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A NEW SPECIES OF *ENYALIOIDES* (IGUANIDAE: HOPLOCERCINAE) FROM SOUTHWESTERN ECUADOR

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ABSTRACT

We describe a new species of *Enyalioides* from lowland cloud forests in southwestern Ecuador. This represents the third species in the genus known to occur west of the Andes in South America; the other two species are *E. heterolepis* and *E. oshaughmessyi*. Among other characters, the new species can be distinguished from other members in the genus by having small, keeled, paravertebrals; a series of skin folds on the lateral aspects of body and neck; size-homogeneous scales on body and limbs; distinct caudal segments; and an extensive dark patch on the gular region of adult males. Morphological similarity suggests that the new species, which we call *E. touzeti*, is closely related to *E. oshaughmessyi*.

KEYWORDS: Ecuador, *Enyalioides*, Hoplocercinae, Iguania, new species.

INTRODUCTION

The neotropical iguanian lizard clade Hoplocercidae (Frost & Etheridge, 1989; Frost *et al.*, 2001), also known as Hoplocercinae (Macey *et al.*, 1997; Schulte *et al.*, 2003), includes 11 species in three genera (*Enyalioides*, *Hoplocercus*, and *Morunasaurus*). Hoplocercines are known from the lowlands between

Panama and southeastern Brazil, on both sides of the Andes, with most species occurring in Colombia, Ecuador, and Peru (Table 1).

Despite the small size of this clade and its phylogenetic importance as a possible basal lineage within Iguania (Etheridge & de Queiroz, 1988; Schulte *et al.*, 1998, 2003), many questions remain to be answered. First, the phylogenetic relationships among its species

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TABLE 1: Distribution of hoplocercine lizards in Central and South America.

	Bolivia	Brazil	Colombia	Ecuador	Panama	Peru
East of Andes (8)						
<i>Enyalioides cofanorum</i>	—	—	—	X	—	—
<i>E. laticeps</i>	—	X	X	X	—	X
<i>E. microlepis</i>	—	—	X	X	—	X
<i>E. palpebralis</i>	X	X	—	—	—	X
<i>E. praestabilis</i>	—	—	X	X	—	X
<i>Hoplocercus spinosus</i>	X	X	—	—	—	—
<i>Morunasaurus annularis</i>	—	—	X	X	—	—
<i>M. peruvianus</i>	—	—	—	—	—	X
West of Andes (4)						
<i>E. heterolepis</i>	—	—	X	X	X	—
<i>E. oshaughnessyi</i>	—	—	X	X	—	—
<i>E. touzeti</i> sp. nov.	—	—	—	X	—	—
<i>M. groi</i>	—	—	X	—	X	—
Total per country	2	3	7	8	2	5

are unclear. Attempts to infer the phylogeny of Hoplocercinae based on parsimony analyses of morphological characters have resulted in several conflicting topologies (Etheridge & de Queiroz, 1988; Wiens & Etheridge, 2003). Second, little is known about the natural history or ecology of hoplocercines (e.g., Avila-Pires, 1995; Vitt & de la Torre, 1996; Cisneros-Heredia, 2005). Finally, as with other groups of iguanian lizards from South America (e.g., *Liolaemus*, *Stenocercus*), the diversity of Hoplocercinae remains underestimated due to lack of collections from certain areas, or lack of detailed taxonomic work. For example, Wiens & Etheridge (2003) reported two possible new species from Bolivia and Peru, but they lacked enough material to assess their taxonomic status.

All species of *Enyalioides* except for *E. palpebralis* Boulenger (1883) are known from Ecuador (Torres-Carvajal, 2007). Of these, two species occur west of the Andes (*E. heterolepis* Bocourt, 1874 and *E. oshaughnessyi* Boulenger, 1881) and four occur east of the Andes (*E. cofanorum* Duellman, 1973; *E. laticeps* Guichenot, 1855; *E. microlepis* O'Shaughnessy, 1881; *E. praestabilis* O'Shaughnessy, 1881) (Table 1). Here we describe a new species of *Enyalioides* based on recent material collected west of the Andes in southern Ecuador.

MATERIAL AND METHODS

Museum symbolic codes follow Leviton *et al.* (1985) and Frost (2007) except for the following institutions in Quito, Ecuador: Fundación Herpetológica Gustavo Orcés (FHGO) and Museo Ecuatoriano de

Ciencias Naturales (DH-MECN). Snout-vent length (SVL) and tail length (TL) measurements were taken with a ruler and recorded to the nearest millimeter. All other measurements were made with digital calipers and recorded to the nearest 0.1 mm. Sex was determined by noting the presence of hemipenes. We follow the terminology of Vitt & de la Torre (1996) for measurements, and Avila-Pires (1995) and Smith (1946) for squamation. Differences in quantitative characters between the new species and *E. oshaughnessyi* were evaluated with *t*-tests after log-transforming morphometric data. One of the assumptions of the *t*-test for two samples is that the variances of both samples are equal; therefore, *F*-tests also were performed for each character to test for equality of variances. If the variances were not the same (i.e., $P < 0.001$), an unequal variance *t*-statistic (Welch test) was used. Statistical tests were performed in PAST 1.27 (Hammer *et al.*, 2004). Specimens of *E. oshaughnessyi* examined in this study are listed in the appendix.

RESULTS

Enyalioides touzeti sp. nov.

Holotype – EPN 10306, an adult male from Finca La Envidia (3°3'0"S, 79°41'25"W, 433 m) Santa Marta hill, Cantón Ponce Enríquez, Provincia Azuay, Ecuador, collected on 13 March 2007 by A. Almendáriz and J. Hernández.

Paratypes – ECUADOR: Provincia Azuay: FHGO 1205, 1451, two females from Tamarindo (2°47'S,

79°33'W, 400 m), collected on 22 April 1995 and 8 April 1996, respectively, by J.M. Touzet; Provincia Cañar: DH-MECN 1396, a male from Manta Real (2°34'S, 79°21'W, 300 m), collected on 10 April 2006 by P. Meza-Ramos, C. Tobar, and J.F. Rivadeneira; Provincia El Oro: DH-MECN 2575, 3847, two females from Buenaventura Biological Reserve (3°38'43"S, 79°45'48"W, 600 m) collected on 24 December 2006 and 22 June 2006, respectively by M. Yáñez-Muñoz, P. Meza-Ramos, M. Reyes, and J.P. Reyes; EPN 10307, a female, same collection data as the holotype; EPN 10700, 10720, 10735, two females and one male, respectively, collected on 24-27 August 2007 nearby the type locality by A. Almendáriz and C. Padilla.

Diagnosis – *Enyalioides touzeti* (Fig. 1) can be distinguished from other species of *Enyalioides* by the combination of the following characters: (1) ventrals keeled; (2) paravertebrals small, imbricate, and strongly keeled; (3) vertebral scales on neck region in adult males more than twice as high as vertebrals

on pelvic region; (4) femoral pores on each side one or two; (5) lateral aspects of body and neck strongly folded; (6) vertebral crest continuous along neck and body; (7) scales on body and limbs homogeneous in size; (8) caudal segments distinct; (9) gular region in adult males dark.

Description of holotype – Dorsal head scales strongly keeled; scales immediately posterior to supraciliaries conical and dorsally projected, forming longitudinal row of eight (left) or nine (right) scales that extends posteriorly over supratemporal region; other temporal scales small, keeled, imbricate; two (left) or three (right) projected, conical temporal scales forming an anterodorsally oriented row starting at anterodorsal aspect of tympanum; one enlarged pretympanic scale; supraciliaries 14 (right) or 15 (left); canthals five (left) or six (right); postrostrals three; left supralabials 14 if counted to a point right below middle of eye, and 18 if counted to comisure of mouth (15 and 20 on right side, respectively); rostral as wide and high as adjacent supralabials; single longitudinal row of lorilabials between suboculars and supralabials at level of middle of eye, longitudinal rows of lorilabials anterior to this point three; loreal region broken into small, longitudinally elongated, and keeled scales; nasal at level of supralabials IV-V; left infralabials 14 if counted to a point right below middle of eye, and 17 if counted to comisure of mouth (15 and 19 on right side, respectively); mental as wide but longer than adjacent infralabials; postmentals three; gulars with ventrally projected keels; prominent gular fold complete midventrally; neck with several longitudinal and oblique folds.

Vertebral crest strongly projected and decreasing in size posteriorly with vertebrals on neck at least two times higher than vertebrals between hind limbs; crest bifurcates posteriorly and extends onto tail less than ¼ its length; body flanks between fore and hind limbs with prominent dorsolateral and ventrolateral folds, as well as several vertical and oblique folds; scales on dorsolateral folds slightly larger than adjacent scales giving the fold the appearance of a crest; scales between dorsolateral folds and vertebral crest small, prominently keeled, and imbricate; scales on flanks, ventral to dorsolateral folds, smaller than dorsal scales, nearly granular; ventral scales strongly keeled, imbricate, more than twice the size of dorsals.

Limb scales strongly keeled; scales on dorsal and posterior aspects of thighs less than half the size of those scales on anterior and ventral aspects; subdigitals on left and right Finger IV 17 and 16, respectively; subdigitals on left and right Toe IV 21 and 22, respectively; one femoral pore on each side; tail lat-



FIGURE 1: Adult male (top; holotype, EPN 10306) and female (bottom; paratopotype, EPN 10307) of *Enyalioides touzeti* sp. nov.

erally compressed and gradually decreasing in height towards tip; caudal scales keeled and imbricate, not projected; ventral larger than dorsal caudals, with individual caudal whorls being three scales long ventrally and 6-7 scales long dorsally.

Color in life of holotype – Head olive-green with yellowish-green labials, some of which have salmon spots; discontinuous yellowish stripe extends posteriorly from mouth comisure to ventral margin of tympanum; a similar longitudinal stripe extends from posterior margin of tympanum to scapular region; dorsal background olive-green; pale-yellow round spots covering dorsal aspect of body, limbs, and proximal portion of tail; chin and gular region covered with dark patch; a few scales on chin clay; ventral surface of body and limbs light brown with dark irregular marks; iris reddish brown; pupil round with yellow margin.

Variation – Variation of meristic and morphometric characters in *E. touzeti* are presented in Table 2.

Females lack the dark gular patch present in adult males. Whereas female paratype EPN 10307 had a nearly uniform light brown dorsal background

(Fig. 1), female paratype DH-MECN 3847 (Fig. 2) had an olive-green dorsal background covered with large dark spots (some open in the center) on body, limbs, and tail. However, the large spots were visible, although faint, in several parts of the body of the light brown female (EPN 10307). A juvenile female (DH-MECN 2575) had the following coloration in life: dorsal and lateral aspects of head grey; dorsal background of body, limbs, and tail reddish brown with scattered grey marks; six large, grey spots with whitish centers form a dorsolateral longitudinal row between fore and hind limbs on each side; venter white. A male paratype (DH-MECN 1396) differed from the holotype by having a lighter dorsal background with a dark reticulate pattern that formed a middorsal longitudinal series of transverse bars that continues onto tail as a series of dark rings incomplete ventrally. Another male (EPN 10735) differed from the holotype by having only the posterior portion of the gular region covered by a dark patch, whereas the anterior portion and chin were densely covered by dark flecks (Fig. 2); in addition, the ventral background color of this specimen was whitish cream with scattered light brown marks.

TABLE 2: Summary of morphological characters, measurements (mm), and color patterns of *Enyalioides oshaughnessyi* and *E. touzeti*. For each quantitative character, the *F*-value, *t*-value, and corresponding *P*-values are given. For those characters with unequal variances (i.e., *F*-test $P < 0.005$), an unequal variance *t*-statistic (Welch test) is presented. Range and mean \pm standard deviation or mode are given for quantitative characters.

Character	<i>E. oshaughnessyi</i> n = 17	<i>E. touzeti</i> sp. nov. n = 10	<i>F</i> -value	<i>P</i>	<i>t</i> -value	<i>P</i>
Paravertebrals in transverse row at midbody	28-36 32.65 \pm 2.52	37-43 40.50 \pm 1.90	1.763	0.390	8.499	< 0.005
Ventrals in transverse row at midbody	26-37 31.00 \pm 3.06	23-32 27.10 \pm 3.11	1.030	0.917	3.179	< 0.005
Vertebrals	45-60 51.18 \pm 3.84	50-71 60.40 \pm 7.03	3.341	0.034	4.435	< 0.005
Gulars	41-53 45.59 \pm 3.54	42-48 44.40 \pm 2.22	2.535	0.159	0.953	0.349
Infralabials	12-15 13.47 \pm 1.07	12-15 13.40 \pm 1.17	1.209	0.709	0.160	0.874
Supralabials	12-16 14.29 \pm 1.10	13-17 15.20 \pm 1.32	1.420	0.518	1.918	0.066
Canthals	5-7 6	5-6 6	1.071	0.953	1.524	0.140
Supraoculars	13-19 15.35 \pm 1.54	13-18 14.90 \pm 1.37	1.261	0.745	0.768	0.450
Ventrals	42-57 47.24 \pm 4.44	37-42 39.57 \pm 1.99	4.982	0.057	4.349	< 0.005
Subdigitals Finger IV	18-24 20.82 \pm 1.88	16-19 18.30 \pm 1.06	3.145	0.086	3.880	< 0.005
Subdigitals Toe IV	23-28 25.47 \pm 1.74	22-29 26.00 \pm 2.49	2.064	0.198	0.651	0.521
Femoral pores	1-2 1	1-21	1.312	0.485	0.408	0.685
Head length/Head width	1.17-1.43 1.32 \pm 0.07	1.20-1.46 1.30 \pm 0.07	1.821	0.283	0.414	0.682
Fore limb length/SVL	0.46-0.55 0.50 \pm 0.03	0.42-0.56 0.50 \pm 0.04	4.790	0.023	0.434	0.668
Hind limb length/SVL	0.71-0.77 0.74 \pm 0.02	0.66-0.80 0.75 \pm 0.05	2.035	0.215	0.841	0.409
Tail length/Total length	0.59-0.62 0.60 \pm 0.01	0.49-0.60 0.55 \pm 0.04	13.304	< 0.005	3.092	0.013
Dark gular patch	Restricted to gular fold	Covering gular region				
Iris in adult males	Bright red	Reddish brown				

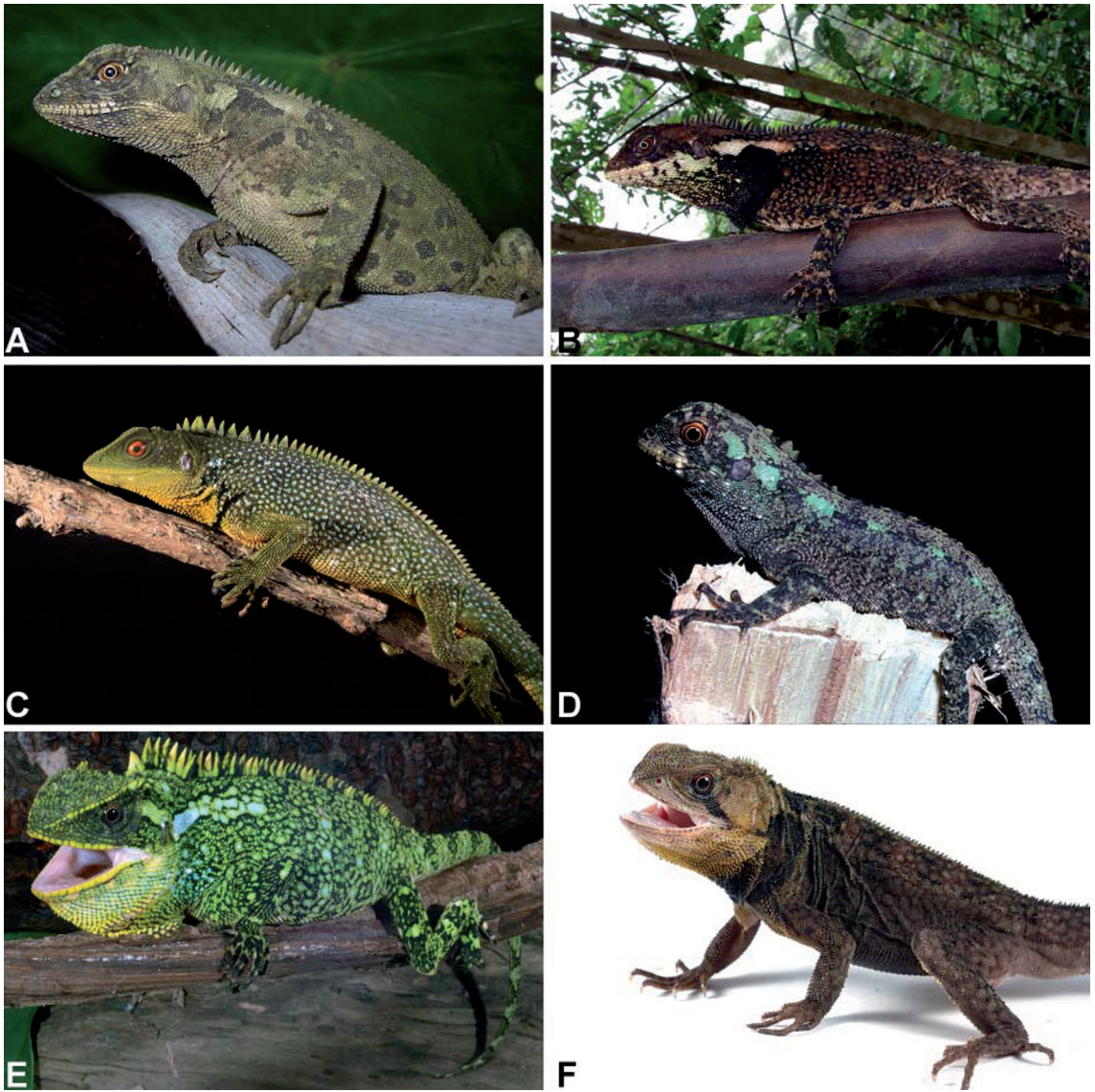


FIGURE 2: Three species of *Enyalioides* from western Ecuador. Female (A; DH-MECN 3847) and male (B; EPN 10735) of *E. touzeti* sp. nov.; male (C); juvenile (D), and female (E) of *E. oshaughnessyi*; male of *E. heterolepis* (F).

Distribution and ecology – *Enyalioides touzeti* inhabits lowland cloud forests on the western slopes of the Andes in southern Ecuador (Fig. 3). It occurs at elevations of 300-700 m in Provincias Azuay, Cañar, and El Oro. This species is not known to occur in sympatry with other hoplocercines, although *E. heterolepis* and *E. oshaughnessyi* occur at nearby localities. The type locality of *E. touzeti* is dominated by a regenerating secondary forest that lies nearby the “Bosque Siempreverde Piemontano” formation, which is characterized by high levels of humidity and tall trees (> 20 m), some of which are covered by lichens, mosses, and other epiphytes (Si-

erra *et al.*, 1999). Similar to other species of *Enyalioides*, specimens of *E. touzeti* were found active on the ground or sleeping in branches (e.g., Vitt & de la Torre, 1996). One female (EPN 10700) was found lying horizontally on a 2 cm-diameter branch 30 cm above ground at 4:30 PM; another female (EPN 10720) was found active on the ground at 4:00 PM; and a male (EPN 10735) was found sleeping on a tree fern branch in vertical position at 8:20 PM.

Etymology – The specific name is a noun in the genitive case and is a patronym for Jean-Marc Touzet, who

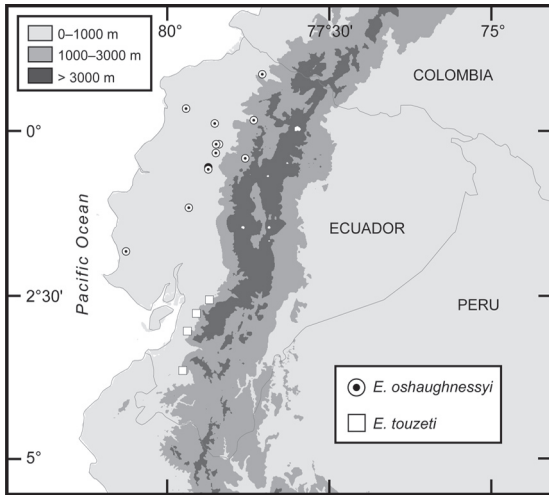


FIGURE 3: Distribution of *Enyalioides oshaughnessyi* and *E. touzeti* sp. nov. in Ecuador.

has made important contributions to the study and conservation of the herpetofauna of Ecuador including valuable collections and the establishment of the Gustavo Orcés Herpetological Foundation in Quito. Touzet has had a great positive impact in the careers of many Ecuadorian herpetologists including most of the authors in this paper. He was the first person to collect a specimen of the species described herein, which he recognized as an undescribed species of *Enyalioides*.

DISCUSSION

Enyalioides touzeti sp. nov. is morphologically similar to *E. oshaughnessyi* (Table 2), which together with *E. heterolepis* are the only species of *Enyalioides* known to occur west of the Andes in South America (Fig. 2), although several authors have mistakenly switched the distributions of *E. oshaughnessyi* and *E. microlepis* (Peters & Donoso-Barros, 1970; Al-mendáriz, 1992; Torres-Carvajal, 2001); the latter species is restricted to the upper Amazon basin in Colombia, Ecuador, and Peru.

E. heterolepis differs from *E. oshaughnessyi* and *E. touzeti* sp. nov. by having small scales on the dorsal aspect of body and limbs intermixed with large conical scales, a less pronounced vertebral crest, smooth ventrals, and a strongly laterally compressed tail. The new species differs from *E. oshaughnessyi* by having the body flanks conspicuously folded (lateral folds absent or inconspicuous in *E. oshaughnessyi*; Fig. 2), small paravertebral scales, each with a conspicuous medial keel (larger and smooth or slightly keeled paravertebrals in *E. oshaughnessyi*); scales on body flanks homogeneous in size (a few non-conical, scattered enlarged scales might be present on flanks in *E. oshaughnessyi*); less subdigitals on Finger IV (16-19 and 18-24, respectively; t -test, $t = 3.880$, $P < 0.005$); less ventrals on a transverse line at midbody (23-32 and 26-37, respectively; t -test, $t = 3.179$, $P < 0.005$); less transverse rows of ventrals between fore and hind



FIGURE 4: Gular región of adult males of *E. touzeti* sp. nov. (EPN 10306; and *E. oshaughnessyi* (USNM 285457; center, right). White arrow indicates black patch on gular fold in *E. oshaughnessyi* (right).

limb insertions (37-42 and 42-57, respectively; *t*-test, $t = 4.349$, $P < 0.005$); more paravertebrals at mid-body (37-43 and 28-36, respectively; *t*-test, $t = 8.499$, $P < 0.005$); and more vertebrals (50-71 and 45-60, respectively; *t*-test, $t = 4.435$, $P < 0.005$). In addition, these two species have differences in color patterns. Adult males of both species have a dark gular patch; however, this patch is extensive and covers partially or completely the gular region in *E. touzeti* sp. nov., whereas in *E. oshaughnessyi* it is restricted to the inner aspect of the gular fold (autapomorphy [Wiens & Etheridge 2003]; Fig. 4); the remainder of the gular region is bright yellow in the latter species (Fig. 2). Unlike *E. touzeti* sp. nov., the dorsum and flanks in males of *E. oshaughnessyi* have a reticulate pattern formed by a dark green or dark brown background covered with numerous light blue or light green dots. Additionally, *E. oshaughnessyi* seems to be the only species of *Enyalioides* in which adult males have a bright red (reddish brown in *E. touzeti* sp. nov.) iris (Fig. 2). Morphological similarity and distribution ranges suggest that *E. touzeti* sp. nov. and *E. oshaughnessyi* are closely related.

RESUMEN

Describimos una especie nueva de *Enyalioides* del bosque nublado al suroccidente de Ecuador. Esta representa la tercera especie de este género que habita al occidente de los Andes en América del Sur; las otras dos especies occidentales son *E. heterolepis* y *E. oshaughnessyi*. La especie nueva se diferencia de otras especies del género por tener, entre otras características, paravertebrales pequeñas y quilladas, pliegues dermales a los lados del cuello y cuerpo, escamas homogéneas en el cuerpo y extremidades, segmentos caudales visibles, y un parche oscuro que cubre gran parte de la región gular en machos. Semejanzas morfológicas sugieren que la especie nueva, a la cual llamamos *E. touzeti*, está cercanamente relacionada con *E. oshaughnessyi*.

PALAVRAS-CHAVE: Ecuador, *Enyalioides*, Hoplocercinae, Iguania, espécies novas.

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the photographs of *E. oshaughnessyi* and *E. heterolepis* shown in Figure 2 we thank R. McDiarmid, L.A. Coloma, and S. Ron. Field trips to the type locality were sponsored by the Ecuadorian Mineral Corporation as part of the study “Diagnóstico Biológico del Proyecto Gaby-Papagrande” conducted by researchers at EPN. MYM is grateful to F. Sornoza-Molina, N. Simpson, and R. Ridgely of the Fundación Jocotoco, as well as A. Neelakantan from the University of East Anglia for their field support at Reserva Biológica Buenaventura. DH-MECN specimens were collected under permit N° 010 – IC-FAU-DNBAP/MA (2005-2006) issued by the Ministerio del Ambiente del Ecuador.

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APPENDIX

Specimens examined

Enyalioides oshaughnessyi – ECUADOR: *Provincia Esmeraldas*: Alto Tambo, QCAZ 6671; Bilsa Ecological Reserve, QCAZ 6866; *Provincia Los Ríos*: Estación Científica Jauneche, QCAZ 6899; Centro Científico Río Palenque, KU 152597, USNM 285456-7; *Provincia Pichincha*: Finca La Esperanza, 5 km W Santo Domingo de Los Colorados, USNM 211105-7; Puerto de Ila, USNM 211104; Recinto Playa Rica, on road Nanegal-Selva Alegre, QCAZ 7426; San Miguel de Los Colorados, USNM 211103; Santo Domingo de Los Colorados, KU 109630, USNM 211109; 1 km S Santo Domingo de Los Colorados, KU 179416; 2 km E Santo Domingo de Los Colorados, KU 179417; Silanchi, Río Blanco, USNM 211102; Unión del Toachi, 300-900 m, QCAZ 5326, 6682.