Copeia, 1990(1), pp. 108–112

A New Species of *Phrynopus* (Anura: Leptodactylidae) from Perú

S. Blair Hedges

***Phrynopus bracki* is described from cloud forest (2600 m) in the Cordillera Yanachaga, Departamento de Pasco, Perú. It is a small (16–20 mm SVL) leaf litter species with short digits and a two-note call. Its affinities to other species of *Phrynopus* are unknown.**

THE leptodactylid genus *Phrynopus* includes 18 species occupying moderate to high elevations (>1000 m) in the Andes of South America (Frost, 1985; Cannatella, 1985; Lynch, 1986). Most species are allopatric in distribution. Phylogenetically, *Phrynopus* is believed to be an offshoot of the large genus *Eleutherodactylus* (ca 450 sp.; Hedges, 1989), differing from that group by the absence of circumferential grooves on the digital pads (Lynch, 1975; Cannatella, 1984, 1985). Also, some species of *Phrynopus* lack the T-shaped terminal phalanges present in *Eleutherodactylus* (Lynch, 1975).

Recently, I had the opportunity to collect in a relatively isolated mountain range east of the Andes in central Perú. Rising to over 4000 m, the Cordillera Yanachaga is bordered on the west by the Río Huancabamba and Río Chontabamba, and on the east by the drainage system of the Río Palcazu and Río Cacazu. Most of the cordillera is within Parque Nacional Yanachaga-Chemillén.

Although herpetological collections have been made in the lower elevations of the Cordillera Yanachaga, especially in the vicinity of Oxapampa and Huancabamba, the upper elevations are virtually unexplored. On 29–30 June 1987, I spent two nights collecting anurans in undisturbed cloud forest at 2600 m on the west slope of the Cordillera Yanachaga. Most of the species encountered were *Eleutherodactylus*. However, three specimens of a small undescribed species of *Phrynopus* were collected in the leaf litter.

In the account below, the following abbreviations are used: E–N (distance between eye and nostril), EYE (horizontal diameter of eye), HL (head length), HW (greatest width of head), IOD (interorbital distance), MHNJP (Universidad Nacional Mayor de San Marcos, Lima, Perú), SHL (shank length), SVL (snout–vent length), THL (thigh length), and USNM (National Museum of Natural History).

Phrynopus ***bracki*** n. sp
Fig. 1

Holotype.—USNM 286918, an adult male, from 2.9 km N, 5.5 km E (airline) Oxapampa in the Cordillera Yanachaga, Departamento de Pasco, Perú (Fig. 2), 10°32′38″S, 75°21′10″W, 2600 m, collected by S. Blair Hedges on 29–30 June 1987.

Paratypes (2).—USNM 286919 (female), MNHJP 4400 (male), paratopotypes, same data as holotype.

Diagnosis.—A very small *Phrynopus* (SVL 15.7–16.2 mm in males, 19.8 mm in female); skin of dorsum rugose (in males) and tuberculate, that of venter smooth; first finger shorter than second; fingers and toes very short and not dilated at tips, length of first toe equal to width; digital pads (sensu Lynch and Myers, 1983) lacking circumferential grooves; toes lacking lateral fringes and basal webbing; two metatarsal tubercles, inner three times size of outer; tarsus with distinct row of tubercles; tympanum absent; snout rounded or slightly truncate in lateral profile; vomerine teeth present; body dark brown above and below with faint trace of dorsal pattern in males; red groin spot in male (holotype).

The presence of T-shaped terminal phalanges (radiographs taken of USNM 286918-919) and direct development (see below) places this species in the leptodactylid tribe Eleutherodactylini (Lynch, 1971). The lack of circumferential grooves on the digital pads further allocates this species to the genus *Phrynopus*. No other species of *Phrynopus* has the combination of smooth venter, first finger shorter than second, and an absent tympanum. In addition, the very reduced digits of *P. bracki*, with a nearly vestigial first toe (width equal to length) serve

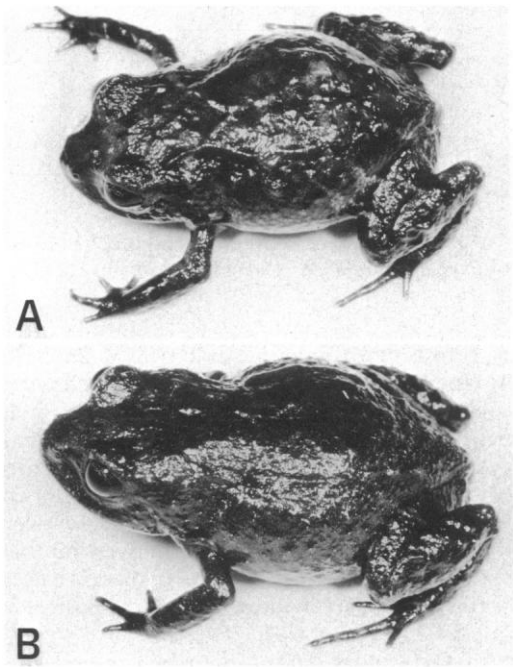

Fig. 1. *Phrynopus bracki.* A) Adult male, holotype (USNM 286918). B) Adult female, paratype (USNM 286919).

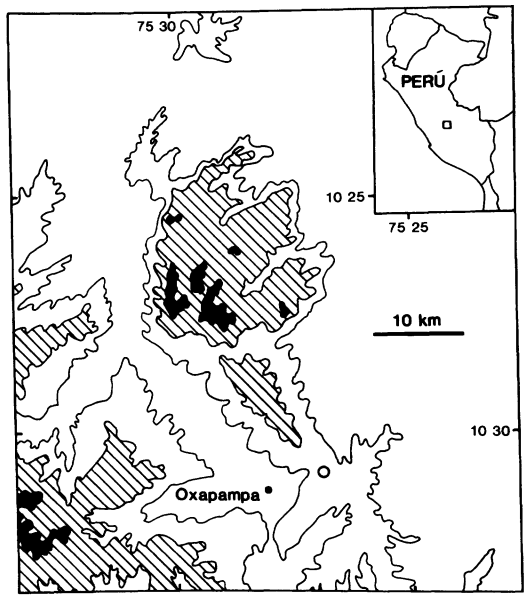

Fig. 2. Map showing the locality of *Phrynopus bracki* (open circle) in the Cordillera Yanachaga, Departamento de Pasco, in central Perú. The eastern slopes of the Andes are in the lower left. Elevations are: 2000–3000 m (unpatterned), 3000–4000 m (diagonal lines), and 4000–5000 m (black).

to easily distinguish this species from all others in the genus.

Description (based on three known specimens).— Head narrower than body, wider than long, head width 37.0–39.4% of SVL ($\bar{x}$ = 38.6%); snout rounded in dorsal view, rounded to slightly truncate in lateral profile; canthus rostralis moderately sharp, concave; loreal region concave; lips not flared; nostrils lateral, weakly protuberant; snout short, E–N 62.8–68.9% of EYE ($\bar{x}$ = 65.1%); interorbital region flat, no cranial crests; upper eyelid width 89.2% and 95.0% of IOD in males, 76.3% in female; tympanum absent; no supratympanic fold; tongue large, oval, not notched posteriorly, posterior two-thirds free; choanae small, round, not concealed by palatal shelf of maxillae; vomerine odontophores present, each 3–4 times size of a choana, slanted posteriorly, as wide as long, each bearing 3–4 teeth, separated by a distance equal to width of a choana; males lacking vocal slits and vocal sacs; testicular peritoneum white.

Skin of dorsum strongly tuberculate and rugose in males, slightly tuberculate in female, ventral surfaces smooth; discoidal folds present (laterally); no dorsolateral folds; slightly raised scapular "M" in holotype (visible only in life); ulnar tubercles present on forearm, forming a ridge; palmar tubercles flat, poorly defined; subarticular tubercles of finger low, round, simple; fingers very short with slight lateral fringe; fingertips not expanded, slightly pointed; first finger shorter than second.

Tarsus with tubercles forming a ridge on outer edge; one moderately large conical heel tubercle present surrounded by several smaller tubercles; two low, oval, metatarsal tubercles, inner three times as large as outer; supernumerary and subarticular tubercles not evident; toes very short (length of first equal to width), lacking lateral fringe and basal webbing; tips of toes not expanded (Fig. 3); SHL 37.3–39.5% of SVL ($\bar{x}$ = 38.3%).

In preservative, dorsal and ventral surfaces dark brown, virtually uniform in female, but with some trace of dorsal pattern in males; pattern in males consisting of a pale interocular triangle with apex oriented posteriorly, a black bar between eye and upper lip (bordered by narrow light lines in holotype; with medial narrow vertical light line in MNHJP 4400, straight narrow light line extending from behind eye

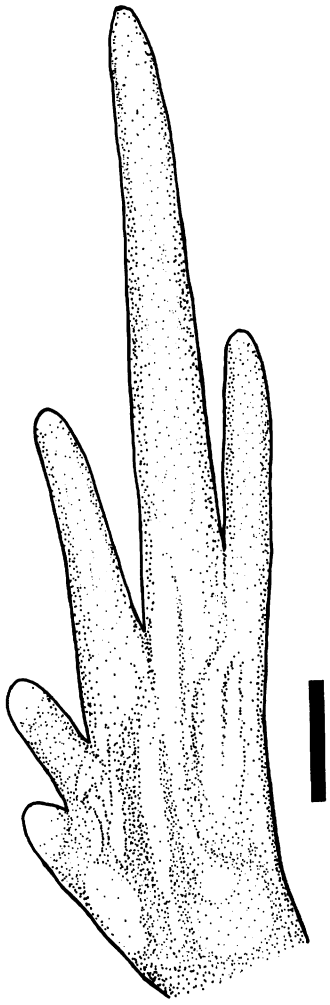

Fig. 3. Ventral view of left foot of *Phrynopus bracki* (USNM 286919). Scale bar = 1 mm.

diagonally to insertion of forearm (with semicircular dark blotch above), a faint light dorsal pattern in holotype of two narrow parentheses connected anteriorly by a scapular "W" and enclosing patches of lighter pigment, two well-defined dark blotches (outlined with narrow light pigment) above groin on body, rounded in shape (in holotype) but continuous with dorsal thigh bars, a pair of narrow light dorsolateral flank bars anterior to groin with posterior ends angled downward, small white spot in groin, dark dorsal blotch on forearm (behind hand) with light patch near insertion of forearm, thigh with two dark bars outlined in light pigment (outer bar incomplete on left leg of holotype), black postanal triangle; oval white blotch on left side

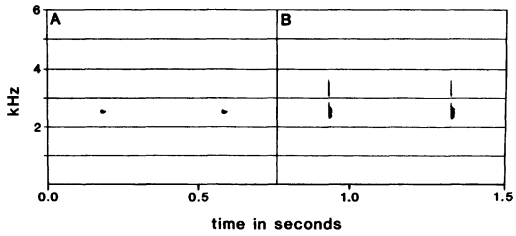

Fig. 4. Audiospectrogram of a single two-note call of *Phrynopus bracki*. A) 45 Hz filter. B) 300 Hz filter.

of chin in both holotype and USNM 286919; in female, the only additional pattern element consists of a narrow white line on posterior thigh extending from vent to behind knee joint and then continuing on ventral surface of shank to below heel; a third light line joining those two leg lines just above the vent, passing down over the vent and becoming a faint midventral line extending anteriorly to the chin (in males, traces of this pattern are evident only on the posterior thighs).

In life, colors darker than in preservative, with dorsal and ventral surfaces nearly uniform black (or very dark brown) except for some faint traces of pattern (lighter brown) as described in detail above; eyes bronze; groin spots red (in holotype).

Measurements.—Measurements (taken to nearest 0.01 mm) of all three specimens are presented in the following order: USNM 286918 (holotype, male), MNHJP 4400 (male), and USNM 286919 (female). SVL (15.7, 16.2, 19.8), HL (5.83, 5.79, 7.28), HW (6.19, 5.99, 7.81), EYE (2.06, 1.90, 2.39), E–N (1.31, 1.31, 1.50), internarial distance (1.95, 1.99, 2.19), IOD (1.86, 1.80, 2.32), THL (6.62, 6.44, 8.25), SHL (6.20, 6.17, 7.40), tarsal length (3.99, 4.13, 4.99), foot length (5.20, 5.83, 7.06), fingertip (III) width (0.29, 0.35, 0.42), toetip (IV) width (0.33, 0.33, 0.40). Live weight: 0.9 g (USNM 286919) and 0.4 g (MNHJP 4400).

Vocalization.—The single call recorded for this species has two notes separated by 0.4 sec (Fig. 4). Each note is about 0.02 sec in duration, and the dominant frequency of the call is 2500 Hz.

Etymology.—Named for Antonio Brack, who was instrumental in the creation of Parque Nacional Yanachaga-Chemillén.

Natural history.—The type locality of *P. bracki* lies at the southern end of the Cordillera Yanachaga, on the western slope (Fig. 2). It is about 4 h by foot from Oxapampa. A dirt road begins at Oxapampa (1825 m) and heads northeast along the Quebrada San Alberto to a small reservoir at about 2100 m. From there, a trail heads east along an eastern tributary of the San Alberto for a short distance before disappearing into the stream bed. At the top of a steep, cultivated hillside nearby, another trail begins just within the forest and continues up the mountain, eventually crossing at a pass called Abra Esperanza (labeled "Esperanza" on some maps, but there is no village or house). In June 1987, a large landslide blocked the trail just below the pass, and thus my collections were restricted to the west slope, mainly in the vicinity of the campsite (on the trail) at 2600 m.

All three specimens of *P. bracki* were taken at night in cloud forest leaf litter near the campsite. The female was uncovered while sorting through dead leaves and humus. Both males were found inside curled dead leaves on the forest floor after tracing deceptive, two-note calls (Fig. 4) to those locations. Other species of anurans syntopic with *P. bracki* were *Eleutherodactylus mendax,* about six undescribed species of *Eleutherodactylus,* and at least one undescribed species of bufonid. The female contained 15 unpigmented eggs weighing a total of 0.1 g (fresh weight) or about 11% of the total body weight (with eggs).

Distribution.—Known only from the type locality.

Remarks.—Lynch (1975) defined four species groups of *Phrynopus* (*flavomaculatus, peruanus, peruvianus,* and *simonsii*) and presented an hypothesis of relationships within the genus. Cannatella (1984) added two new species and reanalyzed the data set of Lynch, arriving at a shorter tree that differed in several ways from Lynch's phylogeny. However, he refrained from redefining Lynch's species groups, preferring to wait until a more comprehensive phylogenetic analysis is performed.

Phrynopus bracki does not fit clearly into any of the four species groups defined by Lynch (1975). With the tympanum absent and first finger shorter than the second, *P. bracki* would appear to be a member of either the *simonsii* or *peruanus* groups. However, the smooth venter (not areolate) and the lack of basal webbing and lateral fringes on the toes excludes it from the *simonsii* group. Also, it can be excluded from the *peruanus* group by the presence of tarsal tubercles, vomerine odontophores, and a smooth venter, although one of the five species in that group (*peruanus*) possesses the latter two traits. Since three of the four species groups of *Phrynopus* (*flavomaculatus, peruanus,* and *peruvianus*) occur in central and southern Perú, distribution does not aid in species group assignment. Until more data become available, the affinities of *P. bracki* will remain unknown.

Acknowledgments

I thank L. Rodriguez for helping me find an interesting and unexplored region of Perú to search for *Eleutherodactylus* and its relatives. A., C., and W. Brack generously provided hospitality and logistical support. P. Aguilar and L. Vajda kindly assisted me in the field. Collecting and export permits were obtained from the Direccíon General Forestal y de Fauna through the courtesy of R. Acero, M. Falero, and M. Romero. N. Carillo, A. Luscombe, V. Morales, and A. Salas assisted me in numerous ways during the Lima segment of my expedition. R. Heyer kindly provided access to the sound analysis laboratory of the Division of Amphibians and Reptiles, Smithsonian Institution. Radiographs were provided by R. McDiarmid. D. Cannatella, C. Hass, R. Heyer, R. Highton, and R. McDiarmid offered helpful comments on the manuscript.

Literature Cited

Cannatella, D. C. 1984. Two new species of the leptodactylid frog genus *Phrynopus,* with comments on the phylogeny of the genus. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 113:1–16.

———. 1985. The systematic status of *Syrrhophus juninensis* Shreve (Anura: Leptodactylidae). Proc. Biol. Soc. Wash. 98:774–777.

Frost, D. R. (ed.). 1985. Amphibian species of the world. Allen Press, Inc., and the Association of Systematics Collections, Lawrence, Kansas.

Hedges, S. Blair. 1989. Evolution and biogeography of West Indian frogs of the genus *Eleutherodactylus*: slow-evolving loci and the major groups. *In:* Biogeography of the West Indies: past, present, and future. C. A. Woods, (ed.). Sand Hills Crane Press, Gainesville, Florida. *In press.*

Lynch, J. D. 1971. Evolutionary relationships, osteology, and zoogeography of the leptodactyloid frogs. Univ. Kansas Mus. Nat. Hist. Misc. Pub. 53: 1–238.

———. 1975. A review of the Andean leptodactylid frog genus *Phrynopus*. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 35:1–51.
———. 1986. New species of minute leptodactylid frogs from the Andes of Ecuador and Perú. J. Herpetol. 20:423–431.
———, AND C. MYERS. 1983. Frogs of the *fitzingeri* group of *Eleutherodactylus* in eastern Panama and Chocoan South America (Leptodactylidae). Bull. Amer. Mus. Nat. Hist. 175:481–572.

DEPARTMENT OF BIOLOGY, 208 MUELLER LAB, THE PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA 16802. Accepted 10 April 1989.

Copeia, 1990(1), pp. 112–118

Exploring Fabens' Growth Interval Model with Data on a Long-Lived Vertebrate, *Trachemys scripta* (Reptilia: Testudinata)

NAT B. FRAZER, J. WHITFIELD GIBBONS AND JUDITH L. GREENE

We used data from a natural population of slider turtles, *Trachemys scripta*, (n = 70) to compare a von Bertalanffy growth equation constructed from known-age data with one constructed using Fabens' method (under the assumption that ages were not known). The 95% confidence intervals revealed no significant differences in estimates of variables *a*, *b*, or *k* for the two equations, both of the form: $L_t = a(1 - be^{-kt})$. We also examined the effects of truncated samples on Fabens' method by omitting large and small individuals. Fabens' method underestimated the asymptotic value, *a*, and overestimated the intrinsic growth factor, *k*, when larger individuals were omitted. The omission of small individuals resulted in little change in estimated values. Our findings confirm the utility of Fabens' method in estimating growth curves for animals of unknown age if data are available across all size classes. Although data on large individuals may be more important in arriving at accurate estimates of variable values, data on small individuals may be necessary to determine if another model (i.e., logistic) might provide a better descriptor of growth trajectories.

GROWTH models are used in ecological studies for a variety of purposes that include estimating age at maturity (Frazer and Ehrhart, 1985), studying differences in life-history characteristics between sexes and among populations or species (Kunz, 1974; Schoener and Schoener, 1978; Gibbons et al., 1981), comparing growth rates under different environmental conditions (McQueen and Carnio, 1974; Dunham, 1978), examining the effects of stress (Zach, 1982), assessing the evolutionary and genetic aspects of differences in life-history traits (Stearns, 1983, 1984), examining the relationship between metabolism and growth (Vleck et al., 1980), and comparing growth rates within a population over long periods of time (Boulon and Frazer, unpubl.).

Constructing growth curves is fairly straightforward for captive specimens of known age or for species that can be aged reliably in the wild. The lack of adequate aging techniques for many species (e.g., most reptiles, Gibbons, 1976) makes the estimation of growth curves somewhat more difficult. Fortunately, Fabens (1965) provided a method for fitting von Bertalanffy growth equations specifically with data from animals of unknown ages. Data required are measurements of size at first capture, size at recapture and the capture-recapture time interval for each individual in the sample.

Fabens' method has been used to provide growth equations for lizards (Schoener and Schoener, 1978; Dunham, 1978; Jun-yi and Kau-hung, 1982), sea turtles (Witzell, 1980; Frazer and Ehrhart, 1985; Frazer and Ladner, 1986), fish (Stearns, 1984), birds (Zach, 1982), bats