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Two distinctive new species of *Pristimantis* (Anura: Strabomantidae) from the Cordillera Oriental with a distributional synopsis of strabomantids in Central Peru

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Abstract

Two new species of the genus *Pristimantis* (*Pristimantis*) that are tentatively placed in the *Pristimantis unistrigatus* Group are described from the Yanachaga-Chemillén region in Departamento Pasco, Peru, where 24 species of strabomantid frogs are known. Both new species inhabit the humid montane forest on the slopes of the Andean Cordillera Oriental, and one of the new species apparently is a cryptic relative of another inhabitant of the region. Among 60 species of strabomantids recorded in a two-degree wide transect from the Amazonian lowland to the crest of the Cordillera Oriental, only three of the species restricted to mid-elevations are known from transects in northern or southern Peru. High elevations are dominated by terrestrial *Phrynopus*, whereas the lowlands and forested slopes of the Andes are dominated by arboreal *Pristimantis.* Within clades there is no elevational correlation with the presence or absence of a tympanum.

Key words: *Pristimantis*, new species, Andes, central Peru, biogeography

Resumen

Se describen dos nuevas especies del género *Pristimantis* (*Pristimantis*) tentativamente asignadas al Grupo *unistrigatus* procedentes de la región del Parque Nacional Yanachaga-Chemillén, departamento de Pasco, Perú, donde se conocen 24 especies de ranas de la familia Strabomantidae. Ambas especies habitan los bosques húmedos montanos de la cordillera oriental de los Andes; una de las nuevas especies aparentemente es un pariente críptico de otra especie, que habita la región. Entre las 60 especies de ranas strabomantidas que fueron registradas en un transecto de dos grados de ancho, desde los bosques lluviosos hasta la cresta de la cordillera oriental, solo tres de las especies están restringidas a elevaciones intermedias y son conocidas en transectos al norte o sur del Perú. Las alturas están dominadas por especies terrestres como *Phrynopus*, considerando que las tierras bajas y las laderas boscosas de los andes están dominados por especies arbóreas de *Pristimantis*. Dentro de los clados no existe ninguna correlación altitudinal en cuanto a la presencia o ausencia del tímpano.

Palabras claves: *Pristimantis*, especies nuevas, Andes, Perú central, biogeografía

Introduction

Biological exploration throughout the Peruvian Cordillera Oriental has revealed the existence of many new species of frogs. This is especially evident in the vicinity of the Parque Nacional Yanachaga Chemillén in

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Departamento Pasco in central Peru, where during the past few years many species of strabomantid frogs have been discovered and named. These include four species of *Phrynopus* (Chaparro et al., 2008; Duellman & Hedges, 2008), 11 species of *Pristimantis* (Boano et al., 2008; Duellman and Hedges, 2005, 2007; Lehr et al, 2004a, 2006), and one species each of *Hypodactylus* (Lehr, 2005) and *Noblella* (Lehr et al, 2004b). We now have two more new species of *Pristimantis;* they are described herein.

Material and methods

Specimens were fixed in 10% formalin and preserved in 70% ethanol. The format for the descriptions follows that of Duellman & Hedges (2007); characters of the tympanum and toes are those defined by Lynch and Duellman (1997). Generic and species group allocations correspond to the classification proposed by Hedges et al. (2008a). Comparative material examined is listed in the Appendix. Measurements were taken with dial calipers to the nearest 0.1 mm. Throughout, snout-vent length is abbreviated SVL and interorbital distance is abbreviated IOD. Coloration in life is from field notes and/or photographs by J.C.C. Museum abbreviations are: KU = Natural History Museum, University of Kansas; MHNC = Museo de Historia Natural, Universidad Nacional de San Antonio Abad del Cusco; and MUSM = Museo de Historia Natural, Universidad Nacional Mayor de San Marcos. The taxonomy follows the classification of strabomantid frogs recently published by Hedges et al. (2008a, b).

Descriptions of New Species

Pristimantis lucasi new species

Holotype: KU 311454–55, MHNC 6475, an adult female, from Abra Esperanza, 2790 m, Distrito Oxapampa, Provincia Oxapampa, Departamento Pasco, Peru (10°31' 54.4" S, 75°20' 58.5" W) one of a series collected on 4 September 2007 by Juan Carlos Chaparro, Aaron Quiroz, and David Salcedo.

Paratopotypes: KU 311454–C55, MHNC 6476, 6478, 6494, 6500, 6504–05, 6526, 6536, and 6565, seven males and five females, collected on 4–10 September 2007 by the same persons, and MHNC 7155, a male, obtained by Juan Carlos Chaparro on 15 May 2008.

Diagnosis. The new species is placed in the *Pristimantis* (*Pristimantis*) *unistrigatus* Group (as defined by Hedges et al., 2008a) because it has expanded digital discs supported by T-shaped terminal phalanges, Finger I shorter than Finger II, and Toe V much longer than Toe III. It has: (1) skin on dorsum smooth with scattered subconical tubercles; that on venter weakly areolate with scattered rounded tubercles; discoidal fold not evident; dorsolateral folds absent; (2) tympanic membrane not differentiated; tympanic annulus absent; (3) snout rounded in dorsal view, bluntly rounded in profile; (4) upper eyelid bearing two large, conical tubercles, slightly less than one half IOD; cranial crests absent; (5) dentigerous processes of vomers absent; (6) males having vocal slits; nuptial pads absent; (7) Finger I shorter than Finger II; discs expanded, truncate, about twice as wide as digits proximal to pads; (8) fingers bearing lateral fringes; (9) ulnar tubercles conical; (10) heel bearing single subconical tubercle; outer edge of tarsus bearing two or three conical tubercles; inner tarsal fold absent; (11) inner metatarsal tubercle elongately elliptical, elevated; no discrete outer metatarsal tubercle; supernumerary plantar tubercles numerous, rounded; (12) toes bearing lateral fringes; webbing absent; Toe V much longer than Toe III; discs equal in size to those on fingers; (13) dorsum with or without bold transverse or longitudinal dark brown markings; venter pale gray with irregular brown or black markings; (14) SVL 15.5–19.1 mm in males, 20.9–23.7 mm in females.

Only five other species of *Pristimantis* in Peru have conical tubercles on the upper eyelid and heel and do not have a differentiated tympanic membrane and tympanic annulus. Two of these species, *P. altamazonicus*

(Barbour and Dunn) and *P. flavobracatus* (Lehr, Lundberg, Aguilar, and von May) differ from *P. lucasi* by lacking lateral fringes on the fingers and toes; moreover, the former also differs from *P. lucasi* by lacking ulnar tubercles and having red and black mottling in the groin and on the posterior surfaces of the thighs, whereas *P. flavobracatus* further differs from *P. lucasi* by having a bright yellow groin. *Pristimantis colodactylus* (Lynch) differs from *P. lucasi* by having short fingers with broadly rounded terminal discs, no ulnar tubercles, and no labial bars. *Pristimantis vilcabambae* Lehr differs from *P. lucasi* by having a rostral papilla, and H-shaped scapular fold, and a brown groin with cream spots (in preservative). The equally sized *P. leucorrhinus* Boano, Mazzotti, and Sindaco from an elevation of 2500 m in the Parque Nacional Yanachaga-Chemillén is the species that is most like *P. lucasi*, especially in having numerous tubercles on the belly. However, *P. leucorrhinus* differs by having several conical and subconical tubercles on the eyelid; one of these is notably larger than the tubercles on *P. lucasi* and is curved terminally. Furthermore in *P. leucorrhinus* the throat, groin, and anterior surfaces of the thighs are black, and there is a pair of large white spots on the anteroventral surfaces of the thighs. For comparative character states in strabomantids in the region of the known distribution of *P. lucasi*, see Table 1.

TABLE 1. Measurements (in mm) and proportions with means in parentheses in *Pristimantis lucasi*.

Character	Eight males	Five females
Snout-vent length	15.5–19.1 (17.03)	20.9–23.3 (22.38)
Tibia length	8.1–9.5 (8.84)	10.2–11.2 (10.82)
Foot length	6.6–8.7 (7.66)	9.4–10.4 (9.94)
Head length	5.0–6.5 (5.65)	6.1–7.3 (6.90)
Head width	5.4–6.5 (5.94)	7.1–7.9 (7.44)
Diameter of eye	1.6–2.0 (1.88)	2.0–2.7 (2.36)
Interorbital distance	3.2–3.8 (3.50)	3.5–4.4 (4.00)
Width of eyelid	1.3–1.8 (1.50)	1.6–2.0 (1.86)
Internarial distance	1.2–1.7 (1.46)	1.6–1.9 (1.76)
Eye–nostril distance	1.1–1.4 (1.24)	1.3–1.7 (1.54)
Head length/SVL	31.3–35.3 (33.15)	28.1–33.5 (30.86)
Head width/SVL	33.5–36.8 (34.91)	32.7–34.4 (33.22)
Width eyelid/IOD	33.5–51.4 (43.04)	43.9–50.0 (46.50)
Eye-nostril/eye	61.1–70.0 (65.98)	61.5–69.6 (65.46)
Tibia length/SVL	50/6–55.5 (52.30)	47.2–49.3 (48.36)
Foot length/SVL	42.6–47.4 (44.99)	42.6–46.1 (44.44)

Description of holotype. An adult female with head about as wide as body; head width 32.7% of SVL; head length 31.4% of SVL; snout rounded in dorsal view, bluntly rounded in profile, barely protruding beyond margin of lower jaw; eye-nostril distance 69.6% of diameter of eye; nostrils not protuberant, directed slightly anterolaterally at level just behind anterior edge of lower jaw. Canthus rostralis curved, rounded in section, not elevated; loreal region concave; lips rounded; internarial region slightly depresssed; top of head flat; upper eyelid bearing two large, conical tubercles an a few small tubercles; its width 45.5% of IOD; supratympanic fold barely evident, only just posterior to orbit; tympanic membrane not differentiated, tympanic annulus absent; no enlarged postrictal tubercles. Choanae small, nearly round, not obscured by palatal shelf; dentigerous processes of vomers not evident; tongue small about twice as long as wide, not notched behind, barely free posteriorly.

Skin on dorsum smooth with scattered small, conical tubercles; skin on flanks smooth; skin on belly

weakly areolate with many scattered rounded tubercles; skin on posteroventral surfaces of thighs coarsely areolate; other ventral surfaces smooth; discoid fold not evident; dorsolateral folds absent; cloacal sheath short, no tubercles in cloacal region. Ulnar tubercles conical, three on each forearm; thenar tubercle elongately elliptical, elevated; palmar tubercle small, deeply bifid; subarticular tubercles large, rounded; supernumerary tubercles prominent, numerous; fingers lacking lateral fringes; relative lengths of fingers I < II < IV < III; Finger I shorter than Finger II; discs on outer fingers expanded, almost truncate, about twice width of digit proximal to disc; all fingers having terminal ventral pads well defined by circumferential grooves (Fig. 1A). Hind limbs moderately robust; when hind limbs flexed perpendicular to axis of body, heels barely overlap; tibia length 48.9% of SVL; foot length 45.4% of SVL; heel bearing one subconical tubercle; outer edge of tarsus bearing conical tubercles (two on right; three on left); tarsal fold absent; inner metatarsal tubercle elongately elliptical, elevated, outer metatarsal tubercle absent; toes slender, bearing lateral fringes and elliptical terminal discs about same size as those on fingers; webbing absent; relative lengths of toes I < II < III < V < IV; Toe III much shorter than Toe V; Toe III extending to proximal base of antepenultimate subarticular tubercle on Toe IV; Toe V extending to proximal base of penultimate subarticular tubercle on Toe IV; subarticular tubercles large, rounded; supernumerary tubercles rounded, numerous on proximal segments of digits (Fig. 1B).

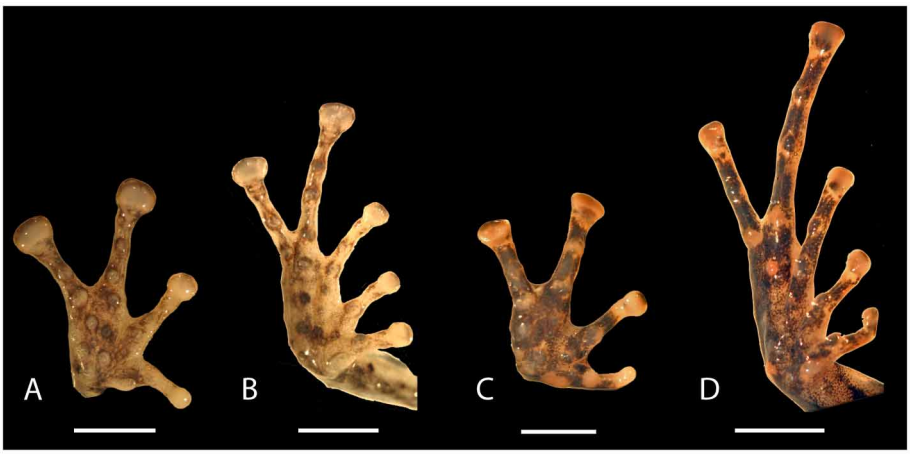

FIGURE 1. A and B. Hand and foot of *Pristimantis lucasi.* C and D. Hand and foot of *Pristimantis spectabilis.* Scale bars = 3 mm.

Coloration in preservative: Dorsum pale gray with dark grayish brown markings, those on head consisting of large spot on top of head anterior to orbits, broad canthal stripe, two diagonal labial bars, narrow postorbital stripe, broad interorbital bar. Body with three broad transverse marks, one in scapular region, one on sacral region, and one postsacrally; first two continue as diagonal marks on flanks. Broad transverse brown bar on forearm; narrower bar on wrist; diagonal bars on hind limbs—two on thigh, two or three on shanks, two on tarsus, one on foot; groin and posterior surfaces of thighs pale greenish yellow with black subcloacal triangle. Venter pale grayish white with irregular black marks, largest on chin and anterolaterally on belly.

Coloration in life: Dorsum pale tan with large dark reddish brown markings—spot anterior to eyes, broad interorbital bar, labial and postorbital bars, broad transverse marks on body (scapular and sacral regions and postsacrally) extending diagonally onto flanks, and diagonal bars on hind limbs (Fig. 2A); groin, posterior surfaces of thighs, and ventral surfaces of shanks pale greenish tan. Throat and belly dull yellowish tan with brown tubercles and lateral blotches on belly and reddish brown marks on throat; palmar and plantar surfaces brown (Fig. 2B); iris pale bronze with reddish brown flecks and narrow streaks.

Measurements of holotype in mm: SVL 22.3, tibia length 10.9, foot length 9.5, head length 7.0, head width 7.3, IOD 4.4, internarial distance 1.9, width of upper eyelid 2.0, diameter of eye 2.3, eye-nostril distance 1.6.

FIGURE 2. *Pristimantis lucasi*—A and B. Dorsal and ventral views of the holotype, MHNC 6475, female, 22.3 mm SVL. C and D. Dorsal and ventral views of a paratype, MHNC 6494, male, 17.0 mm SVL. E and F. Dorsal and ventral views of paratype, MHNC 7155, male, 18.4 mm SVL.

Variation.—Females are slightly larger than males (Table 1). Males have proportionately larger heads and longer shanks than females; otherwise the proportions greatly overlap. All specimens are alike in having two conical tubercles on the upper eyelid and in the anterior tubercle larger than the posterior one. There are two or three conical ulnar tubercles and two or three conical tubercles on the outer edge of the tarsus. Three specimens have a second, somewhat smaller conical tubercle of the heel (Table 2).

Photographs of living individuals and examination of preserved specimens revealed three color patterns. Eight individuals (four males, four females) have essentially the pattern described for the holotype, that is, transverse marks on the dorsum; in two males and one female the markings are narrower than those in the holotype. Three males have an irregular longitudinal dark mark on the body (Fig. 2C), and two others essentially lack markings on the body (Fig. 2E). The ventral coloration varies from the irregular black marks dis-

played by the holotype to dark brown reticulations (Fig. 2D) or solely dark brown tubercles on the belly (Fig. 2F).

TABLE 2. Characteristics of strabomantid frogs in the vicinity of Parque Nacional Yanachaga-Chemillén, Departamento Pasco, Peru. Generic abbreviations are: *Hyp.* = *Hypodactylus*, *Nob.* = *Noblella*, *Phr.* = *Phrynopus*, *Pri.* = *Pristimantis.* In the column Lateral fringes, F = fingers, T = toes. Conditions are those by Duellman and Hedges (2005, 2007, 2008), Lehr et al. (2004a, b, 2006), and personal observations.

Species	Tympanic membrane	Eyelid tubercles	Skin on venter	Fingers	Toes	Lateral fringes	Maximum SVL males;females	Range of elevation
Hyp. lundbergi	Yes	No	Smooth	I=II	V=III	F,T	39.7; 48.8	1800–2760
Nob. duellmani	No	Small	Smooth	I<II	V<III	–,–	—; 20.0	2900
Phr. auriculatus	Yes	No	Smooth	I<II	V>III	–,–	13.4; 14.5	2600
Phr. bracki	No	Small	Smooth	I<II	V>III	F,–	16.2; 19.8	2600
Phr. bufoides	No	No	Areolate	I<II	V>III	–.–	23.9; 33.6	3850–4100
Phr. miroslawae	No	Small	Areolate	I<II	V=III	–,–	—; 29.1	3360
Phr. nicoleae	No	Small	Areolate	I=II	V<III	–,–	—; 21.2	3589
Phr. paucari	No	No	Areolate	I<II	V>III	–,–	—; 23.8	3600
Phr. pesantesi	No	No	Areolate	I<II	V>III	–,–	25.5; 32.7	4280–4390
Phr. tribulosus	No	Small	Smooth	I=II	V=III	–,–	15.2; 14.6	2600–2700
Pri. aniptopalmatus	Yes	1 round	Smooth	I<II	V>III	F,–	23.2; 22.0	2300–2600
Pri. bipunctatus	Yes	No	Areolate	I=II	V>III	–,–	28.8; 41.5	1240–2320
Pri. bromeliaceus	Yes	Small	Areolate	I<II	V>>III	F,T	26.0; 32.8	2200–2600
Pri. flavobracatus	No	2 round	Areolate	I<II	V>>III	–,–	19.6; 23.4	1770
*Pri. leucorrhinus**	No	1 conical	Areolate	I<II	V>>III	F,T	21.1; —	2500
Pri. lucasi	No	2 conical	Areolate	I<II	V>>III	F,T	19.1; 23.7	2790
Pri. mendax	Yes	No	Areolate	I<II	V>>III	F,T	23.3; 28.0	1700–3325
Pri. ornatus	Yes	No	Smooth	I<II	V>III	–,–	20.5; 27.3	2400–3000
*Pri. pardalinus**	Yes	1 round	Areolate	I<II	V>III	F,T	26.7; 34.1	2640
Pri. platydactylus	Yes	Small	Areolate	I<II	V>>III	F,T	23.8; 35.3	930–3470
Pri. rhabdocnemus	No	No	Areolate	1<II	V>>III	F,T	21.2; 27.0	230–2900
Pri. sagittulus	Yes	No	Areolate	I<II	V>>III	F,T	25.7–29.9	1970–2750
Pri. spectabilis	Yes	No	Smooth	I<II	V>>III	–,–	—; 22.7	3300
Pri. stictogaster	Yes	Small	Areolate	I<II	V>>III	F,–	17.7; 23.9	1470–2790

*Also small tubercles on eyelids.

Distribution and ecology. This species inhabits an area of humid elfin montane forest just below the crest of the Abra Esperanza (±3000 m). All individuals were on low vegetation 30–100 cm above the ground at night during the dry season. Other sympatric strabomantid frogs are *Phrynopus auriculatus* Duellman and Hedges, and five species of *Pristimantis*—*P. bromeliaceus* (Lynch), *P. mendax* (Duellman), *P. rhabdocnemus* (Duellman and Hedges), *P. sagittulus* (Lehr, Aguilar and Duellman), and *P. stictogaster* (Duellman and Hedges).

Etymology. The specific name is a patronym for Lucas Morciniec, who has supported field studies in Peru.

Remarks. With the full realization that the *Pristimantis unistrigatus* Group is a paraphyletic assemblage (Hedges *et al.*, 2008a; Lynch & Duellman, 1997), we assign this new species to that group, because it does not

"conveniently" fit in any other group in the genus. *Pristimantis lucasi* and *P. leucorrhinus* are unique among Peruvian members of the genus in having areolate skin on the venter that is bedecked with many prominent, round tubercles. These seem to be cryptic species, like two other pairs in the Cordillera Yanachaga named by Duellman and Hedges (2005, 2008)—*P. adiastolus* and *P. bipunctatus; P. albertus* and *P. stictogaster.*

Pristimantis spectabilis **new species**

Holotype: MHNC 7073, a subadult female, from Santa Bárbara, 3300 m, Distrito Huancabamba, Provincia Oxapampa, Departamento Pasco, Peru (10°20' 14.71" S, 75°38' 27.73" W), obtained on 5 May 2008 by Amanda J. Delgado.

Diagnosis. The new species is placed in the *Pristimantis* (*Pristimantis*) *unistrigatus* Group (as defined by Hedges et al., 2008a) because it has expanded digital discs supported by T-shaped terminal phalanges, Finger I shorter than Finger II, and Toe V much longer than Toe III. It has: (1) skin on dorsum smooth; that on venter smooth with scattered small tubercles; discoidal fold absent; dorsolateral folds absent; (2) tympanic membrane differentiated; tympanic annulus distinct, its length about 56% length of eye; (3) snout rounded in dorsal view and in profile; (4) upper eyelid lacking tubercles, much narrower than IOD; cranial crests absent; (5) dentigerous processes of vomers absent; (6) condition of vocal slits and nuptial pads unknown; (7) Finger I much shorter than Finger II; discs expanded, elliptical, about 1.5 times width of digit proximal to disc; (8) fingers lacking lateral fringes; (9) row of low subconical ulnar tubercles; (10) heel lacking tubercles; outer edge of tarsus bearing row of low, rounded tubercles; distinct inner tarsal fold; (11) inner metatarsal tubercle ovoid, elevated, about 3 × subconical outer metatarsal tubercle; supernumerary plantar tubercles few, low on proximal segments; (12) toes lacking lateral fringes; webbing absent; Toe V much longer than Toe III; discs slightly smaller than those on fingers; (13) dorsum mottled brown and black with discrete white spots and white interorbital bar; venter tan with dark gray spots and midventral line; (14) SVL unknown in males, 22.7 mm in single female.

The coloration alone distinguishes *Pristimantis spectabilis* from all other Peruvian members of the genus. The only other Peruvian member of the *Pristimantis unistrigatus* Group with smooth skin on the venter is *P. diadematus* Jiménez de la Espada, a much larger species (females up to 44.5 mm SVL) in the Amazon Basin. It differs from *P. spectabilis* by having fringes on the fingers and toes, lacking ulnar tubercles, having a narrower IOD (upper eyelid about 75% IOD, contrasted to 39% in *P. spectabilis*), and by having an entirely different color pattern. Among Peruvian *Pristimantis*, the pale interorbital bar is essentially unique to *P. spectabilis.* Some individuals of an Amazonian species, *P. luscombei* Duellman and Mendelson, have a cream or tan interorbital bar that is expanded anterior to the snout or posteriorly to the occipital region.

Description of holotype. A subadult female with head narrower than body, head width 29.5% of SVL; head length 35.2% of SVL; snout short, rounded in dorsal view and in profile, barely protruding beyond margin of lower jaw; eye-nostril distance 74% of diameter of eye; nostrils slightly protuberant, directed laterally at level just behind anterior margin of lower lip. Canthus rostralis nearly straight, rounded in profile, not elevated; loreal region noticeably concave; lips slightly flared; internarial region not depressed; top of head flat; upper eyelid lacking tubercles; its width 38.6% of IOD; cranial crests absent; supratympanic fold thin, extending from posterior edge of orbit, angling ventrally at point posterodorsal to tympanum, barely obscuring upper edge of tympanum; tympanic annulus distinct, smooth; tympanic membrane differentiated, smooth; tympanum round, 55.5% of diameter of eye, separated from eye by distance slightly greater than diameter of tympanum; one slightly enlarged postrictal tubercle. Choanae small, ovoid, not obscured by palatal shelf; dentigerous processes of vomers not evident; tongue about twice as long as wide, shallowly notched behind, posterior two thirds not adherent to floor of mouth.

Skin on all surfaces smooth; discoid fold not evident; dorsolateral folds absent; cloacal sheath short, no

tubercles in cloacal region. Ulnar tubercles low, subconical; thenar tubercle elliptical, elevated; palmar tubercle deeply bifid, elevated; subarticular tubercles large, rounded, none bifid; supernumerary tubercles absent; fingers rather short, lacking lateral fringes; relative lengths of fingers I < II < IV < III; Finger I much shorter than Finger II; discs on Fingers III and IV elliptical, about 1.5 times width of digit proximal to disc; all fingers having terminal ventral pads weakly defined by circumferential grooves (Fig. 1C). Hind limbs slender; when hind limbs flexed perpendicular to axis of body heels overlap by about one fourth length of shank; tibia length 50.7% of SVL; foot length 48.9% of SVL; heel lacking tubercles; outer edge of tarsus bearing row of low, rounded tubercles; distinct inner tarsal fold on distal three-fourths of tarsus; inner metatarsal tubercle ovoid, elevated, about three times size of subconical outer metatarsal tubercle; toes slender, lacking lateral fringes, bearing elliptical terminal discs slightly smaller than those on fingers; webbing absent; relative lengths of toes I < II < III < V < IV; Toe III much shorter than Toe V; Toe III not extending to antepenultimate subarticular tubercle on Toe IV; Toe V extending nearly to proximal base of penultimate subarticular tubercle on Toe IV; subarticular tubercles large, rounded; supernumerary tubercles few, only on proximal segments of toes IV and V (Fig. 1D).

Coloration in preservative: Dorsum of body and limbs brown with conspicuous white interocular bar and small spots on body and shanks; flanks tan with two broad diagonal marks on each side; limbs brown with darker brown transverse bars—one each on wrist, forearm, and tarsus, two each on thigh and shank. Head markings consisting of three dark brown labial bars on dull tan lips and dark brown postorbital bar; canthal stripe absent. Posterior surfaces of thighs tan except for large, triangular, black subcloacal patch. Venter dull tan with black markings—diffuse spots, narrow midventral line from throat to posterior edge of abdomen, and narrow diagonal marks laterally on throat; palmar and plantar surfaces black with tan tubercles and toe pads.

Coloration in life: Dorsum dull brown with chocolate brown markings narrowly outlined in cream; narrow irregular dorsolateral tan area confluent with ground color on dorsal aspects of flanks, becoming reddish orange ventrally (Fig. 3). Markings on head consisting of dark brown labial bars on reddish brown upper lips, dark brown postorbital stripe, pair of dark brown oval spots outlined with cream anterior to level of orbits, and broad greenish white interocular bar on anterior parts of upper eyelids; small greenish white spots on dorsum of body and shanks. Posterior surfaces of thighs reddish brown; ventral surfaces reddish orange with scattered black flecks, irregular, narrow black line from throat to posterior part of abdomen, and diagonal bars laterally on throat; palmar and plantar surfaces mostly black with orange tubercles.

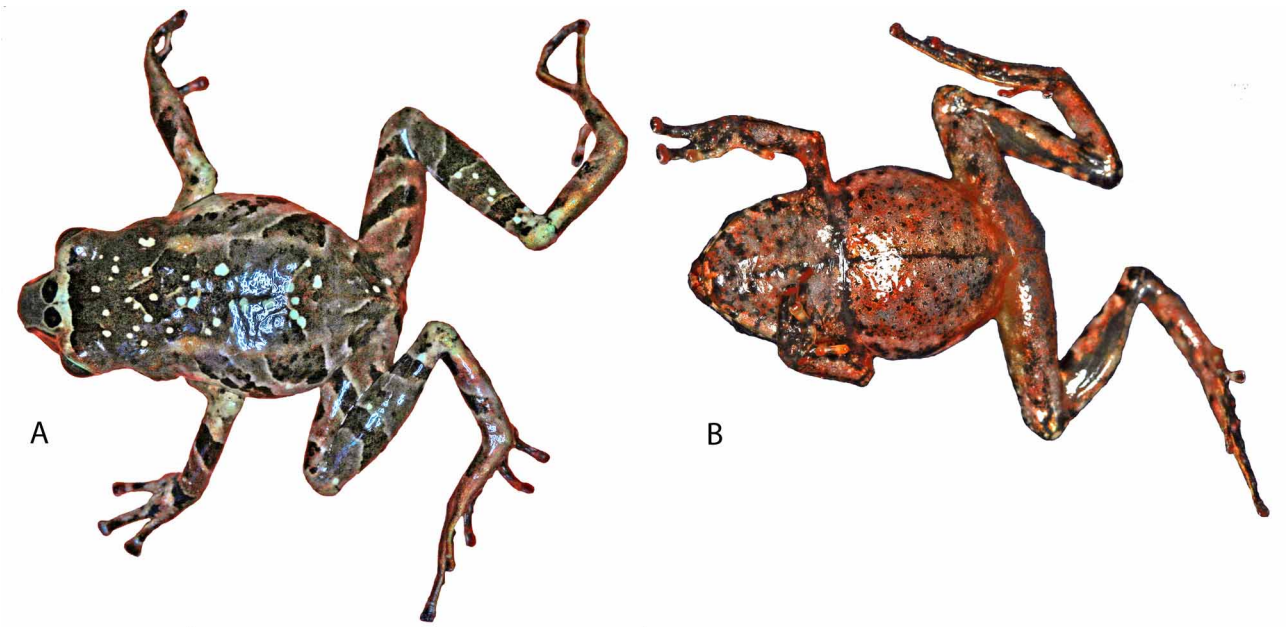

FIGURE 3. *Pristimantis spectabilis*—A and B. Dorsal and ventral views of the holotype, MHNC 7073, subadult female, 22.7 mm SVL. Photographed prior to preservation.

Measurements of holotype in mm: SVL 22.7, tibia length 11.5, foot length 11.1, head length 8.0, head width 6.7, IOD 4.4, internarial distance 2.2, width of upper eyelid 1.7, diameter of eye 2.7, eye-nostril distance 2.0; diameter of tympanum 1.5.

Distribution and ecology. This species is known only from the type locality at an elevation of 3300 m at the upper limits of the elfin forest or "ceja de montaña," where the terrestrial *Phrynopus miroslawae* Chaparro, Padial, and De la Riva was found under moss. The single specimen of *Pristimantis spectabilis* was perched on a leaf about 60 cm above the ground at night in the dry season.

Etymology. The specific name is a Latin adjective meaning showy or notable and refers to the rather gaudy color pattern of this species.

Remarks. Persons unfamiliar with the diversity of strabomantid frogs, especially *Pristimantis* in the Andes, might look askance at the act of describing a species based on a single specimen. However, the type specimen of *P. spectabilis* is so strikingly different from any other species known from the region that we do not hesitate to name it as a new species.

We tentatively place this species in the *unistrigatus* Group of the subgenus *Pristimantis.* As noted by Hedges *et al.* (2008a), this group is a catch-all and certainly is not monophyletic. We anticipate that molecular data will aid in the placement of this species, which is like members of the *Pristimantis unistrigatus* Group in having Toe V much longer than Toe III, but it differs from most members of the group in having smooth skin on all surfaces and weak circumferential grooves on the digits.

Synopsis of distributions

The humid slopes of the Andes are especially rich in the number of species of strabomantid frogs, as has been shown for the Amazonian slopes in Ecuador (Lynch & Duellman, 1980), the Pacific slopes in Ecuador (Lynch & Duellman, 1997), and for northern Peru (Duellman & Pramuk, 1999). However, the greatest known diversity is on the Pacific slopes of the Cordillera Occidental in Colombia, for which Lynch (1997) reported as many as 53 species of "*Eleutherodactylus*" in one of nine transects from the Pacific lowlands to the crest of the Occidental.

In Peru, 41 species of strabomantids are known from the Amazon Basin (humid tropical forest in lowlands below 500 m). The most species known from one site in the Amazonian lowlands in Peru is at an elevation of about 200 m at Panguana, Departamento Huánuco. The greatest number at any one locality in the Amazon Basin is 18 species at an elevation of 340 m at Santa Cecilia, Provincia Sucumbíos, Ecuador (Duellman, 1978; Guayasamin *et al.*, 2006). We now can document 52 species of strabomantids in the northern part of the Cordillera Oriental (north of the Río Apurimac); these include two *Hypodactylus*, one *Noblella*, three *Oreobates*, 21 *Phrynopus*, and 25 *Pristimantis.*

Within the broad range of the Cordillera Oriental, the region that has been best (albeit incompletly) sampled is in the departamentos of Húanuco and Pasco. In order to determine the diversity and elevational distribution we assembled all records of strabomantid frogs from 09°30'S to 11°30'S and from the Amazonian lowlands to the crest of the Cordillera Oriental. This resulted in elevational data for 60 species—1 *Hypodactylus*, 2 *Noblella*, 1 *Oreobates*, 20 *Phrynopus*, and 36 *Pristimantis* (Fig. 4). This diversity is about the same as that between 1°N and 1°S on the Pacific versant of the Andes in Ecuador, where 56 species of "*Eleutherodactylus*" (= *Craugastor, Pristimantis*, and *Strabomantis*) were recorded (Lynch & Duellman, 1997). Fifty-seven species of strabomantids *(Hypodactylus, Oreobates, Pristimantis*, and *Strabomantis*) have been reported from the upper Amazon Basin and Amazonian slopes of the Andes in Ecuador (Duellman, 1978; Lynch & Duellman, 1980).

As pointed out by Lynch (1997) and Lynch & Duellman (1997), species of craugastorid and strabomantid frogs in the humid tropical lowlands tend to have much broader distributions than those species in the high-

lands. This is evident in three regional transects between the Amazonian lowlands and the Andes in Peru. Most of the species that are known from the lowlands in Huánuco and Pasco also occur at the base of the Andes in Departamento San Martín in northern Peru; some of them [e.g., *Oreobates quixensis* (Jiménez de la Espada), *Pristimantis fenestratus* (Steindachner) *P. ockendeni* (Boulenger), and *P. toftae* (Duellman)] occur in the Amazonian lowlands in southern Peru. In contrast to these, most species of strabomantids inhabiting the humid montane forests at mid-elevations in the Andes have more restricted latitudinal distributions. Only two species—*Pristimantis mendax* (Duellman) and *P. platydactylus* (Boulenger)—that occur at mid-elevations in the Huánuco-Pasco region are known from the humid montane forests in the vicinity of the Río Cosñipata in Departamento Cusco, some 600 km southeast of the Parque Nacional Yanachaga-Chemillén. Likewise, only one species (*P. bromeliaceus* (Lynch) is known from the parque (up to 2790 m) and localities to the north—2180 m in the Cordillera Central, 1500–1600 m in the Cordillera del Cóndor, 1700 m in the Cordillera de Cutucú, and 1710–2620 m in the Cordillera Oriental in southern Ecuador (Duellman & Pramuk, 1999).

Strabomantid frogs living at high elevations in the Andes have small geographical ranges. This has been shown for *Pristimantis* in western Ecuador (Lynch & Duellman, 1997) and for *Phrynopus* (= *Psychrophrynella*) in Bolivia (De la Riva, 2007). The same is true all of the species that are restricted to elevations above 2600 m in the Cordillera Oriental. Of the 23 species restricted to high elevations, 11 are known from only one locality; seven others are known from only two closely approximated (<10 km airline) localities, and none of the other five species has a known range greater than about 200 sq. km.

Within the more than 4000-m-elevational range in the area considerable differences exist in the vertical ranges of species. Twenty-five species occur at elevations of less than 1000 m; only seven of these extend above 1000 m, and only three of them (*Pristimantis bromeliaceus, ockendeni,* and *rhabdocnemus*) extend above 2500 m. Three of the six species that have the lower limits of their distributions between 1000 and 2000 m are restricted to those elevations, whereas the ranges of *Hypodactylus lundbergi* (Lehr) and *Pristimantis stictogaster* go up to 2800 m and that of *P. platydactylus* to 3275 m. The lower distributional limits of five species of *Pristimantis* are between 2000 and 3000 m, as are the lower limits of 10 species of *Phrynopus;* nine of the latter do not extend below 2600 m, and three of those extend upward beyond 3000 m. Only one species of *Pristimantis* (*P. spectabilis*) is restricted to an elevation above 3000 m, whereas 12 species of *Phrynopus* reach their lower limits at elevations in excess of 3000 m. Two of these *Phrynopus—P. bufoides* Lehr, Lundberg, and Aguilar and *P. montium* (Shreve)—range upward above 4000 m, and *Phrynopus pesantesi* Lehr, Lundberg, and Aguilar is known only from above 4000 m.

In the Cordillera Oriental north of the Río Apurimac, *Phrynopus* essentially replaces *Pristimantis* at elevations above 3000 m. *Phrynopus* are mostly small strabomantids with relatively short limbs. They are terrestrial and walk about mostly in puna grassland. In contrast, at least in the northern Cordillera Oriental, *Pristimantis* are variable in size and tend to be arboreal in humid montane forests; they leap, rather than walk. Thus, we see two adaptive types of strabomantid frogs inhabiting different environments. *Pristimantis* occur primarily at low and middle elevations and in the northern Cordillera Oriental radically decrease in numbers at elevations above 3000 m.

Although *Phrynopus* is essentially endemic to the Cordillera Oriental north of the Río Apurimac, other lineages of short-legged, terrestrial strabomantids occur elsewhere in the Andes (Hedges et al., 2008a; Lehr and Catenazzi, 2008). *Psychrophrynella* and *Bryophryne* inhabit puna in the Cordillera Oriental south of the Río Apurimac, and the former is diverse in the high Andes in Bolivia (De la Riva, 2007; Hedges *et al.*, 2008a), and *Lynchius* is endemic to the Andes in northern Peru and southern Ecuador (Hedges *et al.*, 2008a). Members of the *Pristimantis orestes* Group in northern Peru and southern Ecuador also have robust bodies and short limbs, and they, too, are primarily terrestrial (Duellman & Pramuk, 1999; Duellman *et al.*, 2006). The same is true of the small frogs in the *Pristimantis myersi* Group in southern Colombia and northern Ecuador (Lynch & Duellman, 1997; Hedges *et al.*, 2008a).

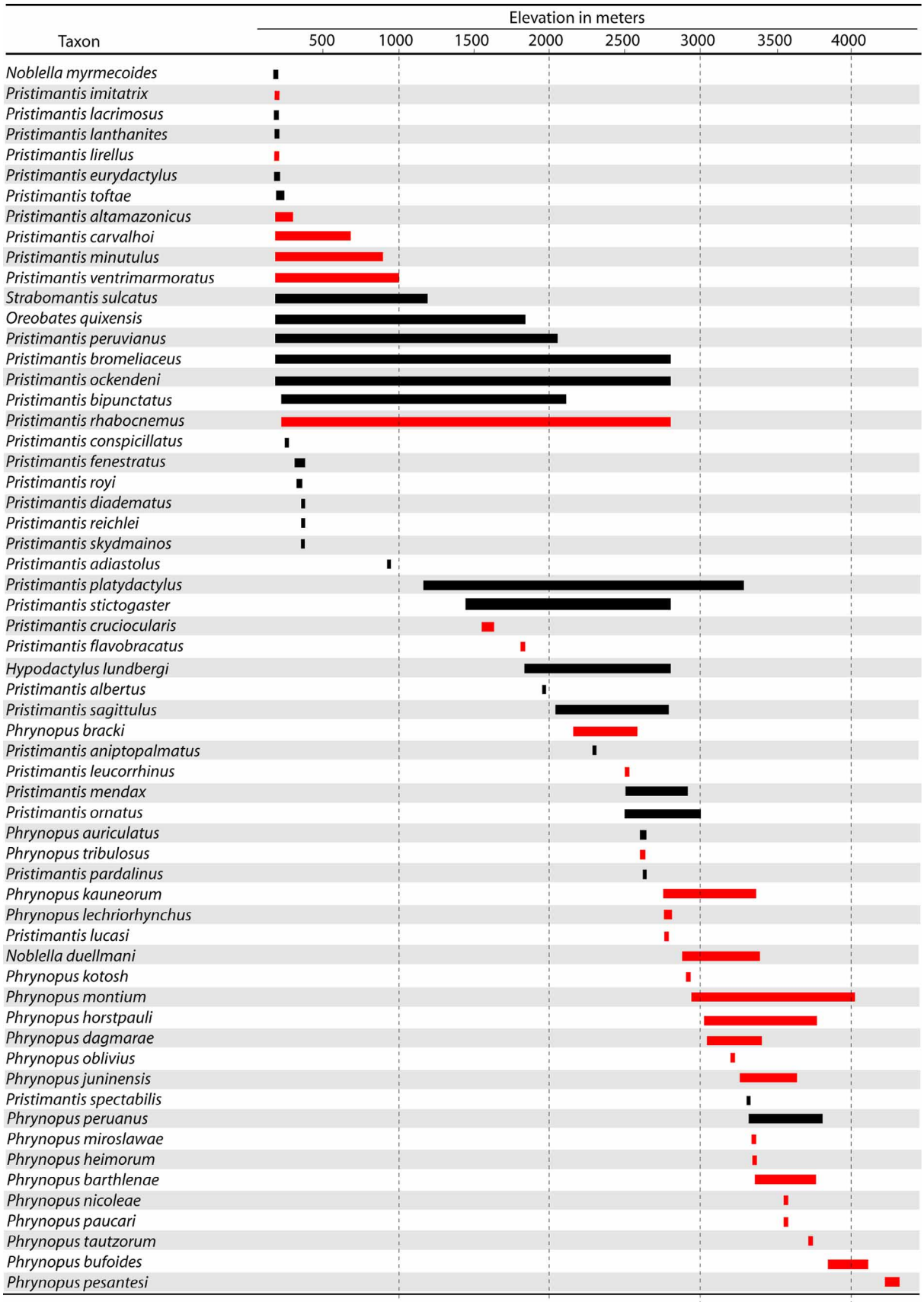

FIGURE 4. Elevational distribution of strabomantid frogs in the Amazon Basin and Amazonian slopes of the Cordillera Oriental between 9°30' and 11°30' south latitude. Horizontal lines indicate known distributional limits; lines in red indicate species in which the tympanic membrane is not differentiated.

In a comparative analysis of 29 species of "eleutherodactylines" in central Peru, Lehr *et al.* (2006) noted that 16 species (55%) lack a tympanum and argued that the absence of a tympanum in central Peruvian "eleutherodactylines" seemed to be associated with increasing elevations, thereby implying an elevational influence on tympanic structure. It is true that among the 60 species in the present transect 15 of the 18 species of strabomantids restricted to elevations above 3000 m lack external ears (Fig. 4). One of these is *Noblella duellmani* Lehr, Aguilar, and Lundberg, a species of questionable relationships (Lehr *et al.*, 2004b), whereas all of the others are *Phrynopus*, nearly all species of which lack a tympanum. The two members of that genus that have external ears (*P. auriculatus* Duellman and Hedges and *P. peruanus* Peters) are the basal members of the clade (Duellman & Hedges, 2008). The majority of species (60%) along the transect are *Pristimantis.* Twelve (33.3%) of those species lack a tympanum. The percentage of absence of a tympanum is highest (30.5%) at elevations below 1000 m, whereas the only species restricted to elevations greater than 3000 m has a tympanum. A trend toward increasing percentage of species having a tympanum is evident from intermediate elevations; of 12 species occurring between 1000 and 2000 m, 25% lack a tympanum, and of the 11 species occurring between 2000 and 3000 m, only 18.2% lack a tympanum. Thus, the implication of an evolutionary trend in the loss of a tympanum (Lehr *et al.*, 2006) does not apply to *Pristimantis*, nor to *Phrynopus*, in which one of the species with a tympanum occurs at 2600 m and the other at 3320–3825 m. Among other high-Andean groups of strabomantid frogs, a tympanum is present in two of three *Niceforonia*, one of three *Lynchius*, nine of 11 members of the *Pristimantis myersi* Group, and 10 of 12 members of the *Pristimantis orestes* Group; a tympanum is absent in all species of *Bryophryne* and *Psychrophrynella*, both of which are restricted to high elevations on southern Peru and Bolivia (Hedges *et al.*, 2008a). We anticipate that increased fieldwork will acquire additional specimens and species that will result in a better understanding of the patterns of distribution and evolutionary relationships of strabomantid frogs.

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Appendix: Specimens examined

Pristimantis altamazonicus—PERU: HUÁNUCO: Finca Panguana, Río Llullapichis, 4-5 km upstream from Río Pachitea, 200 m, KU 154759. MADRE DE DIOS: Cusco Amazónico, 15 km E Puerto Maldonado, 200 m, KU 209956, 215459–60. UCAYALI: Río Curanja, Balta, KU 196441–42.

Pristimantis colodactylus—PERU: PIURA: 31 km [by road] SW Huancabamba, 3080 m, KU 181262–64; 33 km [by road] SW Huancabamba, 3050 m, KU 196443–46; Summit of Cordillera de Huancabamba (on road between Canchaque and Huancabamba), 3100 m, KU 135494, 135496–501.

Pristimantis diadematus—PERU: LORETO: Quebrada Vásquez, north side lower Río Tahuayo, KU 220445, 220570; San Jacinto, 175 m, KU 221996; Teniente López, 310 m, KU 221999; 1.5 km [by road] N Teniente López, 310 m, KU 221997–98.

Pristimantis flavobracatus—PERU: PASCO: Km 34 on road from Oxapampa to Yaupi, Provincia de Oxapampa, 1770 m, MUSM 19848, 19871 (holotype).

Pristimantis leucorrhinus—PERU: PASCO: Refugio El Cedro, 2500 m, MUSM 19996 (holotype).

Pristimantis luscombei—PERU: LORETO: Teniente López, 310 m, KU 222006–07; 1.5 km [by road] N Teniente López, 310 m, 222002–05.