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## A new species of *Phyllonastes* Heyer from the Chapare region of Bolivia, with notes on *Phyllonastes carrascoicola*

(Amphibia, Anura, Leptodactylidae)

Jörn Köhler

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A new minute leptodactylid frog of the genus *Phyllonastes* Heyer is described from lower montane rainforests of the Departamento Cochabamba, Bolivia, 1250 m a.s.l. *Phyllonastes ritarasquinae*, spec. nov. is characterized mainly by having two phalanges in the fourth finger, well-expanded toe tips with terminal papillae, two pale dorsolateral bands, and by lacking a visible tympanum. In addition, information on morphological variation and distribution of *Phyllonastes carrascoicola* De la Riva & Köhler is provided. Its advertisement call is described and illustrated.

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### Introduction

Minute leptodactylid frogs undoubtedly are much more common and diverse within Neotropical herpetofaunas than is expectable when reviewing the literature. Due to their small size and their occurrence in dense forest litter, these frogs go partly unnoticed or are at least not adequately represented in herpetological surveys. Among the described genera of minute leptodactylids – an overview is given by De la Riva & Köhler (1998) – is the genus *Phyllonastes*, erected by Heyer (1977) to accommodate two species originally placed in the genus *Euparkerella* (Lynch, 1976). The genus *Phyllonastes* has been reported for the first time from Bolivia by Reynolds & Foster (1992), was subsequently figured by Köhler et al. (1995), and this finally led to the description of a new species supposedly endemic to the country (De la Riva & Köhler 1998). As a result, five species of *Phyllonastes* have been named until today (Lynch 1976, 1986, Duellman 1991, De la Riva & Köhler 1998). Moreover, undescribed related species have already been recognized in western Bolivia and Peru (M. Harvey, in litt.) and the discovery of additional ones is very probable.

The purpose of this paper is (1) to describe a new species of *Phyllonastes* discovered during fieldwork in lower montane rainforest of Bolivia, and (2) to provide new information on the variation, distribution, and biology of *Phyllonastes carrascoicola*.

### Material and Methods

Notes on colour in life were taken in the field, as were colour slides of specimens and habitat. Measurements of specimens are in millimeters (mm) and were taken to the nearest 0.1 with dial calipers. Sexes were determined by dissection. The phalangeal condition in the fourth finger of the single specimen of the new species was

determined using binoculars with through-light appliance. Geographic positions were obtained using a Magellan 3000 XL GPS receiver. Calls were recorded using a Sony WM-D6C tape recorder, a Sennheiser Me-80 directional microphone, and a TDK MA60 cassette. Recordings were sampled with a rate of 22.05 kHz and 16-bit resolution, and were analyzed with the sound analysis software Cool Edit 96 (Syntrillium Software Corp.) on IBM compatible computers. Frequency information was obtained through fast Fourier transformation (FFT, width 1024 points). Terminology in the description of call characteristics generally follows Heyer et al. (1990). Terminology and description of morphological characters follow De la Riva & Köhler (1998). Morphometric abbreviations used throughout the text are: E-N, eye to nostril distance; IOD, interorbital distance; SVL, snout-vent length. Institutional abbreviations are as follows: CBF, Colección Boliviana de Fauna, La Paz; USNM, National Museum of Natural History, Smithsonian Institution, Washington; ZFMK, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn.

## Results

### *Phyllonastes ritarasquinae* spec. nov.

Figs 1-2

**Types.** Holotype: CBF 3350; an adult female, from 31 km on the "old" road from Paractito via Palmar to Cochabamba (17°06'50"S, 65°34'19"W), Provincia Chapare, Departamento Cochabamba, Bolivia, 1250 m above sea level; collected on 19 December 1998 by Jörn Köhler and Gandy Suárez.

**Diagnosis.** A species of *Phyllonastes* characterized by (1) having only two phalanges in the fourth finger; (2) well-expanded, pointed discs on toes, ending in terminal papillae; (3) lacking a visible tympanum; and (4) a brown dorsum with two broad, pale, dorsolateral bands.

The two Andean species *P. heyeri* and *P. lynchi* are distinguished by having a longer fourth finger with three phalanges. Furthermore, *P. lynchi* differs from the new species by having pustular dorsal skin and a row of tubercles on the outer edge of the tarsus, and *P. heyeri* differs by having less expanded toe tips lacking terminal papillae. From *P. lochites* and *P. myrmecoides*, *P. ritarasquinae* differs mainly by lacking a visible tympanum and by its colouration. The Bolivian species *P. carrascoicola* lacks the pale dorsolateral bands present in *P. ritarasquinae* and has less expanded toe tips which lack terminal papillae. An undescribed species from the Yungas de La Paz region, Bolivia, exhibits a visible tympanum and less expanded toe tips. Another unnamed species from Peru is distinguished by its large inguinal glands (M. Harvey, in litt.).

### Description of holotype

Snout rounded in dorsal view, subacuminate in lateral profile; head wider than long, head width 33.3 % SVL; top of head flat; upper eyelid lacking tubercles; width of upper eyelid 55.6 % of IOD; nostrils hardly protuberant, directed slightly dorsolaterally; distance from nostril to eye about the same as from nostril to tip of snout; canthus rostralis evident, slightly rounded; loreal region slightly concave; E-N 50.0 % of eye length; supratympanic fold absent; tympanum and tympanic annulus absent. Forearms gracile; palmar tubercles large, round, distinct but relatively flat; subarticular tubercles round, distinct, the proximal more marked than the distal ones; relative length of fingers I < II = IV < III; tips of fingers slightly expanded; webbing absent (Fig. 2). Hindlimbs robust; tibia length 46.1% of SVL; no row of tubercles on outer edge of tarsus; inner side of tarsus with well-defined, short fold; inner and outer metatarsal tubercle prominent, conical, nearly equal in size, round in outline; subarticular tubercles distinct, round, the proximal more marked than the distal ones; plantar surfaces smooth; tips of toes expanded, width of tip of toe IV about two times the toe width; discs on outer toes attenuated distally, forming papillae; circumferential grooves present, complete; relative length of toes I < II < V < III < IV; webbing absent (Fig. 2). Skin on dorsum smooth; no dorsolateral or discoidal folds; skin on all ventral surfaces smooth. Choanae small, round; vomerine teeth absent. Tongue subrectangular, anteriorly attached to floor of mouth, its length about two times its width.

Colouration. In life, dorsum tan; interorbital bar broad, dark brown; scapular region with irregular reddish-brown markings; posterior dorsum pale; two symmetric pale dorsolateral bands, with diffuse orange marbling, extending from posterior corner of eye to groin, its dorsal border slightly irregular posteriorly, its lateral border well-defined, straight; two dark brown inguinal spots, somewhat irregular in shape; flanks brown, contrasting with pale dorsolateral bands; upper lip brown, with few, well-





Fig. 1. Dorsolateral and ventral view of the holotype of *Phyllonastes ritarasquinac*, spec. nov. (CBF 3350) in life. SVL 14.1 mm.

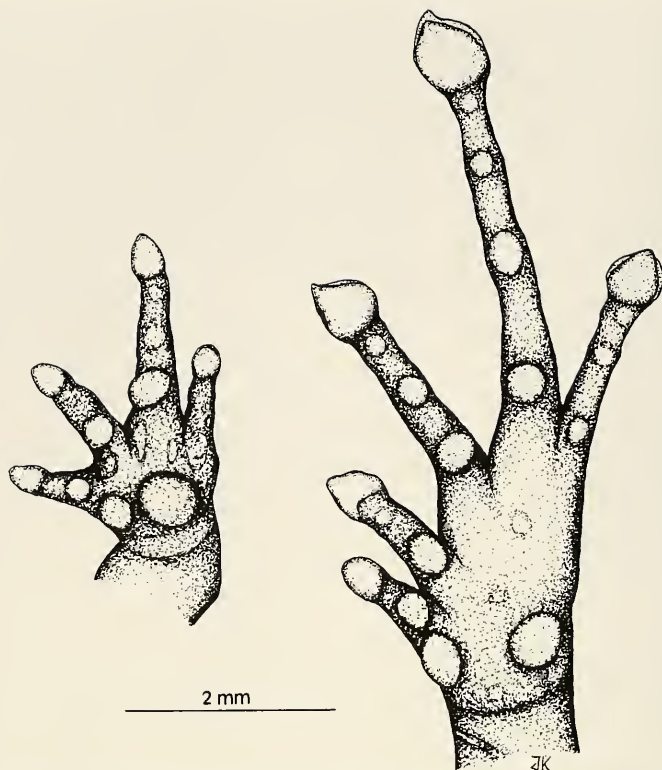


Fig 2. Ventral surfaces of left hand and foot of the holotype of *Phyllonastes ritarasquinae*, spec. nov. (CBF 3350).

separated, white spots; lower lip brown; loreal region brown; groin pale; upper surfaces of limbs tan; hindlimbs with distinct, dark brown bars; posterior side of thighs brown with pale spotting and mottling; cloacal region dark brown; plantar surfaces brown, toe tips brown; forearms dorsally with dark brown flecks; ventral surfaces of forearms dark brown, with irregular white spotting; palmar surfaces brown, finger tips brown; throat orange coloured, with scattered brown mottling; chest orange with diffuse brown mottling; venter reddish brown medially, brown with diffuse white spotting laterally; ventral surfaces of hindlimbs dark brown with distinct scattered white spots; iris dark copper brown, with black spotting.

In alcohol, the ventral colouration differs considerably. The orange and reddish brown colours faded completely and turned into a pale gray. All ventral surfaces appear grayish with fine brown mottling, although the white spots on the ventral surfaces of the hindlimbs remained distinct. The dorsolateral bands turned pale gray, too.

Measurements. SVL: 14.1; head width: 4.7; head length: 4.3; upper eyelid width: 1.0; IOD: 1.8; eye length: 1.8; E-N: 0.9; tibia length: 6.5; foot length: 9.4.

**Distribution and Ecology.** *Phyllonastes ritarasquinae* is known only from the type locality. The locality is situated within lower montane rainforest of the Río San Mateo valley. Annual precipitation in the region was expected to range from 3000 to more than 5000 mm (Ibisch 1996). All months are humid. The region is characterized by extremely steep slopes covered with evergreen forest of medium height ( $\geq 30$  m). The forest is rich in small streams whereas lentic water is rare. The single female was discovered being active during the day in leaf litter at the edge of primary forest. It has enlarged, empty oviducts indicating that a clutch had recently been laid. Other anuran species found in sympatry with *P. ritarasquinae* include *Atelopus tricolor*, *Bufo justinianoi*, *B. veraguensis*, *Bufo* spec., *Gastrotheca testudinea*, *Hyla* cf. *callipleura*, *Hyla* spec., *Eleutherodactylus cruralis*, *E. danae*, *E. mercedesae*, *E. olivaceus*, *E. platydactylus*, *E. rhabdolaemus*, *Leptodactylus griseigularis*, and *L. rhodonotus*.



**Etymology.** The specific name is dedicated to Rita Rasquin (Krefeld) in recognition of her efforts in supporting taxonomic research and nature conservation.

### *Phyllonastes carrascoicola* De la Riva & Köhler

When De la Riva & Köhler (1998) described *Phyllonastes carrascoicola*, only six specimens were referable to this species. The status of another specimen (USNM 257845) from the upper Chapare region of Bolivia (also reported by Reynolds & Foster 1992) was discussed but remained questionable. During fieldwork carried out in the wet seasons 1997/98 and 1998/99, additional specimens of *Phyllonastes* similar to *P. carrascoicola* were collected at Sehuencas (type locality), Provincia Carrasco, as well as in the upper Provincia Chapare, Bolivia. In the following, data on variation in these specimens as well as the resulting conclusions are provided.

**Variation.** All specimens of the female type series of *Phyllonastes carrascoicola* are relatively dark coloured and exhibit pale white lines middorsally, along the posterior surface of hind limbs, as well as midventrally (the midventral line is missing only in ZFMK 59569). The venter is brown with fine white spotting and dark inguinal spots are present except in one specimen (De la Riva & Köhler 1998). A more recently collected female from Sehuencas (ZFMK 66829, SVL 14.7 mm) is similar in having relatively dark dorsal colour but it lacks a pale midventral line and a pale line on the posterior surface of hind limbs. Ventrally, a white line is present only on the throat. The ventral sides of hind limbs and the outer regions of the belly are densely spotted with white and therefore appear pale. A dark brown hourglass-shaped marking is hardly visible on the dorsum. The female ZFMK 71643 (SVL 15.7 mm), collected at 50.5 km on the “old” road from Paractito to Cochabamba, Provincia Chapare, 2100 m a.s.l., exhibits a nearly identical colouration and there remains no doubt that both specimens are conspecific. Two males (CBF [number unknown]; ZFMK 66991, SVL 12.3 mm) from the same locality generally exhibit the same pattern when compared with the female, but are much paler. The dorsum is pale brown and ventral surfaces are cream with brown mottling. This colour pattern coincides well with the male specimen USNM 257845, collected at a nearby locality (see De la Riva & Köhler, 1998). In contrast, a juvenile specimen (ZFMK 71644, SVL 9.2 mm) from the upper Provincia Chapare has a dark venter and a distinct pale line on the posterior surface of hind limbs like present in the *P. carrascoicola* type specimens from Sehuencas. Dark inguinal spots or flecks are present in all of the recently collected specimens.

Summarizing, there is considerable intrapopulational variation regarding colour pattern. At both localities, Sehuencas and the upper Provincia Chapare, specimens occur showing pale lines on dorsum, venter, and/or posterior surface of thighs, as do specimens which lack these lines (or at least part of them) and have a somewhat paler venter. Furthermore, the specimens do not differ in other morphological characters (i.e. condition of digit tips, tympanum, and tubercles). Thus, the only resolved conclusion is that the specimens and populations mentioned above correspond to a single species with intraspecific colour variation, *Phyllonastes carrascoicola*. There seems to be sexual dimorphism in *P. carrascoicola*, with the males being smaller and paler coloured.

However, the knowledge about variation within the species *P. carrascoicola* is far from satisfying. Part of the differences in colouration might be seasonal variation and others might be due to the procedure of preservation. Especially, the ventral colour of certain specimens changed remarkably in alcohol.

**Vocalization.** Advertisement calls (Fig. 3) were recorded on 29 January 1999, 11.00 h, on the “old” Chapare road, Provincia Chapare, Departamento Cochabamba, 2100 m a.s.l. Males called during the day from the leaf litter forming choruses (compare Reynolds & Foster 1992). Calls consisted of a series of 5-8 soft notes (mean  $6.0 \pm 1.2$ ); call duration varied from 254-436 ms (mean  $332.3 \pm 62.6$ ); note duration varied from 12-20 ms; notes were repeated in regular intervals at a rate of approximately 16 notes per second; calls were repeated in regular intervals at a rate of approximately 10 calls per minute; call energy was distributed from 2500-5000 Hz; a distinct upward frequency modulation was present within the calls, with the first note having a dominant frequency of approximately 3300 Hz and the last one having it at almost 4000 Hz. Sixteen calls of three individuals were analyzed. The air temperature was  $16.4^\circ\text{C}$  during recording. Identical calls were heard at an elevation of 1850 m a.s.l. along the same road.

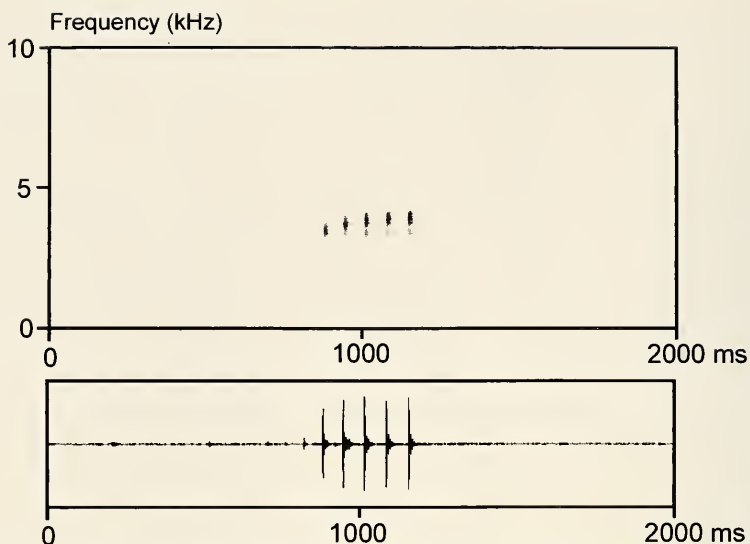


Fig 3. Audiospectrogram and oscillogram of the advertisement call of *Phyllonastes carrascoicola* De la Riva & Köhler. Recording obtained on 29 January 1999, 11.00 h, at 50.5 km on the “old” road from Paracitico to Cochabamba, Provincia Chapare, Departamento Cochabamba, Bolivia, 2100 m a.s.l. Air temperature 16.4 °C.

Males always called hidden under fallen leaves within dense vegetation. Thus, it was not possible to observe *P. carrascoicola* while calling to see the size and shape of the inflated vocal sac. However, *P. carrascoicola* was the only anuran species found when searching the places from which calls were emitted.

The call of *Phyllonastes carrascoicola* can be confused with that of the sympatric *Eleutherodactylus llojsintuta*. However, the call of *P. carrascoicola* is softer, has a higher note repetition rate, a higher dominant frequency, a more distinct frequency modulation, and was emitted only during the day from the ground (compare Köhler & Lötters 1999). *Eleutherodactylus llojsintuta* is a nocturnal species calling from bushes and ferns.

Reynolds & Foster (1992) reported low-pitched, clicky, two-note calls in a chorus made up by males from which the specimen USNM 257845 was taken. This description generally coincides with the data presented above, although the calls analyzed were composed of a larger number of notes.

**Distribution.** Compiling the results presented herein as well as already published data, *Phyllonastes carrascoicola* is distributed in upper montane rainforests and adjacent cloud forests (1850-2700 m a.s.l.) along the northeastern Andean slopes, at least from Provincia Chapare, Departamento Cochabamba, eastward to Provincia Caballero, Departamento Santa Cruz, Bolivia.

**Remark.** An additional species of minute leptodactylid frog, seemingly related to *Phyllonastes*, has been discovered in the Yungas de La Paz region. This new taxon will supposedly be described as a new genus (M. Harvey, in litt.). It may turn out that *P. carrascoicola* actually is more closely related to this new genus than to other species of *Phyllonastes*.

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## Resumen

Se describe una especie nueva del género *Phyllonastes* de un bosque húmedo de montaña, Departamento de Cochabamba, Bolivia, 1250 m s.n.m. *Phyllonastes ritarasquinae* spec. nov. se caracteriza principalmente por poseer solo dos falanges en el cuarto dedo de la mano, dilataciones terminales de los dedos anchas, dos rayas dorsolaterales claras, y por la ausencia del tímpano. Adicionalmente, se presentan datos nuevos sobre la variación, distribución y el canto de la especie *Phyllonastes carrascoicola*.

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