

Two New Species of *Pristimantis* (Anura: Strabomantidae) From the Serranía de los Paraguas: A Priority Site for Conservation of Amphibians in Colombia

OSCAR MAURICIO CUELLAR-VALENCIA^{1,2,5}, FRAY GEOVANNY ARRIAGA-JARAMILLO^{1,2,5}, ISABELLA GARCÍA-GÓMEZ^{1,2}, IRENE CEBALLOS-CASTRO^{1,2}, WILMAR BOLÍVAR-GARCÍA^{1,2}, DAVID ANDRÉS VELÁSQUEZ-TRUJILLO^{1,2}, AYDA SUSANA ORTIZ-BAEZ^{1,3}, AND JHON JAIRO OSPINA-SARRIA^{1,4}

¹ Calima, Fundación para la Investigación de la Biodiversidad y Conservación en el Trópico, Cali, Colombia

² Universidad del Valle, Departamento de Biología, Grupo de Investigación en Ecología Animal A.A. 25360, Cali, Colombia

³ Marie Bashir Institute for Infectious Diseases and Biosecurity, Charles Perkins Centre, School of Life & Environmental Sciences and Sydney Medical School, The University of Sydney, Sydney, NSW 2006, Australia

ABSTRACT: The Serranía de los Paraguas is a mountainous region situated in the central part of the Cordillera Occidental of Colombia. It rises some 2500 m above the wet forest and supports a high concentration of species richness and endemism for plants and terrestrial vertebrates (amphibians, birds, and mammals). In the case of amphibians, 61 named species occurring in The Serranía de los Paraguas are recognized in the literature, which are mostly the works of J.D. Lynch and P. Ruiz-Carranza in the 1990s. During a 9-d survey in the wet season (19–27 July 2019) on the Reserva Natural Comunitaria Cerro El Inglés (one of the hills of the Serranía de los Paraguas) on the frontier between Chocó and Valle del Cauca departments, we discovered two new species of the genus *Pristimantis*. Both species share a divided palmar tubercle as well as a distinctive color pattern on the groin, of which both are distinctive within *Pristimantis*. The first new species is distinguished by its small size and having a distinctive carmine red color pattern on groin, uniform lateral fringes on fingers (no crenulated), palmar tubercle deeply bifid (or divided), advertisement call composed of a short single note distinctly pulsed, and absence of nuptial pads as well as hyperdistal tubercles, inner tarsal tubercle and fold, and partial fusion of Toe IV and V. The second new species is distinguished by having dermal ridges on scapular region, conical tubercle on upper eyelid and heel, palmar tubercle divided, differentiated tympanic membrane, males with vocal slits, orange spots on groin, advertisement call composed of distinctly pulsed 6–8 notes, and absence of dorsolateral folds as well as cranial crest, hyperdistal tubercles, and toe webbing. Considering these new species, the number of amphibians inhabiting the Serranía de los Paraguas has increased to 63 species. It is important to point out that within this outstanding species richness of amphibians, there are 10 endemic species and 17 threatened species according to the International Union for Conservation of Nature Red List (7 Critically Endangered, 5 Endangered, and 5 Vulnerable). Likewise, it is noteworthy that 29 terraranan species can be found in the Reserva Natural Comunitaria Cerro El Inglés. Thus, based on the species richness, endemism, diversity at higher taxonomic levels, and the number of threatened species, it seems reasonable to say that the Serranía de los Paraguas is a priority site for conservation of amphibians in Colombia.

Key words: Amphibia; Colombian Cordillera Occidental; Rufford Small Grants Foundation; Taxonomy; Terrarana; Valle del Cauca

THE SERRANÍA de los Paraguas is a mountainous region situated on the frontier between Chocó and Valle del Cauca departments in western Colombia. This area is recognized as a Coffee Cultural Landscape and World Heritage Site by United Nations Educational, Scientific and Cultural Organization, and at the same time, as the home of tremendous amphibian diversity (Lynch and Grant 1998). So far as found in published literature, the Serranía de los Paraguas holds 45 terraranan species (Lynch 1998), of which 27 species are found in a single place—the Reserva Natural Comunitaria Cerro El Inglés. In addition to the high richness of terraranan frogs, the Reserva Natural Comunitaria Cerro El Inglés holds 17 amphibian species that are threatened according to the International Union for Conservation of Nature (IUCN) Red List (2019), of which 6 are endemic to this place: *Atelopus chochoensis* Lötters 1992, *Nymphargus armatus* (Lynch and Ruiz-Carranza 1996a), *Pristimantis kelephus* (Lynch 1998), *P. phalarus* (Lynch 1998), *P. quantus* (Lynch 1998), and *P. xylochobates* (Lynch and Ruiz-Carranza 1996b). The decline of amphibian populations is a well-documented phenomenon first recognized in the early 1990s and has been associated with habitat destruction, climate change, and emerging diseases (Carey and Alexander

2003). Unfortunately, the Serranía de los Paraguas has not been spared from amphibian population declines.

Lynch and Grant (1998) published a paper titled “Dying frogs in western Colombia: Catastrophe or trivial observation?” in which they registered an unusual encounter of dead frogs at the Serranía de los Paraguas that coincided with an atypical dry season. After this event, researchers visited the area in the last decade and corroborated the reduction in its diversity; nevertheless, such results were derived from short-term surveys, and therefore, there is not conclusive evidence concerning the real conservation status of this anuran species diversity. Although the Colombian amphibian fauna is one of the most diverse in the world (Lynch and Grant 1998), the possibility of amphibian declines in Colombian cloud forests is quite worrying given that such forests are world famous for their high levels of endemism (Lynch et al. 1997). Hence, to identify how the above-stated pressures are affecting amphibian species, it is critical to revisit those localities that have not been assessed in the last decade. Thus, we are currently performing a long-term research program focused on evaluating the threat status, population trends, and conservation needs of the amphibians from the Reserva Natural Comunitaria Cerro El Inglés, which is located within the Serranía de los Paraguas.

As a result of this initiative, our recent explorations at the Reserva Natural Comunitaria Cerro El Inglés led to the discovery of two species of *Pristimantis* exhibiting a

⁴ CORRESPONDENCE: e-mail, sarriajhon@gmail.com

⁵ These authors contributed equally to this work.

combination of character states that have been not previously noticed. Together, the examination of the newly collected material, revision of previously collected specimens, comparisons with type material, and review of the available literature revealed that both species are distinct from other species of the genus *Pristimantis*. Considering these findings, we describe here two newly discovered species of the genus *Pristimantis* based on bioacoustics and morphological evidence. Similarly, we illustrate the importance of preserving and investigating the western-forested slopes of the Colombian Andes, which continue to result in the discovery of new species.

MATERIALS AND METHODS

We visited the Cerro El Inglés, a peak in the Serranía de los Paraguas during a 9-d fieldwork exploration (19–27 July 2019). The expedition team consisted of six members. The Cerro El Inglés was surveyed along transects at the edges of streams and in the forest at different distances from streams. These transects were surveyed during the day from 0900–1300 h and night from 1900–0100 h. Specimens were collected by hand and euthanized by immersion in a 2% xylocaine solution. Specimens were fixed in 10% formalin and preserved in 70% ethanol. In the field, geographic coordinates were determined using two handheld GPS satellite receivers. Insofar as practical, we followed definitions and terminology provided by Lynch and Duellman (1997) and the standardized format for definitions (diagnoses) provided by Duellman and Lehr (2009) for terraranan frogs. For subarticular tubercles notation, we adopted the proposal of Lynch (1999) as modified for general use by Ospina-Sarria and Duellman (2019). To estimate lengths of toes III and V, we adressed both toes against Toe IV, and for lengths of fingers I and II, we appressed those fingers against each other. To identify sex and maturity of specimens, we checked secondary sexual characters (vocal slits and nuptial pads) as well as by direct examination of gonads through dissections. Measurements were taken with a dial caliper (± 0.01 mm) under a Leica dissecting microscope. The following standard abbreviations were used: SVL, snout–vent length; HW, head width; HL, head length; and IOD, interorbital distance.

The recordings of calls were digitized with a 16-bit resolution and a sampling frequency of 44.1 kHz using a TASCAM DR-100MKII LINEAR PCM recorder without external microphone. The recorder was placed at approximately 30 cm from each of the recorded specimens. The temperature of frogs and environment was obtained using a portable digital thermohygrometer. The call analysis was performed with the software Raven Pro v1.5 for Windows (Cornell Laboratory of Ornithology, Ithaca, NY) by using a Blackman algorithm and a window size of 1024. The figures were created with Seewave package v2.1.4 (Sueur et al. 2008) in RStudio v1.1.442 for Windows (2009–2018; RStudio, Inc., Boston, MA). We used the note-centered approach (defining uninterrupted units of sound as notes and their entirety as call) and the terms and definitions for the acoustic parameters as defined by Köhler et al. (2017). Institutional abbreviations are as follows: CPZ-UV, Colección de Prácticas Zoológicas Universidad del Valle, Cali, Colombia; ICN, Instituto de Ciencias Naturales, Museo de

Historia Natural, Universidad Nacional de Colombia, Bogotá, Colombia; and KU, Biodiversity Institute, University of Kansas, Lawrence, KS, USA. All specimens examined are listed in the appendix.

RESULTS

In our 9-d exploration at the Reserva Natural Comunitaria Cerro El Inglés, we found the weather exceptionally wet, with daily rains, and the area was bathed in clouds during day and night. We discovered two species of the genus *Pristimantis* that are distinct from all previously recognized species of the genus in having a unique combination of character states that lead us to describe them as new species. Other species registered were 1 caecilian, *Caecilia subdermalis* Taylor 1968; 1 salamander, *Bolitoglossa walkeri* Brame and Wake 1972; and 22 frogs consisting of 1 bufonid, *Rhinella paraguas* Grant and Bolívar-García 2014; 4 centrolenids, *Centrolene heloderma* (Duellman 1981), *Nymphargus grandisonae* (Cochran and Goin 1970), *N. griffithsi* (Goin 1961), and *N. cf. griffithsi*; and 17 *Pristimantis* species *Pristimantis cf. achatinus*, *P. angustilineatus* (Lynch 1998), *P. brevifrons* (Lynch 1981), *P. calcaratus* (Boulenger 1908), *P. erythropleura* (Boulenger 1896), *P. kelephus* (Lynch 1998), *P. molybrignus* (Lynch 1986), *P. myops* (Lynch 1998), *P. palmeri* (Boulenger 1912), *P. phalarus* (Lynch 1998), *P. ptochus* (Lynch 1998), *P. cf. ptochus*, *P. quantus* (Lynch 1998), *P. restrepoi* (Lynch 1996), *P. silverstonei* (Lynch and Ruíz-Carranza 1996b), and two new species that are described below.

SPECIES DESCRIPTIONS

Pristimantis alius sp. nov.
(Table 1; Figs. 1A, 2A,B, 3A,B)

Holotype.—CPZ-UV 6123, an adult male from the Reserva Natural Comunitaria Cerro El Inglés, municipality of El Cairo, 2350 m elevation (4°45'N, 76°18'W; datum = WGS84 in all cases), Department of Valle del Cauca, Colombia, collected by J.J. Ospina-Sarria, W. Bolívar-García, F.G. Arriaga-Jaramillo, O.M. Cuellar-Valencia, I. Ceballos-Castro, and I. García-Gómez on 23 July 2019.

Paratypes.—Six adult males (CPZ-UV 6124, 6126–30) and one adult female (CPZ-UV 6125) collected with the holotype.

Diagnosis.—*Pristimantis alius* is diagnosed by the following combination of characters: (1) dorsal skin shagreen with scattered tubercles, which become larger in the flank; ventral skin areolate; discoidal fold present, well anterior to groin; dorsolateral folds absent, dermal ridges on scapular region absent; (2) tympanic membrane differentiated, round; its length 27.1–42.4% of eye length in seven adult males and 46.6% in one adult female; prominent tympanic annulus, its upper edge covered by supratympanic fold, extending only just posterior to tympanic annulus; (3) snout moderately long, subacuminate in dorsal view, rounded in profile and lacking of papilla; canthus rostralis concave in dorsal view and profile; (4) upper eyelid bearing two subconical tubercles, upper eyelid width 70–111.1% IOD in males, 67.3% in one female; interocular tubercle absent; cranial crest absent; (5) choanae small, ovoid not concealed by

TABLE 1.—Selected mensural (in mm) and proportional (in percentages) data from the type series of *Pristimantis alius* (values are given as range mean \pm 1 SD).

Trait	Male (n = 7)	Female (n = 1)
Snout–vent length	15.5–19.2 (18.2 \pm 1.2)	24
Head width	5.8–7.1 (6.7 \pm 0.4)	8.7
Head length	6.3–7.4 (7.1 \pm 0.3)	9.2
Interorbital distance	1.8–2.3 (2 \pm 0.1)	2.5
Upper eyelid width	1.6–2.1 (1.8 \pm 0.1)	1.7
Eye diameter	2.1–2.4 (2.2 \pm 0.1)	2.5
Eye–nostril distance	1.5–2.1 (1.9 \pm 0.2)	2.4
Internarial distance	1.5–1.9 (1.7 \pm 0.1)	2.2
Tympanum diameter	0.5–0.9 (0.7 \pm 0.1)	1.1
Tibia length	9.2–10.3 (9.9 \pm 0.4)	12.7
Foot length	7.4–9.9 (13.7 \pm 1.3)	11.8
Head length/snout–vent length	37.5–41.1	38.5
Head width/snout–vent length	35.3–39.2	36.2
Eye diameter/head length	29–32.5	27.3
Eye–nostril distance/eye diameter	74.7–96.2	98.4
Upper eyelid width/interorbital distance	70–111.1	67.3
Interorbital distance/head width	26.9–32.5	29.1
Internarial distance/interorbital distance	76.7–100	88.9
Tympanum diameter/eye diameter	27.1–42.4	46.6
Tibia length/snout–vent length	49.8–59.1	53.1
Foot length/snout–vent length	47.4–55.2	48.4

palatal shelf of maxillary arch; dentigerous process of vomer prominent, ovoid triangular in outline, separate medially by a distance equal to the width of the visible dentigerous process, positioned posterior to edge of choanae, each dentigerous process of vomers bearing two to three teeth; (6) males with vocal slits and subgular vocal sac evident externally; nuptial pads absent; (7) Finger I shorter than Finger II; disc and circumferential grooves present on all fingers; discs truncate, except on Finger I, which is round; disc on Finger I smaller than that of Finger II and this in turn smaller than discs on fingers III and IV (Fig. 3A); (8) fingers with lateral fringes; palmar tubercle deeply bifid (or divided), thenar tubercle oval, slightly smaller than palmar tubercle; supernumerary tubercles low, restricted to the proximal segments of the digits; subarticular tubercles present, except hyperdistals that are absent; subarticular tubercles low, with rounded base and larger than supernumerary tubercles, one on first and second fingers, and two on third and fourth fingers; (9) two or three ulnar tubercles low, not coalesced; (10) heel bearing one small subconical tubercle; outer edge of tarsus bearing low subconical tubercles; inner tarsal tubercle and fold absent; (11) inner metatarsal tubercle elongate, its length twice its width; outer metatarsal tubercle conical, one-third size of inner metatar-



FIG. 1.—Living specimens of *Pristimantis alius* (A; CPZ-UV 6136 adult female, SVL = 20.5 mm), *P. myops* (B; not collected, Reserva Natural Comunitaria Cerro El Inglés, Valle del Cauca), *P. phalarus* (C; not collected, Reserva Natural Comunitaria Cerro El Inglés, Valle del Cauca), and *P. quantus* (D; not collected, Reserva Natural Comunitaria Cerro El Inglés, Valle del Cauca). A color version of this figure is available online.

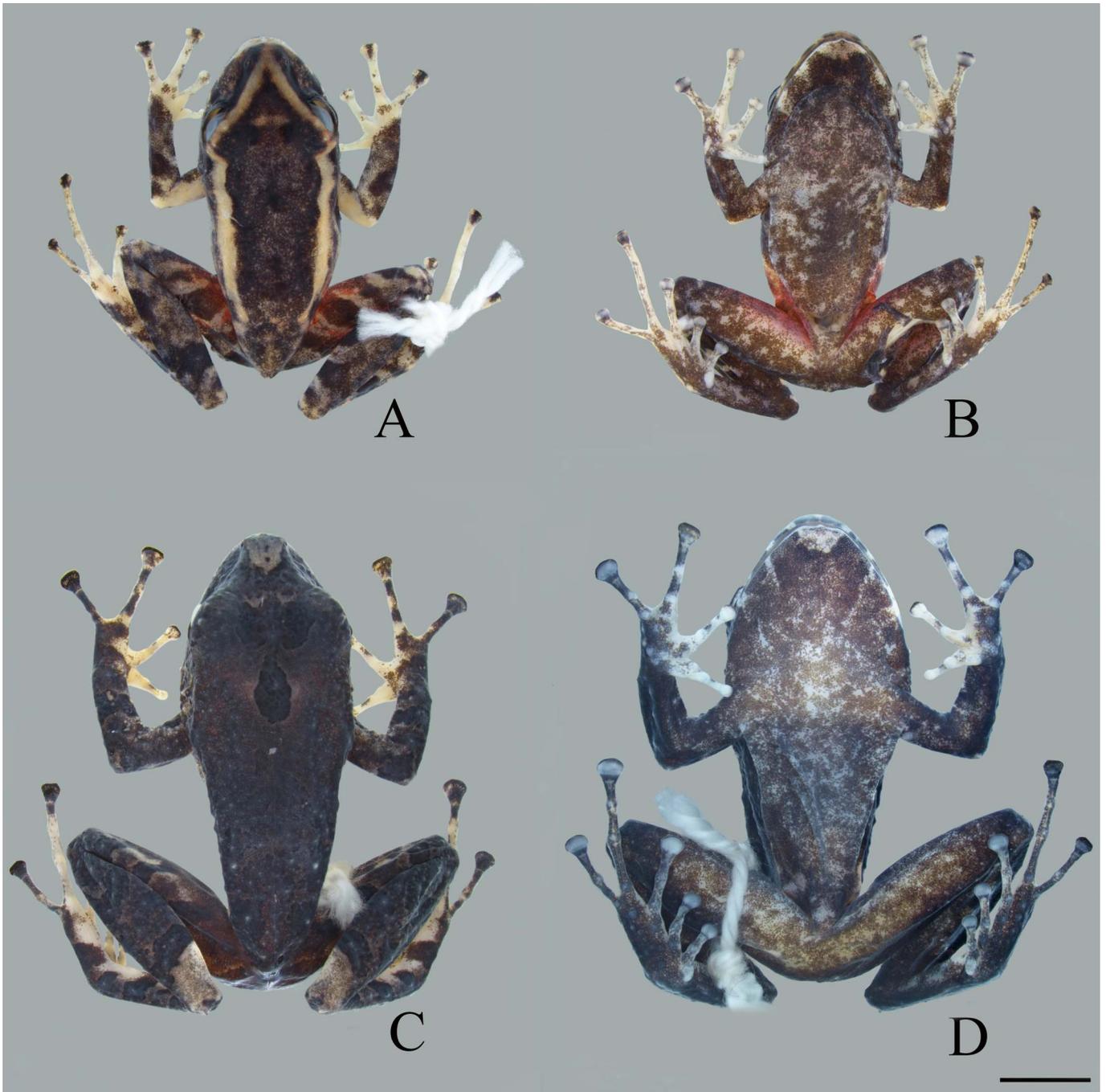


FIG. 2.—Dorsal and ventral views of *Pristimantis alius* (A, B; CPZ-UV 6123, holotype, SVL = 19.1 mm) and *Pristimantis ingles* (C, D; CPZ-UV 6121, holotype, SVL = 24.6 mm). Scale bar = 5 mm. A color version of this figure is available online.

sal tubercle; subarticular tubercles present, except hyperdistals that are absent; subarticular tubercles round, prominent, with rounded base and larger than supernumerary tubercles, one on first and second toes, two on third and fifth toes, three in fourth toe; supernumerary tubercles low, rounded, restricted to base of toes; (12) toes bearing lateral fringes; toe webbing absent; Toe III shorter than Toe V; Toe III extending to proximal edge of penultimate subarticular tubercle of Toe IV; Toe V extending to distal edge of penultimate subarticular tubercle of the Toe IV (Fig. 3B); discs and circumferential grooves present on all toes; discs of

toes smaller than discs on fingers III–IV, disc of toes IV–V of equal size, and larger than disc on Toe III, which is larger than toes I–II; (13) color in life: the dorsum is dull yellow in males, brown with darker markings in the female; the flanks are cream in males, cream with white spots in the female; belly brown with white markings, anterior surfaces of thighs and groin are carmine red; posterior surfaces of thighs brown with darker bars; labial bars darker brown, canthal stripe and interorbital bar darker than the background; iris bright reddish copper with black flecks; (14) adults small, SVL in

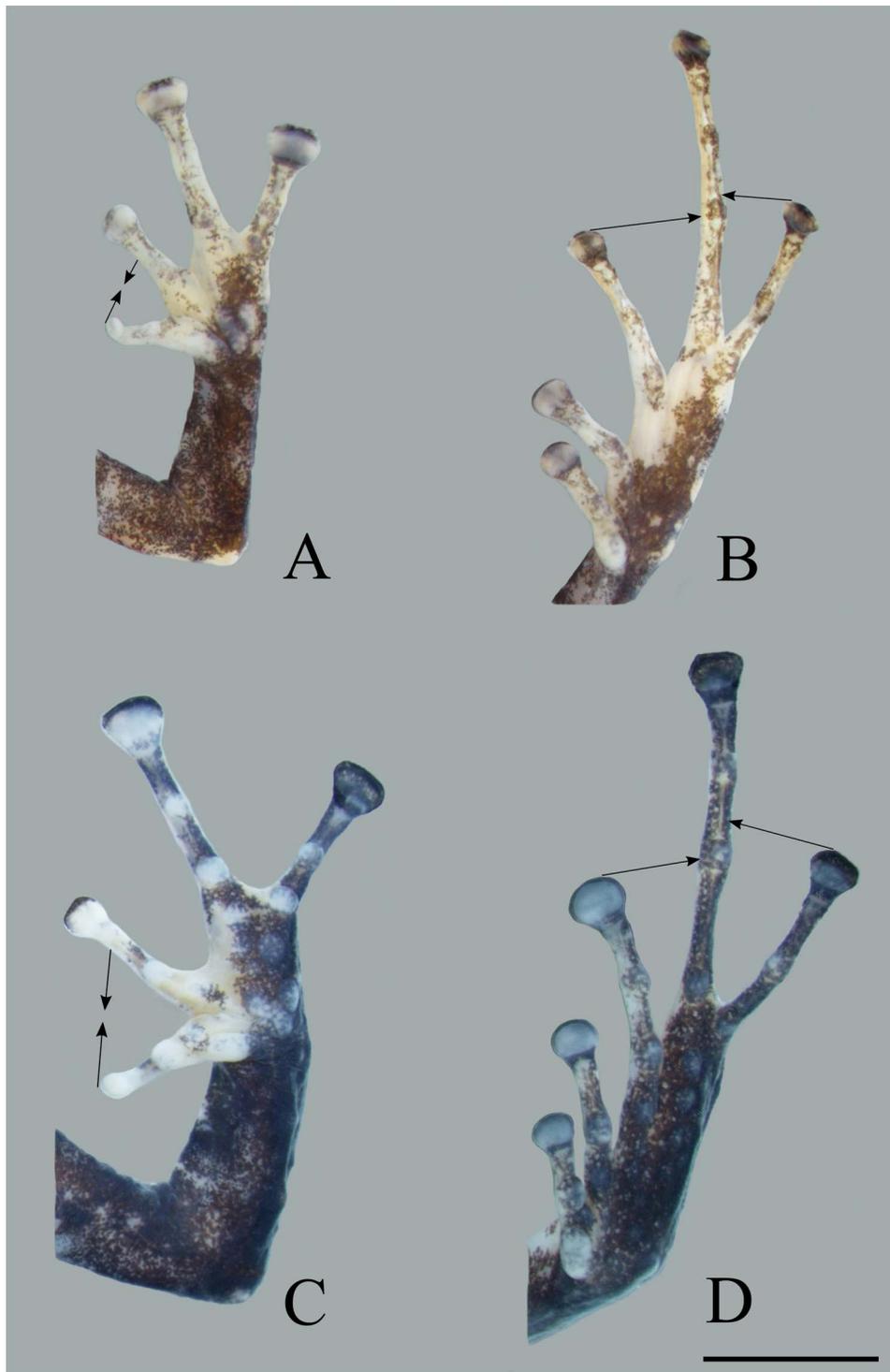


FIG. 3.—Left hands and feet of *Pristimantis alius* (A, B; CPZ-UV 6123, holotype) and *Pristimantis ingles* (C, D; CPZ-UV 6121, holotype). Arrows between first two fingers indicate position of digits when both are appressed. Arrows between toes indicate position of toes III and V when both are adpressed against Toe IV. Scale bar = 5 mm. A color version of this figure is available online.

adult males 15.5–19.2 mm (mean \pm 1 SD = 18.2 \pm 1.2 mm; n = 7) and 24.0 mm in one female.

Comparisons.—*Pristimantis alius* is readily distinguished from all species in the genus by its small size (SVL in adult males 15.5–19.2 mm and 24.0 mm in the female) and by having snout subacuminate in dorsal view, dorsal skin

shagreen with scattered tubercles; upper eyelid bearing two subconical tubercles, dentigerous process of vomer prominent, uniform lateral fringes on fingers (not crenulated, Fig. 3A), palmar tubercle deeply bifid (or divided), distinctive carmine red color pattern on groin extending to concealed surfaces of the limbs, advertisement call composes

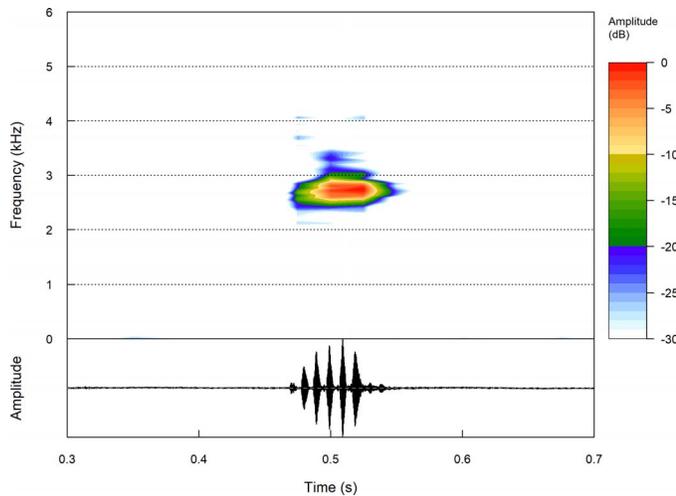


FIG. 4.—Advertisement call (= single note) of *Pristimantis alius*, from male holotype (CPZ-UV 6123) calling from herbaceous vegetation on a tree trunk at the type locality. A color version of this figure is available online.

of a short single note distinctly pulsed (Fig. 4), and by lacking of nuptial pads as well as hyperdistal tubercles, bifid subarticular tubercles (Fig. 3A), inner tarsal tubercle and fold, partial fusion of Toe IV and V (Fig. 3B), and toe webbing. *Pristimantis alius* is most similar to three species inhabiting the Serranía de los Paraguas—*P. myops*, *P. phalarus*, and *P. quantus*—by having a small size and having adult males with vocal slits and no nuptial pads, ventral skin areolate, ulnar tubercles conical or subconical, subconical tubercles along outer edge of tarsus, and prominent tympanic annulus (Fig. 1). *Pristimantis alius* is distinguished from *P. myops* and *P. quantus* by having prominent dentigerous process of vomer (character state absent in *P. myops* and *P. quantus*; Lynch 1998). From *P. myops*, *P. alius* differs by lacking interocular tubercle or fold, bifid subarticular tubercles in fingers, and partial fusion of Toe IV and V (character states present in *P. myops*; see Fig. 18 and 19 in Lynch 1998). Furthermore, *P. alius* is distinguished from *P. phalarus* by having uniform lateral fringes on fingers and Toe V extending to distal edge of penultimate subarticular tubercle of Toe IV (crenulate lateral fringes on fingers and Toe V reaching midway between penultimate and distal subarticular tubercles of Toe IV in *P. phalarus*; see Fig. 20 in Lynch 1998). Lastly, *P. alius* differs from *P. quantus* by being larger, SVL in adult males 15.5–19.2 mm and 24.0 mm in the female (SVL in adult males 11.6–14.5 mm, 14.4–16.7 mm in females in *P. quantus*; Lynch 1998), and by the coloration in life dull yellow in males and brown with darker markings in female (coloration in life green above with bright green interorbital bar in *P. quantus*; Lynch 1998).

By virtue of its small size and structural appearance (dorsal skin shagreen, upper eyelid bearing tubercles, snout subacuminate in dorsal view, dentigerous process of vomer present, males with vocal slits and lacking nuptial pads, and tubercles along outer edge of tarsus), *P. alius* resembles *P. duende* (Lynch 2001). Nevertheless, *P. alius* is distinguished in having Toe III extending to proximal edge of penultimate subarticular tubercle of Toe IV, Toe V extending to distal edge of penultimate subarticular tubercle of the Toe IV, and

dorsal coloration dull yellow in males, brown with darker markings in the female (Toe III reaches midway between penultimate and distal subarticular tubercle of Toe IV, Toe V reaches distal edge of distal subarticular tubercle of the Toe IV, and dorsal coloration olive, pale brown, or reddish-brown with dark olive-brown markings in *P. duende*; Lynch 2001).

Description of the holotype.—An adult male with head slightly wider than body; HW 36.8% of SVL; HL 38.2% SVL; snout moderately long, subacuminate in dorsal view, rounded in profile and lacking papilla; eye–nostril distance 93% of diameter of eye; nostrils not protuberant, slightly visible in dorsal view and directed slightly back. Canthus rostralis concave in dorsal view and profile, not elevated; loreal region weakly concave bearing low rounded tubercles; lips not flared; no tubercles along edge of upper and lower jaw; internarial region slightly depressed; top of head flat without tubercles or fold, interorbital bar darker than the background; upper eyelid bearing two subconical tubercles, its width 70% of IOD; prominent tympanic annulus, its upper edge covered by supratympanic fold, which extends only just posterior to tympanic annulus; tympanic membrane differentiated; two subconical postrictal tubercles. Choanae small, ovoid; no concealed by palatal shelf of maxillary arch; dentigerous process of vomer prominent, ovoid, and separate medially by a distance equal to the width of the visible dentigerous process; positioned posterior to edge of choanae, each odontophore bearing three teeth; tongue as long as broad; its posterior border not notched, posterior third not adherent to floor of mouth; paired vocal slits present, longitudinal, lateral to base of tongue; subgular vocal sac evident externally.

Skin on dorsum finely shagreen with scattered tubercles, which become larger in the flanks; skin on belly, throat, and ventral and posterior surface of the thighs areolate; discoidal fold present, well anterior to groin; dorsolateral folds absent; cloacal sheath short, no tubercles in cloacal region. Three ulnar tubercles low; palmar tubercle deeply bifid; thenar tubercle oval, slightly smaller than palmar tubercle; subarticular tubercles low, with rounded base, and larger than supernumerary tubercles, one on thumb and second finger and two on third and fourth; supernumerary tubercles low, restricted to base of fingers; fingers bearing lateral fringes; relative lengths of fingers I < II < IV < III, all fingers having terminal ventral pads well defined by circumferential grooves; disc on thumb narrow, slightly smaller than Finger II that in turn is slightly smaller than tympanic annulus, disc on fingers III and IV truncate and as wide as tympanic annulus; nuptial pads on the thumbs absent (Fig. 3A). Hind limbs moderately robust; when hind limbs flexed perpendicular to axis of body, heels overlap; tibia length 53.4% of SVL; foot length 51.5% of SVL; heel bearing one small subconical tubercle; outer edge of tarsus bearing low tubercles; inner tarsal tubercle and fold absent; inner metatarsal tubercle elongate, its length twice its width; outer metatarsal tubercle conical, one-third the size of inner; toes bearing lateral fringes and discs (about wider than long) on expanded pads; webbing absent; relative lengths of toes I < II < III < V < IV; Toe III shorter than Toe V; Toe III extending to proximal edge of penultimate subarticular tubercle of Toe IV; Toe V extending to distal edge of penultimate subarticular tubercle of the Toe IV; all toes having terminal ventral pads well defined by circumferential grooves; discs of toes smaller than discs on fingers III–IV,

disc of toes IV–V of equal size, and larger than disc on Toe III, which is larger than toes I–II (Fig. 3B); subarticular tubercles round, prominent, one on first and second toes, two on third and fifth toes, three in fourth toe; supernumerary tubercles low, rounded, restricted to base of toes.

In life, surfaces of body and limbs are dull yellow with wide, cream canthal–dorsolateral stripes. The venter is brown with white markings; posterior surfaces of thighs are brown with darker bars. Anterior, ventral surface of legs and groin are carmine red. Fingers and toes have a dull yellow color. Labial bars are darker brown, and the iris is bright reddish copper with black flecks.

Measurements of holotype (mm).—SVL 19.1, tibia length 10.2, foot length 9.9, HL 7.3, HW 7.1, IOD 2.3, tympanum diameter 0.8, internarial distance 1.8, width of upper eyelid 1.6, diameter of eye 2.1, eye–nostril distance 2.

Variation.—Sexual dimorphism evident in size, with the adult female being larger than adult males; measurements and proportions are presented in Table 1. No sexual dichromatism evident. The most striking variation occurs in dorsal coloration: males are dull yellow and the female is brown with darker markings. Among males, two specimens (holotype and CPZ-UV 6129) have a wide, cream canthal–dorsolateral stripe. There is little variation in the reddish coloration of ventral surface of legs and groin, except that in the female, it is more intense than in the males. The number of teeth on dentigerous processes of vomers varies from two to three. Living specimens have well-defined tubercles on the dorsum and legs, but these tubercles are barely seen on the preserved specimens.

Distribution and ecology.—This small species is known only from the type locality at an elevation of 2246–2350 m (Fig. 5). *Pristimantis alius* is a nocturnal inhabitant of a primary cloud forest, where it is possible to find them perched on low vegetation or on herbaceous vegetation growing on tree trunks. Given its cryptic coloration, individuals are difficult to detect and when they are detected, immediately jump to the ground where it is even harder to detect them. Males were calling frequently between 0600 and 0100 h at the Reserva Natural Comunitaria Cerro El Inglés. They cease calling when approached or when a light was directed toward them.

Call.—The advertisement call of *P. alius* is similar to cricket sounds. It is composed of a short single note distinctly pulsed, with 5–7 pulses per note (5.9 ± 0.6 ; $n = 13$). The notes are separated by intervals of silence (i.e., 100% amplitude modulation), not reflecting harmonics (Fig. 4). The call is 0.091–0.131 s in duration (0.10 ± 0.01 ; $n = 13$), with a call repetition rate of 0.655–1.046 calls per minute (0.850 ± 0.277), and an intercall interval of 19.5–170.9 s in duration (72.9 ± 43.7 ; $n = 11$). Pulse repetition rate is 80–111.1 pulses per s (96.4 ± 12.2 ; $n = 13$). The dominant frequency is 2670.1–2885.4 Hz (2746.3 ± 63.7 ; $n = 13$), and the bandwidth where 90% of the energy of the call concentrates corresponds to 301.5–559.9 Hz (433.9 ± 75.5 ; $n = 13$). These calls were obtained from two males (CPZ-UV 6123, 6129) found calling from low vegetation up to 100-cm height. The body temperature was 11.0°C and 10.8°C, whereas the environment temperature was 18.2°C and 21.3°C, respectively.

Etymology.—The Latin adjective *alius* (= another). When J.D. Lynch described *P. myops*, *P. phalarus*, and *P.*

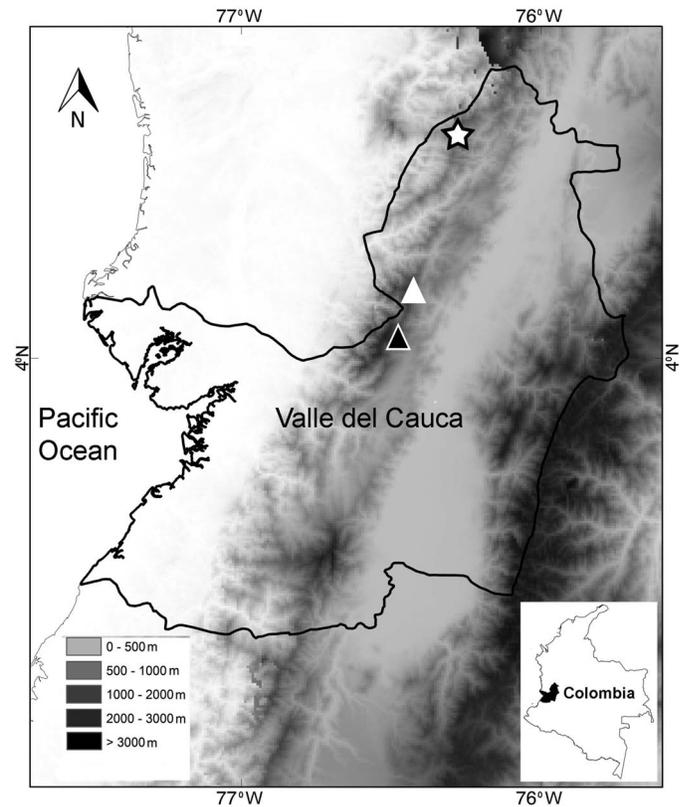


FIG. 5.—Map of southwestern Colombia (inset) showing localities of the new species described herein: Reserva Natural Comunitaria Cerro El Inglés is indicated by a star (*Pristimantis alius* and *P. ingles*); Vereda Monteloro, municipality of Trujillo is indicated by a white triangle (*P. ingles*); and Regional Park Páramo del Duende, municipality of Riofrío is indicated by a black triangle (*P. ingles*). Lines indicate boundaries of the department within which the new species occur.

quantus from the Serranía de los Paraguas (Lynch 1998), he proposed the name *quantus* to the third species found (meaning “How many?”), in reference to his surprise after discovering three miniature sympatric species. Thus, we propose the latin name *alius* (meaning another), in response to J.D. Lynch’s inquiry.

Remarks.—*Pristimantis alius* is the fourth small size species inhabiting the Reserva Natural Comunitaria Cerro El Inglés along with *P. myops* (SVL in adult males 10.9–13.6 mm, 14.6–17.2 mm in females; Lynch 1998), *P. phalarus* (SVL in adult males 15.3–17.6 mm, 17.5–22.3 mm in females; Lynch 1998), and *P. quantus* (SVL in adult males 11.6–14.5 mm, 14.4–16.7 mm in females; Lynch 1998). *P. alius* is distinguished from the previously described species by having uniform lateral fringes on fingers (no crenulated) and other subtleties of coloration and size (see comparison under that species). All specimens of *P. alius* were noticed to develop a dark coloration during manipulation. Likewise, all specimens were more tuberculated before stress induced by handling.

Pristimantis ingles sp. nov.
(Table 2; Figs. 2C,D, 3C,D, 6A)

Holotype.—CPZ-UV 6121, an adult male from the Reserva Natural Comunitaria Cerro El Inglés, municipality of El Cairo, 2112 m elevation (4°45’N, 76°17’W), Depart-

TABLE 2.—Selected mensural (in mm) and proportional (in percentages) data from the type series of *Pristimantis ingles* (values are given as range mean \pm 1 SD).

Trait	Male (n = 2)	Female (n = 5)
Snout-vent length	24.6–24.7 (24.6 \pm 0.03)	26.1–30.8 (28.7 \pm 1.6)
Head width	8.4–8.6 (8.5 \pm 0.1)	9.8–12 (11 \pm 0.8)
Head length	8.3–8.3 (8.3)	8.5–10.5 (9.9 \pm 0.9)
Interorbital distance	2.8–2.8 (2.8)	2.8–3.9 (3.3 \pm 0.4)
Upper eyelid width	2.2–2.3 (2.2 \pm 0.06)	2.3–2.8 (2.5 \pm 0.3)
Eye diameter	3.1–3.2 (3.2 \pm 0.07)	3.5–3.9 (3.7 \pm 0.1)
Eye–nostril distance	2.6–2.7 (2.6 \pm 0.05)	3.1–3.6 (3.5 \pm 0.2)
Internarial distance	1.6–1.8 (1.7 \pm 0.1)	1.9–2.2 (2.2 \pm 0.1)
Tympanum diameter	1.2–1.3 (1.3 \pm 0.1)	1.5–1.6 (1.6 \pm 0.08)
Tibia length	12.9–13.3 (13.1 \pm 0.2)	15.5–17.2 (16.2 \pm 0.6)
Foot length	11.5–12.4 (11.9 \pm 0.5)	13.6–16.8 (15.1 \pm 1.2)
Head length/snout-vent length	33.6–33.9	32.7–36.4
Head width/snout-vent length	34.1–35	37.4–39.1
Eye diameter/head length	38.1–38.9	36.4–41.3
Eye–nostril distance/eye diameter	83.1–83.5	87.3–98.6
Upper eyelid width/interorbital distance	78.7–80.4	70.7–99.7
Interorbital distance/head width	32.5–34.1	27.2–32.3
Internarial distance/interorbital distance	57.1–64.5	57.9–73.7
Tympanum diameter/eye diameter	38.1–42.5	40.7–45.8
Tibia length/snout-vent length	52.2–53.9	55.9–59.6
Foot length/snout-vent length	46.8–50.2	48.5–54.7



FIG. 6.—Living specimens of *Pristimantis ingles* (A; holotype, CPZ-UV 6121 adult male, SVL = 24.6 mm), *P. calcaratus* (B; adult male, not collected, Reserva Forestal Bitaco, Valle del Cauca), *P. kelephus* (C; adult male, not collected, Reserva Natural Comunitaria Cerro El Inglés, Valle del Cauca), and *P. opacobates* (D; adult male, not collected, Reserva Forestal Bitaco, Valle del Cauca). A color version of this figure is available online.

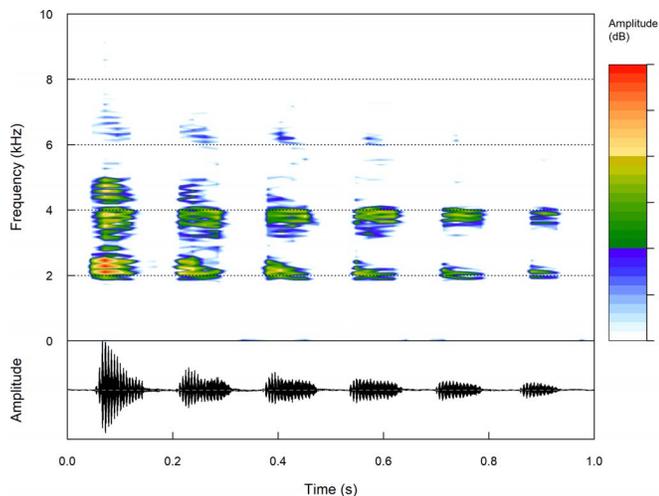


FIG. 7.—Advertisement call of *Pristimantis ingles* from male holotype (CPZ-UV 6121). A color version of this figure is available online.

ment of Valle del Cauca, Colombia, collected by J.J. Ospina-Sarria, W. Bolívar-García, F.G. Arriaga-Jaramillo, O.M. Cuellar-Valencia, I. Ceballos-Castro, and I. García-Gómez on 25 July 2019.

Paratypes.—One adult male (CPZ-UV 5089) and five females (CPZ-UV 5097, 5569, 5571, 5474, and 6122). CPZ-UV 5089, 5097, 5569, and 5571 from Regional Park Páramo del Duende, Municipality of Riofrío, Department of Valle del Cauca, 2413 m elevation (04°02'N, 76°27'W). CPZ-UV 5474 from Quebrada el Indio, vereda Monteloro, Municipality of Trujillo, Department of Valle del Cauca, 2385 m elevation (04°13'N, 76°25'W). CPZ-UV 6122 collected with the holotype.

Diagnosis.—*Pristimantis ingles* is diagnosed by the following combination of characters: (1) dorsal skin finely tuberculate with scattered larger tubercles; becoming larger in the flanks; ventral skin areolate; discoidal fold present, well anterior to groin; dorsolateral folds absent; dermal ridges on scapular region forming a “\ /” shape; (2) tympanic membrane differentiated, round; its length 38.1–42.5% of eye length in two males and 40.7–45.8% in five females; prominent tympanic annulus, its upper edge covered by supratympanic fold, extending only just posterior to tympanic annulus; (3) snout moderately long, subacuminate in dorsal view, rounded in profile and lacking of papilla; canthus rostralis concave in dorsal view and profile; (4) upper eyelid bearing one conical tubercle; upper eyelid width 78.7–80.4% IOD in males, 70.7–99.7% in females; interocular tubercle absent; cranial crest absent; (5) choanae small, ovoid not concealed by palatal shelf of maxillary arch; dentigerous process of vomer prominent, triangular in outline, separated medially by a distance less to the width of the visible dentigerous process, positioned posterior to edge of choanae, each dentigerous process of vomers bearing two to four teeth; (6) males with vocal slits and subgular vocal sac poorly defined; nuptial pads present on the dorsomedial surface on the base of the thumb and on the outer edge of the thenar tubercle; (7) Finger I shorter than Finger II; discs and circumferential grooves present on all fingers; discs truncate, except on Finger I, which is round; disc on Finger I smaller than that on Finger II and this in

turn smaller than discs of fingers III and IV (Fig. 3C); (8) fingers with lateral fringes; palmar tubercle divided; thenar tubercle oval, smaller than palmar tubercle; supernumerary tubercles low, distributed on all fleshy parts of palm; subarticular tubercles present, except hyperdistal that are absent; subarticular tubercles round, prominent, with rounded base, larger than supernumerary tubercles, one on first and second fingers, and two on third and fourth fingers; (9) two or three ulnar subconical tubercles not coalesced; (10) heel bearing one large conical tubercle; outer edge of tarsus bearing subconical tubercles; inner tarsal tubercle on distal one-thirds of tarsus; (11) inner metatarsal tubercle elongate, its length twice its width; outer metatarsal tubercle round, one-third size of inner metatarsal tubercle; subarticular tubercles present, except hyperdistal that are absent; subarticular tubercles round, prominent, with rounded base and larger than supernumerary tubercles, one on first and second toes, two on third and fifth toes, three in fourth toe; supernumerary tubercles low, rounded, distributed on all fleshy parts of plantar surface (12) toes bearing prominent lateral fringes; toe webbing absent; Toe III shorter than Toe V; Toe III extending to proximal edge of penultimate subarticular tubercle of Toe IV; Toe V reaching midway between penultimate and distal subarticular tubercles of Toe IV (Fig. 3D); discs and circumferential grooves present on all toes; discs of toes smaller than discs on fingers III–IV, disc of toes IV–V of equal size, and larger than disc on Toe III, which is larger than Toe I and II; (13) color in life: dorsum brown with darker marks which are cream-bordered in males; flanks and belly gray; orange spots on belly, groin, and axillary region in females, and on groin in males; labial bars, canthal stripe and interorbital bar dark brown on cream background, less distinctive in females; dorsal surfaces of limbs brown with darker bars, which cream-bordered in males and brown to gray anterior limbs in females; inner surfaces of thighs gray, with orange spots only in females; iris reddish-brown with black flecks; concealed tunic of eye blue; (14) males smaller than females; SVL in two adult males 24.6 and 24.7 mm, in five adult females 26.1–30.8 mm (mean \pm 1 SD = 28.7 \pm 1.6 mm; n = 5).

Comparisons.—*Pristimantis ingles* differs from the other species in the genus by having dorsal skin finely tuberculate with scattered larger tubercles; dermal ridges on scapular region forming a “\ /” shape; upper eyelid narrower than IOD (78.7–80.4% IOD) in males; conical tubercle on upper eyelid; conical tubercle on heel; palmar tubercle divided; tympanic membrane differentiated; males with vocal slits; orange spots distributed on belly, groin, and axillary region in females, and on groin in males; and advertisement call composed of distinctly pulsed six to eight notes (Fig. 7) and by lacking of dorsolateral folds as well as cranial crest, hyperdistal tubercles, and toe webbing. *Pristimantis ingles* is most similar to *P. calcaratus*, *P. kelephus*, and *P. orpacobates* (Lynch et al. 1994) by having dorsal skin tuberculate, one conical tubercle on upper eyelid, tubercle on heel, ulnar tubercles not coalesced, palmar tubercle divided, ventral skin areolate, snout subacuminate in dorsal view (except *P. kelephus*), vocal slits (except *P. orpacobates*), and prominent tympanic annulus (Fig. 6). *Pristimantis ingles* differs from *P. calcaratus*, *P. kelephus*, and *P. orpacobates* by having orange spots distributed on belly, groin, and axillary region in females and on groin in males (pale-brown spots on flanks

and inner surface of thighs in *P. calcaratus*, venter dark brown to maroon with cream spots and reticulum in *P. kelephus*, and venter off-white with gray spots in *P. orpacobates*; Lynch et al. 1994; Lynch 1996, 1998; Ospina-Sarria et al. 2011). *Pristimantis ingles* differs from *P. calcaratus* and *P. orpacobates* by having upper eyelid narrower than IOD, 70.7–80.4% IOD in males (95.2–121% IOD in males of *P. calcaratus* and 100.0–139.4% IOD in males of *P. orpacobates*; Lynch et al. 1994; Lynch 1996). Besides, *P. ingles* differs from *P. calcaratus* and *P. kelephus* by having dermal ridges on shoulder forming a “\ /” shape (dermal ridges on shoulder absent in *P. calcaratus* and dermal ridges on scapular region forming H-shape in *P. kelephus*; Lynch 1996, 1998). In addition to these differences, *P. ingles* is also distinguished from *P. kelephus* and *P. orpacobates* by having dorsal finely tuberculate skin with scattered larger tubercles (dorsal skin with many round pustules in *P. kelephus* and dorsal skin granular in *P. orpacobates*; Lynch et al. 1994; Lynch 1998). Finally, *P. ingles* can also be differentiated from *P. calcaratus*, *P. kelephus*, and *P. orpacobates* by its size: SVL in two adult males 24.6 and 24.7 mm, in five adult females 26.1–30.8 mm (SVL 15.8–22.8 in males of *P. calcaratus*, 15.8–21.3 mm in males of *P. kelephus*, and 43.6–48.5 mm in females of *P. orpacobates*; Lynch et al. 1994; Lynch 1996, 1998).

Other species in the Andes of Colombia with comparable size and similar snout shape in dorsal view (subacuminate) and groin coloration (orange spots) are *P. aurantiguttatus* (Ruíz-Carranza et al. 1997), *P. gracilis* (Lynch 1986), and *P. molybrignus*. *Pristimantis ingles* differs from all of these species by having dorsal skin finely tuberculate with scattered larger tubercles instead dorsal skin smooth (Lynch 1986; Ruíz-Carranza et al. 1997). Furthermore, *P. ingles* is distinguished in having two or three ulnar tubercles (only the antebrachial tubercle is present in *P. aurantiguttatus*; Ruíz-Carranza et al. 1997), adult males with vocal slits (adult males lack of vocal slits in *P. aurantiguttatus* and *P. molybrignus*; Lynch 1986; Ruíz-Carranza et al. 1997), and prominent tympanic annulus and conical tubercle on heel (tympanic annulus and heel tubercle absent in *P. gracilis*; Lynch 1986).

Descriptions of the holotype.—An adult male with head slightly wider than body; HW 34.1% of SVL; HL 33.6% of SVL; snout moderately long, subacuminate in dorsal view, rounded in profile and lacking papilla at its tip; eye–nostril distance 83.5% of diameter of eye; nostrils not protuberant, directly dorsolaterally. Canthus rostralis concave in dorsal view and profile, not elevated, with low-nonconical tubercles; canthal stripe dark brown on cream background; loreal region depressed bearing low-nonconical tubercles; lips not flared; internarial region not depressed; top of head flat lacking tubercles or fold; upper eyelid warty and bearing one subconical tubercle, its width 80.4% of IOD; supratympanic fold prominent, on upper and posterior to tympanic annulus; tympanic membrane evident, upper edge of tympanic annulus covered by the supratympanic fold; two large postrictal tubercles present. Choanae small, ovoid, not concealed by palatal shelf of maxillary arch; dentigerous process of vomer prominent, triangular in outline, separated medially medial distal less to the width of the visible dentigerous process, positioned posterior to edge of choanae, each process bearing four teeth; tongue as long as wide, its

posterior border not notched, posterior third not adherent to floor of mouth; paired vocal slits present, longitudinal, lateral to base of tongue; subgular vocal sac poorly defined.

Skin of dorsum finely tuberculate with scattered larger tubercles; becoming larger in the flanks; skin on belly and throat areolate and on posterior surface of the thighs smooth; discoidal fold present, well anterior to groin; dorsolateral folds absent; cloacal sheath short; no tubercles in the cloacal region. Two ulnar tubercles subconical; palmar tubercle divided; thenar tubercle oval, smaller than palmar tubercle; subarticular tubercles round, prominent, with rounded base, and larger than supernumerary tubercles, one on thumb and second finger and two on third and fourth fingers; supernumerary tubercles low, distributed on all fleshy parts of palm; fingers bearing lateral fringes; relative lengths of fingers I < II < IV < III, with all fingers having terminal ventral pads well defined by circumferential grooves; disc on thumb round, slightly smaller than Finger II; discs on fingers III and IV truncate and as large as the tympanic annulus; white nonspinous nuptial pads are present on the dorsomedial surface of the base of the thumb and on the outer edge of the thenar tubercle (Fig. 3C). Hind limbs moderately robust; when hind limbs flexed perpendicular to axis of body, heels overlap; tibia length 53.9% of SVL; foot length 50.2% of SVL; heel bearing one large conical tubercle; outer edge and medial surface of tarsus bearing subconical tubercles; inner tarsal tubercle on distal one-thirds; inner metatarsal tubercle elongate, its length twice its width; subconical outer metatarsal tubercle one-third size of inner; toes slender, bearing lateral fringes and disc (about wider than long) on expanded pads; webbing absent; relative lengths of toes I < II < III < V < IV; Toe III shorter than Toe V; Toe III extending to proximal edge of the penultimate subarticular tubercle of Toe IV; Toe V reaching midway between penultimate and distal subarticular tubercles of Toe IV; discs and circumferential grooves present on all toes; discs of toes smaller than discs on fingers III–IV, disc of toes IV–V of equal size, and larger than disc on Toe III, which is larger than toes I and II (Fig. 3D); subarticular tubercles round, prominent, with rounded base and larger than supernumerary tubercles, one on first and second toes, two on third and fifth toes, three on fourth toe; supernumerary plantar tubercles low, rounded, distributed on all fleshy parts of plantar surface.

In life, the dorsum is brown with darker marks that are cream-bordered, one of them bigger on the scapular region (Fig. 6A); flanks and belly gray; orange spots on groin; labial bars, canthal stripe, and interorbital bar dark brown on cream background; dorsal surfaces of limbs brown with darker bars cream-bordered; inner surfaces of thighs gray; iris reddish-brown with black flecks; concealed tunic of eye blue.

Measurements of holotype (mm).—SVL 24.6, tibia length 13.3, foot length 12.4, HL 8.3, HW 8.4, IOD 2.8, tympanum diameter 1.2, internarial distance 1.6, width of upper eyelid 2.3, diameter of eye 3.1, eye–nostril distance 2.6.

Variation.—Sexual dimorphism evident in size, with adult females being larger than the adult males; measurements and proportions are presented in Table 2. A sexual dichromatism in ventral surface coloration seems to occur, with the presence of orange spots restricted to groin in living

males, whereas the orange area covers throat, groin, belly, axillae, and ventral surface of limbs and legs in living females. Similarly, the males have a cream-bordered dark-brown blotch on the scapular region (Fig. 2C), which is absent in females. Number of teeth on dentigerous processes of vomers varies from two to four. Living specimens have well-defined tubercles on the dorsum and legs, but these tubercles are barely seen on the preserved specimens.

Distribution and ecology.—*Pristimantis ingles* is known from three localities in a humid montane forest at elevations 2112–2413 m in the department of Valle del Cauca (western flanks of the Cordillera Occidental; Fig. 5): (1) Reserva Natural Comunitaria Cerro El Inglés (municipality of El Cairo), (2) Quebrada el Indio, Vereda Monteloro (municipality of Trujillo), and (3) Regional Park Páramo del Duende (municipality of Riofrío). In the Reserva Natural Comunitaria Cerro El Inglés, an amplexant pair was found on vegetation in the forest along the borders of a stream at night (Quebrada las Amarillas).

Call.—The simple advertisement call of *P. ingles* consists of 6–8 notes (6.5 ± 1 ; $n = 4$) distinctly pulsed, with 7–19 pulses per note (14.3 ± 2.7 ; $n = 26$). The notes are separated by intervals of silence (i.e., 100% amplitude modulation) with descending modulation in the energy of note, and two distinctive harmonics (Fig. 7). The call is 0.862–1.172 s in duration (0.943 ± 0.153 ; $n = 4$), with notes of 0.037–0.113 s in duration (0.089 ± 0.015 ; $n = 26$), and internotes of 0.056–0.091 s in duration (0.065 ± 0.007 ; $n = 22$). The call repetition rate is 0.76 calls per minute, the note repetition rate is 6.2–6.4 notes per s (6.3 ± 0.1), and the pulse repetition rate is 147.7–193.5 pulses per s (164.9 ± 11.2 ; $n = 26$). Intercall interval is 59.4–91.3 s in duration (78.4 ± 16.8 ; $n = 3$). The dominant frequency is 2368.7–2454.8 Hz (2400.9 ± 41.2 ; $n = 4$). The dominant frequency of two harmonic bands is 4048.2–4134.4 (4069.8 ± 43.1 ; $n = 4$) and 6029.3 ($n = 4$). The bandwidth where 90% of the energy of the call concentrates corresponds to 2325.6–2454.8 Hz (2400.9 ± 64.6 ; $n = 4$). These calls were obtained from the holotype of *P. ingles* (CPZ-UV 6121) that was found in amplexus along the borders of a stream on low vegetation at approximately 90-cm height. The specimen was recorded calling at night in a plastic bag after the female was released, at an environmental temperature of 17.8°C and body temperature of 16.1°C.

Etymology.—The species name, used as a noun in apposition, is the name given to this peak in the Serranía de los Paraguas by the local community. The Reserva Natural Comunitaria Cerro El Inglés harbors an extraordinary biodiversity of plants and terrestrial vertebrates; it is also a source of many ecosystem services that support human communities. For instance, Las Amarillas microbasin originates in this protected area, which provides water supply to local communities, and it is an affluent of the Garrapatas River in the San Juan River macrobasin.

Remarks.—To the human ear, the call of *P. ingles* resembles the call of the sympatric and morphologically similar *P. calcaratus* (Fig. 6B). However, the train of loud notes of *P. ingles* has a note duration between 0.037–0.113 s and a maximum energy concentrated in the region of 2368.7–2454.8 Hz. In contrast, in the call of *P. calcaratus*, a note duration of 0.634 s with a maximum energy concentrated at 2885.4 Hz is distinctive (Velásquez-Trujillo and

Bolívar-G 2018). Additionally, a remarkable finding in *P. ingles* was the blue coloration of the concealed tunic of the eye, which has also been registered in *P. orpacobates* (Lynch et al. 1994: 36). Nevertheless, *P. ingles* is easily distinguished from *P. calcaratus* and *P. orpacobates* by having distinctive orange spots on belly, groin, and axillary region in females and on groin in males (absent in those species). See comparisons for other resemblances.

DISCUSSION

One of the most clear-cut morphological differences of both new species is the divided palmar tubercle (Fig. 3A,C). A distinctive divided palmar tubercle is less common in *Pristimantis* than a palmar tubercle partially divided distally (Lynch and Duellman 1997; Duellman and Lehr 2009). Other than *P. alius* and *P. ingles*, we found a divided palmar tubercle in *P. calcaratus*, *P. kelephus*, *P. laticlavus*, *P. orpacobates*, *P. sobetes*, and *P. thymalopsoides*. Added to this character state, *P. alius* and *P. ingles* have a distinctive color pattern on the groin extending to the concealed surfaces of limbs. Although color patterns on dorsal, ventral, and posterior surfaces of thighs are highly variable in *Pristimantis*, the color pattern on the groin is a diagnostic character of several species (Lynch and Duellman 1997). With this in mind, in the Serranía de los Paraguas, the presence of a carmine red coloration on the groin area in *P. alius* is shared by females of *P. erythropleura* and *P. quantus*. However, *P. alius* is readily distinguished by lacking folds or tubercles on the inner edge of the tarsus (fold in *P. erythropleura* and tubercles in *P. quantus*; Lynch 1992, 1998). In the case of *P. ingles*, the presence of orange spots on the groin is shared by *P. aurantiguttatus*, *P. gracilis*, and *P. molybrignus*, but these species seem to be readily separated (see comparisons).

So far as we know, *P. alius* and *P. ingles* have restricted distributions in the cloud forests of western Colombia. However, as pointed out by Lynch (1998), species of *Pristimantis* in the cloud forests of western Colombia appear to have moderately widespread distributions. Thus, we presume that *P. alius* and *P. ingles* may have fairly extensive distributions on the Cordillera Occidental in western Colombia.

Amphibian Diversity from the Serranía de los Paraguas

Forty-five species of terraranan frogs occurring in the Serranía de los Paraguas are recognized in the literature (Lynch 1998), which are mostly the works of P. Ruíz-Carranza and J.D. Lynch. In 1988, M.C. Ardila-Robayo and P. Ruíz-Carranza collected frogs on an access ridge to the north but not in the Serranía de los Paraguas itself (San José del Palmar, Department of Choco). The only anuran collections from the Serranía de los Paraguas are those made by personnel of the Universidad del Valle in the mid-1980s (M. Alberico, J.H. Restrepo, and P. Silverstone-Sopkin) and the Universidad Nacional de Colombia in 1990s (J.D. Lynch, M.C. Ardila-Robayo, and P. Ruíz-Carranza). In 1997, Ruíz-Carranza et al. listed 22 terraranan frogs, and Lynch (1998) reported 45 terraranan species inhabiting the Serranía de los Paraguas. In light of this diversity of terraranan species (plus the two new species described here) with the diversity of five known families (Bufonidae, Centrolenidae, Dendrobatidae, Hemiphractidae, and Hyli-

dae; see species list in Lynch and Grant 1998), the Serranía de los Paraguas is inhabited by 63 species of frogs. Of these species, 10 are endemic, namely, *Atelopus chocoensis*, *Ectopoglossus atopoglossus* (Grant et al. 1997), *Nymphargus armatus*, *Pristimantis albericoi* (Lynch and Ruíz-Carranza 1996b), *P. kelephus*, *P. phalarus*, *P. ptochus*, *P. quantus*, *P. signifier* (Ruíz-Carranza et al. 1997), and *P. xylochobates*; 17 species are threatened according to the IUCN Red List (7 Critically Endangered, 5 Endangered, and 5 Vulnerable), and 29 terraranan species may be found in a single place within it—the Reserva Natural Comunitaria Cerro El Inglés. It is evident, given the species-level richness, endemism, diversity at higher taxonomic levels, and the number of threatened species, that the Serranía de los Paraguas is a priority site for conservation of amphibians in Colombia.

Thus far, no long-term research program focused on evaluating the threat status, population trends, and conservation needs of the amphibian has been carried out in the Reserva Natural Comunitaria Cerro El Inglés. Our preliminary results showed that although the Reserva Natural Comunitaria Cerro El Inglés maintains vast primary forests (i.e., forests that have not been disturbed by human activity), the historically known diversity from the Serranía de los Paraguas seems to be decreasing because several species listed as common during the 1980s and 1990s have not been observed again, for instance, *Ectopoglossus atopoglossus*, *Hyloxalus abditaurantius* (Silverstone 1975), *Pristimantis deinops* (Lynch 1996), *P. gracilis*, and *P. xylochobates*. Due the precipitous amphibian declines and extinctions around the world (Gascon et al. 2007), the possibility of amphibian declines in the Serranía de los Paraguas causes much alarm given their high levels of endemism, taxonomic diversity, and threatened species. Therefore, to identify possible amphibian declines in the Serranía de los Paraguas before it is too late to intervene, it is crucial to prioritize funding allocation to conduct comprehensive field research and establish conservation strategies in this area.

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RESUMEN: La Serranía de los Paraguas es una región montañosa localizada en la parte central de la Cordillera Occidental de Colombia, la cual se eleva unos 2.500 m sobre el bosque húmedo y alberga una alta riqueza y endemismo de especies de plantas y vertebrados terrestres (anfibios, aves y mamíferos). En

el caso de anfibios, los principales aportes a su conocimiento fueron liderados por J.D. Lynch y P. Ruíz-Carranza en la década de los 90, a partir de los cuales 61 especies fueron reconocidas por habitar esta Serranía. Entre el 19 al 27 de Julio del 2019 se realizó una visita a la Reserva Natural Comunitaria Cerro El Inglés, uno de los picos de la Serranía de los Paraguas, ubicado en la frontera entre los departamentos de Chocó y Valle del Cauca. Como resultado de esta exploración, se descubrieron dos nuevas especies del género *Pristimantis*, las cuales comparten dos caracteres considerados distintivos dentro de este género: tubérculo palmar dividido y coloración en la ingle. La primera nueva especie es reconocida por su tamaño pequeño y por tener una coloración rojiza en la ingle, rebordes cutáneos uniformes en los dedos manuales, tubérculo palmar profundamente bifido o dividido, canto de advertencia compuesto de notas únicas distintamente pulsadas y por carecer de almohadillas nupciales, tubérculos hiperdistales, pliegue o tubérculo sobre borde interno del tarso y fusión parcial de los dedos pediales IV y V. La segunda nueva especie es reconocida por tener pliegues dermales sobre la región escapular, tubérculos cónicos sobre el parpado superior y el talón, tubérculo palmar dividido, membrana timpánica evidente, machos con hendiduras vocales, manchas naranjas sobre la ingle, un canto de advertencia compuesto de 6–8 notas pulsadas y por carecer de pliegues dorsolaterales, crestas craneales, tubérculos hiperdistales y membrana entre los dedos pediales. Considerando estos nuevos hallazgos, la Serranía de los Paraguas alberga 63 especies de anfibios, de los cuales 10 especies son endémicas y 17 están en alguna categoría de amenaza según la IUCN. De igual manera, es de resaltar que 29 especies de terraranas pueden ser encontradas en la Reserva Natural Comunitaria Cerro El Inglés. Basado en la riqueza de especies, el nivel de endemismo, la diversidad a niveles taxonómicos superiores y el número de especies amenazadas, es razonable reconocer que la Serranía de los Paraguas es un sitio prioritario para la conservación de anfibios en Colombia.

LITERATURE CITED

Boulenger, G.A. 1896. Descriptions of new reptiles and batrachians from Colombia. *Annals and Magazine of Natural History* 17:16–21.
 Boulenger, G.A. 1908. Descriptions of new batrachians and reptiles discovered by Mr. M.G. Palmer in south-western Colombia. *Annals and Magazine of Natural History* 2:515–522.
 Boulenger, G.A. 1912. Descriptions of new batrachians from the Andes of South America, preserved in the British Museum. *Annals and Magazine of Natural History* 10:185–191.
 Brame, A.H., Jr., and D.B. Wake. 1972. New species of salamanders (genus *Bolitoglossa*) from Colombia, Ecuador, and Panama. *Contributions in Science. Natural History Museum of Los Angeles County* 219:1–34.
 Carey, C., and M.C. Alexander. 2003. Climate change and amphibian declines: Is there a link? *Diversity and Distributions* 9:111–121.
 Cochran, D.M., and C.J. Goin. 1970. Frogs of Colombia. *Bulletin of the United States National Museum* 288:1–655.
 Duellman, W.E. 1981. Three new species of centrotenid frogs from the Pacific versant of Ecuador and Colombia. *Occasional Papers of the Museum of Natural History, University of Kansas* 88:1–9.
 Duellman, W.E., and E. Lehr. 2009. *Terrestrial Breeding Frogs (Strabomantidae)* in Peru. *Natur und Tier-Verlag*, Germany.
 Gascon, C., J.P. Collins, R.D. Moore, D.R. Church, J.E. McKay, and J.R.

- Mendelson, III (eds). 2007. Amphibian Conservation Action Plan. IUCN/SSC Amphibian Specialist Group, Switzerland.
- Goin, C.J. 1961. Three new centrolepid frogs from Ecuador. *Zoologischer Anzeiger* 166:95–104.
- Grant, T., and W. Bolívar-García. 2014. A new species of semiarboreal toad with a salamander-like ear (Anura: Bufonidae: *Rhinella*). *Herpetologica* 70:198–210.
- Grant, T., E.C. Humphrey, and C.W. Myers. 1997. The median lingual process of frogs: A bizarre character of Old World ranoids discovered in South American dendrobatids. *American Museum Novitates* 3212:1–40.
- IUCN (International Union for Conservation of Nature). 2019. The IUCN Red List of Threatened Species, Version 2019-3. Available at <http://www.iucnredlist.org>. Accessed on 12 January 2020.
- Köhler, J., M. Jansen, A. Rodríguez, P.J.R. Kok, L.F. Toledo, M. Emmrich, F. Glaw, C.F.B. Haddad, M. Rödel, and M. Vences. 2017. The use of bioacoustics in anuran taxonomy: Theory, terminology, methods and recommendations for best practice. *Zootaxa* 4251:1–124.
- Lötters, S. 1992. A new Harlequin frog (Anura: Bufonidae: *Atelopus chocoensis* Lötters 1992) from the Chocó, West-Colombia. *Sauria* 14:27–30.
- Lynch, J.D. 1981. Two new species of *Eleutherodactylus* from western Colombia (Amphibia: Anura: Leptodactylidae). *Occasional Papers of the Museum of Zoology, University of Michigan* 697:1–12.
- Lynch, J.D. 1986. New species of *Eleutherodactylus* of Colombia (Amphibia: Leptodactylidae) II: Four species from the cloud forests of the western Cordilleras. *Caldasia* 15:629–647.
- Lynch, J.D. 1992. Distribution and variation in a Colombia frog, *Eleutherodactylus erythroleura* (Amphibia: Leptodactylidae). *Studies on Neotropical Fauna and Environment* 27:211–226.
- Lynch, J.D. 1996. New frogs of the genus *Eleutherodactylus* (family Leptodactylidae) from the San Antonio region of the Colombian Cordillera Occidental. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 20:331–345.
- Lynch, J.D. 1998. New species of *Eleutherodactylus* from the Cordillera Occidental of western Colombia with a synopsis of the distributions of species in western Colombia. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 22:117–148.
- Lynch, J.D. 1999. Lista anotada y clave para las ranas (Género *Eleutherodactylus*) chocoanas del Valle del Cauca, y apuntes sobre las especies de la cordillera Occidental adyacente. *Caldasia* 21:184–202.
- Lynch, J.D. 2001. A small amphibian fauna from a previously unexplored paramo of the Cordillera Occidental in western Colombia. *Journal of Herpetology* 35:226–231.
- Lynch, J.D., and W.E. Duellman. 1997. Frogs of the genus *Eleutherodactylus* in western Ecuador: Systematics, ecology, and biogeography. *Special Publication Natural History Museum University of Kansas* 23:1–236.
- Lynch, J.D., and T. Grant. 1998. Dying frogs in western Colombia: Catastrophe or trivial observation? *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 23:149–152.
- Lynch, J.D., and P.M. Ruiz-Carranza. 1996a. A remarkable new centrolepid frog from Colombia with a review of nuptial excrescences in the family. *Herpetologica* 52:525–535.
- Lynch, J.D., and P.M. Ruiz-Carranza. 1996b. New sister-species of *Eleutherodactylus* from the Cordillera Occidental of southwestern Colombia (Amphibia: Salientia: Leptodactylidae). *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 20:347–363.
- Lynch, J.D., P.M. Ruiz-Carranza, and M.C. Ardila-Robayo. 1994. The identities of the Colombian frogs confused with *Eleutherodactylus latidiscus* (Boulenger) (Amphibia: Anura: Leptodactylidae). *Occasional Papers of the Museum of Natural History, University of Kansas* 170:1–42.
- Lynch, J.D., P.M. Ruiz-Carranza, and M.C. Ardila-Robayo. 1997. Biogeographic patterns of Colombian frogs and toads. *Revista de la Academia Colombiana de Ciencias Exactas Físicas y Naturales* 21:237–248.
- Ospina-Sarria, J.J., and W.E. Duellman. 2019. Two new species of *Pristimantis* (Amphibia: Anura: Strabomantidae) from southwestern Colombia. *Herpetologica* 75:85–95.
- Ospina-Sarria, J.J., J. Méndez-Narváez, C.E. Burbano-Yandi, and W. Bolívar-García. 2011. A new species of *Pristimantis* (Amphibia: Craugastoridae) with cranial crests from the Colombian Andes. *Zootaxa* 3111:37–48.
- Ruiz-Carranza, P.M., J.D. Lynch, and M.C. Ardila-Robayo. 1997. Seis nuevas especies de *Eleutherodactylus* Duméril & Bibron, 1841 (Amphibia: Leptodactylidae) del Norte de la Cordillera Occidental de Colombia. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 21:155–179.
- Silverstone, P.A. 1975. Two new species of *Colostethus* (Amphibia: Anura: Dendrobatidae) from Colombia. *Contributions in Science. Natural History Museum of Los Angeles County* 268:1–10.
- Sueur, J., T. Aubin, and C. Simonis. 2008. Seewave: A free modular tool for sound analysis and synthesis. *Bioacoustics* 18:213–226.
- Velásquez-Trujillo, D.A., and W. Bolívar-G. 2018. *Pristimantis calcaratus*. *Catálogo de Anfibios y Reptiles de Colombia*. Medellín 4(2):45–50.
- Taylor, E.H. 1968. *The Caecilians of the World: A Taxonomic Review*. University of Kansas Press, USA.

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APPENDIX

Specimens Examined from Colombia and Ecuador

- Pristimantis aurantiguttatus*.—COLOMBIA: ANTIOQUIA: Municipio Urao, Parque Natural Nacional Las Orquídeas (ICN 19373).
- Pristimantis calcaratus*.—COLOMBIA: VALLE DEL CAUCA: Municipio Dagua, Queremal (ICN 35846, 36937, 36939); Municipio El Cairo, Vereda las Amarillas (ICN 29068–71, 29074–75).
- Pristimantis duende*.—COLOMBIA: VALLE DEL CAUCA: Municipio Riofrío, Páramo del Duende (ICN 43892).
- Pristimantis gracilis*.—COLOMBIA: VALLE DEL CAUCA: Municipio Cali, Farallones de Cali (ICN 7872).
- Pristimantis kelephus*.—COLOMBIA: VALLE DEL CAUCA: Municipio El Cairo, Vereda las Amarillas (ICN 39622–28, 39630, 39635–48).
- Pristimantis laticlavus*.—COLOMBIA: NARIÑO: Municipio de Ricaurte, Reserva Natural La Planada, 7 km S Chucunes (KU 200188).
- Pristimantis molybrigus*.—COLOMBIA: CAUCA: Municipio El Tambo, Quebrada Sopladero (ICN 7895).
- Pristimantis myops*.—COLOMBIA: VALLE DEL CAUCA: Municipio El Cairo, Vereda las Amarillas, El Boquero (ICN 36925, 39684).
- Pristimantis orpacobates*.—COLOMBIA: VALLE DEL CAUCA: Municipio Calima, 1.5 km W lago Lago Calima (KU 168128).
- Pristimantis phalarus*.—COLOMBIA: VALLE DEL CAUCA: Municipio El Cairo, Vereda las Amarillas, El Boquero (ICN 36934, 39678).
- Pristimantis ptochus*.—COLOMBIA: VALLE DEL CAUCA: Municipio El Cairo, Vereda las Amarillas, El Boquero (ICN 39780).
- Pristimantis quantus*.—COLOMBIA: VALLE DEL CAUCA: Municipio El Cairo, Vereda las Amarillas, El Boquero (ICN 29340).
- Pristimantis sobetes*.—ECUADOR: PICHINCHA: 5 km ESE Chiriboga, Quebrada Zapadores (KU 179389).
- Pristimantis thymalopsoides*.—ECUADOR: COTOPAXI: Pilalo (KU 131533).