Two New Species Of Ranitomeya (Anura: Dendrobatidae) From Eastern Amazonian Peru

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Two new species of *Ranitomeya* (Anura: Dendrobatidae) from eastern Amazonian Peru

PEDRO E. PEREZ-PEÑA[1], GERMAN CHAVEZ[2], EVAN TWOMEY[3] & JASON L. BROWN [4,5]
[1]*FUNDAMAZONIA, Malecón Tarapacá 332, Iquitos, Peru*
[2]*Centro de Ornitología y Biodiversidad (CORBIDI). Calle Santa Rita 135. Urbanización Los Huertos de Villa, Surco-Lima, Perú*
[3]*East Carolina University, Department of Biology, Greenville, North Carolina, U.S.A.*
[4]*Duke University, Department of Biology, Durham, North Carolina, U. S. A.*
[5]*Corresponding author. E-mail: jasonleebrown@gmail.com*

Abstract

We describe two new species of *Ranitomeya* (family Dendrobatidae), *R. yavaricola* **sp. nov.** and *R. cyanovittata* **sp. nov.**, from Peru. *Ranitomeya yavaricola* **sp. nov.** is morphologically similar to certain other species of *Ranitomeya* (in particular *R. flavovittata*), but the new species can be easily distinguished from all other species of *Ranitomeya* based on its unique limb coloration: solid bronze without black markings. Despite having searched in numerous localities throughout this region, we have found the new species at only a single locality near the confluence of the Yavarí and Yavari-Mirin rivers. Based on acoustic and molecular data, the new species is a member of the *vanzolinii* group, and is sister to the second new species, *R. cyanovittata*. *Ranitomeya cyanovittata* **sp. nov.** is only known from a single locality in the Sierra del Divisor in Amazonian Peru. This species can be easily distinguished from the other species of *Ranitomeya* by a unique coloration pattern that consists of just two colors: black background with blue lines or reticulations.

Key words: Amazonia, *cyanovittata*, Dendrobatidae, new species, Peru, *Ranitomeya*, Sierra del Divisor, *yavaricola*, Rio Yavarí

Resumen

Se describe dos nuevas especies de *Ranitomeya* (familia Dendrobatidae), *R. yavaricola* **sp. nov.** y *R. cyanovittata* **sp. nov.** de Perú. *Ranitomeya yavaricola* **sp. nov.** es morfológicamente similar a otras especies de *Ranitomeya* (en particular a *R. favovittata*), pero esta nueva especie puede fácilmente ser distinguida de las otras especies de *Ranitomeya* debido a su coloración única en los miembros: bronce sin marcas negras. A pesar de haber realizado muchas investigaciones en diversas localidades en toda la región, nosotros solo registramos esta especie en una sola localidad cerca a la confluencia del río Yavarí y Yavarí Mirín. En base a información acústica y molecular, la nueva especie es un miembro del grupo *vanzolinii* y es afín a la segunda nueva especie, *R. cyanovittata*. *Ranitomeya cyanovitta* **sp. nov.** es conocida solamente en una localidad de la Sierra del Divisor en la Amazonía peruana. Esta especie puede facilmente ser distinguida de otras especies de *Ranitomeya* por el patrón único de coloración que consiste en dos colores: fondo negro con líneas o reticulaciones azules.

Introduction

Peru is home to an incredible diversity of dendrobatid frogs: currently there are 17 species of *Ameerega*, 19 species of *Hyloxalus*, 15 species of *Ranitomeya*, one species of *Epipedobates*, and two species of *Excidobates* (Frost 2009). In recent years this number has grown steadily due to the description of several species of *Ameerega* and *Ranitomeya* from the Northern Amazonian Peru (e.g. see Twomey & Brown 2008, Brown & Twomey 2009). Most of these discoveries involved the exploration of poorly studied regions. Still, large

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expanses of upper Amazonia remain largely unexplored. In fact, much of the large expanses of lowland rainforests adjacent to entire Peru–Brazil border, roughly 1,500 km in length, have received little attention from herpetologists.

One exception is the lowland rainforest bordered by the Ucayali, Amazon, Yavarí, and Blanco rivers (Fig. 1). In recent years, surveys have uncovered several new species: *Scinax iquitorum* (Moravec *et al*. 2009), *Rhinella* sp. (Rodriguez & Knell 2003) and *Allophryne* sp. (Pérez 2007); several endemic species: *Ranitomeya uakarii* (Brown *et al*. 2006) and *R. flavovittata* (Schulte 1999), and several new records of species in Peru, such as the first record of *Hyalinobatrachium iaspidiense* (Yañez-Muñoz *et al*. 2009).

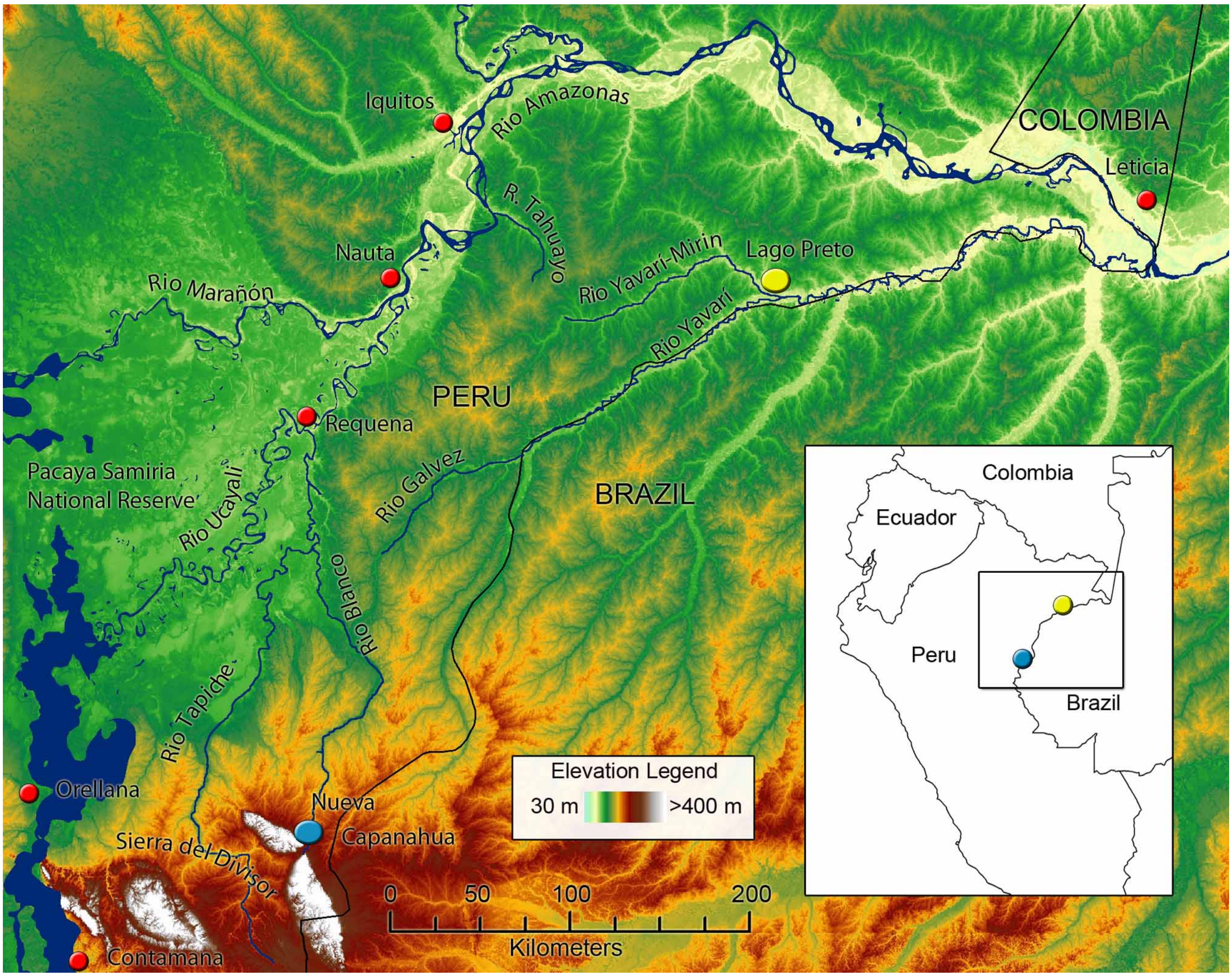

FIGURE 1. Map of study areas. Lago Preto, the type locality of *R. yavaricola* **sp. nov.**, is depicted by a yellow dot. Nueva Capanahua community, the type locality of *R. cyanovittata* **sp. nov.**, is depicted by a blue dot.

This area's geology and vegetation are relatively heterogeneous. Over short distances, soil types range from white sand to clay-based, and forests types range from upland, species-rich *terra firme* to seasonally flooded forests or permanent swamps (Stallard 2006). Two large geological features underlie this area: the Iquitos Arch and the Bata-Cruzeiro fault (Pitman *et al*. 2003, Stallard 2006). The Iquitos Arch is an area of steep topography (relative to other areas in lowland Amazonia), whose hills give rise to the major rivers within this area. The Bata-Cruzeiro fault underlies the Rio Blanco, a tributary to Rio Tapiche (not to be confused with Quebrada Blanco, a tributary to Rio Tahuayo, Fig. 1). In recent geologic times, the areas surrounding this fault have dropped downward during faulting processes, enough to change the courses of tributaries to Rio Blanco (from typical meandering lowland rivers) so that now they flow directly in a straight line to Rio Blanco (Stallard 2006). The uplift of the Iquitos Arch created steep, nutrient-poor hills in the south and lower rolling, nutrient-rich hills in north. This variation is thought to have played a major role in structuring the complex mosaic of forests and soil types that exist there today. This heterogeneity could have also played an important role in generating and maintaining the extraordinary diversity in this area (Hutchings *et al.* 2000).

The Sierra del Divisor, an area immediately south of the above mentioned area (Fig. 1), has only recently begun to be studied, with the first major biotic survey in 2005 by the Field Museum. The Sierra del Divisor is an isolated chain of mountains that rises abruptly from the lowlands of central Amazonian Peru up to a maximum elevation of 750 m. This band of mountains runs roughly north to south and straddles the Peru–Brazil border. These mountains were formed during the Cretaceous period, along with the major uplift of the Andes (Stallard, 2006). Because of the geographic isolation of these mountains and their productive volcanic soils (resulting in unique local flora), several new species of vertebrates have been observed here (Stallard, 2006; Barbosa de Souza & Rivera Gonzales, 2006). The area is also the western range limit of several species (Stallard 2006). Because this area has been underexplored and the factors previously mentioned, it is likely that the Sierra del Divisor possesses many more undiscovered species.

In this manuscript we describe two new species, one of which is endemic to the Rio Yavarí region (herein referred to as *Ranitomeya yavaricola* sp. nov.). This species, which has unique coloration, was first discovered in 2003 on an expedition to the region. At that time, this species was thought to be a morph of *R. flavovittata* based on a similar dorsal pattern, consisting of pale yellow dashes and broken stripes on a black background. However, the new species possessed one unusual characteristic in that its limbs were solid bronze and lacked black markings. Based on additional specimens collected in 2009, we determined that this unusual color pattern is a fixed trait within the population, and that this species is distinct from *R. flavovittata* on the basis of both morphology and genetics. The second new species was discovered in the months of September and December, 2008, when Pacific Stratus Energy S.A. conducted two surveys in the Sierra del Divisor in an effort to increase knowledge of the richness and diversity of fauna in this region. These surveys resulted in new records of many species of mammals, birds, and amphibians: one of these amphibians was recognized as a poison frog of the genus *Ranitomeya* that possessed unique coloration of blue lines on a black dorsum. We herein describe this frog as a new species, *Ranitomeya cyanvovittata*, which can be easily identified by its unique blue coloration.

Material and methods

Type materials are deposited in the Museo de la Facultad de Ciencias Biológicas de la Universidad Nacional de la Amazonía Peruana (MZUNAP), Iquitos, Peru and in the Herpetology collection of the Centro de Ornitología y Biodiversidad (CORBIDI), in Lima, Peru. The following measurements were made with a caliper to the nearest 0.01 mm, following Myers (1982) and Brown *et al.* (2006): snout-vent length (SVL), femur length from vent to lateral edge of knee (FL), tibia length from medial edge of heel to lateral edge of knee (TL), knee–knee distance with both thighs extended at a 90° angle from body (respective to each side), forming a straight line between both femurs (KK), foot length from proximal edge of metatarsal tubercle to tip of toe IV (FoL), hand length from proximal edge of metacarpal tubercle to tip of longest finger (HaL), head length from most exposed corner of occipitum to tip of snout (HL), head width between tympana (HW), body width under axillae (BW), upper eyelid width (UEW), interorbital distance (IOD), internarial distance (IND), horizontal tympanum diameter (TD), horizontal eye diameter (ED), distance from outer corner of eye to tympanum (DET), length of finger I from proximal edge of median palmar tubercle to tip of finger disc (L1F), length of finger II from proximal edge of median palmar tubercle to tip of finger disc (L2F), width of disc of finger III (W3D), width of finger III just below disc (W3F), and body mass (BM). Sex was determined by checking for the presence of vocal slits.

One free-living tadpole was collected of *R. yavaricola* **sp. nov.** and preserved in 70% ethanol for description and staged according to Gosner (1960). Mouthpart formulas follow McDiarmid & Altig (1999).

Linear transects were used to estimate the relative abundance of *R. yavaricola* **sp. nov.** We used two methods: visual encounter surveys (following the methods of Crump & Scott 1994) and acoustic abundances (adapted from Manzanilla & Péfaur 2000, Rödel & Ernst 2004). Monitoring of visual transects involved one to three observers walking slowly, scanning the forest floor, emergent rocks, and vegetation for adult frogs. We surveyed transects at 3 sites around Lago Preto for a total of 30 hours between 27 June 2009–1 July 2009. Each transect consisted of a preexisting trail that was 3–4 km in length. Acoustic transects were performed at two sites. These consisted of broadcasting a single call of *R. yavaricola* **sp. nov.** for 10 min (each note was separated by 100 ms of silence) at 100-m increments along a 1-km transect (total time per transect: 110 min). As individuals responded, they were located and captured. In both transects all individuals were captured (or attempted to be captured), sexed (if possible, based on calling and reproductive activity), photographed, and measured. We recorded time of day, individual identification, location, capture height, air temperature, time required to walk transect, as well as any other notable observation. All transects were surveyed a single time.

Tissue samples, collected by toe clips from preserved adults, were preserved in a buffer solution of 20% DMSO saturated with sodium chloride and EDTA. Genomic DNA extraction, amplification, and sequencing follows Twomey & Brown 2008. This study amplified 2124 base pairs of the following mitochondrial regions: *rrnS* (12s), *rrnL* (16s) and *cob* (cytB). With the exception of sequence data on 4 individuals of the two species described herein, all sequence data is from previous studies (Symula *et al.* 2001, 2003; Santos *et al.* 2003; Darst & Cannatella, 2004; Graham *et al.* 2004; Grant *et al.* 2006; Noonan & Wray, 2006; Roberts *et al.* 2006, Twomey & Brown 2008).

Phylogenetic analysis was done using Maximum Likelihood with a GTR model of nucleotide substitution with gamma distributed rate heterogeneity and a proportion of invariant sites (as suggested by Modeltest 3.7; Posada & Crandall 1998) in GARLI 0.96 (Zwickl 2006). The final data set included 48 individuals. The topology of the phylogeny is consistent with a much larger phylogeny based on largely unpublished data of JLB. This dataset was used to estimate between group genetic distances in MEGA 4 (Kumar *et al.* 2008) under a Kimura 2-paramater model with uniform among site substitution rates. We compared 7 groups (number of individuals contained in each group in parenthesis): *R. lamasi* (22), *R. flavovittata* (5), *R. vanzolinii* (3), *R. imitator* (2), *R. cyanovittata* **sp. nov.** (1) and *R. yavaricola* **sp. nov.** (3).

***Ranitomeya yavaricola* sp. nov.**

Figures 2–5, 11

Holotype. MZUNAP-01-520 (Fig 3.), an adult male collected by Pedro Perez-Peña nearby Lago Preto, 17 km W of Estiron de Ecuador, Provincia Ramon Castilla, Departamento Loreto, Peru; 4° 27' 35.0" S, 71° 45’ 3.5"W, 120 m elevation; August 2009; found foraging in leaf litter within *terra firme* forest.

Paratypes. All from same locality as holotype (MZUNAP-01-518, 519) an adult female and male (respectively) collected by P. Pérez-Peña in August 2009.

Etymology. The specific epithet is noun in apposition that means “inhabitant of the Yavarí” and is formed from the Latin suffix “*-icola*” for “dweller” or “inhabitant” and Río Yavarí, the watershed where this species occurs.

Definition and diagnosis. Assigned to the genus *Ranitomeya* due to the combination of the following characteristics: small size (< 18 mm SVL), first finger distinctly shorter than second, dorsal coloration conspicuous and bright, dorsal skin smooth, toe webbing absent, maxillary and premaxillary teeth absent.

Ranitomeya yavaricola can be distinguished from other species of *Ranitomeya* by the combination of irregular, pale turquoise spots and stripes on the dorsum, solid-bronze limbs, and irregular sky-blue spots on the ventral surface of the upper thighs. *Ranitomeya flavovittata* possesses irregular, bright yellow spots and stripes (often broken) on the dorsum (vs. pale turquoise in *R. yavaricola*). Additionally, the limbs of *R. flavovittata* are black with light blue reticulation (vs. limbs solid bronze in *R. yavaricola*), and *R. flavovittata* typically possesses a complete (to nearly complete) yellow median dorsal stripe and lacks conspicuous spots on the ventral surface of the upper thighs (vs. median dorsal stripe absent and ventral thigh spots present in *R. yavaricola*). *Ranitomeya vanzolinii* possesses bright yellow dorsal spotting, light blue reticulation on a ground color of black on limbs, and lacks conspicuous spots on the ventral surface of the upper thighs. *Ranitomeya* *yavaricola* is similar in appearance to the nominal morph of *Excidobates captivus* and *Adelphobates castaneoticus*. The nominal morph of *Excidobates captivus* has dull brown limbs (vs. bronze in *R. yavaricola*), bears yellow spots on the flanks (vs. flank spots absent in *R. yavaricola*), and has paired reddish-orange dorsolateral dashes (vs. dorsolateral spots and stripes pale turquoise to spring green in *R. yavaricola*). *Adelphobates castaneoticus* is larger in size (SVL up 23 mm), lacks the inner metacarpal tubercle, and lacks distinct bronze limbs. Furthermore, it has conspicuous red flash-marks on the upper surface of the forearms, thighs, and calves.

FIGURE 2. Dorsal and ventral views of *Ranitomeya yavaricola* **sp. nov.** from Lago Preto, Loreto, Peru.

Measurements (in mm) of holotype. The male holotype (Fig. 3) has SVL 15.2; FL 7.1; TL 7.2; KK 13.1; FoL 4.9; HaL3.4; HL 5.5; HW 5.0; BW 4.3; UEW 2.3; IOD 2.2; IND 1.8; TD 0.9; ED 1.9; DET 0.5; L1F 1.9; L2F 2.2; W3D 0.9; W3F 0.3. For paratype measurements see Table 1.

Description of holotype. Widest part of head at jaw articulations. Head width slightly wider than body. Tongue ovoid; teeth absent. Snout sloping and rounded in lateral profile, slightly blunted in dorsal profile. Nares situated at tip of snout and directed laterally; both nares visible from ventral and anterior view but not from dorsal view. Canthus rostralis rounded, loreal region flat and nearly vertical. Upper eyelid approximately equal in width to interorbital distance; internarial distance roughly equal to horizontal eye diameter. Tympanum round, partially concealed posterodorsally.

In life, skin texture nearly smooth on dorsal surfaces of body and head; limbs and rump weakly granular. Venter weakly granular on limbs and body, ventral surface of head nearly smooth.

Hands (Fig. 4) relatively large, length 22 % of SVL. Relative length of appressed fingers III > IV > II > I; first finger 90 % length of second; finger discs greatly expanded, width of disc on finger III 2.6 times width of adjacent phalanx. Unpigmented median metacarpal tubercle present on base of palm; inner metacarpal tubercle present near base of finger I; unpigmented proximal subarticular tubercles present on base of each digit, except on finger I, where tubercle is part-way up the digit; distal subarticular tubercle visible only on finger III. All tubercles raised above level of hands; scutes present on dorsal surface of fingers.

TABLE 1. Measurements of type series of *R. yavaricola* (MZUNAP-01-518 - MZUNAP-01-520) and additional specimens that were not collected. *Sexing based upon calling activity ** observed courting with male number 8

	MZUNAP -01-518	MZUNAP -01-520	MZUNAP -01-519	1	2	3	4	5	6	7	8	9	10	11	12	Mean (Max-Min)
SVL	17.2	15.2	16.8	15.5	16.0	16.2	16.2	15.9	17.1	16.7	16.6	17.7	16.7	15.9	16.7	16.4 (17.7–15.2)
FL	7.0	7.1	7.0	7.2	7.7	7.4	7.5	7.0	8.0	7.6	7.5	7.9	8.0	7.2	7.0	7.4 (8.0–7.0)
TL	7.5	7.2	7.3	6.8	7.5	7.1	7.2	7.4	6.9	7.6	7.6	7.5	7.2	7.2	7.3	7.3 (7.6–6.8)
KK	14.8	13.1	14.0	13.8	14.8	14.2	13.7	14.3	14.2	14.4	14.9	14.7	14.5	14.0	14.1	14.2 (14.9–13.1)
FoL	6.1	4.9	5.5	5.7	6.2	6.4	5.9	5.6	6.0	6.4	5.9	6.0	6.6	6.0	6.5	6.0 (6.6–4.9)
HaL	3.8	3.4	3.8	3.8	4.0	4.0	3.9	4.1	4.0	4.0	4.2	4.2	3.9	4.0	4.2	4.0 (4.2–3.4)
HL	6.1	5.5	5.9	5.8	6.2	6.6	6.2	6.2	6.4	5.9	5.8	5.9	6.3	6.2	6.5	6.1 (6.6–5.5)
HW	5.3	5.0	5.1	5.4	5.4	5.9	5.4	5.5	5.6	5.4	5.6	5.7	5.7	5.5	5.4	5.5 (5.9–5.0)
BW	4.3	4.3	5.4	5.2	5.9	4.9	5.5	5.3	5.7	5.4	5.6	6.1	5.6	5.1	5.8	5.3 (6.1–4.3)
UEW	2.6	2.3	2.4	2.5	2.7	2.9	2.6	2.8	2.6	2.6	2.4	2.4	2.8	2.7	2.0	2.6 (2.9–2.0)
IOD	2.3	2.2	2.3	2.2	2.5	2.3	2.2	2.2	2.2	2.5	2.0	2.1	2.3	2.6	2.6	2.3 (2.6–2.0)
IND	1.9	1.8	2.1	2.0	2.3	2.2	2.2	2.2	2.3	2.3	2.2	2.4	2.0	2.3	2.2	2.2 (2.4–1.8)
TD	0.9	0.9	0.9	0.7	0.5	1.1	0.8	0.7	0.7	0.5	0.7	0.9	0.9	0.9	1.3	0.8 (1.3–0.5)
ED	1.9	1.9	2.2	2.0	2.0	2.0	2.0	2.1	1.9	2.1	1.9	2.0	2.1	1.8	2.0	2.0 (2.2–1.8)
DET	0.3	0.5	0.4	0.5	0.7	0.6	0.3	0.4	0.6	0.7	0.5	0.6	0.8	0.6	0.3	0.5 (0.8–0.3)
L1F	1.8	1.9	2.1	2.0	2.1	2.0	2.0	1.9	2.2	2.0	2.1	2.1	2.0	2.0	2.1	2.0 (2.2–1.8)
L2F	2.5	2.2	2.2	2.6	2.8	2.8	2.6	2.9	3.0	2.5	2.9	2.9	2.8	2.5	2.8	2.7 (3.0–2.2)
W3D	0.8	0.9	0.9	1.0	1.0	1.1	1.0	1.0	1.1	1.0	1.0	1.0	1.1	1.1	1.1	1.1 (2.0–0.8)
W3F	0.4	0.3	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.3	0.4	0.3	0.5	0.4 (0.5–0.3)
BM	-	-	-	0.3	0.3	0.4	0.3	0.3	0.4	0.4	0.5	0.5	0.4	0.3	0.4	0.4 (0.5–0.3)
SEX	♂	♂	♀	♂*	♂*	♂*	♂*	♂*	♂*	♂*	♂*	♀**	♂*	_	_	_

FIGURE 3. Type series of *Ranitomeya yavaricola* with corresponding ventral photos. Left to right: MZUNAP-01-519, MZUNAP-01-518, MZUNAP-01-520. Bar equals 10 mm.

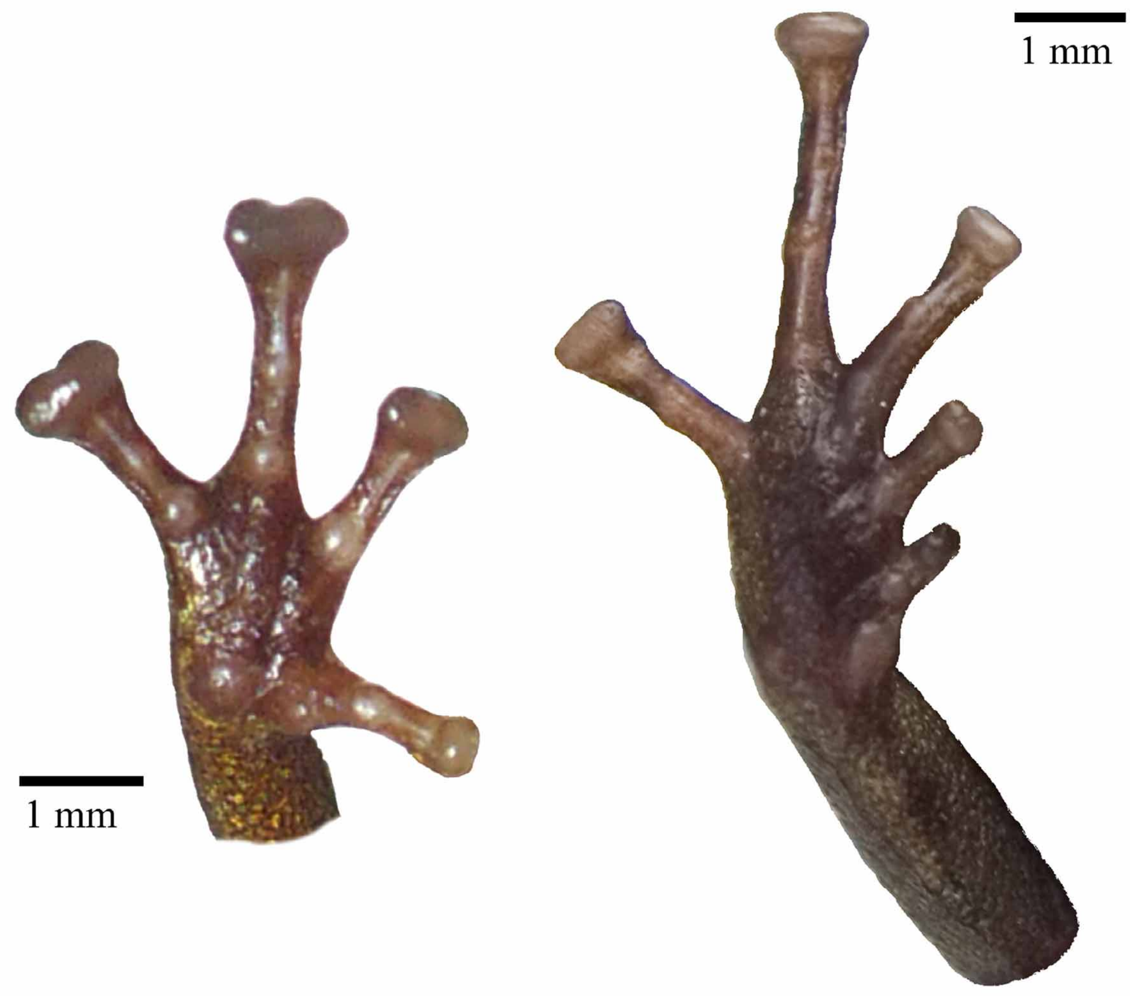

FIGURE 4. Right hand and right foot of *Ranitomeya yavaricola*.

FIGURE 5. Intrapopulation variation of *Ranitomeya yavaricola*. Each row shows the dorsum and venter of an individual. The first three rows are adult males and the last row is an adult female.

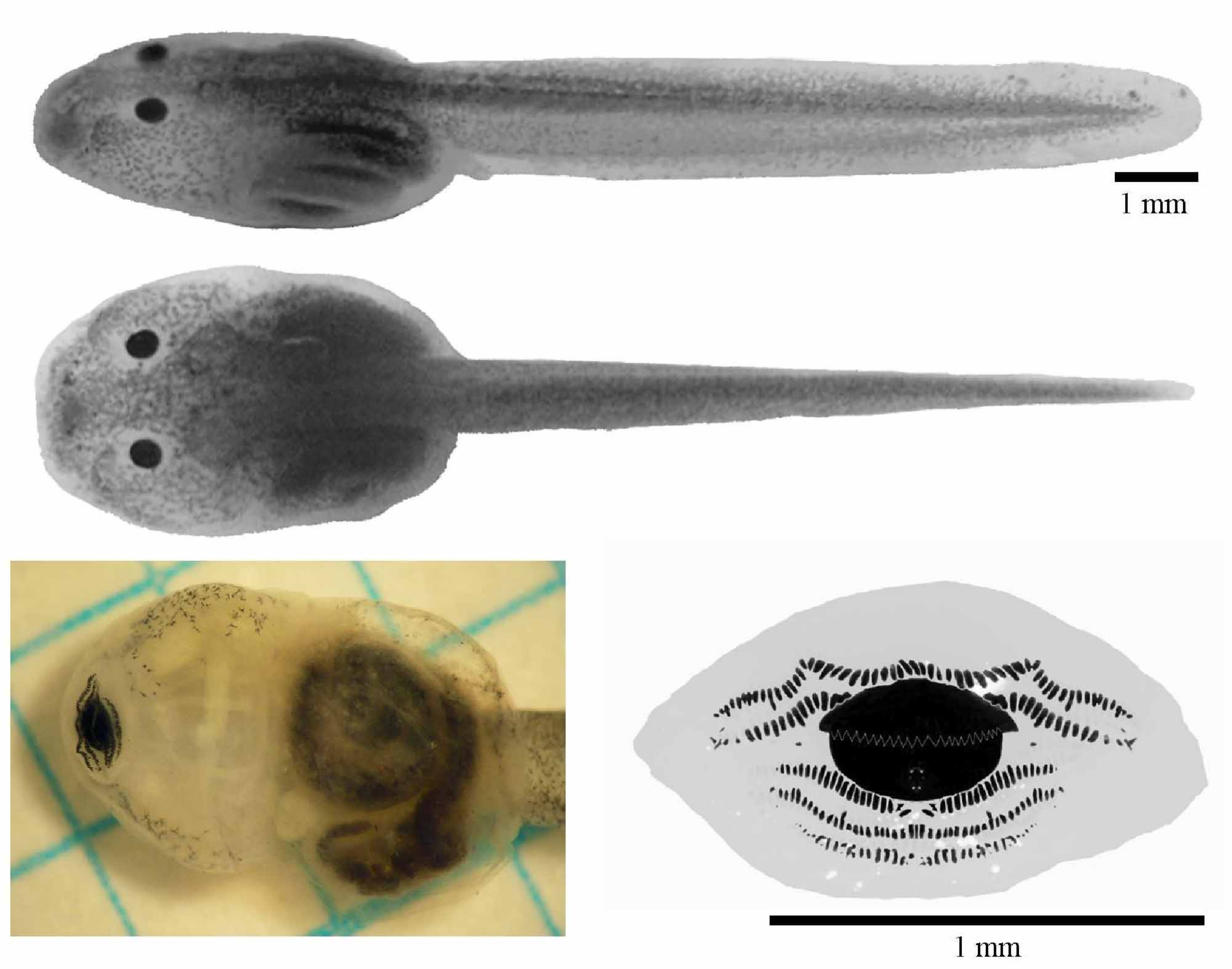

FIGURE 6. Tadpole of *Ranitomeya yavaricola*. Top: lateral and dorsal views of a Gosner Stage 25 tadpole. Bottom left: ventral view of tadpole. Bottom right: mouthparts of the tadpole of *R. yavaricola*.

Hind limbs moderate length, with heel of appressed hind limbs reaching level of eye. Femur and tibia roughly equal in length, femur 99 % length of tibia; knee–knee distance 86% of SVL. Relative lengths of appressed toes IV > III > V > II > I (Fig. 4); first toe short with unexpanded disc; second toe with slightly expanded disc, discs on toes III–V moderately expanded. Two unpigmented metatarsal tubercles on base of foot, one situated medially near base of toe I, the other situated laterally at the base of the fifth metatarsal. Proximal subarticular tubercles present at base of each toe but most notable on toes I, II, III due to lack of pigmentation. Toes III and V with two large subarticular tubercles, toe IV with three subarticular tubercles. Tarsal keel extends from below knee to medial metatarsal tubercle at foot. Tarsal tubercle absent; feet and hands lack webbing and lateral fringing.

Color in life. In life, body black with metallic sage-green dashes anterior and posterior to each eye, a single spot between eyes; metallic-sage dorsolateral stripes extend from upper thighs to shoulders where they each form a single dash. Broad sage oblique-lateral lines extend from the axillae to groin, where they fuse with a large spot on upper surfaces of each thigh. Broad labial stripe present, continues posteriorly to upper surfaces of arms. Limbs and digits solid bronze. Paired sage dashes on underside of thighs. Underside of head sage with two pairs of gular spots, creating appearance of an hourglass. Venter black with coarse, irregular sage marbling. Iris black.

Color in preservative. In preservative, turquoise/sky-blue coloration turns grey and bronze limb coloration turns brown.

Variation (based on 15 adults). Adults 15.2–17.7 mm SVL (mean 16.4 mm). Head about as wide as body except in single gravid female whose body was wider than the head. Head width 98 % of body width (range 81–109 %). Head width 30–36 % of SVL in adults. No apparent sexual dimorphism in external morphology except that males possess faint vocal slits on the floor of the mouth and have a slightly expanded subgular pouch.

The completeness of dorsolateral and medial lateral stripes varies considerably between individuals (Fig. 5). Line/dash/spot coloration varies subtly between a sky-blue to a very light bluish-yellow to pale sage-green, with a majority of individuals being light turquoise.

Venter coloration is typically darker than dorsal coloration and is less variable, being predominantly sky-blue. Ventral ground coloration varies from dark brown to black. Venter reticulation is largely symmetrical and often forms a broad, irregular, black medial-stripe in half of the specimens (Fig. 5). Most individuals possess a large gular spot in the center of the throat (80 %). In all individuals, sky-blue dashes are present on the ventral surface of the upper thighs, though their size varies considerably between individuals.

Hands relatively large, length 22–26 % of SVL. First finger 65–95 % length of second; finger discs moderately expanded in both males and females, width of disc on finger III 2–3.6 times width of adjacent phalanx. Tibia 86–107 % length of femur (mean 99 %); knee–knee distance 82–92 % of SVL (mean 87 %).

Tadpole measurements (in mm). A stage 25 tadpole (MZUNAP-01-521) was used for the description (Fig. 6). Total length 12.5; body length 4.7; internarial distance 0.9; eye to nares distance 0.8; eye diameter 0.5; interorbital distance 0.7; tail length 7.8.

Tadpole description. Snout rounded when viewed from above; body ovoid in dorsal view. Eyes dorsal, angled laterally, pupils white in preservative. Nares not forming tube, situated half-way between eye and tip of snout, directed dorsolaterally. Spiracle sinistral; vent dextral. Ventral tail fin begins at tail base, dorsal tail fin begins just posterior to plane of vent opening, ventral and dorsal fins relatively uniform in thickness throughout tail, tapering towards tip. Musculature depth uniform throughout, tapering toward tip.

Mouth directed anteroventrally. Oral disc emarginate, anterior and posterior labia forming flaps free from body wall, 1.4 mm in width. Marginal papillae absent on anterior labium, present in one complete row on posterior labium. Papillae rounded; submarginal papillae absent. Jaw sheaths deep in longitudinal width, serrate, lacking indentations. Lateral processes short, extending barely past lower jaw. Labial tooth row formula is 2(2)/3[1]. A-1 complete (62 teeth), A-2 with medial gap (34 teeth), same width as A-1. P-1 with medial gap (46 teeth), P-2 (44 teeth), and P-3 complete (44 teeth); P-1 and P-2 equal width, P-3 slightly shorter.

Color in Life. In life, the head appears light grey. Pigmentation on dorsum mottled brown, ground color weakly transparent. Eyes black, papillae white. Ventral coloration is transparent (most internal organs are visible) with irregular faint red flecking that is dense around mouth and nares. Tail musculature white with abundant brown mottling, fins almost transparent.

Color in Preservative. In preservative, coloration is identical, though red pigmentation turns to brown.

Vocalizations. The following values are presented as: min-max (average ± SD, number of individuals). The advertisement call is a short trilled note (Fig. 7) with duration between 630–880 ms (760 ± 140 ms, 7) and is repeated at irregular intervals of 2–7 notes per minute (3.14 ± 1.80 notes per minute, 6). Each note consists of 20–27 pulses (mean = 24). Calling activity is sporadic and continues throughout daylight, but peaks in the early morning and late afternoon. Dominant frequency is 5400–6000 Hz (5600 ± 2000 Hz, 5) at temperatures between 24.5–26 °C.

The call of *R. yavaricola* sounds similar to the calls of other species in the *vanzolinii* group, although there are some slight differences within this group. *Ranitomeya flavovittata* has slightly longer notes (1 sec vs. 760 ms in *R. yavaricola*). *Ranitomeya imitator* ($n = 25$) has a call that is slightly shorter in duration (686 ms vs. 760 ms in *R. yavaricola*) and has a slightly lower dominant frequency (5200 Hz vs 5600 Hz in *R. yavaricola*).

Distribution and natural history. *Ranitomeya yavaricola* occurs in primary forests in a small area of northeastern Peru. This species likely occurs more widely within the broad interfluvium bordered by the Ucayali, Amazon, Yavarí, and Blanco rivers (Fig. 1). Much of the area bordering these rivers is seasonally or permanently flooded and it is possible that these large expanses impose limits to this species' distribution (Fig. 8).

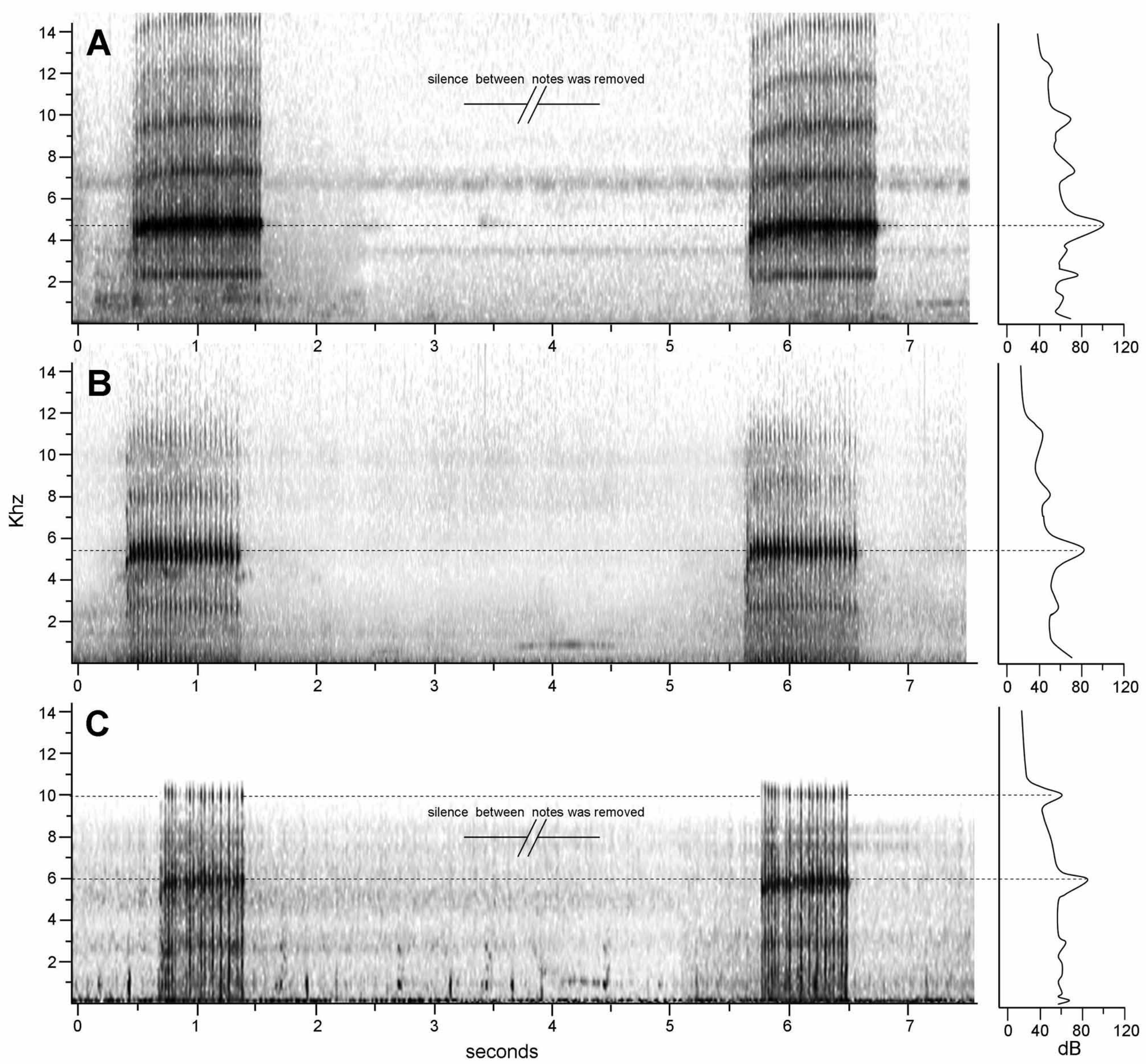

FIGURE 7. Advertisement calls of members of the *vanzolinii* group that occur in close geographic proximity to Lago Preto. Space between notes was reduced so that two notes would fit into spectrogram. **A)** *R. imitator* from San Gabriel de Varadero, Loreto, Peru recorded at 23.5° C. Dominant frequency: 4900 Hz. Mean note length: 1.1 sec. Actual space between notes (not as pictured): 8.2 sec. Note: the note length in this spectrogram is longer than the average for this species (which is 0.7 sec, see *Vocalization* section), however, as mentioned above, we used this population given its close proximity to Lago Preto. **B**) *R. flavovittata* from Quebrada Blanco, Loreto, Peru recorded at 24.5° C. Dominant frequency: 5500 Hz. Mean note length: 1.0 sec. Space between notes (as pictured): 4.3 sec. **C**) *R. yavaricola* from Lago Preto recorded at 24° C. Dominant frequency: 5950 Hz. Mean note length: 0.8 sec. Actual space between notes (not as picture): 16.3 sec.

Ranitomeya yavaricola is only known from forests near Lago Preto (but see discussion). Lago Preto is a large oxbow lake at the confluence of Yavarí and Yavari-Mirin rivers. Near Lago Preto, several forest types are present: seasonally flooded forests, swamp forests that are saturated year-round, and upland *terra firme* forests. At Lago Preto, *R. yavaricola* occurs in upland forests and very low lying forests, just above the flood zone of seasonally flooded forests (i.e. *várzea* forests) and swamps. These sites contained many large trees and a relatively sparse understory. The upland forests in this region are some of the most diverse in the Amazon basin, with estimates of tree diversity exceeding 300 species per hectare in some areas (Pitman *et al.* 2003, Fine *et al.* 2006) These forests are dominated by trees of the families Fabaceae (legumes), Bombacaceae ("mallows" such as kapoks), and Moraceae (figs) (Fine *et al.* 2006). This species is sympatric with three other dendrobatids: *Ranitomeya uakarii*, *Ameerega hahneli*, and *A. trivittata*. This species potentially also co-occurs with *R. flavovittata* and *R. ventrimaculata*, both of which have been observed less than 90 km from Lago Preto (Fig. 8).

Ranitomeya yavaricola was typically observed foraging throughout the leaf litter or calling from the leaves of terrestrial palms (*Genoma spp.*), epiphytes (primarily bromeliads), and on the branches of fallen trees (between 0.2–3 m above the ground). *Ranitomeya yavaricola* is an extremely shy species and when encountered dives to the ground and hides within the leaf litter or within the roots of plants. A single tadpole was observed in the phytotelm of a small bromeliad that was ca. 1.5 m above the ground. Prior to the discovery of the tadpole, a male was observed calling near the bromeliad (< 0.3 m). The pool of water housing the tadpole was small, containing less than 30 ml of water. The most abundant species of bromeliad in the area typically grows in small clumps of 2–6 plants (Fig. 9). *Ranitomeya yavaricola* is the most abundant species of *Ranitomeya* at Lago Preto. Using visual encounters, we observed 3 individuals in 30 man-hours of observation (0.1 encounters per man-hour) and using acoustic estimates, we recorded 20 different individuals in 3.7 man-hours of observation (5.6 encounters per man-hour). Lastly, as the result of casual observations, over a two week period in June 2009, 20 people encountered 6 individuals. During this study 12 individuals of *R. uakarii* were observed at Lago Preto (as the result of both casual observation and surveys).

Conservation status. Following the IUCN Red List criteria (IUCN 2001), this species should be listed as Data Deficient (DD). It is currently known from only a single locality but probably occurs more widely.

Ranitomeya cyanovittata **sp. nov.**

Figures 8, 10

Holotype. CORBIDI 02266 (Fig. 10A), an adult female collected by Diego Vasquez in the Rio Blanco Basin near the Zona Reservada Sierra del Divisor, Departamento Loreto, Peru; 6º55’12”S, 73º50’45W, 206 m elevation; September 2008.

Paratype. CORBIDI 02991 (Fig. 10B), an adult male collected by Diego Vasquez in the Rio Blanco Basin near the Zona Reservada Sierra del Divisor, Departamento Loreto, Peru; 6º54’57”S, 73º50’45”W, 257 m elevation; December 2008.

Etymology. The specific epithet, an adjective, means ‘blue striped’ and is formed from the combination of the ancient Greek noun “κυανοσ” (or “*cyanos*”) for “a blue substance used to adorn armor in the Heroic age” and the Latin adjective “*vittatus*” for “banded.”

Definition and diagnosis. Assigned to the genus *Ranitomeya* due to the combination of the following characteristics: small size (< 18 mm SVL), first finger distinctly shorter than second, dorsal coloration conspicuous and bright, dorsal skin smooth, toe webbing absent, maxillary and premaxillary teeth absent, pale limb reticulation present. *Ranitomeya cyanovittata* is a relatively small species of *Ranitomeya*, adult SVL of approximately 13.8–17.3 mm. Bicolored pattern bright blue and black; teeth absent; finger I shorter than finger II; disc of third finger 1.9–2.2 times wider than finger width.

Ranitomeya cyanovittata can be distinguished from all other dendrobatids by its distinctive bicolored pattern of a black background with turquoise-blue lines or reticulations over the entire body (dorsal and ventral side). Six other species of *Ranitomeya* have a bicolored pattern. *Ranitomeya fulgurita* (Silverstone, 1975) ranges from Panama to Northwestern Colombia and is bicolored dorsally and ventrally, but this pattern consists of a greenish-yellow body with black stripes or spots (Lötters *et al*., 2007). *Ranitomeya abdita* from southern Ecuador (Myers & Daly, 1976) has a solid dark bronze to black body with orange spots on the posterior areas of the upper arm and thigh (Lötters *et al.*, 2007). *Ranitomeya altobueyensis* from the Serrania de Baudó in Colombia (Silverstone, 1975) has a uniform yellow or golden metallic body (sometimes with a greenish hue), occasionally with small black spots on the dorsum and often on the venter (Lötters *et al.*, 2007). *Ranitomeya dorisswansonae* from the Cordillera Central in Tolima, Colombia (Rueda-Almonacid *et al.*, 2006) has a dark brown or reddish brown background with irregular red to yellowish-orange spots that may be absent on the limbs (Lötters *et al.*, 2007). *Ranitomeya sirensis* from the Cordillera El Sira in Central

Amazonian Peru (Aichinger, 1991) has a red dorsum with turquoise-green legs and arms, a turquoise-green venter with a red patch on the belly, and lacks dorsal reticulations or spots (Lötters *et al.*, 2007). Finally, *Ranitomeya summersi* from Central Amazonian Peru has a black ground color with orange stripes on the dorsum and venter (Brown *et al.*, 2008).

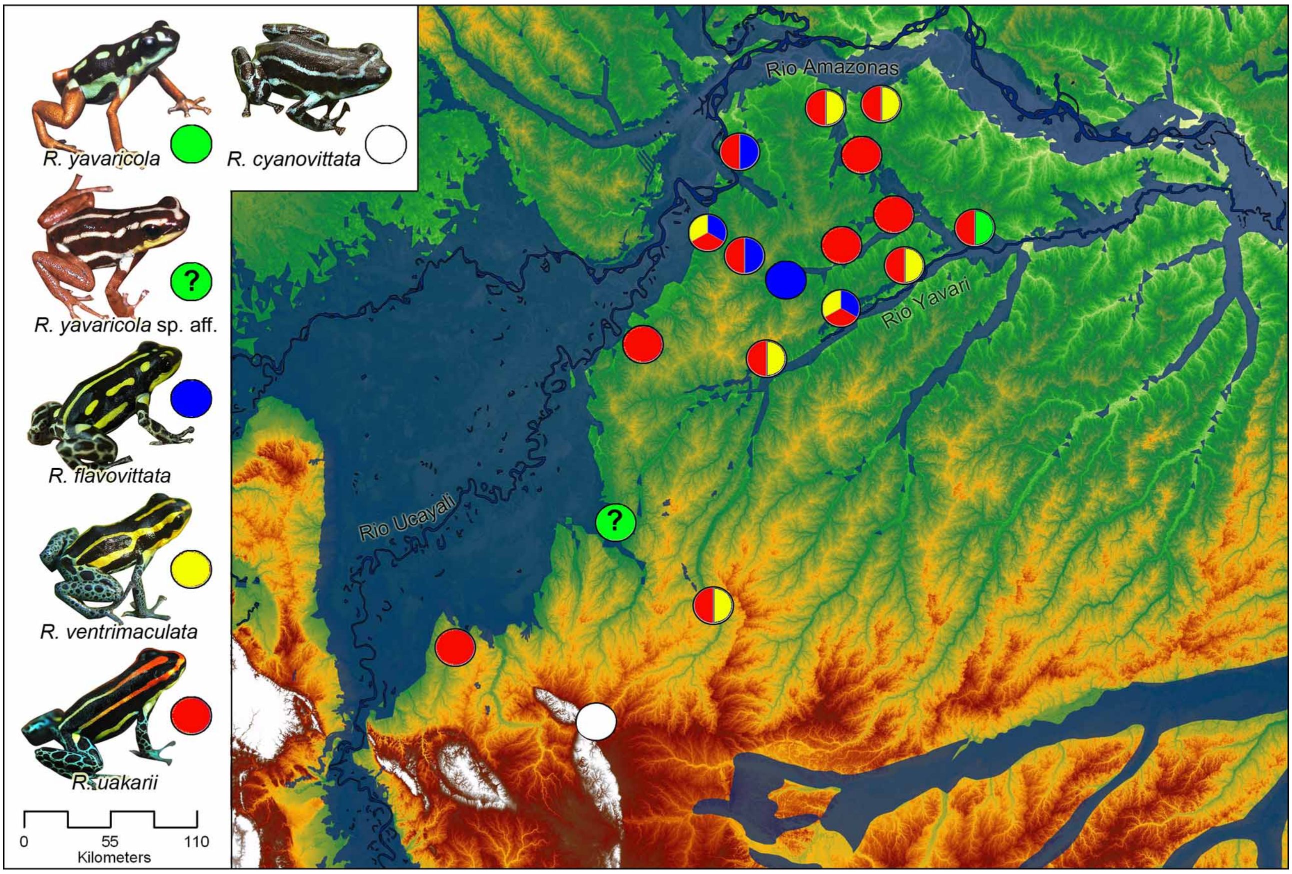

FIGURE 8. Distributions of *Ranitomeya* that occur within the forests bordered by the Ucayali, Amazon, Yavarí, and Blanco rivers. The blue color depicts areas that are prone to flooding or that are permanently flooded. These areas likely act as barriers to gene flow for most *Ranitomeya* species. Each colored circle represents the corresponding species at each site. The white dot depicts the only known locality of the *R. cyanovittata*. The area that becomes seasonally flooded was calculated from two data sources: areas classified as Várzea by the World Wildlife Foundation (Olson *et al.* 2001) and spatial calculations in Environmental Systems Research Institute's GIS ArcView 9.2 that estimated the seasonally flooded areas. The latter was done by calculating the feet above sea-level of major streams that seasonally flooded throughout the area. These values were kriged to create a raster that accounted for elevation changes relative to level of the major rivers. The resulting raster was subtracted from a digital elevation model, and areas below 10 meters were classified as "seasonally flooded".) Both the Varzea and "floodable" areas were summed to create the blue layer area depicted here. Ten meters is an average the annual fluctuation in river levels for the lower Ucayali, upper Amazon, and lower Yavari rivers (Goulding *et al.* 2003).

Ranitomeya cyanovittata is most similar in appearance to the following species: *Ranitomeya biolat*, *R. flavovittata*, *R. imitator*, *R. lamasi*, and *R. ventrimaculata*. *Ranitomeya biolat* and most lowland populations of *R. imitator* possess yellow dorsal stripes (vs. blue stripes in *R. cyanovittata*); *R. flavovittata* has broken, irregular, yellow dorsal stripes (vs. unbroken blue stripes in *R. cyanovittata*); *R. lamasi* has dorsal stripes which can be green, yellow, orange, or red (but never blue as in *R. cyanovittata*) and typically has a yellow patch on the belly (vs. patch absent in *R. cyanovittata*). *Ranitomeya ventrimaculata* has yellow dorsal stripes that are not parallel (vs. blue stripes parallel in *R. cyanovittata*).

Measurements (in mm) of holotype. The female holotype (Fig. 10A) has SVL 17.3; FL 6.5; TL 6.8; KK 13.3; FoL 6.4; HaL 4.2; HL 5.1; HW 5.6; BW 6.4; UEW 1.2; IOD 2.6; IND 2.0; TD 0.46; ED 1.7; DET 0.48; L1F 1.77; L2F 2.28; W3D 1.09; W3F 0.53. Paratype measurements (Fig. 10B): SVL 13.8; FL 5.5; TL 6.1; KK

11.7; FoL 5.09; HaL 3.6; HL 3.6; HW 3.9; BW 3.9; UEW 0.94; IOD 2.0; IND 1.7; TD 0.35; ED 1.3; DET 0.35; L1F 1.28; L2F 1.85; W3D 0.56; W3F 0.26.

Description of holotype. Widest part of head at jaw articulations. Head slightly narrower than body. Tongue ovoid; teeth absent. In life, head black with blue spot in pit of snout, transverse blue stripe between eyes extending through upper eyelid anterior to upper insertion point of thigh; labial stripe extends to upper insertion of arm. Dorsum black with a vertebral line from posterior region of head to vent. Weakly-defined spot present on dorsal surface of axilla. Arms, legs, and toes are covered in a pale reticulations on a black background color, creating round black spots. Underside of head with lateral gular spots, creating the appearance of an hourglass. Venter black with blue irregular reticulation, creating black spots, much like the limbs.

FIGURE 9. The photo depicts habitat where several *R. yavaricola* were observed. The inset is a photo of a bromeliad where a tadpole was observed.

In life, skin texture nearly smooth on the dorsal surfaces of the body and head; limbs and rump weakly granular. Venter weakly granular on limbs and body, ventral surface of head nearly smooth. Snout sloping and rounded in lateral profile, round or slightly blunted in dorsal profile. Nares situated at tip of snout and directed laterally; both nares visible from ventral and anterior view but not from dorsal view. Canthus rostralis rounded, loreal region flat and nearly vertical. Upper eyelid approximately equal in width to interorbital distance; internarial distance roughly equal to eye width. Tympanum round, partially concealed posterodorsally.

Hands relatively large, length 24.5 % of SVL. Relative length of appressed fingers III > IV > II > I; first finger 77.6 % length of second; finger discs moderately expanded, width of disc on finger III 2.05 times width of adjacent phalanx. An unpigmented median metacarpal tubercle is present on base of palm; inner metacarpal tubercle present near base of finger I; unpigmented proximal subarticular tubercle present on base of each digit, except on finger I, where tubercle is part-way up the digit; distal subarticular tubercle visible only on fingers III and IV. All tubercles raised above level of hands; scutes present on dorsal surface of fingers.

FIGURE 10. Left column (A), dorsal and ventral view of the female *Ranitomeya cyanovittata* (CORBIDI 02266, holotype, SVL 17.3 mm); Right column (B), dorsal and ventral view of the male *Ranitomeya cyanovittata* (CORBIDI 02991, paratype, SVL 13.8 mm). Photographs by Diego Vasquez.

Hind limbs moderate length, with heel of appressed hind limbs reaching level of eye. Femur and tibia roughly equal in length, tibia 99.1 % length of femur; knee–knee distance 77 % of SVL. Relative lengths of appressed toes IV > III > V > II > I; first toe short with unexpanded disc; second toe with slightly expanded disc, discs on toes III–V moderately expanded. Two unpigmented metatarsal tubercles present on base of foot, one situated medially near base of toe I, the other situated laterally at the base of the fifth metatarsal. Proximal subarticular tubercles present at base of each toe but most notable on toes I and II due to their lack of pigmentation. Toes III and V with two subarticular tubercles, toe IV with three subarticular tubercles. A tarsal keel is present starting below the knee and turning into the medial metatarsal tubercle at the foot. Tarsal tubercle absent; feet and hands lacking webbing and lateral fringing.

Color in life: Dorsal body, legs, and head are black with blue longitudinal irregular stripes; a longitudinal, bright blue stripe is present from the tip of the labial region to the insertion point of the arms, a blue lateral stripe is present from the armpit to the groin. There is a weakly-defined pale blue spot on the dorsal surface of the axilla. The arms, legs, and toes are covered in pale blue reticulations on a black background color, creating round black spots; toes are blue-black. Underside of head blue with lateral black gular spots, creating appearance of a blue hourglass. Lower lip blue. Venter black with blue irregular spots, creating black spots, much like the limbs. Limbs are brownish. Iris black.

Color in preservative. In preservative, coloration is identical to color in life, with the exception of blue coloration being grey.

FIGURE 11. View of the Rio Blanco basin near the type locality of *R. cyanovittata*, Loreto, Peru. Photograph by Diego Vasquez.

Distribution and natural history. *Ranitomeya cyanovittata* is known only from two sites near Nueva Capanahua community, in the Rio Blanco basin near the Sierra del Divisor, between 200 and 300 m elevation (Figs. 1 and 11). This species inhabits undisturbed upland forests near small streams and rivulets (Fig. 12). The vegetation consists principally of the following trees: *Moronobea* spp., *Cedrella* spp., and *Cedrelinga cateniformis*. Lianas are common but were not noted to occur in dense tangles. At ground level, vegetation was sparse, with some ferns and other large, herbaceous plants (such as *Heliconia* spp.). Bromeliads were not recorded. The leaf litter was sparse and appeared dry after several rainless days. The two individuals observed were foraging in leaf litter (Pers. Comm. Diego Vasquez): this is notable because other members of *Ranitomeya vanzolini* group are almost always found within or upon some sort of plant (e.g. *Heliconia*, *Xanthosoma*, or *Dieffenbachia*). Both specimens were encountered during the day and were sympatric with *Ameerega ignipedis* and *A.* cf. *hahneli*: of these species, *Ameerega ignipedis* was abundant and was frequently observed during the day in the leaf litter (Pers. Comm. Diego Vasquez). Neither courtship nor other behavioral characteristics were observed in *R. cyanovittata*.

Conservation status: Following the IUCN Red List criteria (IUCN 2001), this species should be listed as Data Deficient (DD). Being known from only from two localities that are less than 1 km apart, its extent of occurrence is unknown.

Discussion

We are puzzled by the apparently small distribution of *R. yavaricola*. Much of the forests bordered by the Ucayali, Amazon, Yavarí, and Blanco rivers (herein referred to as the Ucayali-Yavarí forests) have been recently surveyed. One possible explanation may be that this species occurs more widely throughout western Brazil and has recently colonized the Ucayali-Yavarí forests. Future exploration of Brazilian forests along the

Rio Yavarí may shed light on this hypothesis. Also, it possible that this species has been observed elsewhere and is being misidentified as *R. flavovittata* due to their similar appearance.

FIGURE 12. Habitat of *Ranitomeya cyanovittata*. Photograph by Diego Vasquez.

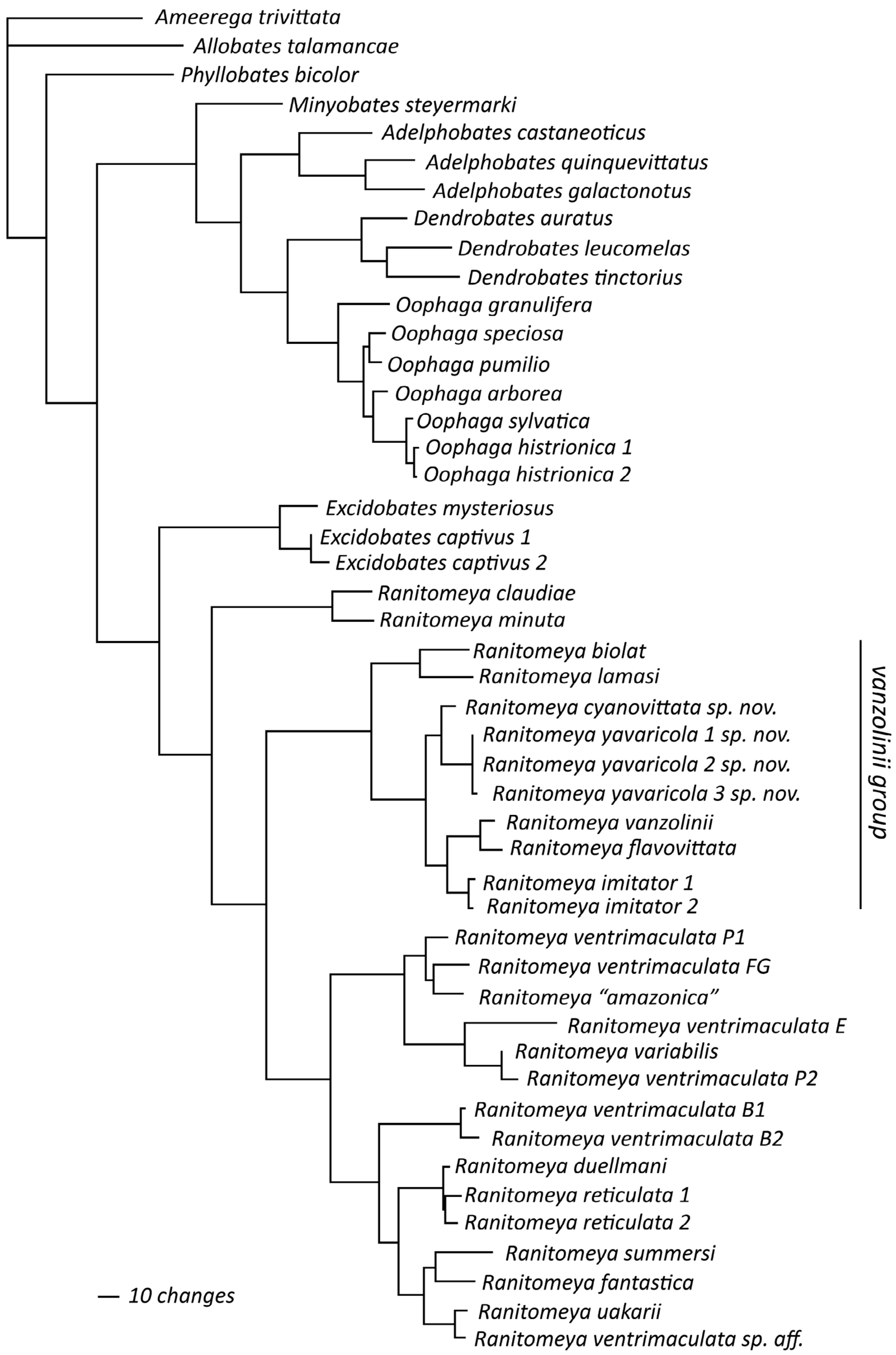

FIGURE 13. Maximum Likelihood phylogeny of *Ranitomeya* based on 2124 base pairs of mitochondrial DNA. All branches within the *vanzolinii* group had bootstrap values greater than 85.

The other *Ranitomeya* species that occur within the Ucayali-Yavarí forests (*R. flavovittata*, *R. uakarii*, and *R. ventrimaculata*) also appear to be locally abundant. In most areas surveyed, only two species have been observed (Rodriguez & Knell 2003, Brown *et al.* 2006, Gordo *et al.* 2006, unpublished data PPP, JLB, ET; Fig. 8). Though, many times the absence of a species is likely the result of misidentification, inappropriate survey methods (due to being small, diurnal and terrestrial), or inadequate survey periods to observe dendrobatid species with low abundances. For example in southern Peru, it took over a year of continuous herpetological sampling to encounter a single *R. uakarii* (R. von May pers. comm.).

The dorsal pattern, call, and distribution of *R. yavaricola* is similar to *R. flavovittata*, and initially seemed to us a morph of *R. flavovittata*. After closer inspection, several morphological differences were identified (i.e. a shorter and higher-pitched call which is more tonal than *R. flavovittata*, Fig. 7) and two taxa were determined to be separate species. This relationship is furthermore supported by the molecular phylogenetics (Fig. 13), which indicate that *R. yavaricola* is sister to *R. cyanovittata*. Both species share the synapomorphy of blue dashes on the ventral surface of the upper thighs.

We were hesitant to describe a species on the basis of two individuals; however, *Ranitomeya cyanovittata* has a combination of morphological characters (when compared to *R. yavaricola*) and phylogenetic evidence (Fig. 13) that supports designation of specific status. Given the remoteness of this type locality (only accessible by helicopter), we publish this description to bring attention to this remarkable species so that future researchers will collect additional samples, as well as ecological and natural history data.

With the limited number of localities known for each species, low genetic divergence (Table 2 and Fig. 13), and, in the case of *R. cyanovittata*, limited number of individuals, there remains the possibility that *R. yavaricola* and *R. cyanovittata* are morphs of the same species. A population of frogs similar in appearance to *R. yavaricola* (which we presume to be another population of *R. yavaricola*) was found 100 km NW from the type locality of *R. cyanovittata* on Rio Blanco (about 280 km from the type locality of *R. yavaricola*). If these two species are, in fact, the same, a dramatic transition in morphology would exist over a short distance. Though this is possible, and several *Ranitomeya* species are polymorphic over very short distances, all examples of dramatic intraspecific variation (on the level that occurs between *R. yavaricola* and *R. cyanovittata*) can be attributed to mimicry (i.e. observed in *R. imitator*). In this situation, there are no apparent ‘mimics’ of both species and all congeneric species possess dramatically different morphologies. Given the extreme morphological differences between *R. yavaricola* and *R. cyanovittata*, we believe both are distinct species that are sister to each other.

The *vanzolinii* group represents one of the more recently discovered lineages of poison frogs, and appears to be more species-rich than previously thought, with several discoveries coming in the past decade. This is perhaps surprising given that these frogs are typically abundant, relatively bold and very vocal (relative to other *Ranitomeya*). However, this group is distributed primarily throughout the forests along the Ucayali drainage (especially to the east), and this region remains one of the most poorly studied in the world. Undoubtedly, further investigation of far-eastern Peru will reveal many new biological discoveries.

TABLE 2. Observed genetic distances between most members of the *vanzolinii* group. Genetic distances are based on a Kimura 2-parameter model.

	R. vanzolinii	*R. cyanovittata*	*R. lamasi*	*R. yavaricola*	*R. flavovittata*
R. cyanovittata	0.068				
R. lamasi	0.216	0.198			
R. yavaricola	0.081	0.019	0.211		
R. flavovittata	0.050	0.079	0.250	0.093	
R. imitator	0.031	0.064	0.220	0.077	0.064

TABLE 3. Species names, collection localities, and GenBank accession numbers (where available) for taxa included in the analysis.

Species	Location	rrnS	rrnL	cob
Adelphobates castaneoticus	E. Brazil	AF482774	AF482789	AF482804
A. galactonotus	E. Brazil	DQ371300	DQ371311	DQ371330
A. quinquevittatus	E. Brazil	AF482773	AY263253	AF482803
Allobates talamancae	Costa Rica	AF128587	AF128586	AF128588
Ameerega trivittata	Peru	AF128570	AF128569	N/A
Dendrobates auratus	Panama	AF128602	AF098745	AF128603
D. leucomelas	Venezuela	AF128593	AF124119	AF128594
D. tinctorius	French Guiana	AF128605	AF128604	AF128606
Excidobates captivus 1	Rio Santiago, Peru	EU325898	EU325900	EU325902
Excidobates captivus 2	Rio Santiago, Peru	EU325899	EU325901	NA
Excidobates mysteriosus	N. Peru	DQ371303	DQ371314	DQ371333
Minyobates steyermarki	Venezuela	DQ371310	DQ371321	DQ371340
Oophaga arborea	Panama	AF128611	AF128610	AF128612
O. granulifera	Costa Rica	AF128608	AF098749	AF128609
O. histrionica 1	Ecuador	AF128617	AF128616	U70154
O. histrionica 2	Ecuador	AF124098	AF124117	AF173766
O. pumilio	Bocas del Toro, Panama	AF128614	AF128613	U70147
O. speciosa	Panama	AF128596	AF098747	AF128597
O. sylvatica	Ecuador	AY364569	AY364569	AF324041
Phyllobates bicolor	Choco, Colombia	AF128578	AF128577	AF128579
Ranitomeya amazonica	Near Iquitos, Loreto, Peru	AF482770	AF482785	AF482800
R. biolat	S. Peru	AF482779	AF482794	AF482809
R. claudiae	Panama	DQ371304	DQ371315	DQ371334
R. cyanovittata	Sierra del Divisor, Peru	HM038419	HM038422	HM038425
R. duellmani	Napo, Ecuador	AY364566	AY263246	N/A
R. fantastica	Cainarachi, San Martin, Peru	AF412447	AF412475	AF412503
R. flavovittata	Tahuayo, Loreto, Peru	DQ371306	DQ371317	DQ371336
R. imitator 1	Huallaga, San Martin, Peru	AF412448	AF412476	AF412504
R. imitator 2	Pongo, San Martin, Peru	AF412459	AF412487	AF412515
R. lamasi	Tingo Maria, Huanuco, Peru	AF482778	AF482793	AF482808
R. minuta	Panama	AF128590	AF128589	MMU70163
R. reticulata 1	Puente Itaya, Loreto, Peru	AF482772	AF482787	AF482802
R. reticulata 2	B. Achille, Loreto, Peru	AF482771	AF482786	AF482801
R. summersi	N. Sauce, San Martin, Peru	AF412444	AF412472	AF412500
R. uakarii	Tahuayo, Loreto, Peru	DQ371305	DQ371316	DQ371335
R. vanzolinii	Porto Walter, Peru	AF128599	AF128598	AF128600
R. variabilis	Cainarachi, San Martin, Peru	AF412463	AF412491	AF412519
R. ventrimaculata B1	Brazil	DQ371307	DQ371318	DQ371337

continued next page

TABLE 3. (continued)

Species	Location	rrnS	rrnL	cob
R. ventrimaculata B2	Brazil	DQ371301	DQ371312	DQ371331
R. ventrimaculata B3	Brazil	DQ371308	DQ371319	DQ371338
R. ventrimaculata E1	Ecuador	AF482780	AF482795	AF482810
R. ventrimaculata E2	Ecuador	AF128620	AF128619	AF120013
R. ventrimaculata FG	French Guiana	DQ371302	DQ371313	DQ371332
R. ventrimaculata P1	N. Bonilla, San Martin, Peru	AF412466	AF412494	AF412522
R. ventrimaculata P2	Near Rio Napo, Loreto, Peru	AF482781	AF482796	AF482811
R. yavaricola 1	Lago Preto, Loreto, Peru	HM038420	HM038423	HM038427
R. yavaricola 2	Lago Preto, Loreto, Peru	HM038421	HM038424	HM038428
R. yavaricola 3	Lago Preto, Loreto, Peru	N/A	N/A	HM038426

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