

Two new species of Andes Frogs (Craugastoridae: *Phrynopus*) from the Cordillera de Carpish in central Peru

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Abstract. We describe two new species of *Phrynopus* from the Unchog Elfin Forest of the Cordillera de Carpish in the eastern Andes of central Peru, Región Huánuco. Specimens were obtained from the Puna at elevations between 3276 and 3582 m above sea level. One of the new species is described based on a single male which has a pale gray coloration with large tubercles on dorsum and flanks. It is most similar to *P. bufoides* and *P. thompsoni*. The second new species is described based on a male and a female. This new species has a grayish-brown coloration with reddish-brown groin, and discontinuous dorsolateral folds. It is most similar to *P. dagmarae* and *P. vestigiatus*. There are currently 32 species of *Phrynopus*, all known from Peru, seven (22%) of which inhabit the Cordillera de Carpish.

Key words. Amphibia, Anura, new species, Puna, singleton species, taxonomy, Unchog forest.

Resumen. Describimos dos nuevas especies de *Phrynopus* del bosque enano de Unchog en la Cordillera de Carpish en los Andes orientales del centro del Perú, en la región de Huánuco. Los especímenes fueron obtenidos en la ecorregión Puna entre 3276 y 3582 m de altitud. La primera especie es descrita en base a un macho de coloración gris pálido con tubérculos grandes en el dorso y en los lados del cuerpo; es muy similar a *P. bufoides* y *P. thompsoni*. La segunda especie es descrita en base a un macho y una hembra. Esta especie tiene una coloración marrón grisáceo con pliegues dorsolaterales discontinuos en el dorso y con angle de color marrón rojiza. Actualmente hay 32 especies de *Phrynopus*, todas de Perú, de las cuales siete (22%) habitan en la Cordillera de Carpish.

Palabras claves. Amphibia, Anura, Bosque de Unchog, especie única, nuevas especies, taxonomía, Puna.

Introduction

Andes frogs of the genus *Phrynopus* PETERS, 1873 are terrestrial-breeding frogs that inhabit montane forests and high Andean grassland habitats (Puna) in northern in central Peru between 2200 and 4400 m a.s.l. (DUELLMAN & LEHR 2009). Currently, 32 species of *Phrynopus* are known (AmphibiaWeb 2017), many of which have been described in the last two decades.

The Cordillera de Carpish is an unprotected mountain range northeast of the city Huánuco of the eastern Andes (Fig. 1). It is relatively easy to reach by car following the road from Huánuco to Tingo Maria and turning northwest at km 19.5 or shortly after crossing the tunnel of Carpish at km 46.6 (see below for details). The area is popular among ornithologists since the seventies because of its high regional endemism. Several new species of vertebrates have been described from the Cordillera de Carpish including

mammals (e.g., PACHECO 2002, JIMÉNEZ & PACHECO 2016), birds (e.g., PARKER & O'NEILL 1976) and six species of frogs (LEHR et al. 2002, DUELLMAN et al. 2004, GUAYASAMIN et al. 2006, LEHR & ORÓZ 2012, CHÁVEZ et al. 2015). The vascular flora of the Cordillera de Carpish includes 876 recorded species of which 29 are local endemics (BELTRÁN & SALINAS 2010).

The type localities of three species of *Phrynopus* are located in the Cordillera de Carpish (*P. daemon* CHÁVEZ, SANTA-CRUZ, RODRÍGUEZ & LEHR, 2015; *P. interstinctus* LEHR & ORÓZ, 2012; *P. vestigiatus* LEHR & ORÓZ, 2012), while two other species of *Phrynopus* (*P. dagmarae* LEHR, AGUILAR & KÖHLER, 2002; *P. kauneorum* LEHR, AGUILAR & KÖHLER, 2002) have been recorded there. Herein, we describe two new species of *Phrynopus* that were collected in the Unchog elfin forest of the Cordillera de Carpish in July 2013.

Materials and methods

Study area and specimens

The Cordillera de Carpish (Fig. 1) covers 1220 km² between 1829 and 3658 m elevation (PARKER 2009) and is located at 10°33'37"–17°37" S and 75°30'21"–20°39" W in eastern central Peru. It belongs to the Yungas (or Selva Alta) (BRACK 1986) ecoregion and the formation of vegetation is defined as sclerophyllous forest (= "Monte Esclerófilo", Salinas 2005). The field survey was conducted from July 20 to 24, 2013 by D. RODRÍGUEZ and R. CHU. Within the Unchog forest, we sampled four sites that had continuous vegetative cover, patches, pasture and shrub land. The Unchog elfin forest which is considered as an ecotone between cloud forest and Puna grassland is characterized by a dry (May–September: < 150 mm rainfall/month) and wet season (October–March: > 200 mm rainfall/month) (GONZALEZ 2015). The Unchog elfin forest can be reached from the city of Huánuco by car, taking the central highway which runs from Huánuco to Tingo María, up to 19.5 km. Then, an unpaved road has to be taken at this point, and continue to Taruca and Cochabamba. Finally, a trail can be walked to reach the forest. Amphibians were preserved in 10% formal and stored in 70% ethanol. Liver tissues were collected

prior to preservation from one of the new species (MUSM 32748, 32749), stored in 96% ethanol and deposited at the Museo de Historia Natural Universidad Nacional Mayor de San Marcos, Lima, Peru.

Morphological characters

The format for the descriptions follow LYNCH & DUELLMAN (1997), except that the term dentigerous processes of vomers is used instead of vomerine odontophores (DUELLMAN et al. 2006), and diagnostic characters are those of DUELLMAN & LEHR (2009). Taxonomic classification follows HEDGES et al. (2008), except that we followed PYRON & WIENS (2011) for family placement. Sex and maturity of specimens were identified by observing gonads through dissections. The senior author measured the following variables to the nearest 0.1 mm with digital calipers under a stereomicroscope: snout–vent length (SVL, straight length distance from tip of snout to vent), tibia length (TL, distance from the knee to the distal end of the tibia), foot length (FL, distance from proximal margin of inner metatarsal tubercle to tip of Toe IV), head length (HL, from angle of jaw to tip of snout), head width (HW, at level of angle of jaw), horizontal eye diameter (ED), interorbital distance (IOD), upper eyelid width (EW), internarial distance (IND), and eye–nostril distance (E–N, straight line distance between anterior corner of orbit and posterior margin of narial opening). Fingers and toes are numbered preaxially to postaxially from I–IV and I–V, respectively. We compared the lengths of toes III and V by adpressing both toes against Toe IV; lengths of fingers I and II were compared by adpressing the fingers against each other. To avoid reflection, the preserved types were photographed immersed in ethanol. All drawings were made by EL using a stereomicroscope and a camera lucida. Photographs taken in the field by D. RODRIGUEZ were used for descriptions of coloration in life. Information on species for comparative diagnoses was obtained from DUELLMAN & LEHR (2009) and from original species descriptions. For specimens examined see Appendix. Specimens were deposited in the herpetological collections of the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos (MUSM) in Lima, Peru. For specimens examined, see Appendix. Conservation status was evaluated using the criteria in IUCN (2001). Maps were designed with ArcGIS 10.0 by J. C. Cusi.

Nomenclatural acts

The electronic edition of this article conforms to the requirements of the amended International Code of Zoological Nomenclature, and hence the names contained herein are available under that Code of this article. This published work and the nomenclatural acts it contains have been registered in ZooBank (www.zoobank.org), the online registration system for the ICZN. The LSID (Life Sci-

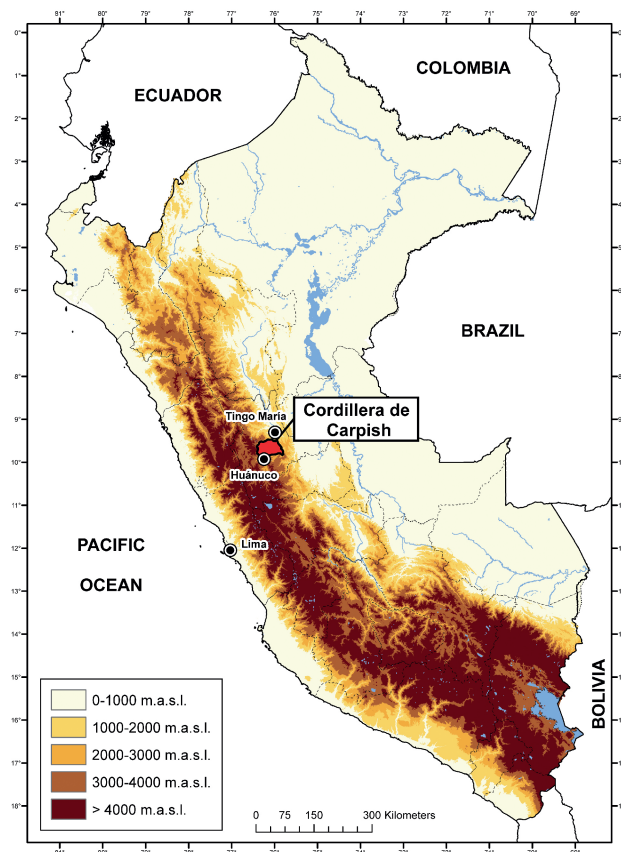


Figure 1. Map of Peru with the Cordillera de Carpish surrounded in red. Map by J. C. Cusi.

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Results

The placement of the two new species to *Phrynopus* is based on the structure of the digital tips that lack circumferential grooves as well as the overall morphological similarity with the other members of the genus. Furthermore, molecular characters (mitochondrial genes [16S rRNA, 12S rRNA] and a nuclear gene [RAG1]) confirmed the placement of *P. unchog* sp. n. in *Phrynopus* (R. VON MAY pers. comm.). Tissues for *P. lapidoides* sp. n. are not available.

Phrynopus lapidoides sp. n. (Figs. 3–5, Table 1)

ZooBank LSID: urn:lsid:zoobank.org:act:2oAEEoA2-D2oo-4E4E-8536-A62ED827FE9D

Proposed common names: English: Stone Rubber Frog. Spanish: Rana cutín goma.

Holotype: MUSM 32750, adult male from Laguna Bombom (09°43'59.95" S, 76°10'57.21" W, 3582 m a.s.l.), Unchog elfin forest, Cordillera de Carpish, Distrito de Churubamba, Provincia de Huánuco, Región Huánuco, Peru, collected on 21 July 2013 by DANIEL RODRÍGUEZ.

Diagnosis: A species of *Phrynopus* having the following combination of characters: (1) Skin on dorsum tuberculate, flanks coarsely tuberculate; skin on venter coarsely areolate; discoidal fold absent, thoracic fold present; prominent, long supratympanic fold; dorsolateral folds absent;

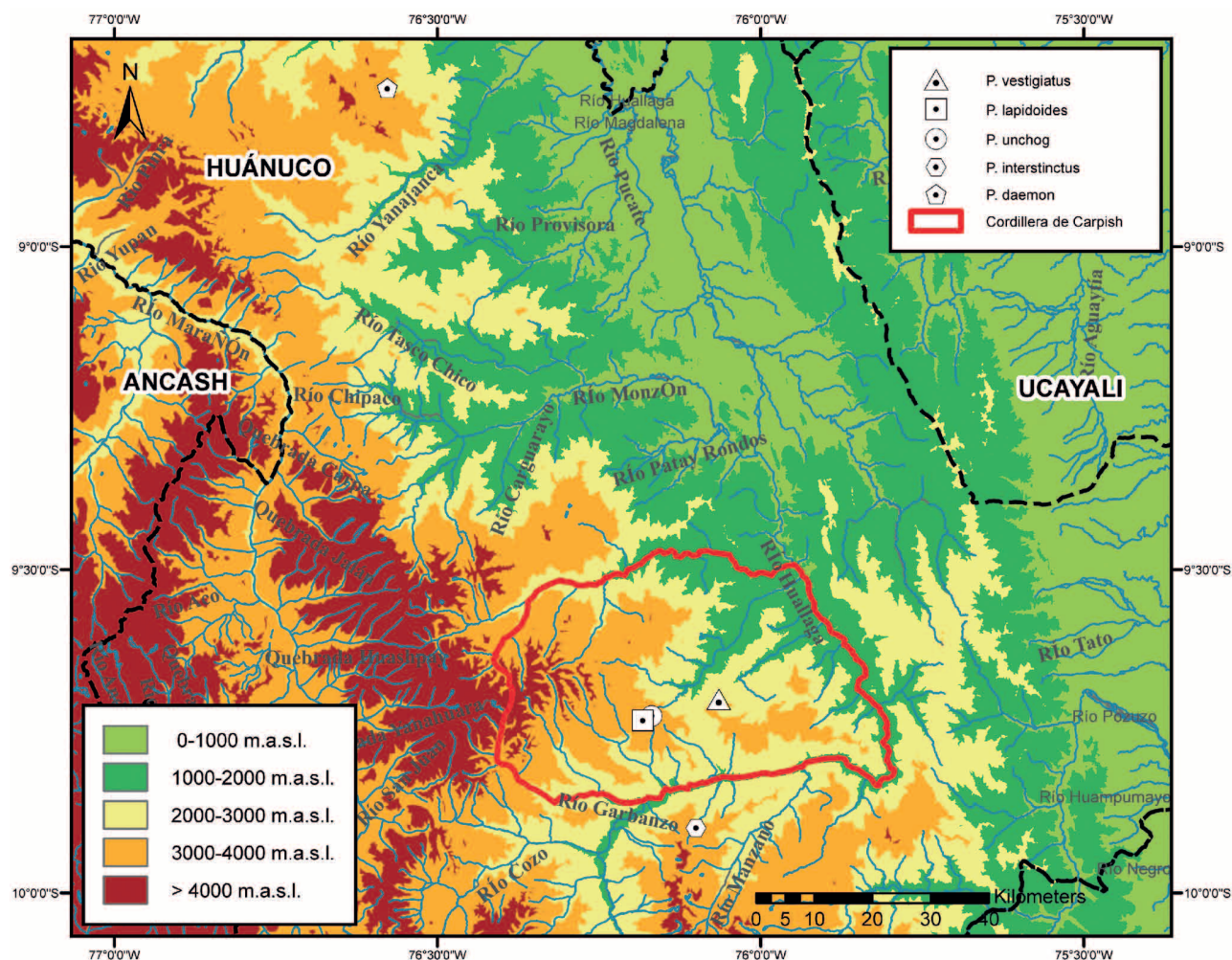


Figure 2. Cordillera de Carpish with location of the type localities (retrieved from original species descriptions; this paper) of the five species of *Phrynopus* described from there or its close surroundings: *Phrynopus daemon*, *P. interstinctus*, *P. lapidoides* sp. n., *P. unchog* sp. n., and *P. vestigiatus*. Map by J. C. Cusi.

Table 1. *Phrynopus* species known from the Cordillera de Carpish with selected characters (CHÁVEZ et al. 2015, DUELLMAN & LEHR 2009, LEHR et al. 2002, LEHR & ORÓZ 2012, this paper). Presence of character indicated by “+”, its absence by “–”.

Characters	<i>P. daemon</i>	<i>P. dagmarae</i>	<i>P. interstinctus</i>	<i>P. kauneorum</i>	<i>P. lapidoides</i> sp. n.	<i>P. unchog</i> sp. n.	<i>P. vestigiatus</i>
Elevation [m a.s.l.]	3138–3341	3020–3380	3100–3180	2735–3380	3582	3276–3477	3100
Max SVL [mm]	24.4	27.3	23.8	56.4	22.1	26.9	18.8
Dorsolateral folds	+, prominent discontinuous	+	+, weakly developed	–	–	+, discontinuous	+, prominent undulated
Dentigerous processes of vomers	–	+	+, minute	+	–	–	+, minute
Skin on dorsum	shagreen with small scattered tubercles	slightly tuberculate	shagreen with small scattered tubercles	smooth	tuberculate	shagreen with small scattered tubercles, some of which forming short ridges	shagreen with small scattered tubercles with Y-shaped and X-shaped ridges
Skin on venter	areolate	areolate	weakly areolate	smooth	areolate	areolate	areolate
Lateral fringes	+	+	–	–	–	–	+
Dorsal colouration	blackish brown	brown or green with grayish-brown blotches	reddish brown, dark grayish brown or olive brown	pale brown with dark brown blotches	dark gray	dorsum dark grayish brown	creamish brown with dark brown X-shaped and Y-shaped ridges
Ventral colouration	blackish brown	dark brown, lime green, yellow, orange or reddish brown with pale gray spots	black with white blotches and flecks	pinkish tan	venter pale gray with dark gray mottling	venter reddish brown with pale gray mottling	dark brown with white spots
Groin colouration	blackish brown	flesh	black with large white blotches that are partially pale salmon	pale brown	dark gray	brownish orange	dark brown with red blotches
Throat colouration	red with pale brown flecks	same as ventral coloration	dark reddish brown with white flecks	pinkish tan	pale brown with dark gray flecks	same as ventral coloration	dark brown with white spots

(2) tympanic membrane and tympanic annulus absent; (3) snout rounded in dorsal and lateral views; (4) upper eyelid tuberculate but without enlarged tubercles; width of upper eyelid 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 digits bulbous, rounded; (8) fingers without lateral fringes; (9) ulnar and tarsal tubercles absent; (10) heel without tubercles; inner tarsal fold absent; (11) inner metatarsal tubercle ovoid, about twice as large as ovoid outer metatarsal tubercle; supernumerary plantar tubercles present; (12) toes without lateral fringes; basal webbing absent; Toe V slightly longer than Toe III; toe tips bulbous, rounded, about as large as those on fingers; (13) in life, dorsum dark gray, venter pale gray with dark gray mottling, throat pale brown with dark gray flecks, groin dark gray; iris gold with fine black reticulations; (14) SVL in single male 22.1 mm.

Phrynopus lapidoides sp. n. is readily distinguished from its congeners by having a gray dorsum with strongly tuberculate dorsum and flanks, and a prominent, long supratympanic fold. *Phrynopus lapidoides* sp. n. shares with ten other species of *Phrynopus* (*P. barthlenae*, *P. bracki*, *P. bufoides*, *P. dagmarae*, *P. heimorum*, *P. horstpauli*, *P. mirosławae*, *P. paucari*, *P. peruanus*, *P. thompsoni*) a tuberculate dorsum and flanks. However, *P. barthlenae* has distinct dark brown canthal and supratympanic stripes (absent in *P. lapidoides* sp. n.) and males with nuptial pads (absent in *P. lapidoides* sp. n.). *Phrynopus bracki* has dentigerous processes of vomers (absent in *P. lapidoides* sp. n.), dorsum and venter brown (gray and pale gray in *P. lapidoides* sp. n.), and max SVL 19.8 mm (22.1 mm in *P. lapidoides* sp. n.). *Phrynopus bufoides* has dorsum and flanks with large round or elongate warts tending to form discontinuous dorsolateral ridges (dorsum less tuberculate with tubercles restricted to lateral and dosolateral surface in *P. lapi-*

doides sp. n.), supratympanic fold short, broad, paratoid-like (prominent, long supratympanic fold in *P. lapidoides* sp. n.), supranumerary plantar tubercles absent (present). *Phrynopus dagmarae* has dorsum strongly tuberculate, dorsolateral folds (absent in *P. lapidoides* sp. n.), dentigerous processes of vomers present (absent in *P. lapidoides* sp. n.). *Phrynopus heimorum* has dorsum slightly tuberculate, and throat, venter, and ventral surfaces of extremities red (gray in *P. lapidoides* sp. n.). *Phrynopus horstpaui* has dorsum tuberculate and dorsolateral folds (absent in *P. lapidoides* sp. n.) and males with nuptial pads (absent in *P. lapidoides* sp. n.). *Phrynopus miroslawae* has a gray dorsum with brown and black blotches (uniformly dark gray in *P. lapidoides* sp. n.), skin on dorsum coarsely tuberculate with enlarged warts (tubercles restricted to lateral and dorsolateral parts in *P. lapidoides* sp. n.), and prominent dorsolateral folds (absent in *P. lapidoides* sp. n.). *Phrynopus paucari* has dorsum and flanks with low, round, tubercles, dorsum dark brown (dark gray in *P. lapidoides* sp. n.), and venter greenish yellow with brown reticulations (pale gray with dark gray mottling in *P. lapidoides* sp. n.). *Phrynopus peruanus* has skin on dorsum tuberculate with tubercles coalesced into ridges dorsally and dorsolaterally, has a tympanum (absent in *P. lapidoides* sp. n.), and males with nuptial pads (absent in *P. lapidoides* sp. n.). *Phrynopus thompsoni* has dorsum with pustules arranged in longitudinal rows forming discontinuous dorsolateral folds (absent in *P. lapidoides* sp. n.), and fingers and toes with lateral fringes (absent in *P. lapidoides* sp. n.).

Seven species of *Phrynopus* have been described or recorded from the Cordillera de Carpish (see Table 1). These are *P. daemon* (CHÁVEZ et al. 2015: Achupampa, 3138 m, Unchog elfin forest, 3341 m), *P. dagmarae* (DUELLMAN & LEHR 2009: Bosque Unchog), *P. interstinctus* (LEHR & ORÓZ 2012: San Marcos, 3100–3160 m), *P. kauneorum* (DUELLMAN & LEHR 2009: Cordillera de Carpish, 2735 m), *P. lapidoides* sp. n. (this paper), *P. unchog* sp. n. (this paper), and *P. vestigiatus* (LEHR & ORÓZ 2012: San Pedro de Carpish, 3100 m). *Phrynopus lapidoides* sp. n. differs from all (except *P. kauneorum*) in lacking dorsolateral folds. *Phrynopus lapidoides* sp. n. has dorsal skin tuberculate (smooth in *P. kauneorum*) and lacks dentigerous processes of vomers (present in *P. kauneorum*).

Description of the holotype: Head as wide as body, slightly longer than wide, HW 94% of HL; HW 39% of SVL; HL 42% of SVL; snout short, rounded in dorsal and lateral views (Figs 3A, D), ED slightly larger than E–N distance; nostrils not protuberant, directed dorsolaterally; canthus rostralis straight in dorsal view, rounded in profile; loreal region slightly concave; lips rounded; upper eyelid tuberculate but without enlarged tubercles; EW narrower than IOD (EW 73% of IOD); supratympanic fold long and prominent, extending from posterior corner of eye to level of upper arm insertion; tympanic membrane and tympanic annulus absent, tympanic region coarsely tuberculate without distinct postrictal tubercles. Choanae small, ovoid, close to but not concealed by palatal shelf of maxilla; dentigerous process-

es of vomers absent; tongue broad, about twice as long as wide, not notched posteriorly, posterior one half free, vocal slits absent.

Skin on dorsum tuberculate, dorsolateral folds absent; skin on flanks coarsely tuberculate with some tubercles coalescing forming short ridges; skin on throat smooth, skin on chest and belly coarsely areolate; discoidal fold absent, thoracic fold present; cloacal sheath short; cloacal region tuberculate. Outer surface of forearm without minute tubercles; outer palmar tubercle bifid, low, ovoid, about 2.5 times the size of ovoid inner palmar tubercle; supernumerary tubercles low, ovoid, about on third the size of subarticular tubercles; subarticular tubercles low, ovoid, most prominent on base of fingers; fingers without lateral fringes; Finger I shorter than Finger II; tips of digits rounded, bulbous, lacking circumferential grooves, lacking nuptial pads (Fig. 5A).

Hind limbs short and fleshy, TL 39% of SVL; FL 45% of SVL; dorsal surface of hind limbs weakly tuberculate; anterior surfaces of thighs smooth, posterior surfaces of thighs tuberculate, ventral surfaces of thighs areolate; heel without a distinct conical tubercle; outer surface of tarsus without small tubercles; outer metatarsal tubercle ovoid, about twice as large as ovoid inner metatarsal tubercle; supernu-



Figure 3. Holotype of *Phrynopus lapidoides* sp. n. in life (MUSM 32750, male, SVL 22.1 mm) in lateral (A), frontal (B), dorsolateral (C), dorsal (D), and ventral views (E). Photos by D. RODRÍGUEZ.

merary plantar tubercles distinct, about one third the size of subarticular tubercles; subarticular tubercles low, ovoid in dorsal view, most distinct on base of toes; toes without lateral fringes; basal webbing absent; toe tips bulbous, rounded, lacking circumferential grooves, about as large as those on fingers; relative lengths of toes: $1 < 2 < 3 < 5 < 4$; Toe V slightly longer than Toe III (tip of Toe V slightly surpassing penultimate subarticular tubercle on Toe IV, tip of Toe III not surpassing penultimate subarticular tubercle on Toe IV; Fig. 5B). Measurements (in mm) of the holotype: SVL 22.1; tibia length 8.6; foot length 10.0; head length 9.3; head width 8.7; eye diameter 2.4; inter orbital distance 3.0; upper eyelid width 2.2; internarial distance 2.1; eye–nostril distance 1.5. Coloration of the holotype in life (Fig. 3): Dorsum, dorsal surfaces of forearms and hind legs dark gray; sides of head dark gray lacking canthal and supratympanic stripes; flanks coloured as dorsum but slightly paler; axilla

and groin coloured as flanks; posterior surfaces of thighs and concealed surfaces of shanks dark gray; throat pale brown with dark gray flecks; chest and belly pale gray with dark gray mottling, thighs dark gray; iris gold with fine black reticulations. Coloration of the holotype in preservative (Fig. 4): As described above but slightly paler; throat grayish tan with dark gray flecks; iris pale gray with black reticulations.

Etymology: The specific name is derived from the Latin noun *lapis* meaning “stone” and *-oides* meaning “like” and refers to the rock-like appearance of skin texture and coloration of the new species.

Distribution, natural history, and conservation status: The species is only known from the type locality inside the Cordillera de Carpish (Figs 1, 2). The habitat of the Laguna Bombom consisted of grassland, shrubs, herbaceous plants, stones, rocks and creeks (Fig. 9A). The holotype was found under a stone, at 11:55 hours. *Phrynopus lapidoides* sp. n. occurs sympatrically with *Phrynopus daemon*, *P. kauneorum*, *P. unchog* sp. n., and *Gastrotheca griswoldi* (Hemiphractidae). We classify *P. lapidoides* sp. n. as ‘Data Deficient’ according to the IUCN (2001) red list criteria and categories based on the limited information on its geographic range.

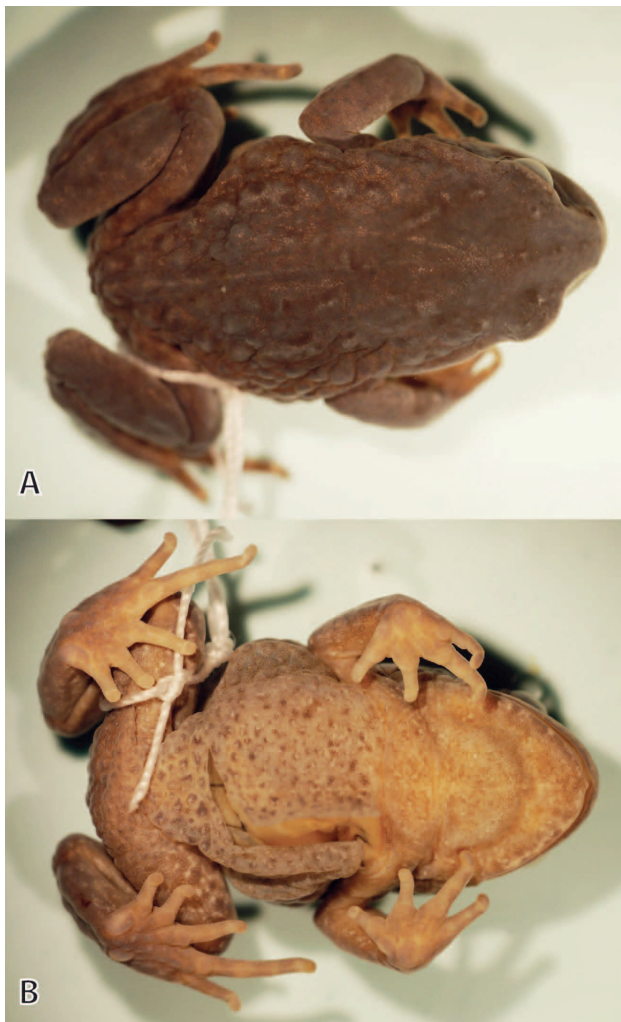


Figure 4. Holotype of *Phrynopus lapidoides* sp. n. in preservative (MUSM 32750, male, SVL 22.1 mm) in dorsal (A), and ventral views (B). Photos by E. LEHR.

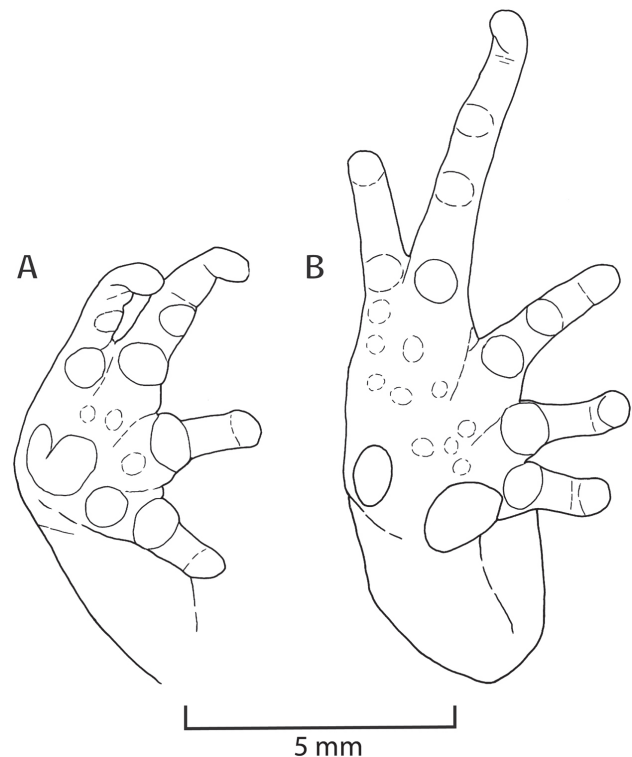


Figure 5. Ventral views of right hand (A) and right foot (B) of holotype of *Phrynopus lapidoides* sp. n. (MUSM 32750). Drawings by E. LEHR.

***Phrynopus unchog* sp. n.**
(Figs. 6–8, Table 1)

ZooBank LSID: urn:lsid:zoobank.org:act:474C241D-1792-433E-B518-6BA455B15330

Proposed common names: English: Unchog Rubber Frog. Spanish: Rana cutín Unchog.

Holotype: MUSM 32749, adult male from Quebrada Chaglla (09°43'34.8" S, 76°10'6.85" W, 3477 m a.s.l.), Unchog elfin forest, Cordillera de Carpish, Distrito de Churubamba, Provincia de Huánuco, Región Huánuco, Peru, collected on 20 July 2013 by DANIEL RODRÍGUEZ.

Paratype: MUSM 32748, adult female from road to Gloria Pata (09°42'42.96" S, 76°9'30.74" W, 3276 m a.s.l.), Unchog elfin forest, Cordillera de Carpish, Distrito de Churubamba, Provincia de Huánuco, Región Huánuco, Peru, collected on 24 July 2013 by DANIEL RODRÍGUEZ.

Diagnosis: A species of *Phrynopus* having the following combination of characters: (1) Skin on dorsum shagreen with small scattered tubercles, some of which forming short ridges, flanks tuberculate, skin on venter areolate; discoidal fold absent, thoracic fold present; postocular folds present, narrow discontinuous dorsolateral folds present; (2) tympanic membrane and tympanic annulus absent; (3) snout rounded in dorsal and lateral views; (4) upper eyelid tuberculate without enlarged tubercles; width of upper eyelid narrower than IOD; cranial crests absent; (5) dentigerous processes of vomers absent; (6) males without vocal slits and nuptial pads; (7) Finger I shorter than Finger II; tips of digits narrow, rounded, weakly pointed; (8) fingers without lateral fringes; (9) ulnar tubercles absent, outer surface of tarsus with row of low, minute tubercles; (10) heel without tubercles; inner tarsal fold absent; (11) inner metatarsal tubercle ovoid, about one and a half as large as rounded outer metatarsal tubercle; supernumerary plantar tubercles present; (12) toes without lateral fringes; basal webbing absent; Toe V slightly shorter than Toe III; toe tips narrow, rounded, weakly pointed, slightly smaller as those on fingers; (13) in life, dorsum grayish brown, flanks dark gray with pale gray spots, venter and throat reddish brown with pale gray mottling, groin brownish orange; iris pale bronze with fine black reticulations (14) SVL in single male 20.4 mm, in single female 26.9 mm.

Phrynopus unchog sp. n. is readily distinguished from its congeners by having a dark grayish brown dorsum, brownish orange groin, and discontinuous dorsolateral folds. *Phrynopus unchog* sp. n. immediately can be distinguished from those species of *Phrynopus* (*P. auriculatus*, *P. montium*, *P. peruanus*) that have a tympanum (absent in *P. unchog* sp. n.), and from those species of *Phrynopus* (*P. dagmarae*, *P. horstpauli*, *P. kauneorum*, *P. kotosh*, *P. mirosławae*, *P. nicoleae*, *P. vestigiatus*) that have dentigerous processes of vomers (absent in *P. unchog* sp. n.), and from those twelve species of *Phrynopus* (*P. barthlenae*, *P. heimorum*, *P. juninensis*, *P. kauneorum*, *P. lapidoides* sp. n., *P. lechriorhynchus*,

P. montium, *P. oblivious*, *P. peruanus*, *P. pesantesi*, *P. tautzorum*, *P. tribulosus*) that lack dorsolateral folds or ridges.

Phrynopus unchog sp. n. shares with 15 species of *Phrynopus* (*P. auriculatus*, *P. badius*, *P. bracki*, *P. bufoides*, *P. curator*, *P. daemon*, *P. dagmarae*, *P. horstpauli*, *P. interstinctus*, *P. kotosh*, *P. mirosławae*, *P. nicoleae*, *P. paucari*, *P. thompsoni*, *P. vestigiatus*) dorsolateral folds or dorsolateral ridges, but differs as follows (condition of *P. unchog* sp. n. in parenthesis): *Phrynopus auriculatus* has a tympanum (absent); *P. badius* lacks supernumerary plantar tubercles (present), had upper eyelid without enlarged tubercles (present), and groin dark brown with bright orange spots (groin brownish orange); *P. bracki* has dentigerous processes of vomers (absent) and ulnar tubercles coalesced into a ridge (absent); *P. bufoides* has dorsum and flanks with large, round or elongate warts (absent); *P. curator* has flanks shagreen with small scattered tubercles (flanks tuberculate), heel with a distinct conical tubercle (absent), and groin brown and gray mottled (groin brownish orange); *P. daemon* has skin on flanks areolate (tuberculate), fingers and toes with lateral fringes (absent), groin dark red (brownish brown), and throat orange-red (reddish brown); *P. dagmarae* has dentigerous processes of vomers (absent), fingers and toes with lateral fringes (absent), and groin with red or flesh coloured spots (brownish orange); *P. horstpauli* has Toe V



Figure 6. Holotype of *Phrynopus unchog* sp. n. in life (MUSM 32749, male, SVL 20.4 mm) in dorsolateral (A), dorsal (B), lateral (C), ventral (D), and ventral views of right foot (E). Photos by D. RODRÍGUEZ.

much longer than Toe III (Toe V slightly shorter than Toe III), and venter cream with grayish brown blotches (reddish brown with pale gray mottling); *P. interstinctus* has dentigerous processes of vomers (absent), and venter black with large white blotches that are partially pale salmon (reddish brown with pale gray mottling); *P. kotosh* has dentigerous processes of vomers (absent); *P. mirosławae* has skin on dorsum coarsely tuberculate with enlarged warts (shagreen with small scattered tubercles), and belly creamy gray with black spots (reddish brown with pale gray mottling); *P. nicoleae* has dentigerous processes of vomers (absent), and Finger I as long as Finger II (Finger I shorter than Finger II); *P. paucari* has dorsum dark brown (dorsum grayish brown), flanks greenish yellow with dark brown blotches and stripes (flanks dark gray with pale gray spots), venter greenish yellow with faint pale brown reticulations (venter reddish brown with pale gray mottling), and groin with diffuse salmon blotches (brownish orange); *P. thompsoni* has skin on dorsum bearing pustules arranged in longitudinal rows (shagreen with small scattered tubercles, some of which forming short ridges), Finger I and Finger II of equal length (Finger I shorter than Finger II), and fingers and toes with lateral fringes (absent); *P. vestigiatus* has

dentigerous processes of vomers (absent), fingers and toes with lateral fringes (absent), and groin dark brown with red blotches (brownish orange).

Seven species of *Phrynopus* have been described or recorded from the Cordillera de Carpish (see Table 1). These are *P. daemon* (CHÁVEZ et al. 2015: Achupampa, 3138 m a.s.l., Unchog elfin forest, 3341 m a.s.l.), *P. dagmarae* (DUELLMAN & LEHR 2009: Bosque Unchog), *P. interstinctus* (LEHR & ORÓZ 2012: San Marcos, 3100–3160 m a.s.l.), *P. kauneorum* (DUELLMAN & LEHR 2009: Cordillera de Carpish, 2735 m a.s.l.), *P. lapidoides* sp. n. (this paper), *P. unchog* sp. n. (this paper), and *P. vestigiatus* (LEHR & ORÓZ 2012: San Pedro de Carpish, 3100 m a.s.l.).

Description of the holotype: Head as wide as body, slightly longer than wide, HW 92% of HL; HW 34% of SVL; HL 37% of SVL; snout short, rounded in dorsal and lateral views (Figs 6A, B), ED slightly larger than E–N distance; nostrils not protuberant, directed dorsolaterally; canthus rostralis straight in dorsal view, rounded in profile; loreal region slightly concave; lips rounded; upper eyelid tuberculate but with three slightly enlarged conical tubercles on each; EW narrower than IOD (EW 78% of IOD); supra-

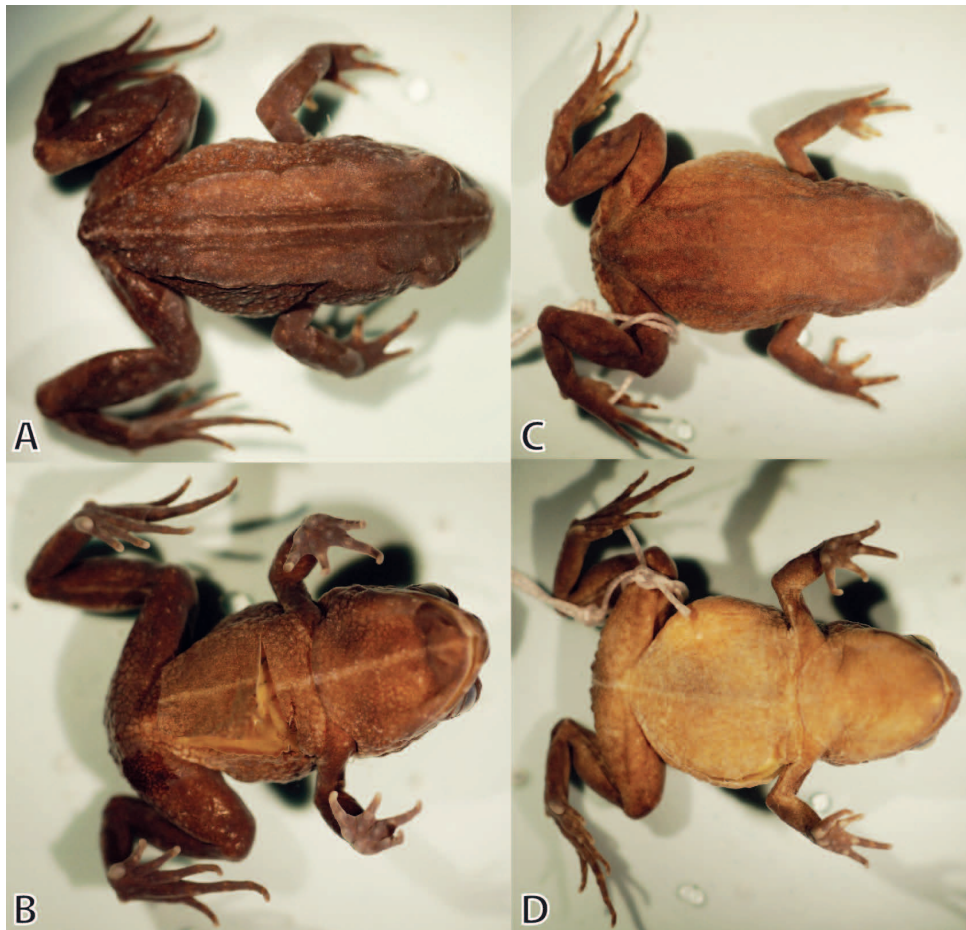


Figure 7. Type specimens of *Phrynopus unchog* sp. n. in preservative: male (holotype MUSM 32749, SVL 20.4 mm) in dorsal (A) and ventral views (B); female (paratype MUSM 32748, SVL 26.9 mm) in dorsal (C) and ventral (D) views. Photos by E. LEHR.

tympanic fold short, not well defined and discernible from tuberculate surrounding skin; tympanic membrane and tympanic annulus absent, tympanic region coarsely tuberculate with two distinct postrictal tubercles on each side. Choanae small, ovoid, close to but not concealed by palatal shelf of maxilla; dentigerous processes of vomers absent; tongue long, narrow, about 2.5 as long as wide, not notched posteriorly, posterior one third free, vocal slits absent.

Skin on dorsum tuberculate, discontinuous dorsolateral folds present; long, narrow middorsal fold on each side of vertebral column; short postocular folds present; skin on flanks more tuberculate than dorsal skin; skin on throat, chest and belly areolate; discoidal fold absent, thoracic fold present; cloacal sheath short; cloacal region tuberculate. Outer surface of forearm without minute tubercles; outer palmar tubercle bifid, low, ovoid, about twice the size of ovoid inner palmar tubercle; supernumerary tubercles low, ovoid, about half the size of subarticular tubercles; subarticular tubercles low, ovoid, most prominent on base of fingers; fingers without lateral fringes; Finger I shorter than Finger II; tips of digits narrow, rounded, weakly pointed, lacking circumferential grooves, lacking nuptial pads (Fig. 8A).

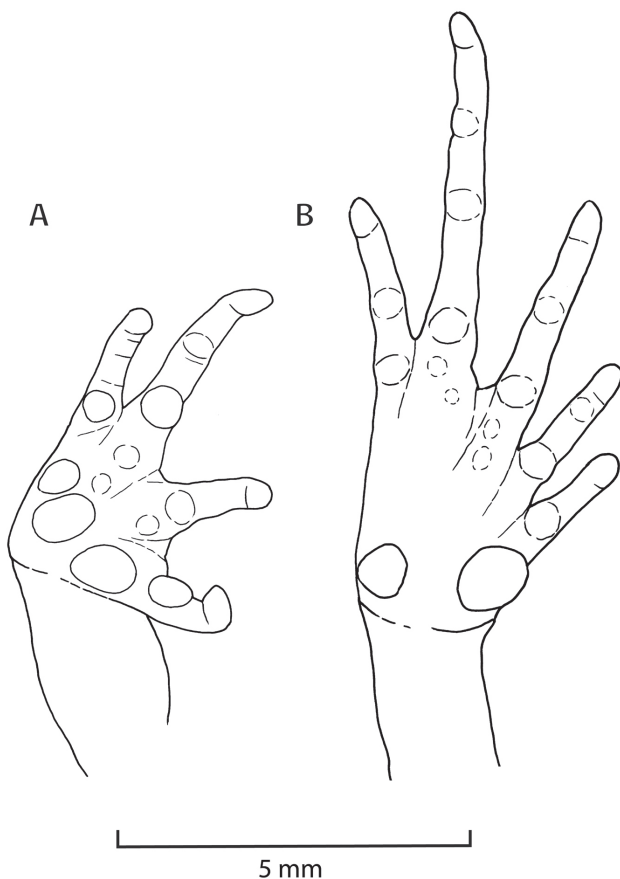


Figure 8. Photos of ventral surfaces of right hand (A) and right foot (B) of *Phrynopus unchog* sp. n. (MUSM 32749). Drawings by E. LEHR.

Hind limbs long and slim, TL 41% of SVL; FL 41% of SVL; dorsal surface of hind limbs tuberculate; anterior surfaces of thighs smooth, posterior surfaces of thighs areolate, ventral surfaces of thighs areolate; heel without a distinct conical tubercle; outer surface of tarsus with small tubercles; outer metatarsal tubercle ovoid, about twice as large as ovoid inner metatarsal tubercle, both prominent and conical; supernumerary plantar tubercles small, not well defined, about half the size of subarticular tubercles; subarticular tubercles low, not well defined, ovoid in dorsal view, about half the size as those on fingers; toes without lateral fringes; basal webbing absent; toe tips narrow, rounded, weakly pointed, lacking circumferential grooves, slightly smaller than those on fingers; relative lengths of toes: $1 < 2 < 3 > 5 < 4$; Toe V slightly shorter than Toe III; Fig. 8B. Measurements (in mm) of the holotype: SVL 20.4; tibia length 8.3; foot length 8.4; head length 7.6; head width 7.0; eye diameter 1.9; inter orbital distance 2.3; upper eyelid width 1.8; internarial distance 1.7; eye–nostril distance 1.6. Coloration of the holotype in life (Fig. 6): Dorsum grayish brown with pale grayish-brown middorsal line; lower arms with a broad, dark grayish-brown blotch; dark grayish-brown canthal and supratympanic stripes, and dark brown bars on upper lip; flanks dark gray with pale gray spots; groin brownish orange; throat and venter reddish brown with pale gray mottling; throat with two dark gray blotches on its tip; narrow, pale gray midventral stripe across throat, chest and belly; transverse narrow, pale gray line ventrally across arms and chest; transverse pale gray line across posterior surfaces of thighs and ventrally across tibiae; remaining ventral surfaces of arms and legs dark gray with pale gray spots; iris pale bronze with fine black reticulations. Coloration of the holotype in preservative (Figs 7A, B): As described above except for brown and orange colors being gray; iris gray.

Variation: The single female (Figs 7C, D) is larger than the holotype and lacks the two middorsal narrow folds. Its upper eyelids are tuberculate but lack enlarged tubercles. Photos of coloration in life are not available. In ethanol, dorsum pale grayish brown; grayish-brown canthal and supratympanic stripes and grayish-brown upper lip bars barely distinguishable; flanks tan; venter pale grayish tan with narrow, pale gray midventral line across chest, belly, and thighs; narrow, transverse pale gray line ventrally across arms and chest; transverse line ventrally across tibiae and posterior surfaces of thighs; iris gray.

Measurements (in mm) of the paratype: SVL 26.9; tibia length 8.9; foot length 9.9; head length 9.3; head width 8.5; eye diameter 2.3; inter orbital distance 2.6; upper eyelid width 2.0; internarial distance 2.1; eye–nostril distance 2.0.

Etymology: The scientific name is used in reference to the type locality, Bosque Unchog (Unchog Forest), where the new species was found. Unchog is derived from the Quechua language meaning “to sit down” or “sitting”. The specific epithet is used as noun in apposition.

Distribution, natural history, and conservation status: *Phrynopus unchog* sp. n. is known from two localities in the Unchog elfin forest of the Cordillera de Carpish (Figs 1, 2). The localities are reached by a narrow trail that ascends the mountain. The habitats consist of trees (~ 5 m in height) with moss-covered branches, bushes, ferns and moss-covered rocks and stones (Fig. 9B). The holotype was found under a rock, at 15:45 h, the paratype was found under a rock at 10:30 h. Sympatric anurans include *Phrynopus daemon*, *P. kauneorum*, and *Gastrotheca griswoldi* (Hemiphractidae). We classify *P. unchog* sp. n. as 'Data Deficient' according to the IUCN red list criteria and categories based on the limited information on its geographic range.



Figure 9. Type localities of *Phrynopus lapidoides* sp. n. (A, Unchog elfin forest, near Laguna Bombom, 3582 m a.s.l.) and *P. unchog* sp. n. (B, Unchog elfin forest, Quebrada Chaglla, 3477 m a.s.l.) in the Cordillera de Carpish with red arrows indicating where holotypes were found under rocks. Photos by D. RODRÍGUEZ.

Discussion

The montane forests and elfin forests of the Cordillera de Carpish are known for their high species diversity and local endemism, and are in need for protection (GONZÁLEZ 2013, RODRÍGUEZ 2007). Especially endemic montane species are at a higher risk of extinction because of their narrow climatic ranges (IPCC 2007) and limited geographical distributions. The Unchog elfin forest is important for local communities because it covers the headwaters of streams that provide water downhill, protects from soil erosion, and provides research opportunities, education and tourism (GONZÁLEZ 2015).

Traditionally, *Phrynopus* was distinguished from other genera of terrestrial-breeding frogs (Craugastoridae) in the Andes based on their finger and toe tips that lack pads and circumferential grooves (LYNCH 1975: p. 4, fig. 1; p. 5, fig. 2) and mostly the lack of a tympanum. However, morphological convergences for these character combinations were revealed by the use of molecular genetics. LEHR et al. (2005) demonstrated that *Phrynopus* is not monophyletic, and even included a species of Microhylidae. Other researchers continued their efforts in their phylogenetic analysis of terrestrial-breeding frogs which resulted in the definition of four new genera *Bryophryne*, *Hypodactylus*, *Lynchi*, and *Psychrophrynella* (HEDGES et al. 2008). There are 37 species of frogs (FROST 2017) that were previously incorrectly assigned to *Phrynopus* and are now placed in ten genera (*Bryophryne*, *Ctenophryne*, *Hypodactylus*, *Lynchi*, *Niceforonia*, *Noblella*, *Oreobates*, *Pleurodema*, *Pristimantis*, *Psychrophrynella*). Consequently, the former wide geographical distribution of *Phrynopus* from Colombia, Ecuador, Peru to Bolivia (LYNCH 1975), is now restricted to northern and central Peru (DUELLMAN & LEHR 2009).

New species of *Phrynopus* are frequently discovered from montane forests and Puna habitats in Peru (e.g., LEHR et al. 2012, MAMANI & MALQUI 2014, RODRÍGUEZ & CATENAZZI 2017), and often the species descriptions are based on a low number of specimens or even a single specimen (= singleton species as defined by LIM et al. 2012), reflecting the rarity of the species or lack of time or commitment during fieldwork. While species descriptions based on a single specimen are common in taxonomic literature (LIM et al. 2012), problems can emerge when additional, similar looking specimens are found and their identification becomes difficult, because of the lack of knowledge regarding intraspecific and interspecific variation (see KÖHLER & PADIAL 2016). Nevertheless, we think our descriptions of a singleton (*Phrynopus lapidoides* sp. n.) and doubleton species (*P. unchog* sp. n.) are justified, because of their distinct suite of morphological characters that distinguishes both from their congeners, and for *P. unchog* sp. n. we have obtained DNA information (GenBank accession numbers of respective sequences will be provided when the research project by R. VON MAY is published; R. VON MAY pers. comm.) supporting its divergence. Furthermore, species of *Phrynopus* occupy habitats at high elevations between 2200 and 4400 m a.s.l. (DUELLMAN & LEHR

2009) and their ranges rarely overlap. We are not aware of a single case of synonymisation of a *Phrynopus* species as the result of a singleton or doubleton species description, but incorrect systematic placement in *Phrynopus* according to morphological convergence has happened: e.g., *Phrynopus carpish* LEHR, RODRÍGUEZ & CÓRDOVA, 2002 moved to the family Microhylidae by LEHR & TRUEB (2007); *Phrynopus spectabilis* DUELLMAN, 2000 synonymized with *Pleurodema marmoratum* by LEHR (2006).

Generic assignment of new species to *Phrynopus* can be challenging without following an integrative taxonomic approach that includes molecular characters. Recently, LEHR & VON MAY (2017) pointed out morphological convergence of a new species of *Pristimantis* from high elevations that lacks circumferential grooves and a tympanum and was considered to be a *Phrynopus* before a phylogenetic analysis of molecular characters revealed otherwise. A taxonomic revision of the genus *Phrynopus* is needed and currently conducted by R. VON MAY (pers. comm.). There are currently 32 species of *Phrynopus* known from Peru, seven (22%) of which inhabit the Cordillera de Carpish, and further new species of *Phrynopus* from central Peru will be described in the near future.

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Appendix

Specimens examined

- Phrynopus barthlenae*: Peru: Huánuco: ca. 15 km SE Maraypata, near Laguna Gwengway, 3680 m: MUSM 20606 (holotype).
- Phrynopus bufoides*: Peru: Pasco: LA VICTORIA, 4100 m: MUSM 18074 (holotype).
- Phrynopus curator*: Yanachaga-Chemillén National Park (Sector San Daniel), 3000 m: MUSM 31106 (holotype).
- Phrynopus daemon*: Peru: Huánuco: Distrito de Churubamba, Cordillera de Carpish, Unchog elfin forest, 3341 m: MUSM 32747 (paratype).
- Phrynopus dagmarae*: Peru: Huánuco: Palma Pampa, 3020 m: MHNSM 20451 (holotype); Huánuco: Cordillera de Carpish, Bosque Unchog, ca. 10 km N Acomayo, 3353 m a.s.l.: USNM 288480.
- Phrynopus interstinctus*: Peru: Huánuco: Cordillera de Carpish, San Marcos, 3100 m: MUSM 29543 (holotype), 3160 m: MUSM 29544–29545 (paratypes).
- Phrynopus kauneorum*: Peru: Huánuco: Chaglla, Palma Pampa, 3020 m: MUSM 20459 (holotype).
- Phrynopus peruanus*: Peru: Junín: Puna of Maraynioc (11°21'35.2"S, 75°28'52.6"W), 3825 m: MHNSM 19977–78.
- Phrynopus vestigiatus*: Peru: Huánuco: Cordillera de Carpish, San Pedro de Carpish, 3100 m: MUSM 29542 (holotype).