

## A NEW ENDEMIC SPECIES OF *LIOLAEMUS* (IGUANIA: LIOLAEMIDAE) FROM THE MOUNTAIN RANGE OF TANDILIA, BUENOS AIRES PROVINCE, ARGENTINA

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**ABSTRACT:** *Liolaemus gracilis* was cited in the categorization of the reptile habitat associations of Buenos Aires province in Argentina as the only *Liolaemus* lizard inhabiting the rocky grounds of the Tandilia System. We describe a new species of the genus *Liolaemus* which was previously confused with the widely ranging *L. gracilis* from the population of this mountain range. We examined samples of populations from coastal sand dunes and from the mountain range of Tandilia. Morphological characters and measurements were taken from specimens of both populations. We recorded ecological and life history notes of the saxicolous form in the field. The new species is an endemic and saxicolous form from Tandilia that can be distinguished from *L. gracilis* by indistinct or absent light dorsolateral stripes, small and segmental paravertebral spots, and by a throat with a denser, fine and diffuse spotted pattern. The ventral coloration is grayish plumb. Temporal scales are keeled or slightly keeled and the auricular scale is less differentiated. Morphometrically, the new species is larger in snout–vent length and head width but smaller in maximum body width and tail length than *L. gracilis*. The new species is oviparous and insectivorous.

**RESUMEN:** *Liolaemus gracilis* es citada en un listado de reptiles y ambientes de la provincia de Buenos Aires de Argentina como la única especie de *Liolaemus* que habita en suelos rocosos del Sistema de Sierras de Tandilia. Describimos a partir de una población de estas sierras una nueva especie del género *Liolaemus* anteriormente confundida con *L. gracilis*, esta última de mayor distribución. Examinamos caracteres morfológicos y medimos especímenes de muestras provenientes de poblaciones de las dunas costeras y de las sierras de Tandilia. En el campo recolectamos datos sobre la ecología e historia natural de la forma serrana. La nueva especie es una forma saxícola endémica de Tandilia que puede distinguirse de *L. gracilis* por las bandas dorsolaterales claras poco evidentes o ausentes, la manchas paravertebrales pequeñas y segmentarias y por una garganta con un patrón denso y difuso de manchas finas. La coloración ventral es gris plomiza. Las escamas temporales son quilladas o levemente quilladas y la escama auricular está menos diferenciada. Morfométricamente la especie saxícola tiene mayor longitud hocico-cloaca y su cabeza es más ancha, pero a la vez es más delgada en la mitad del cuerpo y su cola es más corta que la de *L. gracilis*. La nueva especie es ovípara e insectívora.

**Key words:** Argentina; Iguania; Liolaemidae; *Liolaemus*; Mountain habitat; New species; Tandilia

ALMOST half of the species of *Liolaemus* are in the *chiliensis* group (Lobo, 2001), including the small and slender lizard *Liolaemus gracilis* (Bell, 1843). This species was cited in one of the categorizations of the reptile habitat associations of Buenos Aires province as the only *Liolaemus* species inhabiting the rocky grounds of the Tandilia System (Gallardo, 1977). Later, Chani (in Laurent, 1988) commented that individuals of *L. gracilis* from the coastal sand dunes of Buenos Aires province were lighter than the saxicolous forms from the inner mountain range of this province. Laurent (1988) also called attention to the

geographic variation of *L. gracilis* by showing subtle differences between some specimens from the Buenos Aires and Mendoza provinces of Argentina. In that work, the small sample from Tandilia and from the coastal localities examined, as well as the possibility of a clinal variation of the species, made it difficult to discriminate taxonomically between these two forms.

During our studies of the herpetological communities of the Tandilia System in 1984–90, we collected some specimens and made ecological observations of this saxicolous form of *Liolaemus*. In the resulting list of the herpetofauna from Sierras de Balcarce and Mar del Plata in Tandilia, we included the

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lizard *L. gracilis*, but we cautiously made reference to Laurent's personal communication stating that this population could be a subspecies (Vega and Bellagamba, 1990).

To study these populations in more detail, we examined samples of *L. gracilis* from the Museo Argentino de Ciencias Naturales (MACN), Fundación Miguel Lillo (FML), Carnegie Museum of Natural History (CM), San Diego State University (SDSU) and from the Herpetological Collection of the Universidad Nacional de Mar del Plata (UNMdP). The main purpose was to discriminate and properly describe a new species of lizard which, until now, has been confused with the widely ranging *L. gracilis*.

#### MATERIALS AND METHODS

##### *Meristic and Morphometric Analysis*

To determine the taxonomic status, we compared the new form with *Liolaemus gracilis* and other phenetically similar species belonging to the *chiliensis* group (sensu Etheridge, 1995). We examined 697 specimens deposited in museums of Argentina, Chile and the United States. Specimens and species' details are listed in Appendix I.

Morphological characters were taken from specimens fixed in 10% formalin and preserved in 70% ethanol. We took measurements with a dial caliper to the 0.1 mm and made scale counts with the aid of a stereoscopic microscope. Definitions for scale counts and body patterns follow Lobo and Espinoza (1999), and nomenclature for neck folds follows Frost (1992). Institutional abbreviations follow Leviton et al., (1985), except the following acronyms: MCN: Museo de Ciencias Naturales, Universidad Nacional de Salta, Salta, Argentina; MZUC: Museo de Zoología de la Universidad de Concepción, Concepción, Chile; UNMdP: Universidad Nacional de Mar del Plata, Mar del Plata, Argentina; REE: Richard E. Etheridge collection; UNRC: Universidad Nacional de Río Cuarto, Río Cuarto, Argentina.

The following morphometric traits were measured: snout-vent length (SVL), head length (HL) (from posterior edge of auricular opening to rostral scale), head width (HW) (between corners of the mouth), distance

between fore and hind limbs (DFH) (from axilla to groin), humerus length (HUL) (from elbow to axilla), radius-ulna length (RUL) (from elbow to the internal angle between hand and forearm), hand length (HAL) (including fourth toe claw), femur length (FL) (from knee to groin), tibio-fibula length (TFL) (from knee to the internal angle with the foot), foot length (FOL) (including fourth toe claw), fourth-toe length (4TL) (including claw), maximum body height (HMAX) (at midbody), maximum body width (at midbody) (WMAX) and tail length (TL).

##### *Natural History*

We recorded coloration of gravid females and notes on habitat selection and behavior in the field. We also searched for evidence of clinal variation or hybridization (i.e., morphologically intermediate individuals). At each site, we collected environmental temperatures (substratum perpendicular to sun) and body temperatures (measured at a depth of 0.5 cm in the cloaca) with a Cloacal Thermometer (Miller and Weber Inc.). We also collected and preserved 23 individuals for examination of gonads and stomach contents. Females were considered adults if they had yolked follicles (YF) over 2 mm that were opaque and yellow, or oviductal eggs (OE) or distended oviducts, in which case the width of the left oviduct (OW) was measured. For males, sexual maturity was based on the presence of enlarged testes and a convoluted epididymus. Length (TL) and width (TW) of the left testis were measured. All these measurements were made using the ocular micrometer of a binocular microscope. Stomach contents were examined under a stereomicroscope to identify insects and other arthropods items to the level of Order and/or Family.

##### *Statistical Analyses*

Normal distributions of meristic and morphometric data were examined with Shapiro-Wilk Test, and Shapiro-Wilk values ( $W$ ) with their associated probabilities ( $P_1$ ) are given in Tables 1 and 2. Meristic data were analyzed using a  $t$ -test for those variables which approximated normal distributions (Shapiro-Wilk  $P > 0.05$ ) and a Mann-Whitney  $U$ -test for variables that departed from normality

TABLE 1.—Meristic characters and variation of *Liolaeemus gracilis* and *Liolaeemus tandilensis* n. sp. W = statistic from Shapiro-Wilk test;  $P_1$  = probability associated with W;  $\bar{X}$  = mean; SD = Standard Deviation; MIN = minimum; MAX = maximum; n = sample size. t = statistic from t-test; Z = Z value from Mann-Whitney U-test;  $P_2$  = probability associated with t or Z.

Character	<i>L. gracilis</i>						<i>L. tandilensis</i>										
	W	$P_1$	$\bar{X}$	SD	MIN	MAX	n	W	$P_1$	$\bar{X}$	SD	MIN	MAX	n	t	Z	$P_2$
Scales around midbody	0.96	0.46	42.3	1.9	38	46	33	0.95	0.20	43.0	2.8	38	48	21	1.08		0.208
Dorsal scales between occiput and thigh	0.96	0.33	42.3	2.7	35	47	33	0.93	0.38	43.7	2.7	40	50	22	1.88		0.064
Dorsal head scales	0.85	0.00	12.2	1.0	10	15	33	0.93	0.04	13.0	0.9	11	14	22		2.68	0.004
Ventral scales	0.97	0.58	80	6.4	66	91	33	0.95	0.23	81	5.0	72	90	22	0.57		0.560
Precloacal pores	—	—	3.5	2.1	2	5	2	0.46	0.00	4.4	0.8	3	5	7		0.58	0.520
Scales around interparietal	0.82	0.00	5.9	0.9	5	8	33	0.85	0.00	5.9	0.7	5	7	22		0.00	1.000
Enlarged supraoculars	0.70	0.00	3.7	0.5	3	5	32	0.75	0.00	3.2	0.5	2	4	22		2.61	0.008
Number of temporals	0.78	0.00	8.0	0.6	7	10	32	0.80	0.00	8.0	0.7	6	9	22		0.45	0.650
Number of neck scales	0.97	0.75	25.5	2.8	19	32	33	0.95	0.70	23.6	2.0	20	27	22	2.69		0.009
Number of gulars	0.94	0.10	32.0	3.8	26	42	33	0.97	0.67	32.0	3.1	25	37	21	0.01		0.980
Enlarged supralabials	0.58	0.00	5.9	0.4	5	7	33	0.57	0.00	6.0	0.7	5	8	22		0.07	0.930
Enlarged infralabials	0.46	0.00	4.0	0.3	3	5	33	0.40	0.00	4.0	0.2	4	5	22		0.10	0.910
Scales around nasal	0.45	0.00	6.7	0.5	5	7	33	0.46	0.00	6.7	0.5	6	8	22		0.10	0.910
Scales between rostral and frontal	0.48	0.00	5.0	0.3	4	6	33	0.42	0.00	5.2	0.5	5	6	22		1.59	0.110
Scales between frontal and superciliaries	0.79	0.00	4.8	0.6	4	6	33	0.59	0.00	4.4	0.5	3	5	22		2.02	0.040
Loreolabials scales	0.67	0.00	6.0	0.5	5	7	33	0.65	0.00	6.0	0.5	5	7	22		0.25	0.800
Infradigital lamellae of 4th toe of the hand	0.89	0.00	17.3	1.3	15	19	33	0.80	0.00	18.3	1.1	17	21	22		2.57	0.010
Infradigital lamellae of 4th toe of the pes	0.93	0.05	22.2	1.5	19	25	33	0.91	0.05	22.5	1.2	20	24	22		0.58	0.550

TABLE 2.—Morphometric characters and variation of *Liolaemus gracilis* and *Liolaemus tandiliensis* n. sp. Measurements are in mm.  $W$  = statistic from Shapiro-Wilk test;  $P_1$  = associated probability for  $W$ ;  $\bar{X}$  = mean with adjusted mean in parentheses based on raw data;  $SD$  = 1 Standard Deviation;  $MIN$  = minimum;  $MAX$  = maximum;  $n$  = sample size.  $t$  = statistic from  $t$ -test;  $F$  = statistic from ANCOVA after  $\log_{10}$  transformation of raw data;  $P_2$  = probability associated with  $t$  or  $F$ . See the text for character abbreviations.

	<i>L. gracilis</i>						<i>L. tandiliensis</i>										
	$W$	$P_1$	$\bar{X}$	$SD$	$MIN$	$MAX$	$n$	$W$	$P_1$	$\bar{X}$	$SD$	$MIN$	$MAX$	$n$	$t$	$F$	$P_2$
<b>SVL</b>	0.96	0.28	47.6	4.5	40.5	56.0	31	0.96	0.48	52.2	3.5	45.6	58.2	28	4.29	1.47	0.000
<b>HL</b>	0.98	0.51	10.4 (10.9)	0.8	9.5	12.6	31	0.95	0.22	11.5 (11.2)	0.8	10.3	12.9	28		10.12	0.235
<b>HW</b>	0.95	0.14	7.3 (7.5)	0.6	6.4	8.8	31	0.94	0.17	8.3 (8.0)	0.5	7.6	9.6	28		10.12	0.003
<b>DFH</b>	0.92	0.06	22.6 (23.7)	3.0	17.5	27.0	31	0.96	0.43	23.5 (23.0)	3.2	18.4	29.5	28		1.42	0.243
<b>HUL</b>	0.96	0.17	5.5 (5.8)	0.8	4.1	7.6	31	0.91	0.07	5.5 (5.3)	0.5	4.8	6.7	28		2.63	0.116
<b>RUL</b>	0.96	0.28	5.3 (5.6)	0.6	4.3	6.3	31	0.96	0.52	6.0 (5.8)	0.4	5.2	6.7	28		3.09	0.090
<b>HAL</b>	0.93	0.07	7.5 (7.7)	0.5	6.6	8.6	31	0.97	0.63	8.2 (7.9)	0.6	6.7	9.5	28		1.04	0.316
<b>FL</b>	0.96	0.38	8.2 (8.5)	0.8	6.5	10.2	31	0.97	0.61	8.7 (8.6)	0.7	7.4	10.0	28		0.48	0.494
<b>TFL</b>	0.97	0.70	7.8 (8.0)	0.7	6.6	9.5	30	0.93	0.07	8.6 (8.2)	0.6	7.8	9.8	28		0.85	0.362
<b>FOL</b>	0.98	0.84	13.8 (14.1)	0.9	12.6	15.8	31	0.94	0.18	14.8 (14.3)	1.1	12.8	16.8	28		0.25	0.616
<b>4TL</b>	0.98	0.86	8.4 (8.5)	0.7	7.0	10.3	31	0.98	0.96	9.3 (9.0)	0.6	8.0	10.4	28		3.48	0.072
<b>TL</b>	0.98	0.99	87.8 (87.5)	7.3	70.2	98.2	17	0.96	0.75	78.4 (74.7)	13.4	58.4	104.0	15		8.72	0.006
<b>HMAX</b>	0.95	0.18	7.07 (7.3)	1.0	5.4	9.2	31	0.96	0.50	7.04 (6.8)	1.0	4.8	9.0	27		2.06	0.159
<b>WMAX</b>	0.97	0.42	11.5 (12.0)	1.8	8.3	15.5	30	0.93	0.10	9.14 (8.2)	1.9	4.5	12.7	26		24.60	0.000

distributions (Shapiro-Wilk  $P < 0.05$ ). Morphometric data were  $\log_{10}$  transformed in order to fit the requirements of the “factor model”, in which size is defined as a factor or latent variable that affects linearly expected values of observable data (Bookstein et al., 1985). As *Liolaemus gracilis* ( $\bar{X} = 47.64$  mm SVL,  $n = 31$ ) and Tandilia’s population ( $\bar{X} = 52.21$  mm SVL,  $n = 28$ ) were significantly different in size ( $t = 4.29$ ,  $df = 57$ ,  $P < 0.000$ ), morphometric data were analyzed with ANCOVA, which allowed removal of the effects of SVL when slopes among groups were homogeneous at the  $P < 0.05$  level. Means ( $\bar{X}$ ) are given  $\pm 1$  SD (Zar, 1984).

RESULTS

In relation to lepidosis variation, *Liolaemus gracilis* and Tandilia’s population showed statistical differences in the number of dorsal head scales, enlarged supraoculars, neck scales, scales between frontal and superciliaries and in the number of the infradigital lamellae of 4th toe of the pes (Table 1). Morphometrically, the population from Tandilia was larger in snout-vent length and head width, but smaller in maximum body width and tail length than *L. gracilis* (Table 2).

SPECIES ACCOUNT

*Liolaemus tandiliensis* sp. nov. (Figs. 1,2)

*Holotype*.—UNMdP 0561. Sierra Los Difuntos. Partido General Pueyrredón, Buenos Aires Province, Argentina (37°53’30”S; 57°50’30”W). November 1998. Collected by P. Bellagamba and L. Vega.

*Paratypes*.—UNMdP 0549. Sierra de Los Padres. Partido de General Pueyrredón (37°56’30”S; 57°48’15”W). Buenos Aires Province, Argentina. 27 July 1985. P. Bellagamba and L. Vega cols. UNMdP 0550. Sierra de Los Padres. Partido de General Pueyrredón. Buenos Aires Province, Argentina. 18 November 1987. P. Bellagamba and L. Vega cols. UNMdP 0551. Sierra del Volcán. Partido de Balcarce. Buenos Aires Province, Argentina (37°51’30”S; 58°03’W). 30 September 1987. P. Bellagamba and L. Vega cols. MCN 1605, 1614 (ex-UNMdP 0554 and 0552). Sierra de Los Padres. Partido de General Pueyrredon.



FIG. 1.—Color in life of a male of *Liolaemus tandiliensis* n. sp. (UNMdP 995). Snout-vent length: 55.8 mm. Characteristic pattern of the flanks shared with *L. saxatilis*, *L. robertmertensi*, and *L. sanjuanensis*. Photo: P. Bellagamba.

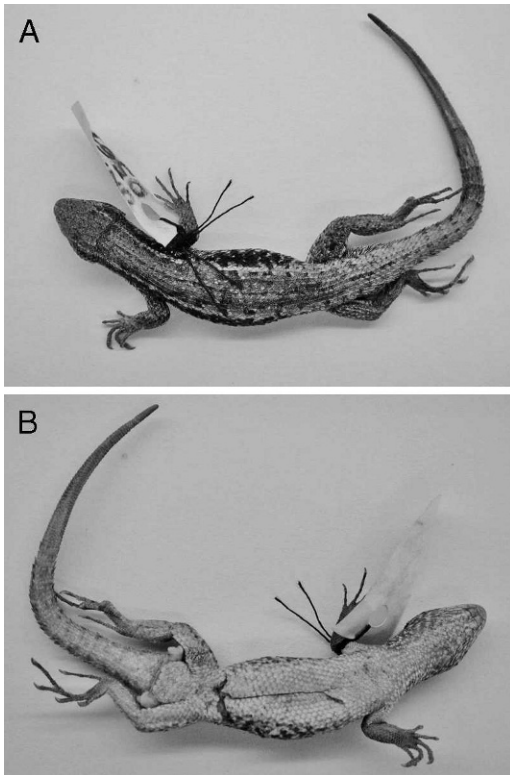


FIG. 2.—Holotype (UNMdP 0561) of *Liolaemus tandiliensis* n. sp. Snout-vent length: 56.2 mm. (A) Dorsal view and (B) ventral view. Photos: R. Espinoza.

Buenos Aires Province, Argentina. 28 August 1985. P. Bellagamba and L. Vega cols. MCN 1604, 1612 (ex -UNMdP 0553, 0555). Sierra de Los Padres. Partido de General Pueyrredon. Buenos Aires Province, Argentina. 7 September 1984. P. Bellagamba and L. Vega cols. MCN 1613 (ex -UNMdP 0556). Sierra La Brava. Partido de Balcarce. Buenos Aires Province, Argentina. 8 March 1988. P. Bellagamba and L. Vega cols. MCN 1607–1609 (ex -UNMdP 0558–0560). Same data as holotype.

*Diagnosis*.—*Liolaemus tandiliensis* is a small, slender, *Liolaemus* morphologically similar to small forms of the *alticolor* group (sensu Lobo and Espinoza, 1999, 2004) that may be distinguished from all other members of this group with the exception of *L. gracilis*, *L. saxatilis*, *L. sanjuanensis*, *L. robertmertensi*, *L. chiliensis* and *L. nitidus* in having lateral nuchal scales that are keeled and imbricate and lacking longitudinal and antegular folds. Additionally, *L. tandiliensis* differs from *L. saxatilis*, *L. sanjuanensis*, *L. robertmertensi*, *L. chiliensis* and *L. nitidus* except *L. gracilis* in having a differentiated auricular scale and two or three enlarged scales on the anterior margin of ear. The new species can be distinguished from the similar species *L. gracilis*, in the following characters: narrow, light (cream, whitish, yellowish) dorsolateral

stripes in *L. gracilis* less evident or absent in *L. tandiliensis*; dorsolateral stripes in *L. gracilis* bordered medially by a thin black line absent in *L. tandiliensis*; small and segmental paravertebral spots present in *L. tandiliensis*, absent in *L. gracilis*; large black spots on the flanks (sometimes nearly completely fused) present in *L. tandiliensis*, absent in *L. gracilis* (Fig. 1); ventral scales of *L. gracilis* are without pigmentation and ventral surfaces (throat, neck, chest, and abdomen) are whitish, grayish-plumb in *L. tandiliensis*; 70% of *L. tandiliensis* have keeled or slightly keeled temporal scales, keeled in 6% of *L. gracilis*; auricular scale more often differentiated in *L. gracilis* (94%) than in *L. tandiliensis* (41%); mean number of dorsal head scales and infradigital lamellae of the 4th. toe of hand in *L. tandiliensis* significantly greater than in *L. gracilis*; mean number of enlarged supraocular scales, neck scales and scales between frontal and superciliaries significantly smaller than in *L. gracilis* (Table 1); and *L. tandiliensis* with a significantly longer snout-vent length and head width but significantly smaller maximum body width and tail length than *L. gracilis* (Table 2).

*Description of holotype.*—Adult male (Fig. 2a,b). Snout-vent length: 56.2 mm. Head width: 9.2 mm. Head length: 12.2 mm (1.3 times longer than wide). Dorsal head scales smooth, 13 from a line drawn horizontally between anterior margin of external auditory meatus to anterior margin of rostral. Left nasal scale in wide contact with rostral, right nearly in contact. Two postrostral scales and four internasals. Canthal separated from nasal by one scale. Loreal region flat. Six supralabial scales enlarged, the fourth (2.4 mm) with the posterior margin curved upward but not contacting subocular. Four infralabial scales. Auditory meatus oval (height: 1.6 mm; width: 1.5 mm). Scales of anterior margin of auditory meatus enlarged and flat, scales of the posterior margin smaller, some almost granular. Three enlarged, flat scales projecting over meatus; no auricular scale differentiated. Eight convex, imbricate and slightly keeled temporal scales between upper anterior corner of auditory meatus and posterior margin of orbit. Seven temporals (counting vertically from buccal

commisure to level of superciliaries). Interparietal scale subpentagonal, bordered by seven scales. Parietals and interparietal of similar size. Orbit-auditory meatus distance (4.7 mm), about equal to orbit-rostral distance (anterior margin of rostral: 5.0 mm). Rostral scale about three times wider than high (width: 2.9 mm; height: 0.9 mm). Mental scale subpentagonal, also wider than high (width: 2.9 mm; length: 1.3 mm). Frontal scale divided. Five scales between frontal and rostral, four scales between frontal and superciliaries. Supraorbital semicircles posteriorly incomplete, formed by nine (left)–eleven (right) scales. Three supraoculares enlarged. Scale organs most apparent on prefrontal and internasal regions (six on each postrostral). Six or seven superciliaries scales strongly imbricate. Ciliaries square-shaped and projecting. Twelve upper ciliaries and thirteen (left)–fourteen (right) lower ciliaries. Subocular longer (3.6 mm) than orbit diameter (2.4 mm from anterior to posterior margin of ciliaries) and separated from supralabials by a single row of lorilabials. Six lorilabials, with third through sixth contacting subocular. Preocular separated from lorilabials by a single scale. Postocular elongated, level with fifth supralabial scale. Mental wider than long (width: 2.9 mm; length: 1.3 mm) in contact with first infralabial (on each side) and two enlarged chinshields. Posmental row formed by three enlarged scales, second posmentals separated from each other. Scales of throat flat, enlarged and imbricate. Twenty-seven gulars between auditory meatus. Some lateroventral neck scales with an apical notch in posterior margin. Two neck folds evident (rietal and postauricular), longitudinal and antegular absent. Lateral side of the neck flat, formed by scales enlarged and smooth (similar size as dorsals), imbricate, keeled. Scales between auditory meatus and shoulder: twenty-three. Dorsal scales lanceolate, imbricate and moderately keeled. Twenty-four rows of keeled scales on dorsum at mid-trunk. Forty-two scales around midbody. Forty-one dorsal scales between occiput and anterior level of thigh. Scales become smooth with round margins along flank and towards belly. Axilla-groin distance: 25.7 mm. Ventral scales about same size as dorsals (dorsal scale length:

1.5 mm; ventral scale length: 1.2 mm). Seventy-two ventral scales counted at the midline between rostral scale and vent. Four preloacal pores. Eighteen subdigital lamellae in the fourth toe of the hand and twenty-three on the foot. Claw length of the fourth toe of left foot 1.2 mm. Tail length 62.3 mm, distal 29.8 mm regenerated, basal region 32.5 mm not regenerated. Hemipenis partially everted, lacking folds and calyx-shaped ornamentation over the bifurcation of sulcus spermaticus.

*Patterns and color in ethanol.*—Vertebral line barely visible and broken into segments, large dark black spots all combined forming a dark area with irregular margins along the flanks. Dorsolateral stripes undifferentiated and paravertebral spots small and barely visible. Dorsal head nearly uniform gray. Subocular scale with a black or dark keel. Dorsolateral stripe, lateral field and lateral line colors are kept, though diffuse, in the temporal region of the head. Color of lateral line only evident over the horizontal fold of the neck. Dorsal trunk dominantly gray, with whitish dorsolateral stripes, becoming narrow along anterior region of shoulders or vanishing on middle of trunk. Black paravertebral spots (5–6) located over medial margin of dorsolateral stripes. Lateral field overall covered by black spots, which are large and partially fused. Some small, whitish scales irregularly spread out under lateral field. Lateral line absent. Ventral field with small, scattered black, gray and white scales. Color of throat, chest and abdomen light leaden-gray as are ventral areas of cloacal region, tail and limbs. Ventral surface of tail uniform light leaden-gray. There is a dark vertebral line on dorsal region of the tail, evident in all individuals.

*Variation.*—Table 1 shows data on lepidosis variation. In this section we provide information about those traits that are not included in that table. Dorsal head scale surface nearly uniform, smooth, (or slightly wrinkled in two specimens); temporal scales keeled in 4, smooth in 17. An enlarged auricular scale at the upper margin of the auditory meatus on which can also be seen 1–3 enlarged scales at the upper margin in 7, absent in 21. Fourth supralabial scale is curve upward at its posterior margin in all except one specimen, and only contacts the subocular in 4 individ-

uals. Three individuals with the nasal scale separated from rostral. Posterior half of supraorbital semicircles complete in 10, incomplete in 11. Canthal scale separated from nasal by one or two scales in nearly equal frequency. Frontal scale divided in 10, undivided in 11. Vertebral line absent in 10, present but fragmented in 11. The series of dark black spots on flanks vary from 7 to 12 and in some individuals they are combined to form a lateral dark zone; in three individuals these spots are indistinct and hardly detectable. Dorsolateral stripes with tenuous coloration in 15, absent in 6, and they are narrow at the anterior region of shoulders, tapering posteriorly. Dorsolateral stripes bordered by a series of small paravertebral dark spots in 16, absent in 5. The number of paravertebral dark spots is variable (8–13). In most individuals the throat, chest and abdomen are light grey-plumb, only 4 of 21 individuals with a tenuous and fine spotted pattern in that region.

*Etymology.*—The name *tandiliensis* refers to the Tandilia System of mountain ranges of Buenos Aires Province in Argentina, in which this species appears to be endemic.

*Natural history.*—The reproductive mode of *Liolaemus tandiliensis* is oviparous. Examination of male and female gonads showed evidence of reproductive activity during late winter (August–September) and spring (October). Females with yolked follicles were found in early September to mid-October, and females with oviductal eggs were also found in October. The smallest reproductive female with yolked follicles measured 49.05 mm SVL, and the smallest with oviductal eggs measured 51.08 mm SVL ( $n = 11$ ). In males, enlarged testes were evident in late August and continued to the middle of October and the smallest male with evident enlarged testes measured 54.40 mm SVL ( $n = 12$ ). Therefore, mean SVL of reproductive females was  $52.70 \pm 3.30$  mm ( $n = 8$ ), with range = 49.05–58.21 mm SVL, and mean SVL of reproductive males was  $55.2$  mm  $\pm 1.04$  ( $n = 3$ ), with range = 54.40–56.76 mm SVL. Clutch size, based on the number of eggs in both oviducts varied between two and four ( $n = 2$ ), and the same number of eggs was recorded when yolked follicles in both ovaries were considered ( $n = 4$ ); therefore,

mean clutch size was  $3 \text{ eggs} \pm 1.41$  ( $n = 2$ ) and  $3.75 \text{ eggs} \pm 0.5$  ( $n = 4$ ), respectively. The main components of habitat structure of *Liolaemus tandiliensis* were patches of rocks, vegetation and loose soft material in a mosaic landscape of this range of mountains. Preferred microhabitats were sites located under the eaves of large quartzite rocks that covered smooth rocky platforms. Many individuals were seen basking on the sunny surfaces of the high vertical walls of rock, which were generally found in the upper third of the mountains at 50–250 m over the plain. This species behaved as a genuine saxicolous form, moving almost exclusively on the rocky substrate. When threatened, they flee to proximal refuges located in the crevices of rocks. The period of annual activity for this lizard extended from late winter (July–August) through spring and summer to early autumn (March–April). Active individuals were observed from morning (about 1000 h) to afternoon (about 1800 h). The body temperatures of lizards recorded in the field ranged from 28 to 34 C ( $n = 12$ ) and the mean temperature was 31.08 C (SD = 3.09) ( $n = 12$ ). In all cases, individual body temperatures exceeded the corresponding value of substrate temperatures at the site. A noticeable behavior of this lizard was a headbob display. In the field we observed two individuals in close proximity facing and quickly moving their heads up and down while clinging to a vertical wall. Individuals ( $n = 5$ ) of this species also were maintained in a terrarium with rocks and stones, where we observed that an adult male occupied the upper sites of rocks and showed head displays toward subadult individuals located in lower positions.

*Feeding habits.*—this species appears to feed on a variety of insects and other small arthropods. Stomach contents showed mainly Araneae, but also Himenoptera, Formicidae, Diptera, Coleoptera larvae and Grillidae, characterizing this lizard as a generalist insectivore. Stomach contents of some individuals also revealed the presence of nematode parasites.

*Distribution.*—*Liolaemus tandiliensis* is known only from the Tandilia Mountain Range System (Fig. 3). Localities where this species was found included the Sierra de los

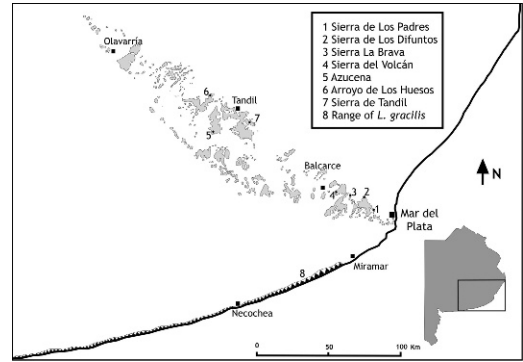


FIG. 3.—Known distribution of *Liolaemus tandiliensis* n. sp. and distribution range of *L. gracilis* in Buenos Aires province of Argentina.

Padres, Sierra de Los Difuntos (both in the Sierras de Mar del Plata subsystem) and also the Sierra La Brava, Sierra del Volcán and Sierra La Vigilancia (included in the Sierras de Balcarce subsystem). We also studied specimens deposited in MACN that were registered for the “Sierra de Tandil”, Tandil, Azucena, and the Arroyo de Los Huesos. The range of the new species appears to be constant all over the area of Tandilia System (Fig. 3), but as the extreme NW point of Tandilia (subsystem of Sierras de Olavarría) was not yet surveyed, we cannot confirm the new species for this zone.

## DISCUSSION

### *Natural History*

Ecological differences between *Liolaemus tandiliensis* and *Liolaemus gracilis* are mainly related to their habitat use. *Liolaemus tandiliensis* is apparently endemic to the Tandilia ridge of mountains and is a genuine saxicolous form, while *L. gracilis* inhabits the coastal sand dunes of Buenos Aires and is a strictly arenicolous form. Although *L. gracilis* is more of a generalist than *L. tandiliensis* in relation to habitat use, it has been found on sandy substrates in many parts of its range (Scolaro, 2005; Vega and Bellagamba, 1992; Videla and Puig, 1994). Otherwise, marked differences in feeding habits or reproductive mode were not observed. Both, *L. tandiliensis* and *L. gracilis* (Vega, 1999) appear to be generalist foragers. Reproductive data on *L. tandiliensis* show signs of a seasonal reproductive cycle, but,



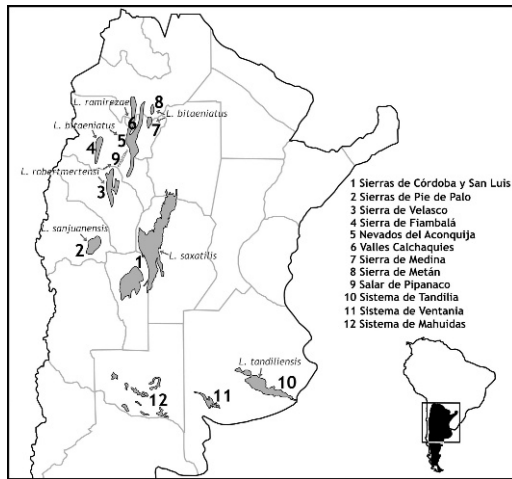


FIG. 4.—The range of mountains of Tandilia, Ventania, Mahuidas, Pampeanas and Subandinas in Argentina and the known distribution of some members of the *alticolor* group of *Liolaemus*.

due to the fragmentary records, a comparative analyses with other *Liolaemus* species is difficult.

### Biogeography

Tandilia and Ventania are the only two systems of mountain ranges located in the grassy steppe called “pampas” in Argentina (Fig. 3). Both systems are known to have a diversity of taxa and endemism, and this particular feature has led to the consideration that these areas functioned as “orographic islands” (Crisci et al., 2001; Kristensen and Frangi, 1995). The Tandilia range is a discontinuous chain of mountains, hillocks and mounds that rises between 50 m and 250 m over the plain along 350 km. It is made of a Precambrian crystalline basement (Buenos Aires complex, older than 2000 my) and a Palaeozoic sedimentary cover with quaternary dregs (Teruggi and Kilmurray, 1975). The island effect of Tandilia appears similar to that of the Sierras Pampeanas, which has led to the origin of morphologically similar forms, i.e., *L. sanjuanensis* (Sierra Pie de Palo), *L. saxatilis* (Sierras de Córdoba and San Luis), and *L. robertmertensi* in the lower hills of the Sierras de Velasco and Salar de Pipanaco (La Rioja and Catamarca provinces) (Fig. 4). It would also be similar to that of some of the mountain ranges of Sierras Subandinas, which

have originated *L. ramirezae* in the lower mountainous places (under 3000 m) of Valles Calchaquíes (Catamarca and Tucumán provinces), and *L. bitaeniatus* (under 3000 m) in Nevados del Aconquija, Sierra de Fiambalá (western Catamarca), in Sierras de Medina (Tucumán) and in Metán (Salta province) (Fig. 4). Crisci et al., (2001) used two methods, the panbiogeography or compatibility track method and the parsimony analysis of endemism (PAE), for a historical biogeographic analysis of the plant species of the Family Asteraceae inhabiting Tandilia and Ventania. He found a historical pattern that related Tandilia with Ventania, Mahuidas (La Pampa province), Sierras Pampeanas, and Sierras Subandinas to the west (Fig. 4), and with Uruguay and southern Brazil to the east. In one of the optimal trees found by Lobo (2005: Fig. 6), *L. tandiliensis*, *L. saxatilis*, and *L. robertmertensi* were found to be closely related, and the geographic distribution is highly congruent with this systematic pattern. According to the Crisci hypothesis (Crisci et al., 2001), the endemism of these mountainous chains is the result of generally arid conditions during the Tertiary and/or Quaternary geologic periods in southern South America, which led to an eventual isolation and differentiation of these populations in the more elevated areas.

### Phylogenetic Affinities

The primary differences between *Liolaemus tandiliensis* and the typical form of *L. gracilis* are related to features of general pattern. This finding is not surprising because similar differences have been found for other groups (i.e., *alticolor* group, Lobo and Espinoza, 1999, 2004; Martínez Oliver and Lobo, 2002), which in the same manner as this case but unlike other groups of *Liolaemus*, may have recently been isolated and differentiated. Characters of the general pattern provide important information about phylogenetic affinities and have been used recently in a morphology-based phylogenetic analysis of the *chiliensis* group (Lobo, 2001, 2005). *Liolaemus tandiliensis* shares with *L. gracilis*, *L. saxatilis*, *L. sanjuanensis*, *L. robertmertensi*, *L. chiliensis* and *L. nitidus* the extreme reduction of lateral neck folds, and longitudinal and antegular folds are

absent in these species. The lateral surface of the neck is formed by large, lanceolate, keeled, and imbricate scales (equal or nearly equal to the size of the dorsal scales at this level). In addition, *L. tandiliensis* has a differentiated auricular scale and two or three enlarged scales on the anterior margin of ear, as do the Chilean species *L. lemniscatus* and *L. fuscus* (Lobo, 2001, 2005). Morphologically, these species are similar to small forms of the *alticolor* group (Lobo and Espinoza, 1999, 2004), although relationships between these species and that group are not yet very clear. The most current analysis of the *chiliensis* group (Espinoza et al., 2004; Lobo, 2005; Schulte et al., 2000) found species included in the *bibronii* group by Cei (1986, 1993) and those from *alticolor* group sensu Lobo and Espinoza (1999) to form a monophyletic group. *Liolaemus tandiliensis* was included in the morphological analysis of Lobo (2005), (as sp.3), and was found to be a member of the *alticolor* group in one hypothesis (Fig. 1, Node 11) as the sister taxon of *L. gracilis*, whereas in the other hypotheses it is not closely related to *L. gracilis* or was found included in a group formed by *L. saxatilis*, *L. chiliensis*, *L. nitidus* and *L. robertmertensi*. In that study (Lobo, 2005), some data for the *alticolor-bibronii* group, which might provide more valuable evidence of relationships, was not included. The flanks of the body in *L. tandiliensis*, *L. saxatilis*, *L. robertmertensi* and *L. sanjuanensis* have large black spots that in some cases can become fused (see Fig. 1). Other characters that would be interesting to consider are the presence/absence of gravid coloration (which is present in *L. tandiliensis*) and communal nesting (known at this time only for *bitaeniatus* and *ramirezae*) (Espinoza and Lobo, 1996). New detailed studies on the *alticolor-bibronii* clade are necessary to test our hypothesis that these mountain species belong to a natural group and share a common evolutionary history.

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- (syntypes), 2052, 2537, 15978, 121214–16, 121217–19, 154180–81, 19704–06, 19982–83, 653993; MVZ 187756–57, 196545–46, 196759, 180736–37, 199420; REE 2515; USNM 64122, 28. *L. cyanogaster*: AMNH 38065–67; CMNH 64720–24; FMNH 133711, 18, 32–33, 210238–40, 207036–38; MCZ 110468, 126733, 65394, 126724–32, 165179, 7269, 7267, 169369, 7268, 157379–81, 164287–294, 164296–300, 164302–311, 164315–324, 165094–098, 157374–78, 165073–93, 164250–51, 164254, 164271, 164280, 164022–34, 164068–70, 164107, 164108–37, 164138–141, 164144, 164147, 164151–152, 165130–137, 165138, 164165–169, 164182–186, 164366–370, 165119–123, 165099–118, 165124–129, 165141–145; MVZ 188724–25; REE 2525; SDSU 1833–36; USNM 00182. *L. exploratorum* (holotype and paratypes): MLP S-567, S-570, S-571, S-573. *L. fitzgeraldi*: MCZ 7263, 147359–60, 147263; USNM 38937; SDSU 1865; UNRC 3998–4003, 4009–11. *L. fuscus*: AMNH 131833–34; CMNH 64725, 64736; MCZ 38621–26, 165149–50, 65395, 165146, 165147, 165148; MVZ 196565, 59, 62, 46, 48, 50, 74–75, 187804, 187797, 196847; REE 2529, SDSU 1866. *L. gracilis*: CMNH 53495, MACN 4892, 4905, 10899, 23509, 25747, 31573–75, 31654, 34444–53; REE 2969; SDSU 1869, 3409; USNM 164911, UNMdP 219, 220, 224, 225, 343, 344, 352, 353, 462, 474, 480, 496, 564, 1071–76; MACN 2156 (ex CS 20); MCN 2157–2158 (ex CMPS 16.18). *L. gravenhorstii*: AMNH 80054–55, MACN 11998–99, MCZ 154184–85, 65396–97, 38627–28, MNHNC 08–011, REE 2831, 2892–95; USNM 165635. *L. hernani*: MNHNC 2131–32, 2134–35, 2137–42. REE 2565, SDSU 1874–76, AMNH 80054–55. *L. lemniscatus*: AMNH 21145, 18335, 21142–43, 37556; CMNH 64727–30; FMNH 214220–30; MCZ 164037–38, 41, 45, 47, 49, 56, 59, 60, 62–64, REE 2530, 2889–91; USNM 165620, 58710. *L. nitidus*: CMNH 64737, MACN 17315–16, MCZ 165447–50, 165452–53, 65402, 19708, 19979; REE 25192834, 2841, 2954. *L. pagaburoi*: FML 57, 477, 537, 632, 648, 658, 667, 816, 849, 861, 2238, 879, 886, 997, 1048, 1264, 1337, 1829, 889, 891, 2435, 2446, 2454, 2456, 2464, 2633, 2746, 2921, 108, 208, 676, 913, 914, 1074, 1226, 1234. *L. paulinae*: FML 1341; MZUC 19360, 19362–67, 19370–71, 19382, REE 2561. *L. sp. 2*: FML 929, 1265, 1512, 1517, 1519, 1533, 1661, 1663, 1761, 1874, 2779, 3647, 3348, 3649; SDSU 3579–82, FML 1852, 1915, MNHNC 583, 585, 588; MZUC 19392 [3]. *L. ramirezae*: FML 1215, 2196, 2240, 2269, 2275, 2279, 2288, 2299, 2306, 2330, 2383, 2386, 2394, 2402, 2436, 2444, 2450, 2463, 2468, 2473, 2481, 2486, 2498, 2569, 2575, 2944, 1658, 3006, 3333; 3335, 3339; 3345, 3346, 1228, 3431, 3612, 2561, 1367, 2715, 2921. *L. robertmertensi*: FML 1706, 1847, REE 2587–88. *L. sanjuanensis*: FML 1016. *L. saxatilis*: AMNH 65193–99, 126616; SDSU 1736–37. *L. schroederi*: AMNH 131847–48, MCZ 51948–49 (paratypes), 14904, 65404, 126712–13, 164310, 165079, 83–84, 86, 165117, 26, 32, 164251, 99; MNHNC 2480–83, 2487; USNM 165636. *L. tacnae*: MCZ 45806 (holotype), 45807 (paratype), 49210–11. *L. variegatus*: FML 1210. *L. walkeri*: AMNH 63389–90 (paratype), 88324–26; FMNH 81380–89, 95–96; MCZ 43770–75, 43777, 43779–81, 43783, 45815–16, 45818, 45887–88, 45850, 100111; SDSU 1937. *L. yanaculca*: MCN 541 (holotype), 538–540, 542–564, 334–335, 387–393, 680–681, 688–689, FML 1361, 1891, 3339, 6342.

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#### APPENDIX I

*Specimens Examined*.—*L. alticolor*: AMNH 169004, 7287 (cotypes), 38068–70, 13501, 13499–500, 81401–03, 77622–23, 31, 79935–39, MCZ 169004, 7287 (cotypes), 12409, 128518–25, 12409, 149852, 149854–56, 149858. *L. bibronii*: AMNH 80046, 80051, FML 3731, MACN 10790–95, 31656–58, 31627–29; MCZ 14923–24, 15897, REE 2305, 2351–55, 2380, 2406–09, 2461; SDSU 1805, 1810–13. *L. bitaeniatus*: MACN 31688; FML 822, (paratypes), FML 2455, 2918, MCZ 149865–66, MCZ 169547, REE 2597–2600. *L. brattstroemi*: MCZ 165139–40. *L. sp. 1*: FML 1459, 1460, 1521, 1524, 1531, 1527, 973, 3428, 1528, 2351, 1878, 1538, 1871, 1461, 2074, 2477, 2513, 3487, 3492. *L. chiliensis*: AMNH 21140–41, 21144, 80052–53, CMNH 57187, 64719, MCZ 2139