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A New Species of the *Eleutherodactylus myersi* (Anura: Leptodactylidae) Assembly from Ecuador

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ABSTRACT.—**A new species of small, terrestrial *Eleutherodactylus* is described from a restricted area of interandean montane forest in central Ecuador. This species is most similar to *E. orestes* from southern Ecuador, but is distinguished by differences in coloration, osteology, morphometrics, and allozymes. The new species is a member of the *myersi* assembly of the *unistrigatus* species group. A phylogenetic analysis of six species of the assembly using allozymic and morphological data suggests the following relationships: ((*E. pyrrhomerus* + *E. leoni*) + ((*E. ocreatus* + *E. trepidotus*) + (new species + *E. orestes*))). *Eleutherodactylus anae* is a junior subjective synonym of *E. curtipes* and is not a member of the *myersi* assembly.**

RESUMEN.—**Se describe una nueva especie de *Eleutherodactylus* pequeño de hábitos terrestres colectado en un refugio de bosque montano interandino en Ecuador central. Esta especie se parece más a *E. orestes* del sur de Ecuador, pero se le distingue por diferencias de coloración, osteología, morfometría, y aloenzimas. Esta especie nueva es miembro del subgrupo (assembly) *myersi* en el grupo de especies *unistrigatus*. Un análisis filogenético de seis especies del subgrupo usando datos de aloenzimas y morfológicos indica las relaciones siguientes: ((*E. pyrrhomerus* + *E. leoni*) + ((*E. ocreatus* + *E. trepidotus*) + (especie nueva + *E. orestes*))). *Eleutherodactylus anae* es sinónimo de *E. curtipes* y no es miembro del subgrupo *myersi*.**

The leptodactylid frog genus *Eleutherodactylus* contains more than ten percent of all anuran species (Frost, 1985), with more than 430 species described (Lynch and Burrowes, 1990). These species are currently distributed among several species groups. The largest of these is the *unistrigatus* group, with over 100 species found mostly in South America. Within the *unistrigatus* group are a number of smaller, informal taxa recognized as assemblies by Lynch and Duellman (1980). Lynch (1981) erected the *myersi* assembly for *E. ginesi, E. myersi, E. nicefori, E. ocreatus, E. orestes, E. trepidotus,* and *E. vidua*. Subsequently, Lynch (1984) placed *E. myersi, E. ocreatus,* and *E. trepidotus* into the *pyrrhomerus* assembly (which contained *E. gladiator, E. leoni, E. pyrrhomerus,* and *E. repens*), but considered the *pyrrhomerus* assembly a monophyletic subgroup within the more inclusive *myersi* assembly. With the recent addition of *E. anae* Rivero 1986, the *myersi* assembly consists of a total of 12 species from the high Andes of Colombia, Venezuela, and Ecuador.

The Bosque Protector Cashca Totoras in west-central Ecuador contains one of the last remaining stands of interandean montane forest in the country. Over the past several years, field parties from the Universidad Católica of Quito and University of Kansas have collected representatives of a small, terrestrial *Eleutherodactylus* at Cashca Totoras, apparently belonging to the *myersi* assembly. The purposes of the present paper are to describe this species and to conduct a preliminary phylogenetic analysis of the *myersi* assembly.

MATERIALS AND METHODS

Specimens examined, including skeletal preparations and specimens examined for allozymic comparisons, are listed in Appendix 1. Museum abbreviations are: KU (The University of Kansas, Museum of Natural History); QCAZ (Museo de Zoología, Pontifica Universidad Católica del Ecuador, Quito); ULABG (Universidad de los Andes, Laboratorio de Biogeografía, Mérida, Venezuela); and UPR-M (University of Puerto Rico, Mayaguez). Terminology for external features and format of the diagnosis and description follow Lynch and Duellman (1980). Measurements were taken to the nearest 0.1 mm using dial-tipped calipers. Abbreviations used in the text are as follows: E-N (eye to nostril distance); HW (greatest width of head); IOD (interorbital distance); and SVL (snout-vent length). Means reported for measurements include one standard error (±). Descriptive statistics were computed using the NCSS statistical package, and multivariate analyses were performed using the SAS statistical package on a mainframe computer. Cleared-and-stained

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skeletons were prepared following a modified version of the technique of Dingerkus and Uhler (1977).

In order to assess the relationships of the new species, we performed a preliminary phylogenetic analysis of the *myersi* assembly using allozymic and morphological data. Liver and skeletal muscle were removed from animals freshly killed in the field (using a 15% solution of benzocaine) and were frozen immediately in liquid nitrogen for transport to the laboratory. Tissues were stored at −70 C and were used within two years of collection. Liver and skeletal muscle were homogenized separately with a teflon homogenizer in a 1:1 (v:v) mixture of tissue and distilled water. Homogenates were centrifuged at 13,445 *g* for 10 min at 5 C. Tissue samples were run at 5 C on horizontal starch gels composed of 12% hydrolyzed potato starch. Presumptive gene loci were visualized by histochemical staining methods (Harris and Hopkinson, 1976; Selander et al., 1971; Siciliano and Shaw, 1976). Enzyme nomenclature follows the recommendations of the International Union of Biochemistry Nomenclature Committee (1984). Loci were numbered from anode to cathode, and alleles were labeled *a, b, c,* etc., in order of increasing anodal mobility. Buffer systems, tissue sources, loci, and IUBNC numbers are as follows: Lithium hydroxide, muscle (*Cbp*—calcium binding protein, nonspecific); Poulik, muscle (*Ldh-2,* 1.1.1.27; *Me,* 1.1.1.40; *Mpi,* 5.3.1.8); Tris-borate-EDTA-NAD pH 9.1, liver (*Ga3pdh,* 1.2.1.12; *G6pdh,* 1.1.1.49; *Ldh-1,* 1.1.1.27; *Mdh-1,* 1.1.1.37; *Mdh-2,* 1.1.1.37; *Sdh,* 1.1.1.14); Tris-citrate-NADP pH 7.0, liver (*Ald,* 4.1.2.7; *Icdh-1,* 1.1.1.42; *Icdh-2,* 1.1.1.42); Tris-citrate-NADP pH 8.0, muscle (*Ck,* 2.7.3.2; *Gpi,* 5.3.1.9; *Pgm,* 5.4.2.2).

Parsimony analysis was performed using David Swofford's PAUP (version 3.0n) and FREQPARS (which analyzes data in the form of frequencies). For the PAUP analysis, the "Exhaustive Search" option was used to guarantee finding the shortest tree, and character state optimizations for each stem were checked using the ACCTRAN and DELTRAN (Swofford and Maddison, 1987) optimization routines and by hand.

The electrophoretic data were coded for the qualitative (PAUP) analysis by considering the locus as the character and the allelic array (combination of alleles present) as the character state (Table 1). Intraspecific polymorphisms were differentially weighted using step matrices (following P. Mabee and J. Humphries, pers. comm.). The appearance of a derived allele as a polymorphism was given an a priori weight of 0.5 as was the fixation of that allele (or apparent loss of the plesiomorphic allele). For example, the minimum hypothesized weight between the allelic arrays *aa* and *ab* would be 0.5 step, between *aa* and *bb* 1.0, between *aa* and *cd* 1.5, and between *ab* and *cd* 2.0 steps.

Six morphological characters were included in the same data matrix (Table 1). Lynch (1984) used 12 morphological characters to generate a phylogenetic hypothesis for the *myersi* assembly (including the *pyrrhomerus* assembly). We used (or modified) four of these characters (17, 19, 21, 22); the remaining characters discussed by Lynch (1984) either appear to vary continuously within and between species (separation of nasals, shape of canthus rostralis, expansion of digits, presence of pads on fingers), or were not applicable at the level of our analysis (length of fingers, iris color, skin texture, size of metatarsal tubercles).

For the purposes of outgroup comparison, we examined representatives of three other assemblies of high Andean *Eleutherodactylus* of the *unistrigatus* group: *E. buckleyi* and *E. curtipes* (*curtipes* assembly), *E. devillei* and *E. vertebralis* (*devillei* assembly), and *E. unistrigatus* (*unistrigatus* assembly). Among these species, the members of the *curtipes* assembly share the presumably derived features of a lateral flange on the frontoparietals and exostosis of the nasals and frontoparietals, and the members of the *devillei* assembly examined are united by the loss of vocal slits and the presence of an inner tarsal fold (Lynch, 1983). The members of the *curtipes* and *myersi* assemblies have very narrow digital pads, presumably a derived feature. Members of the *myersi* assembly examined are united by their reduced size (maximum size of adult females 20.2–27.2 mm SVL versus 38.5–48.8 mm in the putative outgroups). The presence of bright inguinal coloration might also be a synapomorphy for these species. In summary, the following relationships were assumed for outgroup comparison: (*E. unistrigatus* + (*E. devillei* + *E. vertebralis*) + ((*E. buckleyi* + *E. curtipes*) + *myersi* assembly)). Character state polarities were optimized using the algorithm of Maddison et al. (1984).

SYSTEMATICS

Eleutherodactylus simonbolivari sp. nov.
Fig. 1.

Holotype.—QCAZ 1459, an adult female, one of a series from Bosque Protector Cashca Totoras, 10 km southeast Santiago on road to Santa Rosa de Totoras, (78°53'W, 1°42'S, elevation 3200 m), Provincia Bolívar, Ecuador, collected during February 1987 by Felipe Campos, Luis Coloma, and Raúl Ramírez.

Paratopotypes.—KU 218252–56, QCAZ 936, 940–41, 943–44, 1458–1475, and QCAZ 1493–96, cleared-and-stained skeletal preparations.

TABLE 1. Data matrix and frequency data for phylogenetic analysis of the *Euleutherodactylus myersi* assembly using 16 allozymic characters and six morphological characters: (1) *Ald*, (2) *Cbp*, (3) *Ck*, (4) *Ga3pdh*, (5) *G6pdh*, (6) *Gpi*, (7) *Icdh-1*, (8) *Icdh-2*, (9) *Ldh-1*, (10) *Ldh-2*, (11) *Mdh-1*, (12) *Mdh-2*, (13) *Me*, (14) *Mpi*, (15) *Pgm*, (16) *Sdh*, (17) maximum size of adult females (0: 38.5–48.8 mm SVL; 1: 20.2–27.2); (18) testis color (0: white; 1: brown to black); (19) conical tubercles on dorsum, eyelid, and/or tarsus (0: absent; 1: present); (20) discrete white to red spots on dark venter (0: absent; 1: present); (21) reddish wash in inguinal region (0: absent; 1: present); (22) discrete white to reddish spots in inguinal region (0: absent; 1: present). For allozymic characters the

Taxon	Character 1	2	3	4	5	6	7	8	9
E. buckleyi	b	d	a (0.50) b (0.50)	b	a (0.33) c (0.67)	c (0.50) d (0.50)	c (0.17) e (0.17) d (0.67)	f (0.33) g (0.67)	d
E. curtipes	b	d	b	a (0.75) b (0.25)	a	c (0.75) f (0.25)	c	g	d
E. devillei	d	d	b	e	c	b (0.50) e (0.50)	b (0.33) c (0.67)	d	c (0.50) d (0.50)
E. vertebralis	e	a	a (0.50) d (0.50)	b	a	e	c	g	d
E. unistrigatus	e	c	a	e	g	a	b	d	g
HYPANC	0:bb	0:dd	0:bb	0:bb	0:aa	0:cc	0:cc	0:gg	0:dd
E. leoni	3:dd	2:ee	1:cc	0:bb	4:hh	0:cc	1:c (0.75) f (0.25)	5:ee	4:e (0.50) f (0.50)
E. ocreatus	1:aa	0:dd	0:bb	0:bb	2:b (0.90) e (0.10)	0:cc	0:cc	2:g (0.10) h (0.90)	3:aa
E. orestes	2:cc	0:dd	0:bb	0:bb	3:dd	1:a (0.50) c (0.50)	2:aa	3:cc	1:cc
E. pyrrhomerus	3:dd	2:ee	1:cc	1:cc	1:ee	0:cc	3:ee	0:gg	2:b (0.33) c (0.67)
E. simonbolivari	2:cc	0:dd	0:bb	2:dd	3:dd	2:b (0.50) c (0.50)	2:aa	4:a (0.88) c (0.12)	1:cc
E. trepidotus	0:bb	1:b (0.60) d (0.40)	0:bb	0:bb	2:b (0.94) e (0.06)	0:cc	0:cc	1:b (0.62) g (0.38)	1:cc

Referred Specimens.—QCAZ 1497.

Diagnosis.—(1) Skin of dorsum usually smooth, that of venter areolate, lacking dorsolateral folds; (2) tympanum round, visible, indistinct, its length 36.8–52.6% eye length in males, 34.9–57.1% in females; (3) snout rounded in dorsal view and lateral profile; canthus rostralis moderately distinct; (4) upper eyelid width narrower than interorbital distance; cranial crests absent; upper eyelid tubercles usually absent, low and indistinct if present; (5) vomerine teeth and odontophores visible; odontophores flattened, oval; (6) males with vocal slits; testes white; (7) first finger shorter than second; all fingers bearing discs on weakly dilated pads; (8) fingers lacking distinct lateral fringes; (9) ulnar tubercles absent or low and indistinct; (10) tubercles on heel small and non-conical; tubercles on tarsus absent or indistinct; tarsal fold absent; (11) two metatarsal tubercles; outer round, raised, ⅓ to ¾ (usually ⅔) size of large, ovoid, inner metatarsal tubercle; plantar surface smooth to weakly tuberculate; (12) toes lacking webbing and fringes; all bearing discs on pads roughly equal in width to those on Fingers II–IV; (13) dorsum reddish brown (males) or dark brown (females); darker brown labial bars usually present; venter orange (males) or dark brown with lighter spots (females); white spots in axilla, groin and hidden surfaces of legs, bordered by black in females; (14) adults small, males 16.0–19.2 mm SVL ($\bar{x}$ = 17.2 ± 1.4, n = 4), females 18.5–22.0 ($\bar{x}$ = 20.6 ± 12, n = 22).

The areolate venter and the length of the first finger (shorter than second) allow placement of *E. simonbolivari* in the *unistrigatus* group, and its small size, narrow digital pads, and discrete, white inguinal spots support its placement in the *myersi* assembly. *Eleutherodactylus simonbolivari* is most similar to *E. orestes* but differs in the following external characters: (1) dorsum and venter in females generally darker in *E. simonbolivari*, with warts on venter always outlined in darker gray or brown (venter similarly

TABLE 1. Continued.

allelic array follows the assigned character state. Character states were not assigned to allelic arrays in the outgroup taxa. Characters 2, 5–9, 11, and 14–16 were weighted using step matrices, character 20 was weighted by 0.5 (polymorphic), and character 12 is unpolarized (but *d* was arbitrarily selected as the primitive state for the FREQPARS analysis). HYPANC represents the reconstructed hypothetical ancestor of the ingroup. Specimens examined electrophoretically and morphologically are listed in Appendix 1.

	Character											
10	11	12	13	14	15	16	17	18	19	20	21	22
d	d (0.67) i (0.33)	a	c	a	b	c	0	0, 1	0	0	0	0
b	i	d	c	a	e (0.50) f (0.50)	c	0	0, 1	0	0	0, 1	0
b	a (0.67) h (0.33)	b	c	c	e	c	0	0	0	0	0	0
b	i	e	a	e	f	d	0	0	0	0	0	0
e	i	c	b	c	c	d	0	0, 1	0	0	0	0
0:bb	0:ii	?:b or d	0:cc	0:cc	0:ee	0:cc	0	0	0	0	0	0
0:bb	6:kk	1:dd	0:cc	1:b (0.25) c (0.75)	0:ee	0:cc	1	1	1	0	1	0
1:aa	3:ee	0:bb	0:cc	0:cc	0:ee	0:cc	1	1	0	0 (0.38) 1 (0.62)	0	1
2:cc	5:jj	4:hh	0:cc	0:cc	3:cc	1:ee	1	0	0	0	0	1
0:bb	2:c (0.75) g (0.25)	2:ff	0:cc	2:c (0.75) f (0.25)	0:ee	0:cc	1	0	1	0	1	0
3:ff	1:a (0.75) b (0.25)	3:gg	0:cc	0:cc	2:a (0.50) d (0.50)	2:e (0.50) f (0.50)	1	0	0	0	0	1
0:bb	4:ff	1:dd	1:aa	3:c (0.50) d (0.50)	1:d (0.18) e (0.82)	3:a (0.50) b (0.50)	1	1	0	0 (0.04) 1 (0.96)	0	1

colored in only 8% of *E. orestes*; n = 26); (2) males (in life) with reddish brown dorsum and orange venter in *E. simonbolivari* (reddish coloration absent in *E. orestes*); (3) inguinal region in females with many small white spots, most peripheral to groin itself; in *E. orestes* a few large white spots are present on the groin; (4) dorsum usually smooth (72%; n = 26) in *E. simonbolivari*, usually areolate or with a few scattered tubercles in *E. orestes* (92%; n = 27). Osteologically, *E. simonbolivari* differs from *E. orestes* in having a more extensive anterior ramus of the pterygoid, more widely separated nasals, and a shorter ethmoidal portion of the skull. *Eleutherodactylus simonbolivari* also is distinct morphometrically from *E. orestes*, and shares no alleles with this species at five electrophoretic loci (*Ga3pdh*, *Ldh-2*, *Mdh-1*, *Mdh-2*, and *Pgm*).

Description.—Head as wide or narrower than body, wider than long, HW 33.8–36.0% SVL ($\bar{x}$ = 35.1 ± 0.9, n = 4) in males, 32.7–37.3% ($\bar{x}$ = 34.7 ± 1.2, n = 22) in females; snout short, E–N 60.0–68.4% eye length ($\bar{x}$ = 65.1 ± 4.1, n = 4) in males, 65.2–86.4% ($\bar{x}$ = 72.8 ± 6.7, n = 22) in females; canthus rostralis weakly concave in dorsal view; loreal region concave, sloping abruptly to lips; lips not flared; upper eyelid usually with low, indistinct tubercles; upper eyelid width 61.9–70.0% IOD ($\bar{x}$ = 67.6 ± 3.9, n = 4) in males, 50.0–70.8% ($\bar{x}$ = 61.4 ± 5.8, n = 22) in females; distinct supratympanic fold absent; tympanum length equal to or slightly larger than distance to eye; tympanum length 36.8–52.6% eye length ($\bar{x}$ = 42.6 ± 6.9, n = 4) in males, 34.9–57.1% ($\bar{x}$ = 45.2 ± 5.5, n = 22) in females; postrictal tubercles low and indistinct; choanae small, subcircular, situated near edge of palate, partially concealed or almost concealed by palatal shelf of maxilla when roof of mouth viewed directly from above; vomerine odontophores median and posterior to choanae; odontophores closer to each other than choanae; each process bearing 0–7 ($\bar{x}$ = 3.4, n = 21) teeth in a patch; tongue longer than wide, posterior ½ to ¼ not

FIG. 1. Paratype of *Eleutherodactylus simonbolivari*, KU 218252, female, 19.3 mm SVL.

adherent to floor of mouth, not notched posteriorly; males with vocal slits (absent on one side of one male) posterolateral to tongue and median, subgular vocal sac.

Skin of head and dorsum usually smooth; flanks areolate in some individuals; vertebral, dorsolateral, and paravertebral folds absent; anal opening round and unornamented at upper level of thigh; skin of throat usually smooth.

Ulnar tubercles low and indistinct if present, increasing in size distally; palmar tubercle bifid, roughly three times size oval thenar tubercle; subarticular tubercles large, round, raised, simple; numerous supernumerary tubercles on palm; digital tips dilated into pads that are broader than longer; inner two fingers less dilated; pads smaller than tympanum; nuptial pad absent in males (Fig. 2).

Several small, rounded (non-conical) tubercles usually present on heel; tubercles low and distinct or absent on outer edge of tarsus; inner metatarsal tubercle longer than wide, not compressed, raised; outer metatarsal tubercle subcircular, raised; indistinct supernumerary plantar tubercles present in some individuals; subarticular tubercles round, simple; toes lacking lateral fringes and webbing; fourth and fifth toe fused basally for nearly one third length of fifth toe; tips of toes with discs on weakly dilated pads; discs roughly equal in width on all toes; discs as wide as or wider than long; when flexed hind limbs are held at right angles to sagittal plane, heels almost or barely overlap; adpressed heel does not extend to insertion of forelimb; tibia 37.2–42.6% SVL ($\bar{x}$ = 39.8 ± 2.6, n = 4) in males, 36.0–44.0% ($\bar{x}$ = 39.1 ± 2.2, n = 22) in females.

Coloration in preservative: in females, dorsum dark brown, gray, or black, a thin cream mid-dorsal stripe or small cream flecks present in some specimens; short, dark supratympanic stripe and dark vertical bars on lips present in lighter colored specimens; venter light gray or brown; in some females thin cream stripes forming cross on venter, longitudinal stripe intersecting perpendicular stripe on ventral surface of forelimbs in sternal region; pustules on venter outlined in darker gray or brown with cream flecks at their centers; throat gray or brown with numerous minute cream flecks; groin, anterior surface of thighs, and concealed surfaces of shank and tarsus with white spots bordered with black. In males, dorsum tan with irregular dark brown mottling; venter tan with minute dark brown flecks; throat tan with small brown flecks; indistinct white spots on groin, anterior surfaces of thighs, and concealed surfaces of shank and tarsus. Coloration in life: in females, dorsum dark brown, with or without reddish tone; labial bands brown with white borders; flanks nearly black with minute white spots; venter dark brown to nearly black with lighter spots corresponding to centers of pustules; axilla, inguinal region, and interior surfaces of shank and tarsus black with white spots; iris gray with median horizontal brown streak. In males: dorsum reddish brown with darker spots; brown labial bars; venter orange; underside of thighs gray; digits orange; white spots present in axilla, groin, and concealed surfaces of shank and tarsus.

Measurements of Holotype (in mm).—SVL 20.9, tibia length 8.4, head width 7.2, head length 4.6, upper eyelid width 1.6, IOD 2.6, tympanum length 1.0, eye length 2.1, E–N 1.6.

Distribution and Ecology.—Known only from

the type locality in the Bosque protector Cashca Totoras and a nearby site (Fig. 3) at elevations of 3000–3300 m on the western slopes of the Hoya de Chimbo in the Cordillera Occidental (between Guaranda and Riobamba) of Provincia Bolívar, Ecuador. The distribution lies within the Very Humid Montane Forest life zone (Cañadas Cruz, 1983), where the annual mean precipitation is 1000–2000 mm and the annual mean temperature is 7–12 C. At the type locality, open and disturbed areas are characterized by the presence of shrubs (local names given in parentheses), such as *Baccharis polyantha* (chilca), *Euphorbia laurifolia* (lechero), *Chusquea scandens* (suro), *Brugmansia arborea* (floripondio); undisturbed forest is characterized by *Weinmannia* sp. (cashca), *Podocarpus oleorifolius* (romerillo), *Myrcianthes* sp. (arrayán), *Alnus acuminata* (aliso), *Polylepis sericea* (quina), *Oreopanax* sp. (pummaqui), *Oreocallis grandiflora* (cucharilla), and *Clusia* sp. (ducu). At Cashca Totoras, *E. simonbolivari* were found associated with a spring in largely undisturbed forest and in open areas at the edge of forest. Individuals were collected by day in leaf litter, under rotten logs and under moss growing over logs. At the other locality, a single dead individual (QCAZ 1497) was under a rock near a stream surrounded by cleared forest. *Eleutherodactylus simonbolivari* has been found syntopically with *E. curtipes*, *E. pyrrhomerus*, and at least one undescribed *Eleutherodactylus* of the *unistrigatus* group.

Etymology.—The specific epithet is a patronym for Simón Bolívar, a pivotal figure in South American history, and for whom the Ecuadorian province of Bolívar (to which the new species is endemic) is named.

Osteology.—The skeleton of *E. simonbolivari* is generally similar to that of *E. orestes*, as described by Lynch (1979), but three differences in the skull were noted (compare Fig. 4 with Fig. 11 in Lynch, 1979). In *E. simonbolivari* (n = 4), the anterior ramus of the pterygoid bears an extensive articulation with the maxilla and extends anteriorly to almost contact the palatine. In *E. orestes* (n = 3), the pterygoid articulates with the maxilla for only a short distance and does not approach the palatine (but comes closest in KU 141995). The ethmoidal portion of the skull is conspicuously shorter in *E. simonbolivari* than in *E. orestes*, and the skull of *E. orestes* is therefore noticeably more elongate than that of *E. simonbolivari*. The nasals are slightly more separated medially in *E. orestes* than in *E. simonbolivari*.

Morphometrics.—Descriptive statistics for nine measurements from four adult male, 22 adult female *E. simonbolivari* are as follow: SVL 16.0–19.2 ($\bar{x}$ = 17.2 ± 1.42), 18.5–22.0 ($\bar{x}$ = 20.6 ± 1.16); tibia length 6.4–7.3 ($\bar{x}$ = 6.8 ± 0.40), 7.5–8.7 ($\bar{x}$ = 8.0 ± 0.39); HW 5.6–6.5 ($\bar{x}$ = 6.0 ± 0.38), 6.4–7.9 ($\bar{x}$ = 7.1 ± 0.37); head length 3.5–4.3 ($\bar{x}$ = 3.8 ± 0.38), 4.4–5.4 ($\bar{x}$ = 4.8 ± 0.26); upper eyelid width 1.3–1.4 ($\bar{x}$ = 1.4 ± 0.06), 1.2–1.8 ($\bar{x}$ = 1.5 ± 0.17); IOD 1.9–2.1 ($\bar{x}$ = 2.0 ± 0.08), 2.1–2.8 ($\bar{x}$ = 2.5 ± 0.15); tympanum length 0.7–1.0 ($\bar{x}$ = 0.8 ± 0.13), 0.8–1.2 ($\bar{x}$ = 1.0 ± 0.12); eye length 1.9–2.2 ($\bar{x}$ = 2.0 ± 0.14), 2.0–2.5 ($\bar{x}$ = 2.2 ± 0.14); E–N 1.2–1.4 ($\bar{x}$ = 1.3 ± 0.08), 1.4–1.8 ($\bar{x}$ = 1.6 ± 0.12).

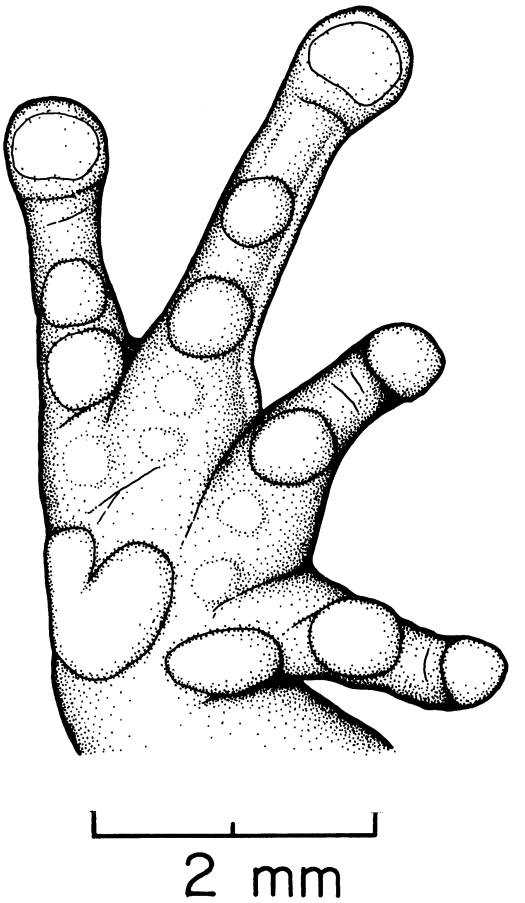

FIG. 2. Palmar view of right hand of *Eleutherodactylus simonbolivari*, QCAZ 1468.

In order to examine potential morphometric differences between the new taxon and similar species, we performed multivariate comparisons of adult *E. simonbolivari* (n = 26), *E. orestes* (n = 21), and *E. trepidotus* (n = 40). The nine measurements listed above were included in a stepwise discriminant function analysis to determine which variables contribute most to distinguishing among these species. Three variables (F's for removal <0.01) were selected from the stepwise analysis for inclusion in a canonical discriminant analysis: SVL, head length, and E–N. The canonical discriminant analysis yielded the following raw canonical coefficients for

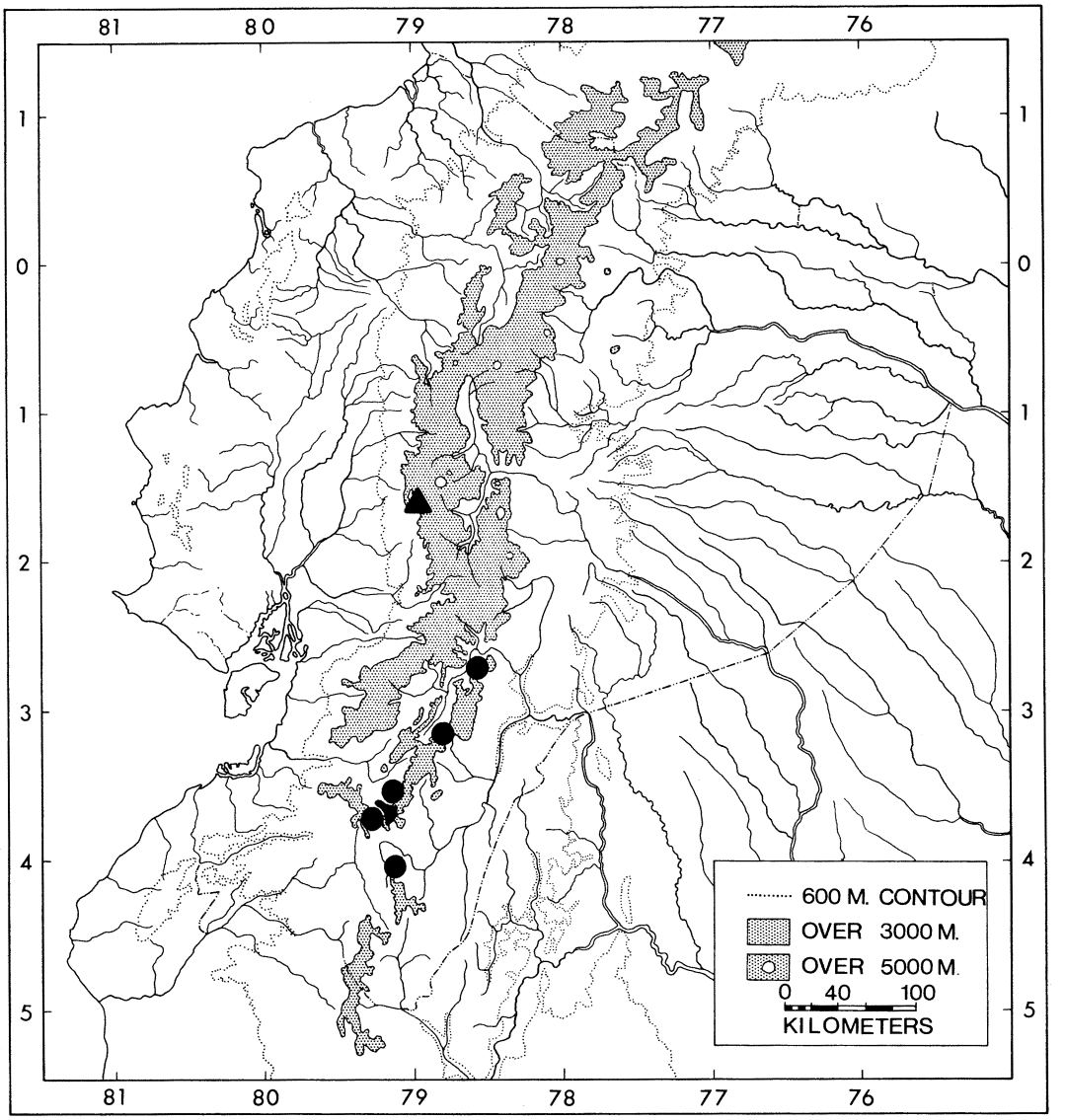

FIG. 3. Map of Ecuador showing the distribution of *Eleutherodactylus simonbolivari* (triangle) and the closely related *E. orestes* (circles). Localities in close proximity are represented by a single symbol.

these variables (pooled within-species standardized canonical coefficients are given in parentheses): CAN I = SVL: −0.33 (−0.76), head length: 2.96 (1.87), E-N: −5.71 (−1.07) CAN II = SVL: −0.70 (−1.65), head length: 1.14 (0.72), E-N: 7.40 (1.38). *Eleutherodactylus trepidotus* is well separated from *E. simonbolivari* and *E. orestes* along Canonical Axis I (Fig. 5). *Eleutherodactylus simonbolivari* and *E. orestes* are not as well separated morphometrically, but there is little overlap among the plots of individual specimens. These species are discriminated along Canonical Axis II.

Phylogenetic Relationships.—Phylogenetic analysis of the data matrix (Table 1) yielded a single shortest tree (Fig. 6) with a length of 51 steps (using PAUP) or 98.32 (using FREQPARS). Because the tree-reconstruction algorithm of FREQPARS is relatively weak, FREQPARS was used also to evaluate lengths of the shortest and near shortest topologies derived from the PAUP analysis. In addition to the shortest tree, there were two trees with 52 steps, one with 52.5, three with 53, two with 53.5, and six with 54 steps. Among these trees, the two next-shortest trees had FREQPARS branch lengths of 100.32 (52 steps using PAUP). FREQPARS branch lengths and possible character state optimiza-

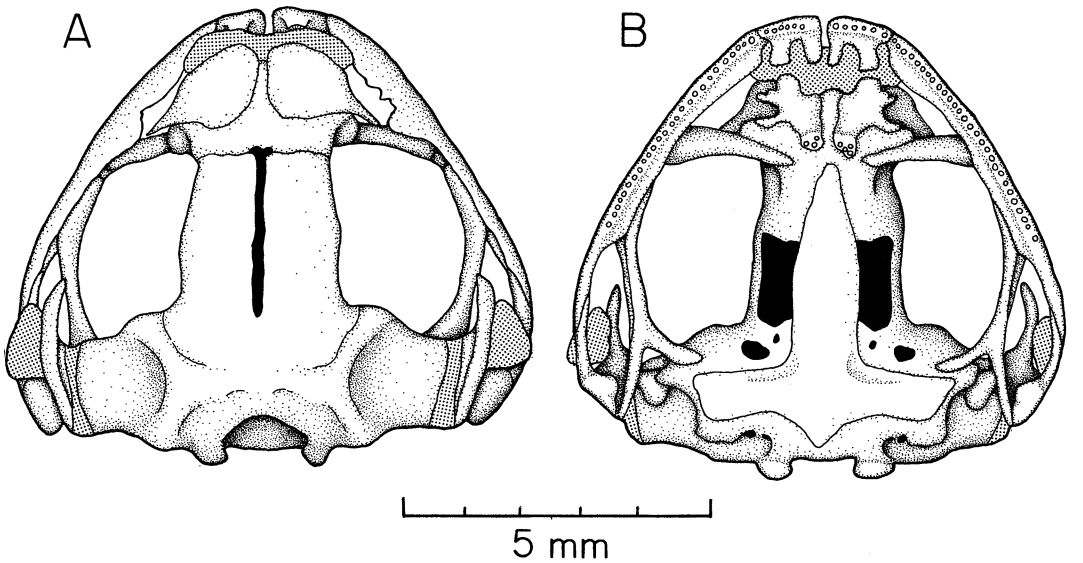

FIG. 4. Dorsal (left) and ventral (right) views of skull of *Eleutherodactylus simonbolivari*, QCAZ 1493. Stippled overlay indicates cartilage.

tions for each stem of the shortest tree (Fig. 1) are listed in Appendix 2; unambiguous character support for each stem is discussed below. The monophyly of the ingroup is supported by three synapomorphies (Internode A: $G6pdh^{ee}$, $Ldh\text{-}1^{cc}$, and reduced size). Five synapomorphies ally *E. leoni* and *E. pyrrhomerus* (Internode B: Ald^{dd}, Cbp^{ee}, Ck^{cc}, conical tubercles, reddish inguinal wash). Only one synapomorphy supports a clade including *E. simonbolivari*, *E. ocreatus*, *E. orestes*, and *E. trepidotus* (Internode C); the presence of discrete white to red spots in the inguinal region. We follow Lynch (1984) in considering the presence of these spots to be derived, but because these spots could be homologous with (or even plesiomorphic to) the reddish inguinal wash of *E. leoni* and *E. pyrrhomerus*, the support for this node should be considered weak at best. Five synapomorphies place *E. simonbolivari* as the sister taxon to *E. orestes* (Internode D; Ald^{cc}, $G6pdh^{dd}$, $Icdh\text{-}1^{aa}$, $Icdh\text{-}2^{cc}$, Sdh^{ee}). *Eleutherodactylus ocreatus* and *E. trepidotus* share three synapomorphies (Internode E: $G6pdh^{be}$, brown testes, white to red spots on venter).

The results of the phylogenetic analysis

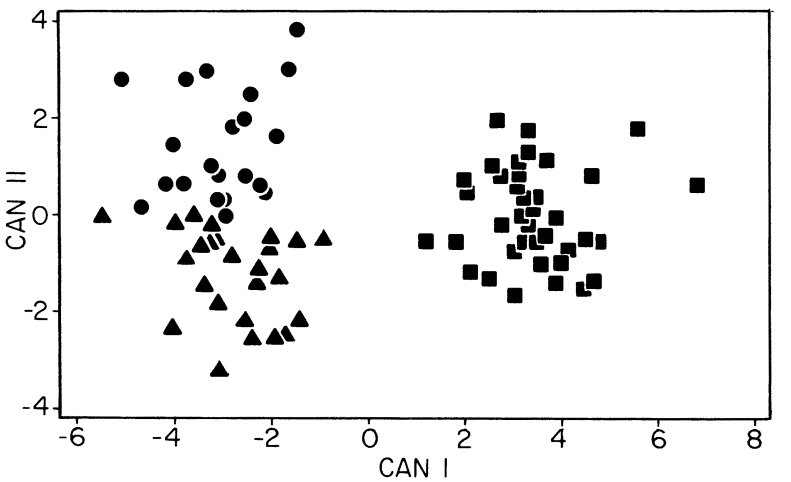

FIG. 5. Plot of canonical discriminant scores for *Eleutherodactylus simonbolivari* (triangles), *E. orestes* (circles), and *E. trepidotus* (squares). One triangle and two squares (representing one individual of *E. simonbolivari* and two *E. trepidotus*) are completely hidden.

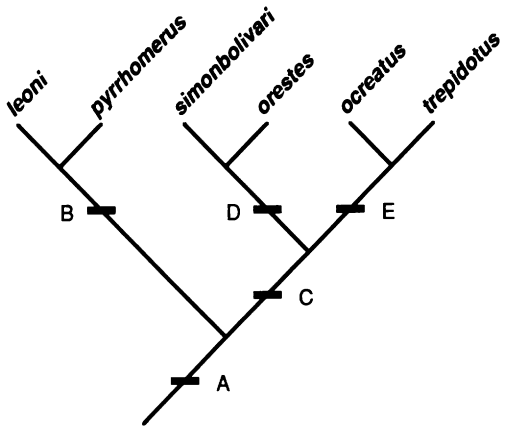

FIG. 6. Cladogram for six species of the *Eleutherodactylus myersi* assembly. Character state optimizations and FREQPARS branch lengths for each of the lettered internodes and given in Appendix 2.

should be considered tentative. The number of individuals scored for allozymic characters is small for some species. Also, species of the *myersi* assembly for which biochemical data were not available were not included in the analysis; some of these species may interdigitate on the cladogram among the species we examined. According to Lynch (1984) and our own observations, *E. gladiator*, *E. myersi*, and *E. repens* have conical tubercles on the eyelid, dorsum and/or tarsus and are probably closely related to *E. leoni* and *E. pyrrhomerus* (as postulated by Lynch, 1984). *Eleutherodactylus vidua* lacks the reddish inguinal wash and discrete white to red spots characterizing the species we examined; we suspect that *E. vidua* is a relatively primitive member of the assembly and outside of the ingroup of this analysis. The relationships of the northernmost members of the *myersi* assembly (*E. ginesi* and *E. nicefori*) are unclear, but Lynch (1984) considered them to be sister taxa and not closely related to any of the species we examined. Based on our observations, *Eleutherodactylus anae* is conspecific with *E. curtipes* and is therefore not a member of this assembly (see following section), but there is an undescribed species from northern Peru that may belong to either the *myersi* or *curtipes* assemblies. The monophyly of the *myersi* assembly and relationships of its outgroups also are highly problematic.

STATUS OF *ELEUTHERODACTYLUS ANAE* RIVERO

While attempting to gather specimens of the putative members of the *myersi* assembly, we collected repeatedly near the type locality of *E. anae*. The only *Eleutherodactylus* found there were *E. curtipes* and *E. unistrigatus*. This prompted us to examine the type material of *E. anae*. Based on comparison of *E. anae* with material of *E. curtipes*, we conclude that *E. anae* is a junior subjective synonym of *E. curtipes*.

An important discrepancy exists between the description of Rivero (1986) and our observations. Rivero (1986) described the three type specimens of *E. anae* as females; according to our observations all three specimens are males. This discrepancy is not trivial, because the size of the holotype (SVL = 28.0 mm) is somewhat large for a female of the *myersi* assembly, but is far larger than any male known in the group (largest male we have observed is a 20.5 mm SVL *E. orestes*, KU 142002). Based on our examination of the gonads, the paratypes of *E. anae* are clearly immature (UPR-M 7015, SVL = 17.5 mm; UPR-M 7016, SVL = 17.8 mm).

According to Rivero (1986) and Lynch (1981), the following characters could potentially distinguish these taxa: (1) cranial crests ("not apparent" in *anae*, present in *curtipes*); (2) vomerine teeth (absent in *anae*, present in *curtipes*); (3) lateral fringes on fingers and toes (absent in *anae*, present in *curtipes*); (4) dorsum with low flat warts (absent in *anae*, present in *curtipes*); (5) palmar and thenar tubercles (indistinct in *anae*, distinct in *curtipes*); and (6) reddish inguinal coloration (present in *anae*, absent in *curtipes*). According to our observations and those of Lynch (1981), the first two characters are ontogenetically variable in *E. curtipes*. Cranial crests are not apparent in *E. anae*, but also are indistinct in specimens of *E. curtipes* of similar size. The holotype of *E. anae* is unusual in lacking vomerine teeth on one side (not absent as reported by Rivero, 1986), but *E. curtipes* of similar size also may lack vomerine teeth. The presence of lateral fringes on the digits is intraspecifically variable in *E. curtipes*. The difference in tuberculation of the dorsum appears to be due to an artifact of preservation; although the dorsum is clearly smooth as reported by Rivero (1986), the venter is also smooth, suggesting an artifact of preservation. The venter is areolate in all other members of the *curtipes* and *myersi* assemblies, as is characteristic for members of the *unistrigatus* species group. The distinctness of the palmar and thenar tubercles also appears to be due to the poor state of preservation of the type specimens of *E. anae*, although the distinctness of these tubercles is also intraspecifically variable in *E. curtipes*. The "orange-pink" inguinal coloration noted by Rivero (1986) in one of the three specimens of *E. anae* also occurs in individuals of *E. curtipes* (Lynch, 1981, p. 10).

Even if *E. anae* is specifically distinct from *E. curtipes*, the absence of vocal slits and presence of a pale labial stripe (presumably derived features) support its placement in the *curtipes* assembly rather than the *myersi* assembly. The

concealed tympanum of *E. anae* and *E. curtipes* is further evidence that they are sister species, if not conspecific (but also concealed in some individuals of *E. vertebralis* and *E. vidua*).

Discussion

Despite the tentative nature of our results, several taxonomic and evolutionary implications of our cladogram merit discussion. According to Lynch (1984; and 1985 in Frost, 1985) the *pyrrhomerus* assembly is a monophyletic subgroup of the *myersi* assembly that includes *E. leoni, E. ocreatus, E. pyrrhomerus,* and *E. trepidotus* but not *E. orestes*. Our results provide weak support for a close relationship between *E. orestes* and *E. ocreatus* and *E. trepidotus* (making the *pyrrhomerus* assembly paraphyletic), and provide no support for the monophyly of the *pyrrhomerus* assembly. We suggest that the *pyrrhomerus* assembly not be recognized.

Species in the *myersi* assembly are sympatric at four localities in the Ecuadorian Andes: (1) Bolívar; Cashca Totoras (*E. simonbolivari* and *E. pyrrhomerus*); (2) Imbabura; Nudo de Mojanda (*E. leoni* and *E. trepidotus*); (3) Loja; Abra de Zamora (*E. orestes* and *E. vidua;* Lynch, 1979); and (4) Napo; vicinity of Cuyuja (*E. gladiator* and *E. trepidotus;* Lynch and Duellman, 1980—KU 177882 may be a hybrid between these species, Wiens and Coloma, unpubl. obs.). According to our results, all four points of sympatry involve species which are not closely related. Thus, all speciation in the group seems to have occurred allopatrically.

Lynch (1979) noted a striking preponderance of females in collections of *E. orestes, E. trepidotus,* and *E. vidua*. Our observations confirm this and suggest that the apparent scarcity of males is characteristic of at least three other species in the assembly: *E. simonbolivari* (5 males: 23 females), *E. leoni* (4:24), and *E. myersi* (3:12). In other species in the assembly, this bias is not as clear: *E. gladiator* (2:2), *E. ocreatus* (7:7), *E. nicefori* (18:30), *E. pyrrhomerus* (2:6), and *E. repens* (12:17; Lynch, 1984). Obviously, many factors could be responsible for this seeming bias apart from actual differences in sex ratios at hatching. Nevertheless, it is interesting that the apparent rarity of males seems to be restricted to some members of the *myersi* assembly (at least among the high Andean *Eleutherodactylus* of Ecuador; Lynch, 1979), and that this group is characterized by sexual size dimorphism and reduced size. Further study of this phenomenon, utilizing a phylogenetic hypothesis, could be an intriguing area for future research.

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APPENDIX 1

Specimens Examined

Cleared-and-stained skeletal preparations are followed by an (AA); specimens examined electrophoretically are followed by an (E).

Eleutherodactylus buckleyi.—Ecuador: Provincia Carchi: 23 km SW Tulcán, 3700 m, KU 117558-60, 117565; 26.6 km W Tulcán on road to Maldonado, 3690 m, KU 217837-39 (E); Provincia Imbabura: 13-15 km NW Otavalo, 3300-3350 m, KU 117499, 117507, 117509. *Eleutherodactylus curtipes.*—Ecuador: Provincia Napo: 20 km W Papallacta, 3610 m, KU 110804-43; 5 km W Papallacta, 3400 m, KU 110845-89; 1 km W Papallacta, 3200 m, 110891-95. Provincia Pichincha: Bosque Protector Pasochoa, 3260 m, KU 217871-73 (E); Pifo, 3000 m, UPR-M 7017 (holotype of *E. anae*), UPR-M 7015-16 (paratypes of *E. anae*); 12 km E Pifo, 3250 m, KU 217876; 17 km E Pifo, 3800 m, KU 110794-803. *Eleutherodactylus devillei.*—Ecuador: Provincia Napo: 6.1 km E Papallacta, 2750 m, KU 217993 (E); 9.9 km E Papallacta, 2690 m, KU 217994-95 (E); 58.2 km E San Miguel de Salcedo, 2700 m, KU 202388-92, 202394. *Eleutherodactylus ginesi.*—Venezuela: Estado Mérida: Laguna de Mucubaji, 3420 m, ULABG 55-56, 471-76; Estado Trujillo: Páramo El Pajarito, ULABG 940, 947-49, 952-53, 957-59. *Eleutherodactylus gladiator.*—Ecuador: Provincia Napo: 3.3 km ESE Cuyuja, 2350 m, KU 143516; 5.7 km E Papallacta, 2910 m, KU 143513-15. *Eleutherodactylus leoni.*—Ecuador: Provincia Carchi: 51.3 km W Tulcán on road to Maldonado, 3150 m, KU 218227-31 (E); 14 km SE Maldonado, 2500 m, KU 177320-28, 177329 (AA), 177330-40; 5.7 km NW El Carmelo, 2910 m, KU 177341-42; Provincia Imbabura: N slope Nudo de Mojanda, 3400 m, KU 130870; La Delicia, 2710 m, KU 132779; Provincia Napo; Santa Bárbara, 2650 m, KU 174535-36, 189966-68; 0.8 km NW Santa Bárbara, 2450 m, KU 177343; Provincia Pichincha: 14 km W Chiriboga, 1960 m, KU 165897-98. *Eleutherodactylus myersi.*—Colombia: Cauca: San Juan, Aguas Terminales, 3000 m, KU 143954; Purace, 2900-3000 m, KU 143956; 23 km E Purace, 3275 m, KU 168432-35; 26 km E Purace 3180 m, KU 168436-38; 30 km E Purace, 3030 m, KU 168439; Nariño: 12 km E Pasto, 3050 m, KU 168440 (AA), 168441-44. *Eleutherodactylus nicefori.*—Colombia: Norte de Santander: 18.5 km S Chitaga, 2850 m, KU 168445 (AA), 168446-80, 170146 (AA); 32 km S Chitaga, 3400 m, KU 168481-515, 168516 (AA). *Eleutherodactylus ocreatus.*—Ecuador: Provincia Carchi: 26.6 km W Tulcán on road to Maldonado, 3690 m, KU 218507-12 (E); 10 km W Tufiño, 3500-3800 m, KU 117573-77, 117578 (AA), 117579-81. *Eleutherodactylus orestes.* Ecuador: Provincia Azuay: 10 km S Cutchil, 2900 m, KU 218260-65 (E); 6.2 km S Cutchil, 2800 m, KU 218266 (E); 3.1 km S Cutchil, 2730 m, KU 141467; 2.1 km S Cutchil, 2720 m, KU 141468; 7 km E Sigsig, 2890 m, KU 218257-58; 8 km E Sigsig, 2890 m, KU 218259; Provincia Loja: 13-14 km E Loja, 2850 m, KU 120094; 13 km E Loja, Abra de Zamora, 2850 m, KU 165550; Saraguro, 2510 m, KU 141995; 9.5 km S Saraguro, 3120 m, KU 141469-71, 141472 (AA), 151052 (AA); 10 km S Saraguro, 3100 m, KU 141996-97, 165551, 165552 (AA), 165553-54; 12 km NE Urdaneta, 3000 m, KU 177817; 11 km NE Urdaneta, 2970 m, KU 141998-003; 10 km NE Urdaneta, 2850 m, KU 165555. *Eleutherodactylus pyrrhomerus.*—Ecuador: Provincia Bolívar: Bosque Protector Cashca Totoras (10 km SE Santiago on road to Santa Rosa de Totoras), 3000 m, KU 218030-33 (E), QCAZ 1498-99, 1500 (AA); Provincia Cotopaxi: Pilaló, 2400 m, KU 177837-38; 2580 m, KU 131606; 1.5 km E Pilaló, 2200 m, KU 187481; 3 km E Pilaló, 2900 m, KU 131607-11; 4.6 km E Pilaló, 2600 m, KU 152038; 6 km E Pilalo, 2670 m, KU 142167-70. *Eleutherodactylus simonbolivari.*—Ecuador: Provincia Bolívar: Bosque Protector Cashca Totoras (approximately 10 km SE Santiago on road to Santa Rosa de Totoras), 3000-3300 m, KU 218252-56 (E), QCAZ 936, 940-41, 943-44, 1458-1475, 1493-96 (AA); 12 km E Guaranda on road to Riobamba, 3000 m, QCAZ 1497. *Eleutherodactylus trepidotus.*—Ecuador: Provincia Imbabura: 13.8 km W Tabacundo on road to Mojanda, 3840 m, KU 218234-39 (E); Lagunas de Mojanda, 3200-3800 m, QCAZ 937-939; 1477 (AA), 1478, 1479 (AA), 1480, 1481 (AA), 1482-91; Provincia Napo: 1 km W Papallacta, 3170 m, KU 106938-42; 2 km W Papallacta, 3270 m, 177883-87; 4 km W Papallacta, 3300 m, KU 117618-22, 118134-35 (AA); 4.7 km W Papallacta, 3360 m, KU 177881; 6.7 km W Papallacta, 3030 m, 218240-49 (E); Laguna de Papa-

llacta, 3330 m, KU 143435, 143436 (AA), 143437–40, 165588–89; 3.4 km ESE Papallacta, 2960 m, KU 177882; 2.5 km WNW Cuyuja, 2550 m, KU 143434; E slope Paso de Guamaní, 3650 m, KU 109061–63; Río Bermejo, Cordillera Guacamayos, KU 106937. *Eleutherodactylus unistrigatus.*—Ecuador: Provincia Napo: 6.9 km E Pifo, 2850 m, KU 218073–77; 12 km E Pifo, 3250 m, KU 218078–80 (E), 218081–84. *Eleutherodactylus vertebralis.*—Ecuador: Provincia Cotopaxi: road between Pilaló and Latacunga, 2870 m, KU 218112–13 (E); Pilaló, 2320 m, KU 202546–48, 202550, 202552, 202554–55. *Eleutherodactylus vidua.*—Loja: 13–14 km E Loja, 2850 m, KU 120089; 8–9 km N San Lucas, 3000–3100 m, KU 120092; Provincia Zamora-Chinchipe: 15 km E Loja, 2710 m, KU 141994; 2800 m, KU 120082–88, 120090–91, 120093 (AA).

APPENDIX 2

Apomorphy Lists

Summary of character state optimizations (using PAUP) and FREQPARS branch lengths for cladogram (Fig. 6). Changes in allelic arrays are superscripted, primitive to derived shown left to right. Ambiguously placed transformations are asterisked and are followed by the optimization routine that places them at that stem (in parentheses).

Internode A.—PAUP: $G6pdh^{aa\text{-}ee}$, $Ldh\text{-}1^{dd\text{-}cc}$, $Mdh\text{-}1^{ii\text{-}ee}$* (ACCTRAN), reduced size. FREQPARS: 8.00. Internode B.—PAUP: $Ald^{bb\text{-}dd}$, $Cbp^{dd\text{-}ee}$, $Ck^{bb\text{-}cc}$, $Mdh\text{-}1^{ee\text{-}kk}$* (ACCTRAN), conical tubercles, reddish inguinal wash. FREQPARS: 15.46. Internode C.—PAUP: discrete inguinal spots. FREQPARS: 3.60. Internode D.—PAUP: $Ald^{bb\text{-}cc}$, $G6pdh^{ee\text{-}dd}$, $Icdh\text{-}1^{cc\text{-}aa}$, $Icdh\text{-}2^{88\text{-}cc}$, $Ldh\text{-}2^{bb\text{-}cc}$* (ACCTRAN), $Mdh\text{-}1^{ee\text{-}jj}$* (ACCTRAN), $Mdh\text{-}2^{dd\text{-}gg}$* (ACCTRAN), $Pgm^{ee\text{-}cc}$* (ACCTRAN), $Sdh^{cc\text{-}ee}$. FREQPARS: 16.14. Internode E.—PAUP: $G6pdh^{ee\text{-}be}$, brown testis, ventral spots. FREQPARS: 5.20. *E. leoni.*—PAUP: $G6pdh^{ee\text{-}hh}$, $Icdh\text{-}1^{cc\text{-}cf}$, $Icdh\text{-}2^{88\text{-}ee}$, $Ldh\text{-}1^{cc\text{-}ef}$, $Mdh\text{-}1^{ii\text{-}kk}$* (DELTRAN), $Mpi^{cc\text{-}cb}$, brown testis. FREQPARS: 8.00. *E. pyrrhomerus.*—PAUP: $Ga3pdh^{bb\text{-}cc}$, $Icdh\text{-}1^{cc\text{-}ee}$, $Ldh\text{-}1^{cc\text{-}cb}$, $Mdh\text{-}1^{kk\ or\ ii\text{-}cg}$, $Mdh\text{-}2^{dd\text{-}ff}$, $Mpi^{cc\text{-}cf}$. FREQPARS: 8.50. *E. simonbolivari.*—PAUP: $Ga3pdh^{bb\text{-}dd}$, $Gpi^{cc\text{-}bc}$, $Icdh\text{-}2^{cc\text{-}ac}$, $Ldh\text{-}2^{bb\ or\ cc\text{-}ff}$* (DELTRAN), $Mdh\text{-}1^{ii\ or\ jj\text{-}ab}$, $Mdh\text{-}2^{dd\text{-}gg}$* (DELTRAN), $Pgm^{cc\ or\ ee\text{-}ad}$, $Sdh^{ee\text{-}ef}$. FREQPARS: 12.26. *E. orestes.*—PAUP: $Gpi^{cc\text{-}ac}$, $Ldh\text{-}2^{bb\text{-}cc}$* (DELTRAN), $Mdh\text{-}1^{ii\text{-}jj}$* (DELTRAN), $Mdh\text{-}2^{dd\text{-}hh}$* (DELTRAN), $Pgm^{ee\text{-}cc}$* (DELTRAN). FREQPARS: 2.00. *E. trepidotus.*—PAUP: $Cbp^{dd\text{-}bd}$, $Icdh\text{-}2^{88\text{-}bg}$, $Mdh\text{-}1^{ee\ or\ ii\text{-}ff}$* (ACCTRAN or DELTRAN), $Me^{cc\text{-}aa}$, $Mpi^{cc\text{-}cd}$, $Pgm^{ee\text{-}de}$, $Sdh^{cc\text{-}ab}$. FREQPARS: 8.96. *E. ocreatus.*—PAUP: $Ald^{bb\text{-}aa}$, $Icdh\text{-}2^{88\text{-}gh}$, $Ldh\text{-}1^{cc\text{-}aa}$, $Ldh\text{-}2^{bb\text{-}aa}$, $Mdh\text{-}1^{ii\text{-}ee}$* (DELTRAN), $Mdh\text{-}2^{dd\text{-}bb}$. FREQPARS: 10.16.

NOTES

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Seasonal Occurrence of *Kinosternon baurii* on a Sandhill in Central Florida

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The striped mud turtle, *Kinosternon baurii* (Testudines, Kinosternidae), occurs throughout peninsular Florida and extends as far north as South Carolina and Virginia (Lamb and Lovich, 1990). Few published studies exist on the natural history of this species despite the fact that it is common in aquatic habitats in many parts of its range. Previous work has shown *K. baurii* to be a continuous breeder, producing multiple annual clutches of 1–5 eggs (Einem, 1956; Lardie, 1975; Iverson, 1977). Two studies report laboratory incubation times of 117–119 days (Lardie, 1975) and 97–143 (mean = 119) days (Iverson, 1979). Ewert (1985) reported an incubation period of 120 days at 25 C, and 87 days at 30 C. Anecdotal evidence suggests that hatchlings of *Kinosternon* overwinter in their nests and emerge in early to late spring (Richmond, 1945; Lardie, 1975). It is possible that *Kinosternon baurii* may overwinter in the egg because Ewert (1985) reported that some individuals have a delayed hatching and embryonic aestivation period (a late embryonic dormancy) of up to 131 days under warm (30 C) and dry conditions. Although striped mud turtles are active for most of the year, a decline in activity of adults is reported to occur during the later summer months, apparently because of increased environmental temperatures (Iverson, 1977; Wygoda, 1979). Here we report our findings on the seasonal occurrence of *Kinosternon baurii* on a sandhill partially bordered by a hardwood swamp forest in central Florida from 1982–1988. We compare our results with those of other studies of this species and its close relatives *K. subrubrum* and *K. flavescens* (Iverson, 1991).

Our research was conducted on the Ecological Research Area of the University of South Florida. Most of this 200 ha reserve is a hardwood swamp forest that borders an isolated patch (about 40 ha) of high pine characterized as a turkey oak-long leaf pine sandhill community (Myers, 1990). The sandhill soils are well-drained, yellowish sands with a limestone base. Ground cover includes extensive grasses (*Aristida* spp., *Andropogon* spp.) and numerous herbaceous species. A 50–100 m wide band of pine flatwoods consisting predominantly of longleaf pine (*Pinus palustris*) and saw palmetto (*Serenoa repens*) separates the sandhill from the hardwood swamp forest. A road and human dwellings border the portion of the sandhill not bordered by swamp forest. The hardwood swamp forest extends to the Hillsborough River and is seasonally inundated with water, especially during the late spring and summer wet seasons of central Florida (May–September). Dominant vegetation of the swamp forest includes red maple (*Acer rubrum*), cabbage palm (*Sabal palmetto*), water oak (*Quercus nigra*), and bald cypress (*Taxodium distichum*). Ground cover