannatella 1985; Lynch 1975). Hedges’ (1990) naming of *Phrynopus bracki* from Departamento Pasco, Peru, brought the total number of species to four. Within the past decade 13 species of *Phrynopus* have been named from the Cordillera Oriental of the Andes in the adjacent departments of Ayacucho, Huánuco, Junín, and Pasco in central Peru by Lehr and collaborators (Lehr 2001, 2007a; Lehr & Aguilar 2002, 2003; Lehr et al. 2000, 2002, 2005b); one of these new species, *Phrynopus carpish* Lehr, Rodríguez & Córdova, 2002, was found to be a microhylid and was designated the type species of *Melanophryne* Lehr & Trueb (2007).

In addition to the type series of *Phrynopus bracki* Hedges in 1987 collected several specimens of previously described species of frogs, including *Pristimantis* (formerly *Eleutherodactylus*) *bromeliaceus* Lynch, *P.*

mendax Duellman, and several new species—*P. aniptopalmatus*, *bipunctatus*, *rhabdocnemus*, and *stictogaster* (Duellman & Hedges 2005), as well as *P. sagittulus* (Lehr et al. 2004), and two more species of *Phrynopus* described herein.

Lynch (1975) reviewed the genus *Phrynopus*; in his discussion of morphological characters, he described several new species and placed *Noblella* Parker and *Niceforonia* Goin and Cochran as junior synonyms of *Phrynopus*. Cannatella (1984) described two other species that he placed in *Phrynopus* and provided a partial morphological-based phylogeny. Lehr et al. (2005a) provided the first molecular phylogeny to include several species of *Phrynopus*. The family designation of *Phrynopus* and related genera has swayed from Leptodactylidae to Brachycephalidae (Lynch 1975; Darst and Cannatella 2004; Frost et al. 2006); the familial arrangement was questioned by Heinicke et al. (2007). In their molecular phylogenetic arrangement, “*Phrynopus*” was not monophyletic. Herein we refer to a clade of species in central Peru as *Phrynopus (sensu stricto)*. The genus contains 19 species (including the two described herein) and is known to occur at elevations of 2200–4400 m in humid upper montane forests and puna in the central part of the Cordillera Oriental (departments of Ayacucho, Húanuco, Junín, and Pasco) northwest of the Río Apurímac in Central Peru; one species, *P. thompsoni*, occurs in an adjacent part of the Cordillera Occidental in the southern part of Departamento La Libertad.

Material and methods

Treatment of the animals in the field followed the standardized guidelines (Anonymous, 1987). Color photographs were taken of living frogs. Subsequently, frogs were euthanized in ice water, tissues were removed and stored in liquid nitrogen, and specimens were fixed in 10% formalin and later transferred to 70% ethanol. The format for the diagnoses and descriptions of the new species follow those of Lynch & Duellman (1997) with the exception that dentigerous processes of vomers is used in place of vomerine odontophores. Measurements were taken with dial calipers and rounded to the nearest 0.1 mm. Snout-vent length is abbreviated SVL throughout. The following abbreviations are used for museum collections: KU = Natural History Museum at the University of Kansas; MHNSM = Museo de Historia Natural Universidad de San Marcos, Lima, Peru; MTD = Staatliche Naturhistorische Sammlungen Dresden Museum für Tierkunde.

Phrynopus auriculatus new species

Holotype: KU 291633, adult male, 2.9 km N, 5.5 km E (airline) Oxapampa, 2600 m, 10°32'38"S, 75°21'10"W, Departamento Pasco, Peru, obtained on 2 July 1987 by S. Blair Hedges.

Paratype: KU 291634, female, from the same locality, obtained on 3 July 1987 by S. Blair Hedges.

Diagnosis. A species of *Phrynopus* characterized by: (1) skin on dorsum smooth with low longitudinal ridges on body; that on venter smooth; dorsolateral folds low, narrow; discoidal fold not evident; (2) tympanic membrane and tympanic annulus present; (3) snout rounded in dorsal view and in profile; (4) upper eyelid lacking tubercles, narrower than IOD; cranial crests absent; (5) dentigerous processes of vomers present; (6) vocal slits present; nuptial pads absent; (7) Finger I shorter than Finger II; tips of digits rounded, barely expanded; (8) fingers lacking lateral fringes; (9) ulnar tubercles low, diffuse; (10) heel lacking tubercles; inner tarsal fold absent; (11) inner metatarsal tubercle low, round, about 2x round outer metatarsal tubercle; supernumerary plantar tubercles absent; (12) toes lacking lateral fringes; webbing absent; Toe V slightly longer than Toe III; tips of digits rounded; (13) dorsum brown; belly creamy white; (24) SVL in one male 13.4 mm, in one female 14.5 mm.

The presence of a differentiated tympanic membrane readily distinguishes *Phrynopus auriculatus* from all congeners except *P. peruanus*. In *P. ayacucho* the tympanic annulus is visible below the skin, and in *P. mon-*

tium, the ventral part of the tympanic annulus is visible externally, but in neither of these species is the tympanic membrane differentiated. *Phrynopus auriculatus* differs from *P. peruanus* in being smaller and in having Toe V slightly longer than Toe III, in contrast to Toes III and V being equal in length in *P. peruanus*. Furthermore, the two species differ in the texture of the skin on the dorsum, which is somewhat uniformly tuberculate in *P. peruanus* but smooth with three longitudinal ridges in *P. auriculatus*. Also there are distinct differences in color pattern with black and white ventral mottling and many irregular dark brown marks on the dorsum of the body in *P. peruanus*, in contrast to nearly uniform reddish brown dorsum and cream venter in *P. auriculatus* (Figs. 1A & 1C). Moreover, females of *P. peruanus* have a conspicuous orange blotch in the groin (Lehr, 2007). See Table 1 for comparisons with all other species of *Phrynopus*.

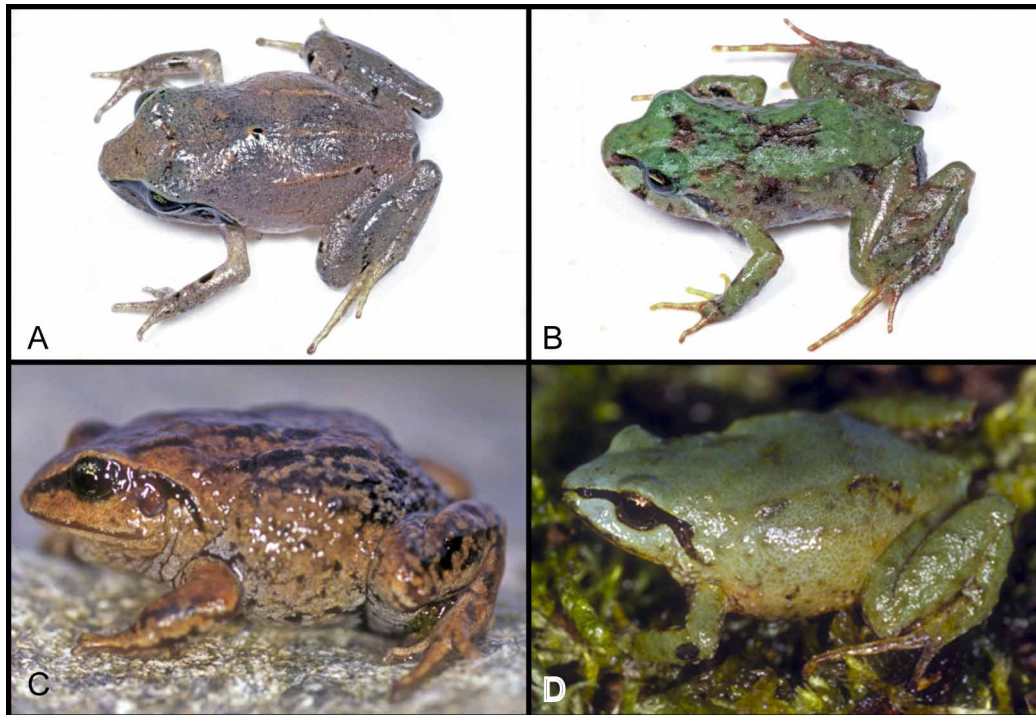


FIGURE 1. Species of *Phrynopus*: (A) *P. auriculatus*, KU 261633, male holotype, 13.4 mm SVL; (B) *P. tribulosus*, KU 261630, male holotype, 15.2 mm SVL.; (C) *P. peruanus*, MTD 46802, male, 22.5 mm SVL, from Puna of Maraynioc, Pasco, Peru; (D) *P. dagmarae*, MHNSM 20453, male, 26.6 mm SVL, from 15 km SE Maraypata, Huánuco, Peru. A and B by S. B. Hedges; C and D by E. Lehr.

Description of holotype. Adult male; body moderately robust; head about as wide as body, longer than wide; head width 38.8% SVL; head length 44.8% SVL; snout bluntly rounded in dorsal view and in profile; canthus slightly curved, rounded in profile; loreal region nearly flat; lips rounded; nostrils barely protuberant, directed laterally; internarial region barely depressed; top of head flat; width of upper eyelid less (81.2%) than IOD; eye large, its diameter much greater than its distance from nostril; tympanum vertically ovoid with distinct membrane and annulus, separated from eye by distance 1.5x length of tympanum; supratympanic fold weak, angling posteroventrally from point above tympanum, obscuring posterodorsal edge of tympanum. Tongue nearly as broad as long, deeply notched posteriorly, free behind for about one third of its length; choanae small, round, not concealed by palatal shelf of maxillary; dentigerous processes of vomers low, transverse behind level of choanae, each bearing two teeth; vocal slits present, short, longitudinal, lateral to base of tongue.

Forelimb slender; ulnar tubercles low, diffuse; palmar tubercle low, round, about same size as thenar tubercle; subarticular tubercles large, rounded; supernumerary tubercles absent; fingers slender, lacking lateral

fringes; relative lengths of fingers I<II<IV<III; tips of fingers barely expanded, rounded, lacking circumferential grooves; nuptial pads absent. Hind limb moderately slender; tibia length 51.5% SVL; foot length 50.8% SVL; heel and tarsus lacking tubercles; inner tarsal fold present on distal third of tarsus; inner metatarsal tubercle low, round, about 2x round outer metatarsal tubercle; subarticular tubercles small, rounded; supernumerary tubercles absent; toes slender, lacking lateral fringes; relative lengths of toes I<II<III<V<IV; tips of toes narrow, rounded, lacking circumferential grooves.

TABLE 1. Structural characters of the known species of *Phrynopus*.

Species	Skin on Venter	Skin on dorsum	Tympanum	Eyelid tubercles	Heel tubercles	Toe lengths	Vomerine teeth	Maximum SVL Males/Females
<i>P. auriculatus</i>	smooth	smooth	present	absent	absent	V>III	present	13.4/14.5
<i>P. ayacucho</i>	areolate	tuberculate	subdermal	present	absent	V>III	present	—/29.1
<i>P. barthlenae</i>	areolate	tuberculate	absent	present	small	V>III	absent	28.1/35.0
<i>P. bracki</i>	smooth	tuberculate	absent	absent	conical	V>III	present	16.2/19.8
<i>P. bufoides</i>	areolate	pustulate	absent	absent	absent	V>III	absent	20.9/33.6
<i>P. dagmarae</i>	areolate	tuberculate	absent	absent	absent	V=III	present	18.1/27.3
<i>P. heimorum</i>	areolate	tuberculate	absent	absent	absent	V>III	absent	16.6/26.0
<i>P. horstpauli</i>	areolate	tuberculate	absent	absent	absent	V>>III	absent	25.6/39.7
<i>P. juninensis</i>	smooth	smooth	absent	absent	absent	V=III	absent	30.6/41.3
<i>P. kauneorum</i>	smooth	smooth	absent	absent	absent	V>III	present	25.6/56.4
<i>P. kotosh</i>	areolate	tuberculate	absent	present	small	V=III	present	17.4/26.2
<i>P. montium</i>	areolate	areolate	ventrally	present	absent	V>III	absent	21.0/29.9
<i>P. oblivius</i>	areolate	tuberculate	absent	present	small	V>III	absent	19.7/23.9
<i>P. paucari</i>	areolate	tuberculate	absent	absent	absent	V>III	absent	—/23.8
<i>P. peruanus</i>	areolate	tuberculate	present	absent	absent	V=III	absent	22.5/30.0
<i>P. pesantesi</i>	areolate	tuberculate	absent	absent	absent	V>III	absent	25.5/32.7
<i>P. tautzorum</i>	areolate	tuberculate	absent	absent	absent	V=III	absent	—/29.9
<i>P. thompsoni</i>	areolate	pustulate	absent	absent	absent	V=III	absent	—/27.6
<i>P. tribulosus</i>	smooth	smooth	absent	present	subconical	V=III	absent	15.2/—

Skin on dorsum smooth with narrow, low, dorsolateral and middorsal folds, and low, tubercular, interrupted, transverse interorbital fold; upper eyelids lacking tubercles; skin on venter smooth; discoidal fold not evident; skin ventral and ventrolateral to cloaca granular.

Coloration of holotype in preservative: Dorsum and flanks pale brown with dark brown markings consisting of canthal stripe, face mask, blotch on medial surface of forearm, small middorsal spot on body, and small, irregular marks on posterior part of body and dorsal surfaces of hind limbs; cloacal area dark brown; venter cream with minute brown flecks.

Coloration of holotype in life: Dorsum of head, body, and limbs pale grayish brown with pinkish tinge on snout and flanks and with golden orange-tan dorsolateral and middorsal ridges on body and interorbital ridge on head (Fig. 1A); dark brown to black markings consist of broad canthal stripe, face mask including tympanic area, large spot on medial surface of each forearm, middorsal spot on back, and irregular small marks on posterior part of body and dorsal surfaces of hind limbs; posterior surfaces of thighs lacking flash marks; iris greenish gold with fine black reticulations.

Measurements of holotype and paratype in mm: Data are for male holotype followed by female paratype. SVL 13.4, 14.5; tibia length 6.9, 7.3; foot length 6.8, 7.0; head length 6.0, 6.2; head width 5.2, 5.6; interorbital

distance 2.0, 2.2; width of eyelid 1.3, 1.3; internarial distance 1.6, 1.8; eye-nostril distance 1.4, 1.4; diameter of eye 2.1, 2.1; diameter of tympanum 1.3, 1.3.

Distribution and ecology. This species is known only from the type locality in humid montane forest, where both individuals were found on the ground after rains.

Etymology. The specific name is Latin meaning having an ear. The name is applied to this species because of the presence of a differentiated tympanic membrane.

Phrynopus tribulosus new species

Holotype: KU 291630, adult male, from 2.9 km N, 5.5 km E (airline) Oxapampa, 2600 m, 10°32'38"S, 75°21'10"W, Departamento Pasco, Peru, obtained on 3 July 1987 by S. Blair Hedges.

Diagnosis. A species of *Phrynopus* characterized by: (1) skin on dorsum finely shagreen with scattered small tubercles; that on venter smooth; dorsolateral folds absent; discoidal fold absent; (2) tympanic membrane not differentiated; tympanic annulus absent; (3) snout moderately short, bluntly rounded in dorsal view, rounded and inclined anteroventrally in profile; (4) upper eyelid bearing small tubercles, narrower than IOD; cranial crests absent; (5) dentigerous processes of vomers absent; (6) vocal slits and nuptial pads absent; (7) Finger I shorter than Finger II; tips of fingers rounded, barely expanded; (8) fingers lacking lateral fringes; (9) ulnar tubercles absent; (10) heel bearing one subconical tubercle, outer edge of tarsus with row of subconical tubercles; inner tarsal fold absent; (11) inner metatarsal tubercle ovoid, about equal in size to rounded outer metatarsal tubercle; supernumerary plantar tubercles absent; (12) toes lacking lateral fringes; webbing absent; Toes III and V equal in length; tips of toes rounded; (13) dorsum green with brown markings; (24) SVL in one male 15.2 mm.

The presence of a single subconical tubercle on the heel and a row of subconical tubercles on the outer edge of the tarsus distinguishes *Phrynopus tribulosus* from most other species in the genus. *Phrynopus barthlenae* Lehr & Aguilar, *P. kotosh* Lehr, and *P. oblivius* Lehr have several small tubercles on the heel, and the last two species also have small tubercles on the outer edge of the tarsus; of these species, *P. barthlenae* and *P. oblivius* differ from *P. tribulosus* in having Toe V slightly longer than Toe III (instead of equal in length) and in color pattern—gray and black dorsally and ventrally in *P. barthlenae*, mottled tan and brown dorsally and ventrally in *P. kotosh*, and white spots on a brown dorsum and red venter in *P. oblivius*. The tubercles in *P. bracki* and *P. dagmarae* are larger and much like those in *P. tribulosus*; *P. bracki* differs from *P. tribulosus* in having Toe V slightly longer than Toe III (instead of equal in length), vomerine teeth present (absent in *P. tribulosus*) and in coloration—predominately brown dorsally and ventrally. *Phrynopus tribulosus* is most like *P. dagmarae*, which differs by being larger with a more robust body and in lacking vocal slits. Also, *P. dagmarae* has a red blotch in the groin; some individuals are brown and others are green (Fig. 1D). See Table 1 for comparisons with all other species of *Phrynopus*.

Description of holotype. Adult male with white testes; body moderately slender; head as wide as body, slightly longer than wide; head width 33.6% SVL; head length 34.9% SVL; snout bluntly rounded, nearly truncate in dorsal view, rounded and slightly inclined anteroventrally in profile; canthus slightly curved, rounded in profile; loreal region distinctly concave; lips not flared; nostrils not protuberant, directed laterally; internarial region not depressed; top of head slightly convex; width of upper eyelid much less (64.7%) than IOD; eye large, its diameter much greater than its distance from nostril; tympanum and supratympanic fold absent. Tongue longer than broad, shallowly notched posteriorly, free behind for about one fourth of its length; choanae small, ovoid, partially concealed by palatal shelf of maxillary; dentigerous processes of vomers not visible; vocal slits absent.

Forelimb slender; ulnar tubercles absent; palmar tubercle large, ovoid, slightly bifurcate distally, barely larger than elliptical thenar tubercle; subarticular tubercles large, rounded to subconical; supernumerary tuber-

cles absent; fingers slender, lacking lateral fringes; relative lengths of fingers I<II<IV<III; tips of fingers barely expanded, rounded, lacking circumferential grooves; nuptial pads absent. Hind limb short, moderately slender; tibia length 44.1% SVL; foot length 44.7% SVL; heel bearing small, subconical tubercle; outer edge of tarsus having three broad subconical tubercles; inner tarsal fold absent; inner metatarsal tubercle ovoid, about same size as round outer metatarsal tubercle; subarticular tubercles small, rounded; supernumerary tubercles absent; toes slender, lacking lateral fringes; relative lengths of toes I<II<III=V<IV; tips of toes narrow, rounded, lacking circumferential grooves.

Skin on dorsum smooth with scattered, small, round tubercles most prominent on flanks and hind limbs; tubercles on upper eyelids small; dorsolateral folds absent; skin on venter smooth; discoidal fold not evident; skin around cloaca and ventrolateral to cloaca granular.

Coloration of holotype in preservative: Dorsum pale tan with brown markings consisting of canthal stripe, labial bars, postorbital stripe, interorbital bar, blotch on medial surface of forearm, and middorsal rectangular mark on body; cloacal area dark brown continuous with dark brown longitudinal stripe on posterior surface of thigh; flanks pale brown; faint brown bars on hind limbs; venter cream with brown blotches.

Coloration of holotype in life: Dorsal surfaces of head, body, and limbs dull green with dark brown markings consisting of canthal stripe, three labial bars on each upper lip, short postorbital stripe, broad interorbital bar, irregularly bordered diagonal mark from behind orbit to X-shaped mark on midbody, blotch on medial surfaces of forearms, and diagonal bars on hind limbs (Fig. 1B); flanks tannish green with brown smudge anteriorly and dark brown blotch in upper groin; posterior surfaces of thighs dark brown; Fingers I and II and Toes I–III dull greenish yellow; other digits brown; venter; posterior surfaces of thighs lacking flash marks; iris dark brown with gold flecks.

Measurements of holotype in mm: SVL 15.2; tibia length 6.7; foot length 6.8; head length 5.3; head width 5.1; interorbital distance 1.7; width of eyelid 1.1; internarial distance 1.7; eye-nostril distance 1.3; diameter of eye 2.0.

Distribution and ecology. The species is known only from the type locality in humid montane forest, where it was found deep within a mossy bank by day.

Etymology. The specific name is Latin meaning thorny. The name refers to the short, thorn-like tubercles on the heel and outer edge of the tarsus.

Discussion. Species of *Phrynopus* have restricted distributions at elevations of 2200–4400 m in the Andes in central Peru. Most frequently they are the only anurans found at the higher elevations, and there are few cases of sympatric pairs of species—*P. dagmarae* and *P. tautzorum*, *P. heimorum* and *P. hortspauli*, and *P. kotosh* and *P. montium* all at elevations above 2900 m in Departamento Huánuco; *P. juninensis* and *P. montium* as well as *P. oblivius* and *P. peruanus* at elevations in excess of 3000 m in Departamento Junín; *P. juninensis* and *P. paucari* at an elevation of 3600 m in Departamento Pasco (Lehr 2007b; Lehr et al. 2002, 2005b). The type locality of the two new species at an elevation of 2600 m harbors three species of *Phrynopus*, the two species described herein plus *P. bracki* (Hedges, 1990).

In the Andes in central Peru species of *Phrynopus* generally occur at higher elevations than do *Pristimantis*. The localities in the vicinity of Oxapampa are the lowest for species of *Phrynopus*. At the type locality at 2600 m, the three species of *Phrynopus* occur sympatrically with *Pristimantis bromeliaceus* and *P. rhabdonemus*, and at San Alberto at 2200 m, *Phrynopus bracki* occurs sympatrically with these same two species of *Pristimantis*, plus *Pristimantis sagittulus* (Duellman and Hedges 2005; Lehr et al. 2004).

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