

## Another New Riparian Dendrobatid Frog Species from the Upper Amazon Basin of Peru

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**ABSTRACT.**—A new dendrobatid frog of the genus *Colostethus* is described from the Cordillera El Sira, an isolated mountain ridge in the upper Amazon basin of central Peru. It has bright yellowish dorsolateral stripes thus resembling *Colostethus exasperatus*, *Colostethus* sp. (cf. *exasperatus*), and *Colostethus nexipus*, all from the upper Amazon basin of Ecuador and Peru. In morphology, the new species is most similar to *Colostethus mcdiarmidi* from the eastern Andean slopes of Bolivia and *Colostethus alessandroi* from the eastern Andean slopes of Peru. The new species can be distinguished from all these taxa on the basis of coloration including the color of the ring around pupil in life, adult male size, length of Finger I relative to Finger II, and toe webbing extension. The advertisement call and aspects of the skeleton of the new species are described.

**RESUMEN.**—Se describe una especie nueva de dendrobátido del género *Colostethus* de la Cordillera El Sira; una formación montañosa aislada en la parte central de la Amazonía peruana. La especie nueva presenta una franja dorsolateral amarillenta, semejante a la franja en *Colostethus exasperatus*, *Colostethus* sp. (cf. *exasperatus*) y *Colostethus nexipus*. Todas ellas de las cuencas altas de la amazonía de Ecuador y Perú. Morfológicamente, la nueva especie es más similar a *Colostethus mcdiarmidi* de las laderas orientales de los andes de Bolivia y a *Colostethus alessandroi* de las laderas orientales de los andes del Perú. La especie nueva puede ser distinguida de todos estos taxa, básicamente, por su coloración incluyendo el color en vivo del anillo alrededor de la pupila, tamaño del macho adulto, largo del Dedo I palmar con relación al II y extensión de la membrana interdigital en los dedos plantares. Se describe el llamado de advertencia y el esqueleto de la especie nueva.

Amphibian species richness and endemism in the upper Amazon basin of Peru are extraordinarily high (Rodríguez and Duellman, 1994), as exemplified by the dendrobatid frogs that occur in this area (e.g., Silverstone, 1976; Lötters and Vences, 2000). More than 40 species are currently known from Amazonian Peru alone (Rodríguez et al., 1993; Morales, 1995; Lötters and Vences, 2000), which make up about 20% of the total number of dendrobatids known (cf. Glaw et al., 1998).

The Cordillera El Sira (also known as Serranía de Sira) is an isolated mountain ridge in the upper Amazon basin of Peru between the Ríos Pachitea and Ucayali, exceeding 2000 m above sea level at its highest elevations. Collections of amphibians from this area are limited (Duellman and Toft, 1979; Aichinger, 1991; Henle, 1992; Lötters and Henzl, 2000). Approximately 20 species have been reported, six of which are endemic. Among them is *Dendrobates sirensis* Aichinger. Other dendrobatid frogs from the Cordillera El Sira include *Colostethus* sp. (cf.

*marchesianus* [Melin]), *Colostethus conspicuus* Morales, *Epipedobates* sp. (cf. *hahneli* [Boulenger]) and *Epipedobates petersi* (Silverstone) (Silverstone, 1976; Duellman and Toft, 1979; Aichinger, 1991; Haddad and Martins, 1994; Morales, 1994, 2002).

Collections in the late 1980s by the University of Vienna (Lötters and Henzl, 2000) and in November 1994 by a group of Peruvian researchers revealed additional anuran records. Among them is another new species of dendrobatid frog that was found along small creeks. Some dendrobatid genera are not well defined, and generic allocation based on morphological characters remains problematic in part (cf. Silverstone, 1976; Lötters et al., 2000). Although the new species shows bright yellowish dorsolateral stripes in life, which is more typical for *Allobates*, *Cryptophyllobates*, or *Epipedobates*, we allocate it to *Colostethus*. We drew this conclusion because the new species, in other aspects than life color, is similar to *Colostethus mcdiarmidi* Reynolds and Foster from the eastern Andean versant of Bolivia and *Colostethus alessandroi* Grant and Rodríguez from adjacent Peru. Bright dorsolateral stripes are uncommon but no

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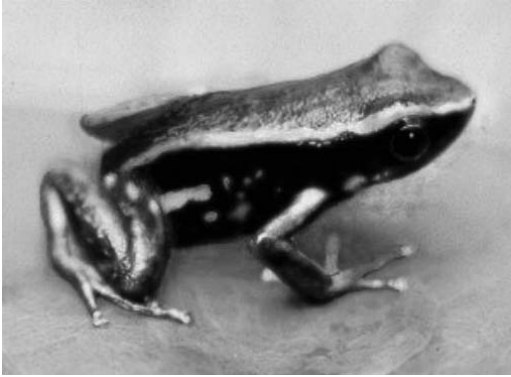


FIG. 1. Male *Colostethus patitae* in life (MHNSM 16609).

exception in *Colostethus*. As far as is known, they occur in *C. exasperatus* Duellman and Lynch, an unnamed species similar to *Colostethus exasperatus* and *Colostethus nexipus* Frost, all from the Andean versant in Amazonian Ecuador and Peru (Melin, 1941; Coloma, 1995; Grant and Castro, 1998). The purpose of this paper is to describe the new species from the Cordillera El Sira.

#### MATERIALS AND METHODS

The type specimens of the new species are deposited in the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima (MHNSM, formerly MHNJP and MUSM), Naturhistorisches Museum Wien (NHMW) and Texas Cooperative Wildlife Collection, Texas A&M University, Austin (TCWC). Specimens examined for comparisons include *Colostethus mcdiarmidi* only and are in the Museo de Historia Natural "Noel Kempff Mercado" (amphibian collection), Santa Cruz de la Sierra (NKA), and the United States National Museum, Washington (USNM): Bolivia: Departamento Cochabamba, 0.25 km east of the road to San Onofre, at 3.3–3.5 km (by road) of the Cochabamba-Villa Tunari road, at a point 97.5 km from Cochabamba, 1653–1693 m above sea level, USNM 257804, 257806 (paratypes); Departamento La Paz, Territorio Comunitario y Reserva de la Biosfera "Pilon Lajas" (15°06'S, 67°32'W), 1350 m above sea level, NKA 3708, 3712.

Definitions of characters and diagnosis follow Coloma (1995), with few additions (i.e., points 16–19 in diagnosis; compare Grant et al., 1997; Grant and Rodríguez, 2001). The diagnosis of the new species is based on adult specimens only. Measurements were taken with calipers to the nearest 0.1 mm. All measurements and ratios refer to adults only, except where mentioned (mean  $\pm$  SD are presented). Sex determination was by dissection in the manner described by

Grant and Rodríguez (2001). To facilitate comparisons with similar species, the scheme of the type series description follows that of Grant and Rodríguez (2001); subadult proportions are excluded from the description.

Clearing and staining of MHNSM 16610 was undertaken using the method of Dingerkus and Uhler (1977). Vocalizations were recorded with an AVR General Electric® minicassette recorder. The sound analysis was done with the software Canary 1.2.4 (cf. R. A. Charif, S. Mitchell, and C. W. Clark, Cornell Univ. Ithaca, New York, 1995). Terminology follows Lötters et al. (2003).

#### *Colostethus patitae* sp. nov.

Figures 1–3

*Holotype*.—MHNSM 16614 (filed number VRM 18772), adult female from Don Simon Camp, 210 m above sea level, 5 km southeast Comunidad Nativa de Davis (approximately 9°59'S, 74°40'W), Cordillera El Sira (also known as Serranía de Sira), Departamento Pasco, Peru; leg. 5 November 1994 by V. R. Morales and P. Vargas.

*Paratypes*.—Nine adult males, six adult females, 13 subadults and juveniles including fresh metamorphs: MHNSM 16608–609, 16610 (cleared and stained), 16611–6613, 16615–626, 17013, TCWC 84728–731, same data as holotype; MHNSM 11513, NHMW 33874:1–5, 500–800 m above sea level, Cordillera El Sira, Departamento Pasco, Peru; leg. between July and December 1987 by M. Aichinger.

*Diagnosis*.—A species characterized by (1) SVL of adult males 19.5–22.2 mm ( $N = 9$ ; mean =  $20.7 \pm 0.98$ ), of adult females 20.8–23.2 mm ( $N = 7$ ; mean =  $22.4 \pm 1.08$ ); (2) disc of Finger III expanded for one and a half to two times width of penultimate phalanx; (3) Finger I shorter than adpressed Finger II; (4) no fringe but keel present on Finger II; (5) disc on Toe IV expanded one and a half to two times width of penultimate phalanx; (6) no fringe but keel present on Toe IV; (7) outer metatarsal fold absent; (8) toes without webbing; (9) dorsolateral stripe present from tip of snout via eye to dorsal area of groin (thinner in males than in females), bright yellowish in life; (10) light oblique lateral stripe present, but usually interrupted by ventrolateral reticulation (if distinct, it runs from groin to half of abdominal lateral area); (11) ventrolateral stripe absent; (12) discrete marks of gular-chest region absent in both sexes or dark gray in adult males; (13) venter tan or brownish (throat darker) with or without irregular brown stipples in adult males and with grayish brown reticulation in adult females; (14) Finger III not swollen in adult males; (15) testes small, white, occasionally with sparsely scattered pigmentation; (16) median lingual process absent; (17) cloacal tubercles

absent; (18) anal sheath absent; (19) black arm band absent; and (20) reddish ring around pupil in life.

The new species is similar to *C. alexandroi* and *C. mcdiarmidi* (Reynolds and Foster, 1992; Grant and Rodríguez, 2001). *Colostethus patitae* is distinguished from *C. alexandroi* by lacking toe webbing (vs. moderately webbed), Finger I < Finger II (vs. Finger I > Finger II), Finger III not swollen in adult males (vs. swollen), dorsolateral stripe bright yellowish in life (vs. pale brown with a bronze tinge anteriorly), absence of ventrolateral stripe (vs. present), lighter venter (vs. usually dark), and reddish ring around pupil in life (vs. golden). *Colostethus patitae* is distinguished from *C. mcdiarmidi* by smaller adult male SVL (19.5–22.2 mm in *C. patitae* vs. 22.5–24.3 mm; female SVL is similar), Finger I < Finger II (vs. Finger I > Finger II), Finger III not swollen in adult males (vs. swollen), dorsolateral stripe bright yellowish in life (vs. tan or gold), oblique lateral stripe present and ventrolateral stripe absent (vs. oblique lateral stripe absent and ventrolateral stripe present), and reddish ring around pupil in life (vs. bluish gray; cf. De la Riva et al., 2000:86).

Other members of the genus *Colostethus* with bright dorsolateral stripes include *C. exasperatus*, *Colostethus* sp. (cf. *exasperatus*), and *C. nexipus* (Coloma, 1995). They also occur in *C. peruvianus* (Melin); V. R. Morales unpubl.. In *C. exasperatus* (and its junior synonym *Colostethus parvus* Rivero) plus the unnamed species similar to *C. exasperatus* (cf. Grant and Castro, 1998) is Finger I = Finger II (Finger I < Finger II in *C. patitae*), and the ring around the pupil is brown in life (reddish in *C. patitae*). In addition, males of *C. exasperatus* possess a swollen black gland on the inner surface of the elbow (absent in *C. patitae*). *Colostethus nexipus* (and its junior synonym *Colostethus citreicola* Rivero) is the only other known *Colostethus* exhibiting a reddish ring around the pupil in life. It differs from the new species in having extensive toe webbing and fringes on fingers and toes (all absent in *C. patitae*). In life, the dorsolateral stripe in *C. nexipus* is pink to orange (yellowish in *C. patitae*). *Colostethus peruvianus* is a poorly known species. The holotype, examined in the past by one of the junior authors (Morales, 1994), exhibits a well-defined oblique lateral stripe from the groin to behind the eye and a heavily tubercular palm and sole. In contrast, in *C. patitae*, the oblique lateral stripe usually is interrupted and runs from the groin to only half of the abdominal lateral area; palm and sole are poorly tubercular (Fig. 2). Following Melin (1941), *C. peruvianus* is "greenish yellow to brown, above the eye reddish" in life, thus different from *C. patitae*. *Colostethus whymperi* (Boulenger) from western Ecuador is similar to *C. exasperatus* (Coloma, 1995). It is

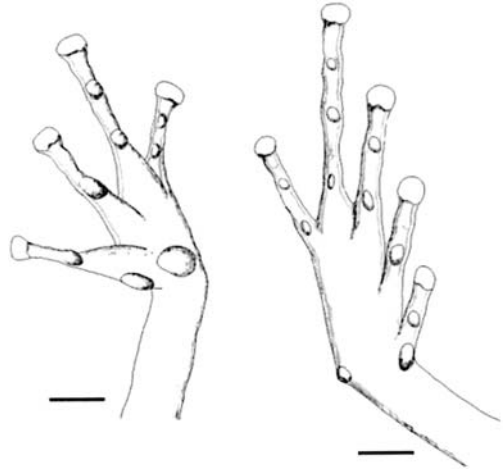


FIG. 2. Palm and sole of female holotype of *Colostethus patitae* (MHNSM 16614). Bars each equal 1.0 mm.

a poorly known species, and data on color in life are not available. According to Coloma (1995), *C. whymperi* has Finger I = Finger II (Finger I < Finger II in *C. patitae*), and it lacks an oblique lateral stripe (present in *C. patitae*).

The Peruvian *Cryptophyllobates azureiventris* shares with *C. patitae* bright yellowish dorsolateral stripes and webless toes. However, *C. azureiventris* has a labial line (absent in *C. patitae*), Finger I = Finger II (Finger I < Finger II in *C. patitae*), and a black versus reddish ring around the pupil (cf. Lötters et al., 2000).

From other dendrobatid frogs known from the Cordillera El Sira, *C. patitae* can be distinguished as follows: from *Colostethus* cf. *marchesianus* by lacking extensive toe webbing (vs. present), having bright yellowish dorsolateral stripe in life (vs. whitish) and absence of ventrolateral stripe (vs. present); from *C. conspicuus* by larger adult SVL (males  $\leq 16.5$  m vs.  $\geq 19.5$  mm), having bright yellowish dorsolateral stripe in life (vs. whitish), and absence of ventrolateral stripe (vs. present); from *Dendrobates sirensis* by lacking bright red and green dorsal coloration in life and having toe and finger discs not greatly expanded (cf. Aichinger, 1991); from *Epipedobates* sp. (cf. *hahneli*) and *E. petersi* by having oblique lateral stripe (versus absent), and lacking light inguinal spot (and *Epipedobates* sp. [cf. *hahneli*] also calf spot) and bluish venter in life (cf. Silverstone, 1976; Haddad and Martins, 1994; unpubl. obs.).

*Description of Type Series.*—The type series consists of nine adult males with small testes having white with sparsely scattered pigmentation, seven adult females with expanded oviducts and enlarged ova, and 13 subadult and juveniles including fresh metamorphs (sexes not

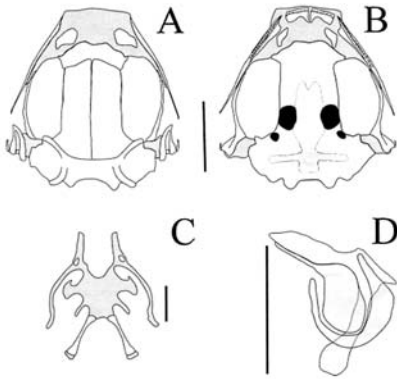


FIG. 3. Osteological characters of *Colostethus patitae* (MHNSM 16610): (A) dorsal view and (B) ventral views of skull; (C) hyoid apparatus; (D) squamosal and tympanum. Cartilage gray. Bars each equal 2.0 mm.

determined). When characters vary among the type series, conditions for the female holotype are given in parentheses. Measurements (in millimeters) of the holotype are as follows: SVL 22.6; forearm length from proximal edge of palmar tubercle to outer edge of flexed elbow 5.4; hand length from proximal edge of palmar tubercle to tip of Finger III 6.6; shank length from outer edge of flexed knee to heel 11.1; foot length from proximal edge of outer metatarsal tubercle to tip of Toe IV 10.4; head width between angles of jaws 6.9; head length diagonally from corner of mouth to tip of snout 7.2; eye length from posterior to anterior corner 3.3; eye to naris distance from anterior corner of eye to center of naris 2.2; distance between centers of nares 3.3; snout length from anterior corner of eye to tip of snout 3.3; interorbital distance 2.4; greatest diameter of tympanum 1.0.

Adult male SVL range 19.5–22.2 mm ( $N = 9$ ; mean =  $20.7 \pm 0.98$ ), adult female range SVL 20.8–23.2 mm ( $N = 7$ ; mean =  $22.4 \pm 1.08$ ), and the 13 subadults and juveniles range 10.9–17.3 mm SVL. Small, low, weak tubercles may be almost absent or scattered over posterior dorsolateral area, posterior back and upper surfaces of legs (almost absent in holotype). Preaxilar and cloacal tubercles absent. Ventral surfaces smooth. Head width between angles of jaws 30–38% of SVL and 1.01–1.12 times head length (35% and 1.04 in holotype). Interorbital distance 31–47% of head width (35% in holotype). In profile, snout gently rounded above and bluntly pointed, protruding beyond jaws. In dorsal aspect, snout bluntly pointed. Loreal region flat and slightly sloping outward to lip. Canthus rostralis rounded and well-defined. Eye length 46–59% of head length (46% in holotype). Eye-naris distance 59–69% of snout length and 52–74% of eye length (66% and 67% in holotype). Nares

protuberant in dorsal aspect. Tympanum small, its greatest diameter 26–39% of the eye length (36% in holotype). Choanae rounded. Tongue white, free for about half its length, and anteriorly broadened, lacking median lingual process. Teeth present on maxillary arch.

Hand length 26–29% of SVL (29% in holotype), 1.05–1.2 times forearm length (1.2 in holotype). Relative lengths of adpressed Fingers III > IV > II > I. Finger webbing absent. Fingers II–IV with lateral keels. A single subarticular tubercle on Fingers I and II, two on Fingers III and IV. Palmar tubercle almost triangular and prominent. The naris tubercle elongate, about half the width of palmar tubercle and less well defined. Rest of palm smooth. Digital discs of all fingers expanded for about one and a half to two times the width of penultimate phalange. Scutes on dorsal surface of each disc well developed. Finger III of adult males not swollen.

Shank length 45–52% of SVL (49% in holotype). Foot length 41–50% of SVL (46% in holotype). Relative lengths of adpressed toes IV > III > V > II > I. Toe webbing absent. All toes with lateral keels. Inner tarsal fold present, outer metatarsal fold absent. One subarticular tubercle on Toes I and II, two on Toes III and V, and three on Toe IV. Outer metatarsal tubercle round and well developed, about half the size of inner ovoid one. Rest of sole smooth. Digital discs of Toes I–III weakly expanded, discs of Toes IV and V expanded about one and a half to two times the widths of penultimate phalange. Scutes on dorsal surface of each disc well developed.

In preservative, dorsal coloration is tan to black, sometimes paler between the eyes. The snout occasionally is light tan with few dark brown flecks. One to several whitish flecks below eye and tympanum, extending to shoulder. A light tan dorsolateral stripe extends from the tip of the snout over the eye to the dorsal area of groin, or dorsolateral stripe runs into diffuse light tan area (with few dark brown flecks) on posterior back. Labial line absent. Oblique lateral stripe usually interrupted by ventrolateral reticulation (if distinct, it runs from groin to half of abdominal lateral area). Ventrolateral stripe absent. Ventral coloration is light to dark brown, with or without irregular blackish brown stipples in adult males, and with grayish brown reticulation in adult females. In adult males, the throat is grayish to dark brown, sometimes with dark gray discrete marks in the gular-chest region. Whitish area on proximal dorsal surface of upper arm; anterior surface with blackish bar. Rest of dorsal arm and hand tan, occasionally with darker blotches, or dark brown; arms ventrally paler; palm colored tan to dark brown; Fingers I and II tan or whitish, occasionally with tips dark brown; Fingers III and IV brown,

usually with tan transversal lines. Black armband absent. Dorsal surface of shank tan, with two brown transverse bands and diffuse markings continued on dorsal side of foot or brown diffuse markings only, or uniformly dark brown; inner dorsal surface of foot always light tan. Ventral side of leg tan with or without some diffuse dark brown or whitish markings and occasionally whitish lines. Sole tan with few darker markings or uniformly dark brown; tips of toes dark brown. Subadults have the same color pattern as adult males, except that the ventral and gular areas are paler.

Field notes and color slides by the collectors indicate that, in life, dorsal color is dark olive to brown with or without very small greenish bronze dots. A bright yellow dorsolateral stripe runs from the tip of the snout above the eye to the dorsal area of groin (paler posteriorly than anteriorly). An oblique lateral stripe is present, but usually it is interrupted by grayish ventrolateral reticulation. Below eye and on upper arm, there is a noncontinuous whitish to greenish yellow stripe with a distinct black bar on anterior surface of upper arm. Dorsal surfaces of extremities greenish brown, occasionally with white spots. Fingers I and II completely whitish or with few tan markings, other toes and fingers tan with white areas. Diffuse bluish gray patches in groin. Ventral side is bluish gray with diffuse dark spots or reticulation in adult females. The iris is black with reddish ring around the pupil. The periphery of the eye and tympanum are bluish gray. Adult size and ventral pattern are sexually dimorphic characters.

**Osteology.**—Skull almost as long as wide. Cranial exostosis absent. Nasals triangular, lacking medial contact and not contacted with the sphenethmoid. Frontoparietals rectangular and in medial contact throughout; fenestra absent. Sphenethmoid: nasal component in contact with nasal capsule; ventral portion fused; posterior margin contacts anterior margin of optic foramina. Prootic fused with frontoparietals. Stapes present. Premaxilla: alary process dorsal; pars palatina small, forming an emargination. Maxilla separated from nasals; pars facial small and triangular. Conspicuous teeth present on maxillae and premaxillae. Neopalatines absent. Quadratojugal small and not in contact with the squamosal or maxilla. Squamosal: the otic/zygomatic rami are parallel to the skull roof; ventral ramus straight; zygomatic much shorter than otic ramus. Tympanic annulus very broad. Pterygoid: anterior ramus separated minimally from maxilla, overlapping the posterolateral border of the planum antorbitalis; medial ramus not contacting ventrally with crista parotica. Vomer triangular; anterior process large; pre- and postchoanal process absent. Cultriform pro-

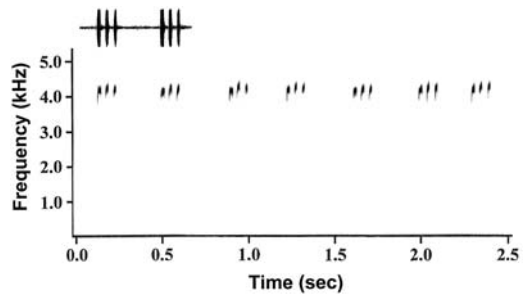


FIG. 4. Waveform oscillogram of two (upper left) and audiospectrogram of seven advertisement calls of paratype of *Colostethus patitae* (MHNSM 16612) recorded in the field at 23.4°C air temperature.

cess of parasphenoid inconspicuous. Hyoid: medial branch of anterior process of hyale present; hyolaryngeal sinus deep; alary process broad with a distal dilation. Mandible with pronounced retroarticular process. Eight presacral vertebrae present, lacking fusions; sacral diapophyses barely dilated. Phalangeal formula of hand 2–2–3–3, of foot 2–2–3–4–3. Figure 3 provides details of the skull in general, the hyoid, and the squamosal.

**Distribution and Ecology.**—*Colostethus patitae* is known only from humid rain forest in the Cordillera El Sira at elevations between 210 and 800 m above sea level. Specimens of *C. patitae* were found by day active along small creeks, especially near waterfalls where small caves provide shelter. If disturbed, the shy and agile frogs immediately took refuge in the water. On 10 September 1987, a male *C. patitae* was observed carrying seven tadpoles. A freshly metamorphosed froglet was found on 26 February 1988 sitting on a rock in a small creek. By night, specimens were occasionally seen sleeping on vegetation in the vicinity of running water at approximately 90 cm above ground. Not all specimens seen were collected.

**Vocalization.**—Male *Colostethus patitae* can be heard calling the entire day. One advertisement call (Fig. 4) consists of one note group containing three notes. Seven analyzed note groups (recorded at 23.4°C air temperature; call voucher MHNSM 16612) lasted  $110.6 \pm 5.4$  msec (102–118 msec) at a dominant frequency of  $4135.0 \pm 42.8$  Hz (4090–4,170 Hz). There is a slight upward frequency modulation within each note group. The six corresponding intervals between these note groups lasted  $247.7 \pm 35.0$  msec (191.0–277.0 msec). Notes within one note group differed in length. In the seven analyzed note groups, mean note duration was (first, second, third)  $22.7 \pm 2.8$  msec (19.3–27.3 msec),  $19.36 \pm 2.7$  msec (16.8–23.3 msec), and  $15.8 \pm 1.0$  msec (14.5–17.1 msec). The interval between the first and second

note was  $19.7 \pm 2.0$  msec (16.5–22.7 msec) and between the second and third note was  $27.6 \pm 2.5$  msec (23.6–31.0 msec).

In contrast, the advertisement call of *C. alessandroi* consists of one note group containing two notes, measuring  $>84.4$  msec (first note) and 75.0 msec (second note), respectively (cf. Grant and Rodríguez, 2001). Data on vocalizations of *C. mcDiarmidi* are not available. The advertisement call of *C. nexipus* is a "trill" (cf. Lötters et al., 2003) consisting of 20–29 notes, each 30–40 msec long (Coloma, 1995).

*Etymology*.—The new species is named after Patricia Vargas, whose nickname is Patita, for her valuable and innocent courage as a herpetologist assistant in the hard slopes of the Cordillera El Sira.

*Remarks*.—Apart from assessing intrafamilial relationships (cf. Vences et al., 2000, 2003), the identification of synapomorphies at the species level in *Colostethus* is difficult (e.g., Grant et al., 1997). In addition, several alpha-taxonomic problems among the many, very similar *Colostethus* species remain to be resolved (e.g., Morales, 1994; Coloma, 1995). Consequently, at this point, the resemblance of *C. alessandroi*, *C. mcDiarmidi*, and *C. patitae* can only be understood to reflect a phenetic unit. Overall similarity and geographic distributions suggest that the three species are closely related phylogenetically. However, Grant and Rodríguez (2001) discussed the possibility of clinal variation among different populations of a single species. *Colostethus patitae* shares some characters with *C. mcDiarmidi* but not with *C. alessandroi*. Likewise, it shares other characters with *C. alessandroi* but not with *C. mcDiarmidi*. This, at least, negates clinal variation in *Colostethus* populations from the Cordillera El Sira south to the eastern Andean versant of Bolivia.

Most *Colostethus* species are dull colored. This is associated with the lack of lipophilic skin alkaloids as found in brightly colored dendrobatids (e.g., *Dendrobates*, *Phyllobates*), although one dull colored *Colostethus* species from Central America has the water-soluble tetrodotoxin in its skin (Daly et al., 1994). Taking the brightly colored *C. exasperatus*, *Colostethus* sp. (cf. *exasperatus*), *C. nexipus*, or *C. patitae*, it may be worth testing them for presence of lipophilic skin alkaloids. Moreover, bright colors and sympatry with toxic *Epipedobates* species suggest that these *Colostethus* may be participants in mimicry systems.

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