

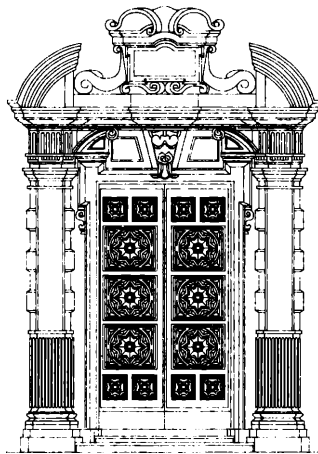
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*archeforus* and *kingii* groups:  
a morphological and taxonumerical  
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## Systematic status and relationships of *Liolaemus* species of the *archeforus* and *kingii* groups: a morphological and taxonumerical approach (Reptilia: Tropiduridae)

### ABSTRACT

A general survey of the several species of the *archeforus* and *kingii* groups of the genus *Liolaemus* was carried out. *Liolaemus tristis* is described as a new species of the *kingii* group, and *L. tari* and *L. escarchadosi* as new species of the *archeforus* group. Discriminant analyses have been made to support the real taxonomic status of the new forms. General considerations on their conditions of evolutionary species in the tropidurid *Liolaeminae* branch were presented.

### INTRODUCTION

The extremely specious genus *Liolaemus* has a distribution in Austral South America that extends from central Perú and south-eastern Brazil southwards to Tierra del Fuego. Among the most austral and poorly known species of the genus, two are of particular interest: *Liolaemus archeforus* Donoso-Barros and Ceí, 1971 and *L. kingii* (Bell, 1843). They are interesting because Laurent (1985) found them to be morphometrically similar, and because they differed from other *Liolaemus* in being "primitive", he suggested the resurrection of *Rhytidodeira* Girard, 1858, as a species group name for them. They are also remarkable because Etheridge (1995) found that these species lack any derived characteristics that would unite them with one other, or with either of the two major species groups that include all other *Liolaemus* species. That is, they lack the small number

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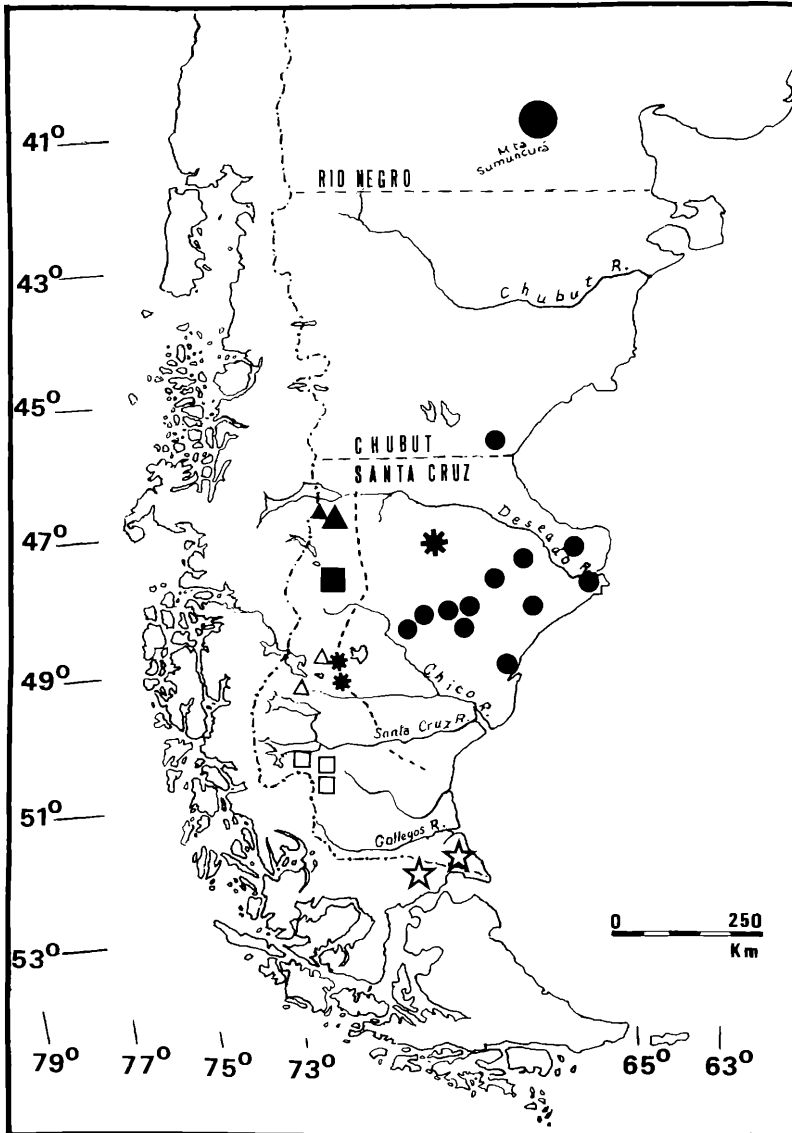


FIGURE 1.- Map of the tentative distribution of the *archeforus* and *kingii* groups of the genus *Liolaemus* from Argentina. Symbols, corresponding only to the samples considered in the present work, are: larger black circle (*L. somuncurae*); small black circles (*kingii*); larger radiated star (*L. tristis*); small radiated star (*L. baguali*); larger black triangle (*L. archeforus*); small black triangle (*L. zullyi*); black square (*L. gallardoi*); white pentagonal star (*L. sarmientoi*); white squares (*L. escarchadosi*); white triangles (*tari*). An irregular broken line indicates the tentative western borders of the *kingii* species group in Santa Cruz Province.

of narrow supralabials that diagnoses his *nitidus* group, and lack the hypertrophied puboischiotalis muscle that diagnoses his *signifer* group. Thus, *Liolaemus archeforus* and *L. kingii* are of special interest within the extremely specious genus *Liolaemus*, because they appear to be the most basal, as well as among the most austral species of the genus.

Until recently, *Liolaemus archeforus* was considered to consist of three subspecies: *L. a. archeforus*, *L. a. gallardoi* Cei and Scolaro 1982 and *L. a. sarmientoi* Donoso-Barros 1973. *Liolaemus kingii* was considered to consist of three subspecies: *L. k. kingii*, *L. k. somuncurae* Cei and Scolaro 1981 and *L. k. baguali* Cei and Scolaro, 1983. However, Cei and Scolaro (in press) considered these subspecies to be diagnosable, allopatric lineages rather than simple pattern classes, and elevated them to species status in accordance with the definition of evolutionary species of Frost and Hillis (1990) and Frost et al. (1992). Because of their close phenetic similarity, Cei and Scolaro (1996) recognised the former subspecies of *L. kingii* as a “*kingii* species group” and the former subspecies of *L. archeforus*, together with a new species, *Liolaemus zullyi* (1996), as an “*archeforus* species group”.

Recent field work in Santa Cruz Province has led to the discovery of an additional new species of the *kingii* group and two new species of the *archeforus* group, described below (Fig. 1).

#### THE *KINGII* SPECIES GROUP

Species of the *kingii* group (including the above mentioned new species) may be characterised as having not strongly keeled but distinctly imbricate dorsal body scales, numbering from 72 to 97 at midbody ( $x = 79.15$ ; see also Tables 1 and 2); a snout-vent length from 62 to 100 mm; a relatively short forelimb; a reddish or yellowish-brown dorsal color pattern with prevailing distinct white

	Males ( n = 11 )		Females ( n = 11 )	
	mean(S.D.)	range	mean(S.D.)	range
snout-vent length (mm)	77.1(5.70)	68.5-85.5	72.9(3.10)	67.0-79.0
head width/head length rate	0.97(0.04)	0.87-1.00	0.93(0.03)	0.89-0.98
snout-vent/forelimb rate	3.22(0.20)	2.85-3.62	3.21(0.13)	3.03-3.44
axilla-groin/hindlimb rate	0.89(0.05)	0.82-0.97	1.05(0.04)	1.01-1.14
scale number at midbody	77.6(3.55)	71-84	77.4(2.38)	74-84
precloacal pore number	8(1.18)	6-10	-----	-----

Table 1 - Variation of some morphometric counts and measurements in *Liolaemus tristis*, type and paratypes (means, S.D. and range).

Variables	<i>L. somuncurae</i> (N = 14)	<i>L. baguali</i> (N = 21)	<i>L. kingi</i> (N = 28)	<i>L. tristis</i> (N = 23)
Snout-vent length (mm)	76.3 (5.7)	81.8 (6.1)	80.4 (7.2)	74.8 (5.3)
Head length (mm)	14.9 (1.0)	15.3 (1.5)	15.3 (1.9)	13.9 (1.5)
Head width (mm)	13.2 (1.1)	13.9 (1.6)	13.9 (1.9)	13.4 (1.5)
Fore limb length (mm)	24.4 (2.0)	25.4 (1.9)	23.5 (2.2)	23.3 (1.3)
Hind limb length (mm)	39.1 (2.5)	41.1 (2.7)	38.4 (4.4)	37.5 (2.8)
Axilla-groin length (mm)	38.0 (4.5)	39.0 (4.3)	40.1 (4.3)	36.2 (2.5)
Fourth finger lamellae	19.8 (1.4)	21.5 (1.3)	19.2 (1.6)	17.8 (0.7)
Scale number around midbody	79.1 (3.0)	81.1 (2.9)	80.1 (5.1)	77.1 (2.9)
Supralabial scale number	8.5 (0.5)	8.2 (0.6)	8.7 (0.8)	8.3 (0.5)
Infralabial scale number	5.8 (0.4)	5.9 (0.5)	6.3 (0.8)	5.8 (0.6)
Red scales percentage (%)	0.3 (0.2)	1.2 (5.5)	52.0 (26.3)	0.3 (0.1)
Ventral pigmentation (%)	53.6 (8.7)	94.0 (10.6)	52.7 (22.5)	71.7 (18.5)

Table 2. Treated information for all considered variables in discriminant analysis. Values represent Mean and Standard Deviation (SD).

or yellowish, black bordered bands mainly with conspicuous central spot, and more unusually showing some longitudinally recognisable dorso-lateral markings or stripes; a very low or void percentage of red and deep orange scales in dorso-lateral patterns; a whitish grey or yellowish belly, more or less mottled with black in the most specimens, seldom melanic; a number of preanal pores ranging from 5 to 10.

Related characteristics are shared by the species of the *archeforus* group, but their dorsal scales are more strongly keeled and sharply imbricated, numbering from 58 to 78 at midbody ( $\chi = 68.94$ ; see also Tables 4-5); the snout-vent length ranges from 64 to 102, measures not diagnostic but suggesting a somewhat stouter body in the *archeforus* lizards; the forelimb is larger (see Tables 3-5); the dorsal ground color is dark grey or brownish, with white or yellowish transverse streaks or broken lines, irregular and almost indistinct in many specimens, broken dorso-lateral stripes being likewise recognisable in several species of the group; a noticeable percentage of red or deep orange scales is generally observed; the belly is strongly mottled by black, or dusky black, a whole ventral melanism being a very usual condition in most of these forms; the number of preanal pores ranges from 6 to 8.

Thus, for the *kingii* group, as well as the *archeforus* group, common morphological trends, but also several characteristics in which they differ, can be noted. Both the groups can be sufficiently diagnosed by the above reported general differences in the number of scales at midbody, the different forelimb length, and their significantly distinct general dorso-ventral color patterns. Among the shared similar conditions could be included the general body shape and size, the general morphological lepidosis features, the tail ratio about one and a quarter, or fifth, as long as the snout-vent, the number of preanal pores, but above all the lack of any derived characteristics that "would unite them with one another, or with either of the two major species

	Males ( n = 7 )		Females ( n = 7 )	
	mean(S.D.)	range	mean(S.D.)	range
snout-vent length (mm)	87.8(11.9)	77.2-102	84.0(10.6)	70.1-100
head width/head length rate	0.91(0.02)	0.88-0.94	0.93(0.02)	0.89-0.96
snout-vent/forelimb rate	3.02(0.26)	2.60-3.28	3.28(0.45)	2.69-3.57
axilla-groin/hindlimb rate	0.89(0.07)	0.76-0.98	1.08(0.07)	1.02-1.22
scale number at midbody	72.8(3.90)	67-77	66.7(2.30)	63-70
precloacal pore number	7(0.81)	6-8	-----	-----

Table 3 - Variation of some morphometric counts and measurements in *Liolaemus tari*, type and paratypes.

groups including all other *Liolaemus* species” (see Introduction).

As concisely indicated in Fig. 1 the geographic distribution of these species groups provides some significant trends of their present dispersal. The *kingii* group has an extensive eastern range in the Patagonian provinces, from southern Rio Negro to the Atlantic shores of Chubut and Santa Cruz, reaching nearly the estuary of the Santa Cruz river southwards (50°S) and the volcanic embossments south the Cardiel lake eastwards (72°W). The *archeforus* group shows a subandean and austral distribution, only in Santa Cruz province, from its northernmost boundaries to the Strait of Magellan southwards.

Among the *kingii* species group, the northernmost *Liolaemus somuncurae* is an endemic inhabitant of the isolated basaltic Somuncurá plateau, from 1300 to 1400 m a.s.l.; the more widespread and polymorphic *L. kingii*, as well as the apparently localised taxon to be described below, is also found mainly in volcanic regions of Santa Cruz, from the Atlantic shores to the summits (1000-1200 m a.s.l.) of the more or less isolated central tablelands (“mesetas”), covered by the arid Patagonian steppe and characterised by rocky, dry environments such as the basaltic ravines or sandy and stony flats; *L. baguali*, at last, lives in similar basaltic landscapes, in the desert Sierra del Bagual (900 m a.s.l.) and neighbouring scarped tablelands (49°20’S, 72°00’W).

The *archeforus* species group assembles in its northernmost area two easily recognisable taxa: *Liolaemus archeforus* from the volcanic tableland south of Buenos Aires lake and its morrenic borders, between 800-1500 m a.s.l., and *Liolaemus zullyi* (Cei and Scolaro, 1996) from the western sharpened slopes of the same tableland to the deep river bed of the Jeinement Stream, at about 700-800 m a.s.l., surrounded by relicts of the ancient *Nothofagus* forest, from some 40 km south of the Buenos Aires Lake to the Posadas Lake southwards. No intergradation or intermediate forms have been still observed, in spite of the extreme neighbourhood of these species along their peculiar habitats.

	Males ( n = 17 )		Females ( n = 14 )	
	mean(S.D.)	range	mean(S.D.)	range
snout-vent length (mm)	82.2(4.14)	73.0-90.0	81.0(4.99)	73.5-91.0
head width/head length rate	0.85(0.03)	0.81-0.91	0.91(0.03)	0.86-0.97
snout-vent/forelimb rate	3.07(0.14)	2.88-3.40	3.18(0.19)	2.80-3.50
axilla-groin/hindlimb rate	0.91(0.11)	0.76-1.07	1.12(0.04)	1.06-1.21
scale number at midbody	67.3(4.40)	60-76	63.1(3.21)	55-67
precloacal pore number	6.6(1.00)	5-8	-----	-----

Table 4 - Variation of some morphometric counts and measurements in *Liolaemus escarchadosi*, type and paratypes.

Variables	<i>L. escarchadosi</i> (N = 24)	<i>L. tari</i> (N = 21)	<i>L. sarmientoii</i> (N = 15)	<i>L. archeforus</i> (N = 20)	<i>L. gallardoii</i> (N = 21)
Snout-vent length (mm)	82.6 (5.1)	87.4 (9.2)	81.3 (3.8)	82.1 (6.8)	78.3 (9.1)
Head length (mm)	15.7 (1.3)	16.2 (1.5)	17.3 (1.4)	16.4 (1.7)	15.6 (2.1)
Head width (mm)	13.8 (0.8)	15.9 (1.8)	14.6 (1.3)	13.7 (1.5)	14.2 (2.1)
Pore limb length (mm)	26.3 (1.6)	27.3 (1.7)	27.2 (1.5)	26.0 (2.2)	25.2 (2.3)
Hind limb length (mm)	41.5 (3.0)	44.6 (5.8)	41.0 (3.5)	40.7 (3.1)	39.5 (4.5)
Axilla-groin length (mm)	42.1 (5.0)	44.6 (5.8)	39.5 (2.8)	41.8 (4.3)	38.5 (3.9)
Fourth finger lamellae	18.3 (1.5)	19.1 (1.9)	17.7 (0.8)	19.5 (2.2)	18.9 (1.4)
Scale number around midbody	65.2 (4.6)	71.0 (3.8)	65.4 (1.9)	72.8 (3.2)	70.3 (3.3)
Supralabial scale number	8.2 (0.7)	8.1 (0.7)	7.7 (0.6)	8.1 (0.8)	8.7 (0.7)
Infralabial scale number	5.8 (0.5)	5.8 (0.4)	5.5 (0.6)	5.2 (0.4)	5.6 (0.6)
Red scales percentage (%)	36.7 (26.5)	64.3 (32.3)	73.3 (24.0)	22.7 (26.6)	1.2 (5.5)
Ventral pigmentation (%)	96.9 (8.3)	94.0 (10.6)	90.0 (15.3)	81.2 (10.8)	54.8 (12.5)

NOTE - *L. zutivi*, is not included in the present discriminant analysis, its description was still in press when this paper was coming to its end.

Table 5 - Treated information for all considered variables in discriminant analysis. Values represent Mean and Standard Deviation (SD).



Another species, *Liolaemus gallardoi*, is known from the cold, harsh volcanic tablelands extending from the Belgrano Lake or the Meseta del Aguila-Asador northwards and the Lake Strobel and Quiroga basin southwards (47°40'S-48°20'S). The southernmost taxon, *Liolaemus sarmientoi*, occurs in the open steppe range along the rivers and springs of the Gallegos and Coyle drainage

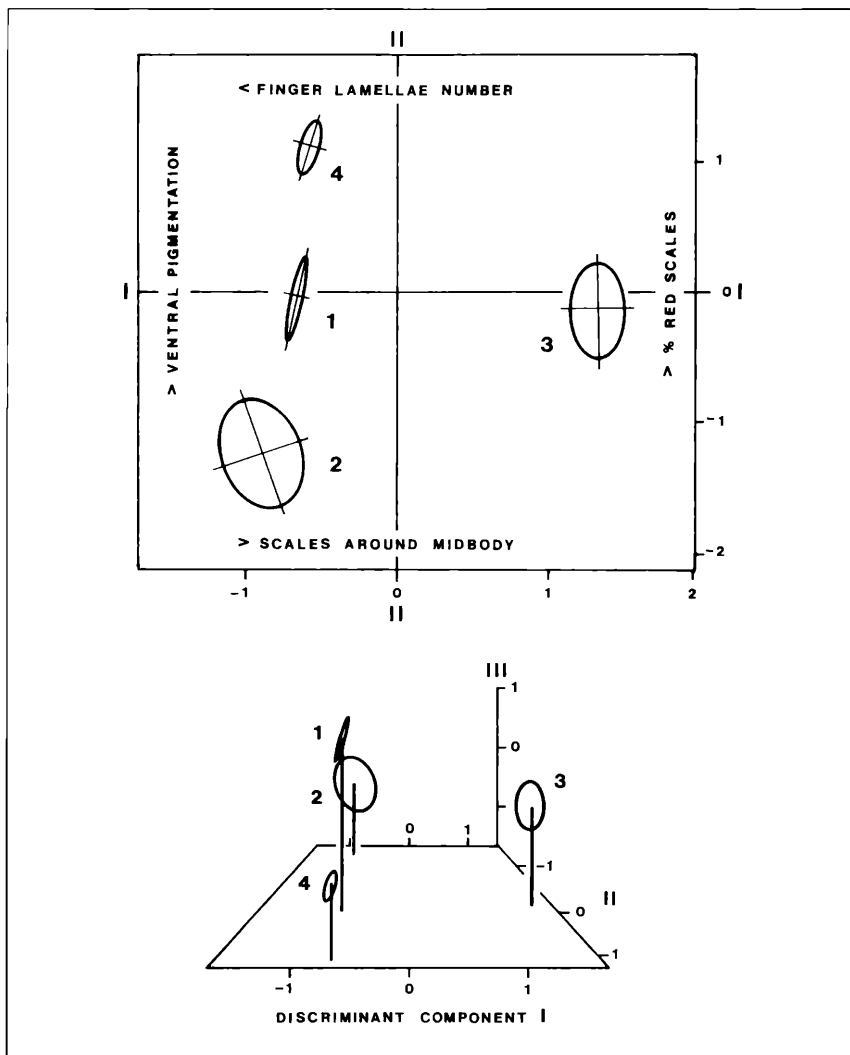


FIGURE 2.- Ellipses of equiprobability for all the cases ( $P < 0.05$ ): 1. *Liolaemus somuncurae*, 2. *L. baquali*, 3. *L. kingii* and 4. *L. tristis*. In the lower graphic are represented the three canonic axes that define each group centroids (ellipses drawn  $\times 0.3$  app.).

systems, reaching the stony neighbours of the Strait of Magellan (Fig. 1). Differing from the other saxatile species of the group, a more versatile ecology is indicated by the dense *Festuca*, *Poa* or *Stipa* meadows scattered by the thorny Patagonian black bush (*Nassauvia*, *Berberis*) in which *Liolaemus sarmientoi* takes refuge. The two new species of the *archeforus* group whose description shall follow, also are typical inhabitants of stony or basaltic environments. Ravines and stony Patagonian steppe are their habitats, in the volcanic regions north the Viedma Lake and south the Argentino Lake, respectively (Fig. 1 and 3).

All of known taxa of these austral species groups are viviparous, on the basis of careful, repeated personal observations (Ceï, 1975, 1986; Ceï and Scolaro, unpublished data). Reproductive females give birth to three, four or more young each, generally in January and February. A pregnant female of the new species from the *kingii* group to be described below, is reproduced in the photograph at the Color Plate 2 of this paper. No eosine/orange pigmentations on the sides of the head and neck has been observed in all of the species of both group. That is a characteristic feature of gravid females of several species of *Liolaemus* (Etheridge, 1993).

The description of a new species of the *kingii* group will follow.

#### ***Liolaemus tristis* sp. nov.**

**Holotype.** MRSN R-1204-1, adult male: Meseta de las Lagunas Sin Fondo, 70-80 km south of Las Heras, at about 47°S-69°20'W, west of the Ruta Provincial 501 from Pico Truncado to Laguna Madre e Hija, eastern Santa Cruz Province, Argentina, 900-1100 m a.s.l., collected by J. A. Scolaro, 22 January 1981.

**Paratypes.** Males: MRSN R-1204-2,3 (adults), from the same locality and date of collection as the holotype; MRSN R-1076-1,2,4,5,6 (adults) and MRSN R-0079-1,2,15 (adults), the same locality as the holotype, collected by J.A. Scolaro and J.A. Upton, 16 February 1988; Females: MRSN R-1204-4 (adult), MRSN R-1076-3 (adult), MRSN R-0079-3 to 8,13,14,16 (adults); MRSN R-0079-9,10,11,12 (young).

**Diagnosis.** *Liolaemus tristis* is a member of the *kingii* species group, and within this group differs from *L. kingii* in having a very different chromatism, lacking the well defined dorsal color pattern of *L. kingii*, with 12-13, black-bordered, white broken bands, showing a notorious central white spot on the flanks and extending on a brownish background from the neck to the proximal portion of the tail. Such a typical "*kingii* pattern" is replaced on the back of *L. tristis* by a reddish brown confused coloration, scattered with minute whitish speckles irregularly edging the tips of its scales and assembled in some lighter transverse marks (10-12) on the vertebral-paravertebral region (Color Plate 1). Specific chromatic differences are improved in the female specimens, being their dorsal color pattern quite similar to that of the male in *L. kingii*, but showing in *L. tristis* two symmetrical dorso-lateral lighter brownish stripes (two scales

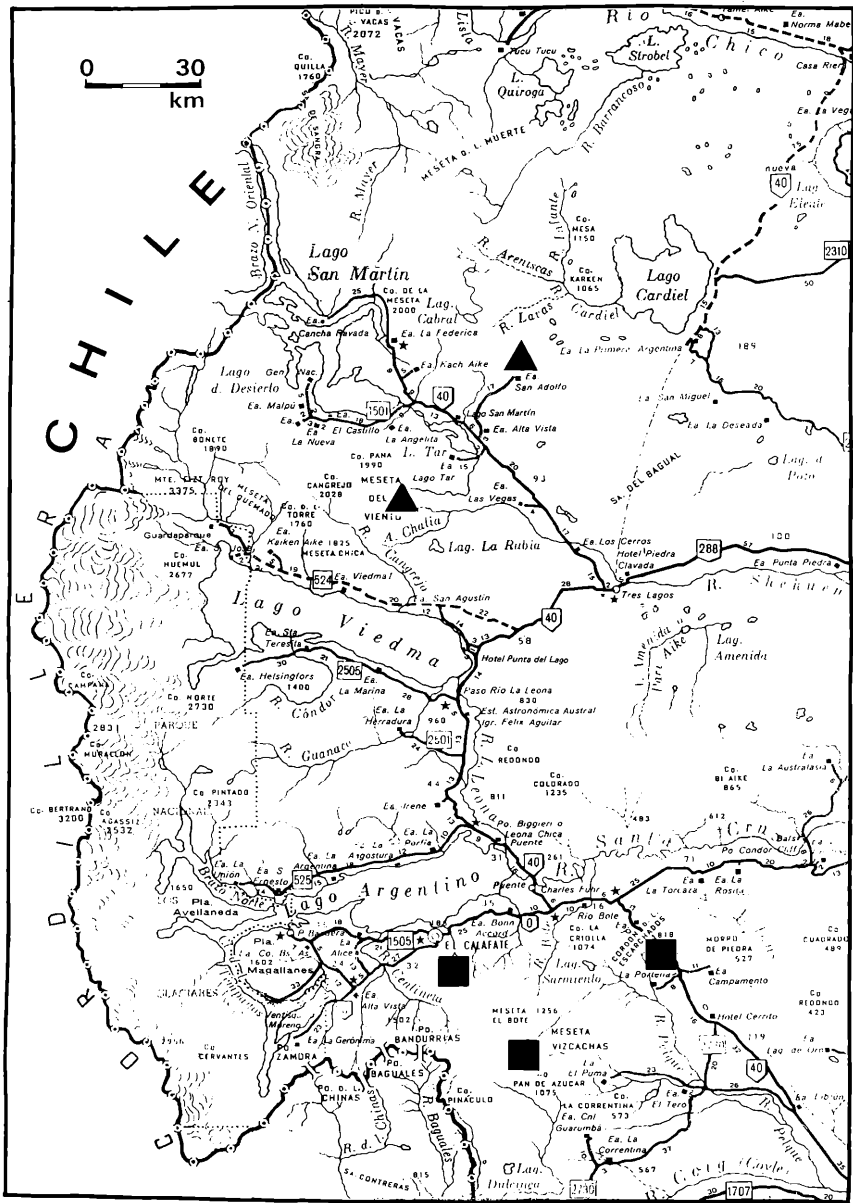


FIGURE 3.- Reported samples of *Liolaemus tari* (black triangles) and *Liolaemus escarchadosi* (black squares) from Santa Cruz (Argentine Patagonia). The periglacial distribution of these forms and the probable important part played by the great glacial lakes as geographic isolating barriers, can be pointed out.

each) entering from the neck the proximal portion of the tail, also on a darker ground quite similar to that of the males, although more irregularly speckled with the minute whitish spots (Color Plate 2). A minor morphological characteristic could be included for taxonomic distinction between *L. kingii* and *L. tristis*: the more salient and bulky cephalic scales of this latter, mainly in the parieto-occipital region. Although several other metric or meristic characters could suggest some interspecific differences, a still broader overlap in their ranges prevent them to be considered diagnostic.

*Liolaemus tristis* differs from *L. baguali* in having a still more distinct dorsal color pattern, contrasting with the impressive homeomorphic color pattern of *L. baguali*, showing a velvet black background with bluish reflections when exposed to the sun, crossed by 9-10 evident white bands (1-2 scales each), chevron-like on the vertebral line: a whole black, or melanic, venter and throat is also a peculiar character of *L. baguali*, absent at all in our new species *L. tristis*.

*Liolaemus tristis* differs from *L. somuncuræ* in having males slightly larger than females, which are significantly larger than males in *L. somuncuræ* (Cei and Scolaro, 1981). *Liolaemus tristis* is also clearly diverging in having a quite distinct color pattern, which in *L. somuncuræ* shows a homeomorphic, almost uniform, brownish background, extending on tail and limbs, finely speckled with many minute yellowish spots edging the tip of scales and forming transversally some very narrow, somewhat irregular, lighter streaks (16-18) from the neck to the proximal portion of the tail. Characteristic of the *L. somuncuræ* pattern is the blackish strongly pigmented area on the occipital region, or "pileus", absent in *L. tristis*.

**Description of the Holotype.** A slender form, snout-vent length (SVL) 72.5 mm; tail 81 mm; head length 13 mm; head width 12.5 mm; hind limb 36.1 mm; fore limb 23.5 mm; axilla-groin distance 32 mm; scales around midbody 77; supralabials 6; number of sub-digital lamellae on the fourth toe of the right foot 24; number of sub-digital lamellae on the fourth finger of the right hand 18; precloacal pores 9. Cephalic scales slightly rough; supra-orbital semicircles irregular, not complete; 5 unequal posterior supraocular scales, separated by 2-3 rows of minute, irregular granular scales from the sharply keeled 5 superciliaries; temporals irregular, smooth or weakly keeled; rostral broader than high; nasals lateral, separated by 4 squared scales; one row of nearby equal lorilabials; ear opening oval, with very small irregular scales on its anterior border and very small granular scales posteriorly; lateral granules on the neck; a longitudinal fold behind the ear reaching the shoulder, above the moderate prehumeral pocket; parietals and interparietal slightly rugous, almost equal; nuchals small, irregular and keeled; dorsals strongly keeled, larger and in regular longitudinal rows on the vertebral and paravertebral region, smaller but sharply keeled on the flanks; keeled scales on the tail and posterior upper hind limbs almost smooth on fore limbs and anterior upper hind limbs; ventral caudal scales slightly keeled or smooth, subtriangular.

Color in the living specimen as in the *Diagnosis* (Color Plate 1,2,3, dorsal and ventral view). Color in preservative: a brownish or dark grey dorsal ground, showing paler or whitish marks, and darker bands on the flanks; ventrally marbled by black; precloacal pores whitish, but deep orange in the living specimen.

**Variation.** Variations in scale counts, preanal pore number and measurements are given in Table 1. As shown in the Table, the only dimorphic condition supported by the examined paratype variation is a significant major axilla-groin distance in the females: on the other hand, this characteristic is an usual morphological feature in all of the other species of the *kingii* and *archeforus* groups (Cei: unpublished data). The general trends of the sexual variation in the color pattern have been reported in our former diagnosis of *Liolaemus tristis*. The brownish dorsal background scattered with minute whitish marks, usual in the males, is present with more lively tonality in the females, where lighter bilateral strikes also appear. The individual variation of such a color pattern can lead to a major or minor expression of the scattered whitish or yellowish dorsal marks in both sexes, and of the lighter bilateral strikes in the females. The reduced intensity of that chromatic detail can also determine in some specimens a somewhat confused or almost indistinct female color pattern. No peculiar sexual or individual variation of the ventral color pattern can be emphasised for male or female of *Liolaemus tristis*. Exceptionally pigmented scales may yield a very dark or black belly in both sexes, but a typical melanism is an unusual condition in all of the observed specimens.

No data on geographic variation of color pattern are available, given the scarcity of the still obtained samples of the new species and its apparent localisation in the arid central stony area of Santa Cruz province.

**Etymology.** The specific Latin name *tristis* comes from the generally dark and monotonous dorsal pattern emphasised by the pale brownish longitudinal stripes in the females.

**Natural History.** Due to lack of more extensive field observations, few general remarks are available about the biological or ecological features of these somewhat rare and secretive lizards. Their habitat are the characteristic dry Patagonian environments, in a tabular, broken volcanic landscape, in which rocky hollows and isolated basaltic ravines rise. In spite of the local name of "Meseta de las Lagunas Sin Fondo", no permanent lagoons or natural bogs have been observed in the area of our former collections. The thinly scattered shrub of the Patagonian steppe is there the vegetal cover, with *Verbena tridens*, *Berberis*, *Stipa*, bushes and the thorny pads of *Chuquiraga sp.* as dominant elements. Very cold, dry, snowy winters are the rule: an almost continuous windiness is another peculiar trait of this climate.

Lack of a regular research, our information on alimentary habits and general behaviour of these tropidurids is still very poor. They make basking in the

late hours of the morning and in the afternoon, feeding presumably mainly on arthropods. Such as the other species of the group, *Liolaemus tristis* is viviparous and pregnant females captured in January gave birth in February to three, four or more young each.

**Distribution.** Known exclusively from the collected samples in its relatively wide and poorly known "terra typica" in Santa Cruz. Probably the form could be extended more westwards, towards the area of the glacial Buenos Aires lake. Further collecting is necessary to define and understand its real whole distribution.

### RESULTS OF THE DISCRIMINANT ANALYSIS

To test the specific fitness of the new taxa and to examine the intra-group relationships, a discriminant analysis was performed. A previous principal components analysis was carried out including continuous and discontinuous variables. Such analysis allowed us to reduce the total number of variables to be used in the discriminant analyses, strengthening the distinctive group features. Variables with similar contribution to the explained variance in each canonical axis, or that were not significant, or that were absent in one of the taxa considered, were disregarded. A numerical evaluation of some chromatic patterns was added to the statistical treatment with discontinuous variables. These variables, arranged according to an arbitrary numerical scale, were applied by careful comparative observations, following our previous surveys (Scolaro and Cei, 1987, 1991). They were "lateral red scales percentage" and "ventral pigmentation", referring, respectively, to the number and to the relative and to the relative chromatophore density of red or black color in the scales. The data from these variables were standardized to approach a normal distribution according to Hafner et al. (1982).

The Foucart's methods were applied emphasising the intergroup variance, maintaining the total variance equal to one, and nullifying the inter-group covariance (Foucart, 1982). Variables showing significant differences between groups were analysed for normalcy by using Snedecor's F test. When normal Gaussian distribution was observed, the comparison between means was made by the Student t test. When character distribution were not normal, the Mann-Whitney U test and the Proportions' test have been used.

A total of 12 variables were selected, and the included 82 specimens have been assembled in the following samples: *L. somuncurae* (n = 14), *L. baguali* (n = 17), *L. kingii* (n = 28) and *L. tristis* (n = 23). The treated information for all considered variables are summarised in Table 2.

The analysis provided three significant canonic axes for the samples considered. Canonic axis I absorbs 47.2% of the total variance, canonic axis II absorbs 35.4% and canonic axis III the remaining 17.4%. Canonic axis I allows the separation of *L. kingii* from the remaining samples, associating in its positive sec-

tor most of the variables having a major expression in *L. kingii* in comparison to the rest, such as lateral red scales percentage ( $P < 0.001$ ), supralabial and infralabial scale number ( $P < 0.05$ , respectively). Other significative variables assembled are related to the major values in *L. kingii* when compared with *L. tristis* and *L. somuncurae*, such as the snout-vent length ( $P < 0.05$ ) and axilla-groin length ( $P < 0.05$ ). In the negative sector of the axis, only the variable ventral pigmentation is associated because of its minor value in *L. kingii* when compared with *L. baguali* ( $P < 0.001$ ) and *L. tristis* ( $P < 0.01$ ).

The canonic axis II associates only in the negative sector the variables that exhibits major values in *L. baguali*, which allow its separation from *L. tristis* (in the positive sector), such as the scale number around midbody, fourth finger lamellae number, hind limb length, fore limb length and head length (all  $P < 0.001$ , respectively), snout-vent length ( $P < 0.01$ ) and axilla-groin length ( $P < 0.05$ ).

According to Foucart's method, the last canonical axis III can be interpreted in biological terms; it provides only one variable, ventral pigmentation, in the negative sector, that contributes to a clearer separation of *L. somuncurae* (in the positive sector). This variable exhibits minor value in *L. somuncurae* when compared with *L. tristis* ( $P < 0.01$ ) and *L. baguali* ( $P < 0.001$ ).

Other variables also permit consistent separation between *L. tristis* and *L. somuncurae*; a greater numerical value is shown by the latter for the variables such as the fourth finger lamellae number ( $P < 0.001$ ), fore limb length ( $P < 0.01$ ), scale number around midbody and head length ( $P < 0.05$ , respectively). On the other hand, *L. tristis* can be also distinguished from *L. kingii* by a smaller value in the variables head length and scale number around midbody ( $P < 0.01$ , respectively) and fourth finger lamellae number ( $P < 0.001$ ).

Analysing the distance between centroids of the samples, it may be pointed out a remarkable equidistance between *L. kingii*, *L. baguali* and *L. tristis*, being *L. somuncurae* at intermediate position from both *L. baguali* and *L. tristis* and some more distant from *L. kingii*. That is pointed out by both the graphics in the Fig. 2, where relationships between ellipses of equiprobability for all the cases are shown. To verify the validity of the discriminant analysis, all the data were grouped and checked against individual cases. Among species a total of 90.2% of cases were correctly classified; for *L. tristis*, the high number of well classified cases (95.5%) may be considered in agreement with the postulated category of evolutionary species for the new form.

#### THE ARCHEFORUS SPECIES GROUP

Diagnostic characters of this group have been given in the comparative analysis carried out at the beginning of our former paragraph devoted to the *kingii* group and its taxa. Equally a summarized geographical survey of the several taxa belonging to the *archeforus* group and their Patagonian distribution was presented in the same introductory paragraph. Two not yet identified species

of this group have been also considered in the above mentioned examination of the basal or likely primitive “*kingii*” or “*archeforus*” *Liolaemine* lizards. Both species were indicated as being morphologically related to the southernmost taxon *Liolaemus sarmientoi* from the Argentina or Chilean regions neighbouring the Strait of Magellan. Their disjoined ranges extend in the mostly volcanic periglacial areas bordering the great glacial basins of the Viedma lake and the Argentino lake, from 49°S to 51°S approximately. In spite of the frail support offered to their taxonomic distinction by the most part of their broadly overlapping morphometric characters, easily recognizable differences in color pattern, together with the topographical isolation, the evident allopatry, and the apparent lack of morphologically intermediate populations, may justify to postulate a specific status for these forms, fitting in the recently proposed paradigm of the evolutionary species, such as in the just cited concepts of Frost and Hillis (1990) and Frost et al. (1992).

The northernmost populations inhabiting the volcanic tablelands between the San Martín-Tar lakes and the Viedma lake, as well as the tablelands northwest of the Shehuen River or Chalia River, shall be the first of the new species to be described below.

#### ***Liolaemus tari* sp. nov.**

**H o l o t y p e .** MRSN R-1202-1, adult male: type locality, Meseta del Viento, 1150 m a.s.l., 20 km SW of Tar Lake, Santa Cruz Province, Argentina, collected by J.M. Cei and J. Olazabal, 13 March 1982. Collected in volcanic ravines on the summit of the tableland.

**Paratypes .** Males: MRSN R-1202-2, R-77-1 (adults); R-77-5 (half-ground); JMC-DC 757, 759, 760 (adults). Females: MRSN R-77-2, 5, 6, 8; R-78-1 (adult); R-78-2, 5 (half-ground). The same locality and data of the Holotype.

**D i a g n o s i s .** Within the *archeforus* group, *Liolaemus tari* differs from *L. sarmientoi* in having a major number of scales at midbody in males (see Table 3), showing this latter a mean of 65.6 ( $n = 12$ ;  $SD = 2.15$ ; range = 63-70;  $P < 0.001$ ). It also differs in having a broader head, showing the males of *L. sarmientoi* a mean of 0.85 ( $n = 12$ ;  $SD = 0.03$ ; range = 0.79-0.90;  $P < 0.001$ ). *L. tari* exhibits a different dorsal pattern, such as synthesised in Fig. 4 (A-B). Our simple sketches indicate there a vertebral stripe of 7-10 black scale rows with unpigmented whitish or yellowish terminal points, successively followed in *L. tari* by 3-4 black scale rows with a longitudinal series of rounded spots, 2-3 bright red scales each, which extend up to the melanic venter with a wide zone of 16-18 blackish scale rows irregularly scattered by scarce white, yellowish or red minute marks: however, in *L. sarmientoi*, under the sprinkled dark vertebral stripe, a similar zone of 3-4 black scale rows longitudinally punctuated with evident spaced spots of 2-3 scales each, appears continued up to the melanic



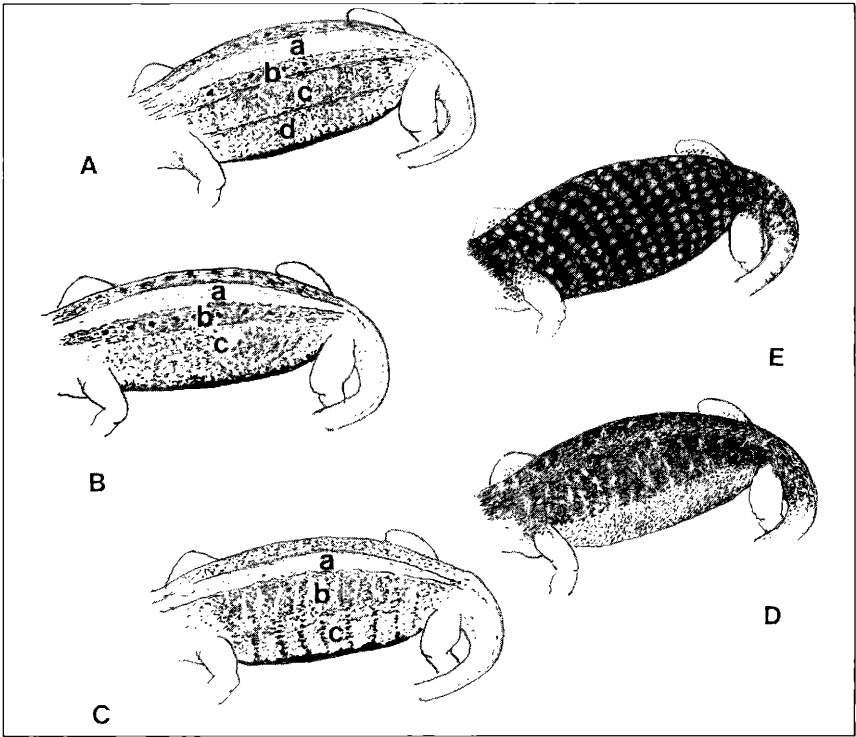


FIGURE 4.- Diagrammatic sketches synthesising the fundamental dorsal color patterns of the *archeforus* group, shown by A- *Liolaemus sarmientoi*, the nearly related species B- *L. tari* and C- *L. escarchadosi* (Color Plates 3-6), D- *L. gallardoi* and E- *L. archeforus*.

A- From a wide vertebral stripe (a) of 7-10 black scale rows with not pigmented yellowish areas on terminal points, successively follow: (b) 3-4 black scale rows with evident spaced marks of 2-3 red scales; (c) 8-9 black scale rows with alternate irregularly broken transverse white lines of almost not pigmented scales; (d) 12-14 scale rows, alternating black, red or whitish scales until the ventral, often melanic, scale rows.

B- From a wide vertebral stripe (a) of 8-9 black scale rows, with not pigmented yellow or whitish points, successively follow: (b) 3-4 black scale rows with a longitudinal series of rounded spots, 2-3 red scales each, sometimes included in a narrow, diffuse red band; (c) 16-18 black scale rows irregularly scattered with red, white or yellowish marks until the marbled yellow-black or whitish-black borders of the generally melanic ventral scales.

C- From a vertebral stripe (a) of 4-5 dark scale rows with largely not pigmented yellowish or pale brownish areas on terminal points, successively follow: (b) a wide zone of 14-16 blackish scale rows with narrow whitish terminal borders, showing some 8-11 spaced transverse whitish broken lines, 1-2 scales each; (c) a lower ventrolateral zone of about 12-14 yellowish or reddish scale rows, until the ventral melanic scales, being crossed such a lower ventrolateral region by several (9-11) transversally spaced bands of black and white scales.

D- A pattern with almost regularly arranged white or yellowish rounded spots, scattered on a dark dorsal background.

E- An almost uniform dark or blackish dorsal background, without evident light vertebral stripe and showing faint whitish dorsolateral marks, until a confuse ventrolateral zone characterised by deep red coloration from axilla to groin.

venter by 20-22 scale rows which are divided in two lengthwise zones, one upper somewhat narrower zone of 8-9 scale rows with alternate, irregularly broken, transverse lines of whitish scales, and another wide lower zone making evident several somewhat irregular transverse bands of bright red and black or whitish scales. A black and white ringed tail, moreover, is an usual chromatic feature of *L. tari*, being a very unusual one in *L. sarmientoi* (Color Plates 3-5).

*Liolaemus tari* is distinguishable at first sight from the allopatric species of the same group *L. gallardoi* and *L. archeforus*, in having a quite different color pattern, characterized in both these taxa by a blackish dorsal background transversally crossed by more or less regularly arranged whitish or yellowish spots (*L. gallardoi*), or marks (*L. archeforus*), being the reddish or orange scales present in *L. archeforus* always assembled mostly in the ventrolateral region (Fig. 4, D-E). From the recently described *Liolaemus zullyi*, the new species *L. tari* is obviously recognizable by the significant difference ( $P < 0.001$ ) in body size (range in *L. zullyi* 65-77.5 mm in males, 62-67 mm in females); by the significant difference ( $P < 0.001$ ) in the number of scales at midbody (range in *L. zullyi* 78-97 in males, 78-90 in females); by striking differences in the color pattern peculiarly characterized in *L. zullyi* by a very broad dark vertebral stripe with white and yellow irregular marks, and by the narrow longitudinal reddish strikes.

**Description of the Holotype.** A stout lizard, snout-vent length (SVL) 86 mm; tail 103 mm; head length 18 mm; head width 16 mm; hind limb 47 mm; fore limb 29.6 mm; axilla-groin distance 42 mm; scales at midbody 76; supralabials 9; infralabials 6; number of sub-digital lamellae on the fourth toe of the right foot 23; number of sub-digital lamellae on the fourth finger of the right hand 22; precloacal pores 7. Cephalic scales bulky and slightly rough; orbital semicircles complete; 5 nearby equal supraoculars, separated by two rows of small rounded irregular scales from the sharpened 5 superciliaries; temporals smooth or softly keeled; rostral broader than high; nasals lateral, separated by 4 enlarged scales; one row of nearby equal loreolabials; ear opening transversally enlarged with conical scales on its anterior border and small granular scales backwards; lateral granules on the neck; a longitudinal fold behind the ear, moderately developed; prehumeral pocket evident; parietals and interparietals rugose, almost equal; nuchals small, heterogeneous, conical and keeled; dorsals moderately keeled, smooth on the flanks, groin and ventrolateral region; keeled scales on the tail and upper limbs; ventrals smooth, slightly smaller than dorsals; caudal scales ventrally smooth, sub-triangled.

In accordance with the *Diagnosis*, conveying a full information on chromatic characters of *Liolaemus tari*, the dorsal color pattern of the holotype is a very significant one, emphasising its wide dark vertebral stripe speckled with unpigmented terminal scale points, the narrower dorsal-lateral black stripe longitudinally punctuated with spaced bright red spots, and the lower ventrolateral blackish zone scattered with scarce yellowish, white or red minute marks up to the melanic belly. Coloration in preservative: a dark, greyish back-

ground remembering the living pattern, showing whitish or pinky longitudinal spots and faint transverse pale stripes on bluish flanks; preloacal pores a faint orange-yellow color, paler than in the living lizards.

**Variation.** Variations in scale counts, preloacal pore number and measurements are given in Table 3. In accordance with this Table, the species is sexually dimorphic in the number of scales around midbody, besides the formerly mentioned dimorphism supported by sexual differences in the axilla-groin distance/hind limb length ratios.

The variation of the dorsal color pattern is noticeable in *L. tari*. Specimens may show a more confused dorsal-lateral red spotted stripe, with a progressive increase of red scales on flanks and lower scale rows limiting the melanic venter (Color Plate 5, 1); other specimens may exhibit a remarkable reduction, or almost lack of red dorsal and lateral scales; some individuals show since the birth (Color Plate 5, 2) a very faint presence of red dorsal scales, often replaced by yellowish or pale brownish scales, mainly in females. As individual and geographic variation in some neighbouring populations of *L. tari* discovered in other tabular basaltic embossments north of Tar Lake (Meseta La Siberia, Estancia San Adolfo, 1000 m a.s.l.), specimens with a very extensive lateral red coloration or a whole melanic coloration have been found (Color Plate 5, 3). A deep ventral melanism is generally present in all adults of the species.

**Etymology.** The specific name *tari* comes from the geographic region (Tar Lake and its neighbouring reliefs) from where the type specimen was collected.

**Natural History.** They are robust, nimble, saxatile Liolaemine tropidurids, sheltering under basaltic stones, preferably in rocky ravines surrounding small temporary lagoons on the summit of their mountainous habitat. They are also sheltering under the radical nets of the stepparian bushes. A very cold, snowy winter climate is an environmental characteristic of their harsh peri-glacial range: the austral continental ice field lies at scarcely 70-80 km from the Meseta del Viento, terra typica of *L. tari*. Mating and reproduction occur fundamentally in the summer season. Pregnant females have been found in January, giving birth in February to three, four, active newborn lizards, promptly running and foraging. The usual basking period was observed from the late hours of the morning to the late afternoon; in spite of their evident insectivorous diet, no important research on the alimentary habits was still carried out. This new species is then ecologically and physiologically very poorly known.

**Distribution.** *Liolaemus tari* was examined from the volcanic Meseta del Viento, above 900 m a.s.l., but it was absent in the lower lands (at altitudes from 300 to 800 m a.s.l.) surrounding the Tar lake which belong to the post-glacial lacustrine system of the glacial San Martin lake, on the Chilean frontier. Additional populations referable to this form were lately found above 900-1000 m a.s.l. in the Meseta La Siberia (Estancia San Adolfo), at about 25

km EN of the Tar lake. Further collecting is necessary to determine its present whole distribution.

The following new taxon of the *archeforus* group, collected at about 100 km or more from the known range of *Liolaemus tari* southwards, and disjoined from this species by remarkable geographical and topographical barriers, has been named:

***Liolaemus escarchadosi* sp. nov.**

**H o l o t y p e .** MRSN R-1203-1. adult male: Cordón de los Escarchados, 850 m a.s.l., near to Laguna Los Escarchados, 50 km SE of Calafate (Lago Argentino), Santa Cruz Province, Argentina. Collected by J.M. Cei and J.A. Scolaro, 26 January 1985.

**Paratypes .** Males: MRSN R-1203-2 to 13 (adults); J.M.C.-DC 1151 to 1153 (adults); Females: MRSN R-1203-14 to 24 (adults); J.M.C.-DC 1154 to 1156 (adults). All the same locality and data of the holotype.

**D i a g n o s i s .** Within the *archeforus* group, *L. escarchadosi* fundamentally differs from *L. sarmientoi* and *L. tari* in having a clearly distinct color pattern (Fig. 4, A-C). The male homeomorphic patterns of *L. escarchadosi* can be easily distinguished from the more variable male patterns of *L. sarmientoi* in having a narrower, almost indistinct, lighter vertebral stripe and two lower, well differentiated chromatic zones until its melanic belly: a dorsolateral brownish zone scattered with whitish marks or points, and a yellowish ventrolateral zone crossed by parallel white and black bands. The diversity between such a pattern and the above reported pattern of *L. sarmientoi* is a suitable diagnostic tool, as well as the chromatic differences between *L. escarchadosi* and *L. tari* (Color Plates 3-6). Males of both the species *sarmientoi* and *tari* exhibit distinct patterns for distribution and breadth of dorsal and lateral stripe, shape and number of coloured spots and marks, frequency and brightness of red scales, practically absent in *L. escarchadosi*. Similar differences may be observed in female specimens, whose pattern is referable to a somewhat attenuated male pattern, in spite of a relative presence of juvenile female individuals of *L. escarchadosi* morphologically converging to the morphological features of *L. sarmientoi*. Most of the metric and meristic characters of *L. escarchadosi* are statistically too faint to be suitable for diagnostic purposes within the austral forms of the *archeforus* group. But *escarchadosi* differs from *L. tari* in having a minor number of scales at midbody and a narrower head in males ( $P < 0.001$ , respectively; see Tables 4 and 5). *L. escarchadosi* shows a distinct color pattern, such as synthesised in Fig. 4, (B-C).

According to its sketches, and comparing them with the just commented dorsal color pattern of *L. tari*, we can observe how it is clearly recognisable from the peculiar color pattern of *L. escarchadosi*, which shows a narrow vertebral stripe, 4-5 dark scale rows wide, with unpigmented marks on terminal

scale points, being followed: a) by a wide lateral zone (14-16 scale rows) crossed by some 8-11 spaced, transverse broken lines, 1-2 scales each; and b) more ventrolaterally, by a lower lighter zone of about 12-14 yellowish or reddish scales, until the ventral melanic scales, which is notoriously crossed by 9-11 black and white bands from the axillary to the inguinal region.

*Liolaemus escarchadosi* differs from the allopatric species *L. archeforus* and *L. gallardoi*, whose chromatic characteristics are completely diverging from its color pattern, given their almost uniform dark dorsal background, scattered with transversally arranged yellowish spots in *L. gallardoi*, but irregularly speckled by minute transverse light marks in *L. archeforus*, where a ventrolateral region with many red or reddish scales is also evident (Fig. 4, D-E). *L. escarchadosi* differs obviously from the peculiar, north-western *L. zullyi* in having significant differences in size, in number of scales at midbody and a strikingly distinct color pattern, as well as in the similar case of *L. tari* (Cei and Scolaro: Color Plate 1-2, 1996).

**Description of the Holotype.** A stout lizard, snout-vent length 84 mm; tail 95 mm; head length 17.1 mm; head width 14.6 mm; hind limb 44.5 mm; fore limb 28 mm; axilla-groin distance 38 mm; scales at midbody 70; supralabials 8; infralabials 6; number of subdigital lamellae on the fourth toe of the right hind foot 22; number of subdigital lamellae on the fourth finger of the right hand 22; precloacal pores 8. Cephalic scales bulky and slightly rough; orbital circle complete; 5 nearly equal supraoculars, separated by 3 rows of irregular, small granular scales from the narrow and sharply keeled 6 superciliaries; temporals smooth or gently keeled; rostral broader than high; nasals lateral, separated by 4 enlarged scales; one row of nearly equal loreolabials; ear opening transversally enlarged, with some conical scales on anterior border and very small granules posteriorly; minute granules on the lateral neck; longitudinal fold behind ear very evident, ending above a deep prehumeral pocket; parietals and interparietal very rugous, almost equal; nuchals small, irregular; dorsals strongly keeled, triangular and smooth on the flanks, groin and ventrolateral region; keeled scales on upper tail and limbs; ventrals smooth, rounded, larger on chest, somewhat narrower on abdominal region, slightly larger than dorsals; caudal scales ventrally subtriangular and smooth.

Color in the living specimen as in the *Diagnosis* and photography (Color Plate 6, 1, dorsal view). Color in preservative: a blackish or dark grey dorsal ground, with pale scales or marks indicating the living pattern; flanks grey-bluish; ventrally melanic; precloacal pores yellowish, orange in the living lizard.

**Variation.** Variations in scale count, precloacal pore number and measurements are given in Table 5. In accordance with this Table, *L. escarchadosi* does not exhibit sexual dimorphism, excepting the above reported significant sexual difference in the axilla-groin distance/hindlimb length ratios, constant in its species group (Cei: unpublished data). Male and female specimens of *L.*

*escarchadosi* are particularly similar in size and dorsal or ventral color pattern; however younger females may show a dorsal coloration with more accentuated transverse dark bands, remembering that of *L. sarmientoi* female, which becomes less distinct with the age (Donoso-Barros, 1966, Plate lxii). In spite of the commented usually homeomorphic color pattern of *L. escarchadosi*, some specimens can be found sharing a noticeable yellowish shade in their 4-5 vertebral and paravertebral scale rows; in few individuals scarce reddish or yellow scales may be present in the alternate bands of the ventrolateral region (Color Plate 6, 2). Ventral melanism is observed in almost all the population (Color Plate 6, 3). This new species was still only studied in a localised rocky environment: thus, data on any eventual geographic variation are unavailable.

**E t y m o l o g y.** The specific name *escarchadosi* comes from the geographic region of Cordón de los Escarchados ("Ridge of the frozen people"), Santa Cruz Province, from where the type specimens were collected. The name may be referred to the low winter temperature ( $-30^{\circ}\text{C}$ ) registered in such a isolated and uninhabitable zone.

**N a t u r a l H i s t o r y.** These lizards have been collected in a desert and harsh stony ridge, in a Patagonian steppe with predominating thinly scattered bushes of *Festuca*, *Bromus*, *Hordeum*, *Stipa* or *Agropyron*, being interrupted the monotonous poor grasslands by scarce, often cushion-like, shrubs of *Verberna*, *Chuquiraga*, *Nassauvia*, *Berberis*, etc. Some shallow lagoons are scattered in this arid, broken landscape, such as the Laguna de los Escarchados, the Laguna La Nevada and the Laguna La Escondida, where the most important trophic element are in spring-summer the characteristic floating associations of the red-green hydrophyte *Myriophyllum elatinooides*. In this area a natural Reserve (Fundación Vida Silvestre Argentina) has been recently established, to protect a remarkable endemic podicipedid bird, the *Podiceps gallardoi* or Macá Tobiano, making its nest seasonally in the above mentioned lagoons. No other reptiles have been collected in the terra typica of *L. escarchadosi*, with the exception of *Liolaemus lineomaculatus*.

*Liolaemus escarchadosi* is a viviparous, relatively slow liolaemine lizard, heavily running and sheltering under isolated stones or ravines. Its homing is a very limited one; the basking in the late morning and afternoon occurs near to the habitual hiding-places. The ventral melanism exhibited by the species, as well as by several other Patagonian taxa, could represent -according to Donoso-Barros- an "ecological adaptive trend" for a better heat absorption by the abdominal black surface in basking (Donoso-Barros, 1966, Plate lxix).

No regular research was carried out on the alimentary habits or other ecological features of *L. escarchadosi*. Probably it is feeding mainly on terrestrial beetles, as tenebrionids or carabids. Of course it is still a very poorly known member of the austral *archeforus* species group.

**D i s t r i b u t i o n .** The species was examined from the southern Patagon-

ian region of Cordón de los Escarchados, 800-900 m a.s.l., near the National Route 40, leading from the Lago Argentino shores to La Esperanza and Río Gallegos southwards. Scattered populations, referable to this form, have been also sighted at about 600 m a.s.l., some 40 km SE of Cordón de los Escarchados; also near Cerro Pan de Azúcar (1075 m a.s.l.), west of that locality; and at last near Calafate, on the southern shores of the glacial Argentino lake, at about 45-50 km NW of the terra typica (Lanza: photographic records, 1974, January). It is evident that for this taxon as well, further collecting is necessary to extend and understand its whole post-glacial distribution.

### RESULTS OF THE DISCRIMINANT ANALYSIS

To improve our critical screening of the evolutionary diversity of so morphologically similar taxa such as *Liolaemus sarmientoi* and its northern similar species *tari* and *escarchadosi*, several multivariate analysis were planned and carried out, using also the Foucart's method (1982).

A first discriminant analysis were performed with population samples of *L. sarmientoi* (n = 15), *L. archeforus* (n = 20), *L. gallardoi* (n = 21) and *L. baguali* (n = 21) from the *kingii* group. Samples of the new taxa, *L. escarchadosi* (n = 23) and *L. tari* (n = 15), were analysed as supplementary cases of unknown group, in order to check the association and/or similarity with the nearer taxa above mentioned.

The discriminant analysis provided three significant canonic axes for the four samples considered. Canonic axis I absorbs 53.8% of the total variance, canonic axis II absorbs 41% and the canonic axis III the remaining 5.2%. Canonic axis I allows the separation of *L. sarmientoi* and *L. baguali* from the rest, associating in its positive sector most of the variables having a major expression in *L. baguali* in comparison to the remaining taxa, such as scale number around midbody ( $P < 0.001$ ). In its negative sector, the variables associated showed major values in *L. sarmientoi* such as ventral pigmentation ( $P < 0.05$ ) and forelimb length ( $P < 0.01$ ).

Canonic axis associates in the positive sector the variables axilla-groin length and snout-vent length that exhibits major values ( $P < 0.01$  and  $P < 0.05$ , respectively) in *L. archeforus*, which allow its separation from *L. gallardoi*.

A major distance between ellipse centroids was shown in comparison of *L. sarmientoi* and *L. baguali*; the nearer distance was shown between *L. sarmientoi* and *L. archeforus*, whereas *L. gallardoi* appeared approximately equidistant from the former. Ellipses of equiprobability ( $P < 0.05$ , Sokal and Rohlf, 1979) for all specimens revealed no overlap between the groups (Fig. 5).

Discriminant analysis of individual specimens resulted in a very high percentage of correct classification (92.3%). Using the same classification equation, the sample of 38 specimens of *L. tari* and *L. escarchadosi* was individually tested. All these specimens showed a wide range of spread spatial distribution, although somewhat near to *L. sarmientoi* and *L. archeforus* ellipses,

because of its major values of variables such as ventral pigmentation and snout-vent length. However, the analysis does not permit a clear-cut association of them to the mentioned taxa.

With the aim of allowing to assess the degrees of similarity among all the taxa belonging to the *archeforus* complex, another discriminant analysis was carried out comparing *L. escarchadosi*, *L. tari*, *L. sarmientoi*, *L. archeforus*, *L.*

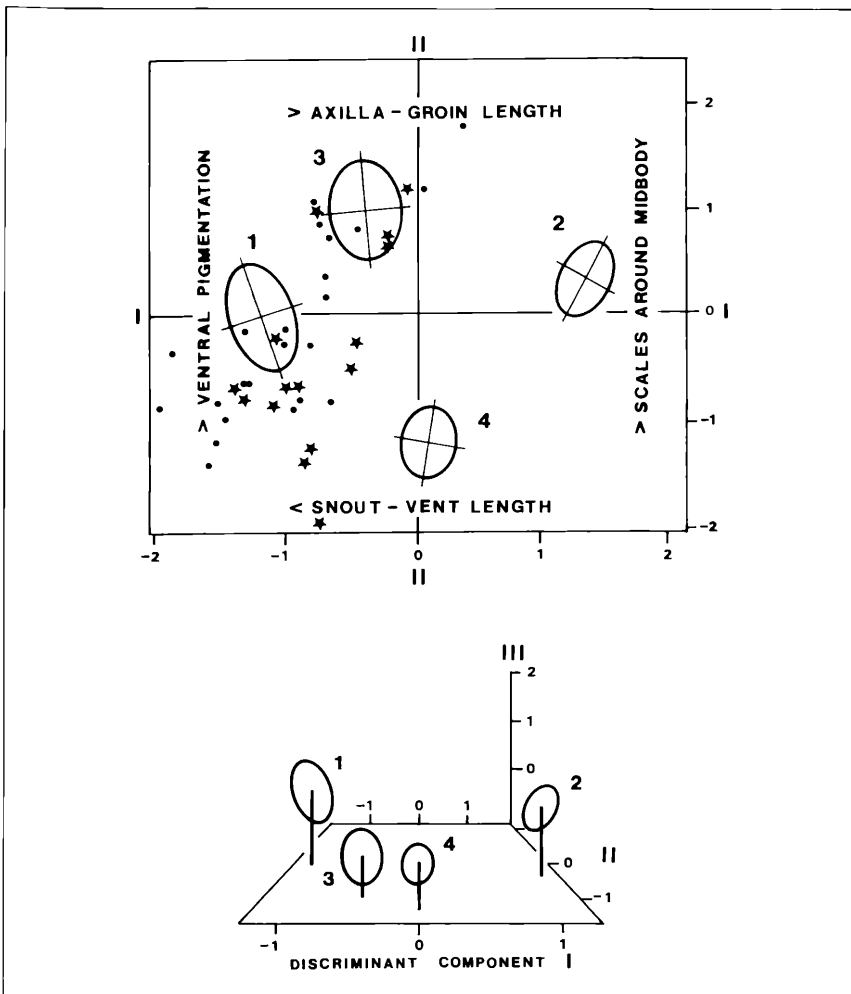


FIGURE 5.- Ellipses of equiprobability for all the cases ( $P < 0.05$ ): 1. *Liolaemus sarmientoi*, 2. *L. baguali*, 3. *L. archeforus*, 4. *L. gallardoi*, checking individual cases of *L. escarchadosi* (black dots) and *L. tari* (black stars). In the lower graphic are represented the three canonic axes that define each group centroids (ellipses drawn  $\times 0.3$  app.).



*gallardoi* and including the nearer geographic related *L. baguali* (belonging to *kingii* group). A summary of statistics for the measured variables are presented in Tables 2 and 5).

Five canonic axes were obtained absorbing 36.3%, 31.8%, 21%, 7.9% and 3% of the total variance, respectively; the two latter axes do not associate any variables significantly. The canonic axis I associates, with the most significance, the variables scale number around midbody, fourth finger lamellae and supralabial scale number (positively), and red scales percentage and head length (negatively). Such an axis allows separation of *L. baguali* from *L. sarmientoi* by its major expression of the former variables ( $P < 0.001$  and  $P < 0.01$ , respectively) and a minor expression of the latter ( $P < 0.001$ ).

The canonic axis II allows the separation of *L. escarchadosi* from *L. gallardoi*, associating only in its positive sector most of the variables having a major expression in *L. escarchadosi*, such as ventral pigmentation ( $P < 0.001$ ), axilla-groin length ( $P < 0.01$ ), snout-vent length and forelimb length ( $P < 0.05$ , respectively). The canonic axis III only associates as negative the variables head width and infralabial scale number, which exhibits major expressions ( $P < 0.001$ , respectively) in *L. tari*, and allowing its separation from the remaining *L. archeforus*.

If the means of the remaining variables are compared, *L. escarchadosi* versus *L. archeforus* shows a major expression for the variables ventral pigmentation and infralabial scale number, but a minor expression for the variable scales at midbody ( $P < 0.001$ , respectively); *L. escarchadosi* versus *L. gallardoi*, shows a major expression for the variables, red scales percentage ( $P < 0.001$ ), forelimb length ( $P < 0.05$ ), but a minor expression for the variables, scales at midbody ( $P < 0.001$ ) and infralabial scale number ( $P < 0.05$ ), in spite of the variables assembled to canonic axis II. *L. escarchadosi* versus *L. baguali* shows a major expression for the variables ventral pigmentation, forelimb length ( $P < 0.001$ , respectively) and hindlimb length ( $P < 0.01$ ) and a minor expression for the variables scales around midbody, red scales percentage ( $P < 0.001$ , respectively), fourth finger lamellae number ( $P < 0.01$ ), supralabial and infralabial scale number ( $P < 0.05$ , respectively). *L. escarchadosi* versus *L. sarmientoi* shows a major expression of the variable supralabial scale number ( $P < 0.01$ ) and a minor expression of the variables head length ( $P < 0.01$ ) and head width, forelimb length, and red scales percentage ( $P < 0.05$ , respectively).

Comparing *L. tari* versus *L. escarchadosi* a major expression of the variables head width ( $P < 0.001$ ), hindlimb length, forelimb length and scales around midbody ( $P < 0.01$ , respectively) are evident for the former taxon. *L. tari* versus *L. sarmientoi* shows a major expression for the variables head width, hindlimb length, axilla-groin length and fourth finger lamellae number ( $P < 0.05$ , respectively) and snout-vent length and scale number around midbody ( $P < 0.01$ , respectively). Comparing *L. tari*, *L. archeforus*, *L. gallardoi* and *L. baguali*, the bigger size of the former taxon is evident, showing a major expression for the variables snout-vent length, head width, forelimb length,

hindlimb length, axilla-groin length ( $P < 0.01$ , respectively) and ventral pigmentation and red scales percentage ( $P < 0.01$ , respectively). However, *L. tari* versus *L. gallardoi* and *L. baguali* shows a minor expression for the variable supralabial scale number ( $P < 0.05$ ); *L. tari* versus *L. archeforus* shows besides a major expression of the variable infralabial scale number ( $P < 0.001$ ).

In spite of the variables mentioned in the first discriminant analysis, *L. sarmientoi* versus *L. archeforus*, *L. baguali* and *L. gallardoi*, shows a major expression for the variables forelimb length ( $P < 0.05$ ) and red scales percentage ( $P < 0.001$ ) and a minor expression for the variables fourth finger lamellae number, scales around midbody ( $P < 0.001$ , respectively) and supralabial scale number ( $P < 0.05$ ). Moreover, *L. sarmientoi* versus *L. gallardoi* shows a major expression for the variable ventral pigmentation ( $P < 0.001$ ). *L. archeforus* versus *L. baguali* and *L. gallardoi* shows a major expression for the variable red scales percentage ( $P < 0.01$ ). Moreover, *L. archeforus* versus *L. gallardoi* shows a major expression for the variables axilla-groin length and scales around midbody ( $P < 0.01$ , respectively), and versus *L. baguali* shows a minor values for the variables scales around midbody and fourth finger lamellae number and ventral pigmentation ( $P < 0.01$ , respectively).

*Liolaemus baguali* versus *L. gallardoi* shows a major expression for the variables fourth finger lamellae number and scales around midbody ( $P < 0.01$ , respectively) and ventral pigmentation ( $P < 0.001$ ).

The discriminant analysis also shows a good percentage of correct classifications of the cases (81.4%) and the ellipses of equiprobability ( $P < 0.05$ ) for all specimens revealed overlapping only between *L. sarmientoi* and *L. escarchadosi* (Fig. 6). Analysing the distance between ellipse centroids, a major distance was shown in comparison of *L. baguali* and *L. sarmientoi*, whereas *L. gallardoi* appeared to be nearer and approximately equidistant from both these forms; *L. archeforus* appeared approximately in a central position among the above mentioned taxa. *L. tari* and *L. escarchadosi* appeared closer to *L. sarmientoi* and showing a remarkable equidistance among them. As in the three-dimensional graphic is shown, there are a noticeable evidence of a nearer inter-group relation between the forms: *escarchadosi* - *tari* - *archeforus* - *sarmientoi* (*archeforus* group), being *baguali* (*kingii* group) more distant, and *gallardoi* showing an intermediate position.

The reported results from these two discriminant analysis, stress a noticeable distance between all the presently known forms of the *archeforus-kingii* complex, as suggested by the clear-cut separation of the population groups assembled by the respective ellipses of equiprobability. The significance of the results justify the postulation of the specific status for the new forms.

However, a new discriminant analysis were performed comparing the more nearer taxa *L. tari*, *L. escarchadosi* and *L. sarmientoi*, in spite of possible, but not proved sympatry, suggested by the relative approximation of their distribution boundaries. Table 5 summarises the treated information for all considered variables.

The discriminant analysis defines two canonical axes that explain 57.3% and 42.7% respectively, of the total variance. The canonic axis I allows separation of *L. tari* from *L. sarmientoi*. It associates in its negative sector most of the variables having a major expression in *L. tari* in comparison to the remaining taxa, such as hindlimb length, axilla-groin length, fourth toe lamellae number ( $P < 0.05$ , respectively) and scales around midbody ( $P < 0.01$ ).

Canonic axis II associates in the positive sector the variable supralabial scale

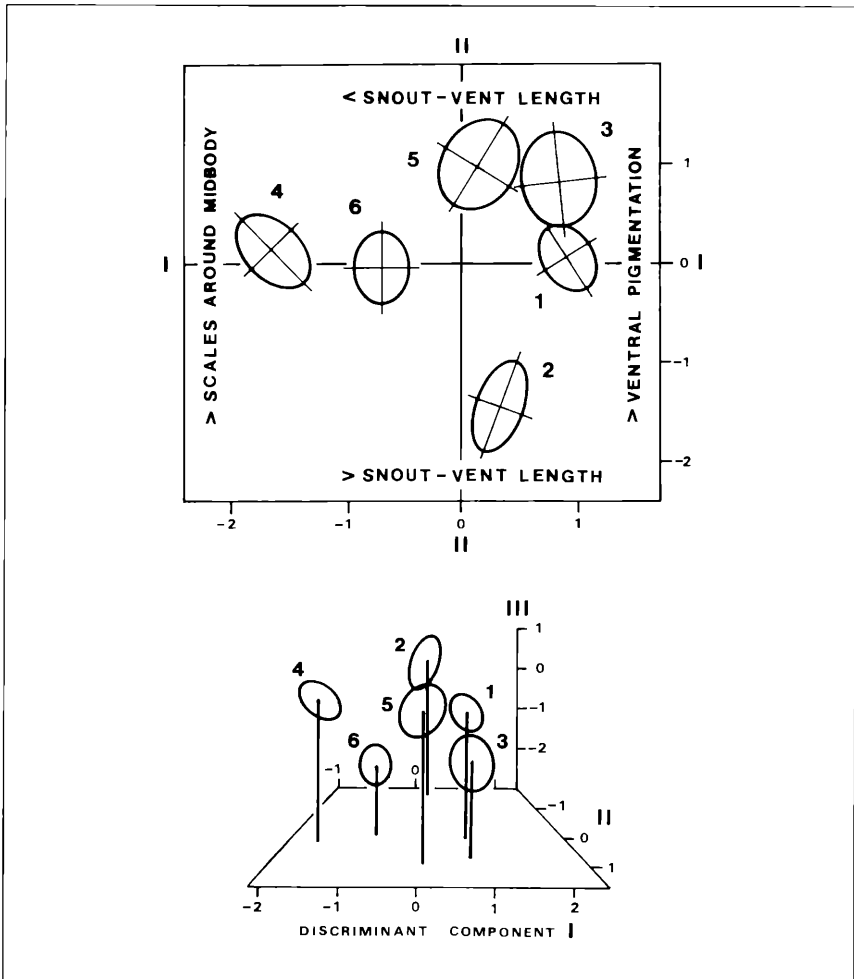


FIGURE 6.- Ellipses of equiprobability for all the cases ( $P < 0.05$ ): 1. *Liolaemus escarchadosi* 2. *L. tari*, 3. *L. sarmientoi*, 4. *L. baguali*, 5. *L. archeforus* and 6. *L. gallardoi*. In the lower graphic are represented the three canonic axes that define each group centroids (ellipses drawn  $\times 0.3$  app.).

number that exhibits major values in *L. escarchadosi*, while in its negative sector assembles variables that exhibits minor numerical values, such as head width, red scales percentage, forelimb length ( $P < 0.05$ , respectively) and head length ( $P < 0.01$ ). Moreover, the canonic axis II strengthens the difference between *L. tari* and *L. escarchadosi* by means of the latter mentioned variables and hindlimb length and scales around midbody ( $P < 0.01$ ) that exhibits major values in the former taxa. When *L. sarmientoi* versus *L. escarchadosi* are considered, the former shows a major numerical value for the variables head length ( $P < 0.001$ ) and head width, forelimb length and red scales percentage ( $P < 0.05$ , respectively).

The distance between the ellipse centroids of each taxon is relatively equal in the three species, being *L. sarmientoi* the more distant taxon. Ellipses of equiprobability for all specimens revealed no overlap between the samples (Fig. 7). Discriminant analysis of individual specimens resulted in a high percentage of correct classification (87.1%).

The assumed specific status for the new taxa, *L. tari* and *L. escarchadosi* appears also supported by the results of the presented analyses.

#### GENERAL COMMENTS AND CONCLUSIONS

The available morphological evidence, together with the quite significant results of the discriminant analysis and the dialectic support of the recent discussion by Frost and Hillis (1990) on the critical value of the evolutionary species concept, enabled us to establish status for the new forms of the *archeforus* and *kingii* groups here described. However, we believe that further speculations on the internal relationships of the different taxa of these groups would result a somewhat premature and little appropriate task. A suitable information is primarily lacking here on the evidence for their monophily or the more recent common ancestors with each other than with any other species, as well as on the polarity of the states that are variable within each group. That will require necessary comparisons with their nearest relatives, or "sister group", which is yet to be determined. Apparently, to the present general knowledge, "all of the characteristics which members of the *archeforus* group, together with members of the *kingii* group, share with one other, are plesiomorphic: e.g., high number of preloocal pores in males, granular lateral nuchal scales, keeled and imbricate dorsal body scales, the absence of an hypertrophied puboischiotibialis muscle, etc." (Etheridge, pers. comm.). Of course, any further well supported discussion on character-state polarisation and derived conditions in the species of both groups should be desirable, allowing to better underscore the valuable implications of such a kind of data and assumptions, given the peculiar evolutionary and biogeographic significance of these basal liolaemine species and their extreme continental location.

But we assume that an useful critical job should be now to discuss again other available kinds of evidence for species status of the named taxa in this work. It

is a logical question, e.g., to establish what is the real possibility that geographically and morphologically intermediate populations may occur between species as *Liolaemus zullyi* and *L. archeforus* in their almost contiguous distribution in the north-western corner of the Santa Cruz Province. We recall first our repeatedly observed want of intermediate specimens alongside the peculiar topographical limits between the stout *archeforus* populations inhabiting the dry volcanic plateau south the large Buenos Aires lake, and the smaller, slender *Liolaemus zullyi* from the near milder Jeinement valley facing the sharpened western slopes of the above mentioned tableland. Such as a natural barrier, the steep basaltic borders of this ancient, likely pre-glacial embossment, may to have been acting as a suitable obstacle to the gene flow between the ancestors of these lizards until the possible actual genetic isolation. It would be also suggestive to cite a very similar, frankly well proved case, described in other different *Liolaemus* species group from the northernmost Patagonian districts. In the peculiar ecotonal region of the Payunia volcanic reliefs, the southern Mendoza Province, two nearly allo-sympatric members of the *elongatus* species group are found: *L. elongatus* Koslowsky, 1896 and *L. austromendocinus* Cei, 1974, whose local distribution by planimetry and altimetry was carefully studied by Bottari (1974), mainly at different levels of the Payún Liso Volcano, from altitudes of about 2000 m a.s.l. to its cloudy summit (3680 m). While in the surrounding sub-desertic flats, on the lower rocky slopes scattered with basaltic drosses, a relatively abundant population of *L. austromendocinus* was observed, together with other kinds of lizards and very rare, occasional specimens of *L. elongatus*, from 2700 m to 3000 m a.s.l. an exclusive, numerous and even polymorphic popula-

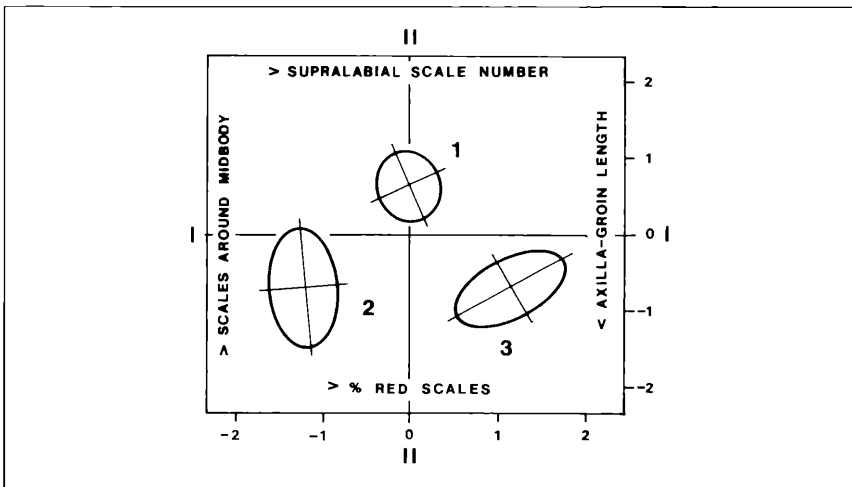


FIGURE 7.- Ellipses of equiprobability for all the cases ( $P < 0.05$ ): 1. *Liolaemus escarchadosi*, 2. *L. tari* and 3. *L. sarmientoi*.

tion of this latter was found and studied; unquestionably, without any intermediate individual or evident gradation. Specific eco-physiological features of both the investigated forms have been analysed and proposed by the mentioned author as a suggestive environmental factor improving their striking topographical isolation, probably already joined to a clear lack of interbreeding.

Somewhat general or preliminary remarks concerning the genetic isolation of the just described and analysed species *Liolaemus tristis*, *L. tari* and *L. escarchadosi* could be added, given the poorly explored, very extended areas of their habitats. Some scarce samples of *L. kingii* have been collected recently (1995), on the northern borders of the Buenos Aires lake, the westernmost locality of its known distribution and at about 180 km from the terra typica of *L. tristis*. Localities of *L. kingii* at about 70-80 km from the *L. tristis* habitat have been reported eastwards and south-eastwards (Fig. 1). *L. gallardoi* is the only species of the *archeforus* group having a possible contact with *L. tari* in the harsh, poorly visited tablelands north of the Lago Tar-Río Chalfá basin: however, no apparent inter-gradating populations have been still pointed out there. On the other hand, the interposed spacious reliefs extending between the southern great glacial lakes (Viedma, Argentino), together with the wide Santa Cruz river may to have represented a very effective natural barrier to any past potential interbreeding between *L. tari* and *L. escarchadosi* (Fig. 1).

Latitudinal geographic barriers are less impressive for the known distribution of *L. escarchadosi* and that of *L. sarmientoi*, but the interposed break of almost 150 km needs a more diligent and repeated exploration. At any rate intermediate samples are yet unreported, and the distinct ecological trends of both these forms in their very different, dry and wet, typical environments, may to have act as segregating factors to prevent past and present efficient specific interbreeding.

#### A TENTATIVE CHROMATIC KEY TO THE LIOLAEMINE LIZARDS OF THE *KINGII* AND *ARCHEFORUS* GROUPS

1. a. Dorsal color patterns usually banded: red scales unusual.....2  
b. Dorsal color patterns usually stripped: red scales usually present.....5
2. a. Dark or black dorsal ground, with bright white or yellowish transversal band.....3  
b. Dorsal color pattern not as above.....4
3. a. Dark brown ground, with white or yellowish broken bands, showing a central round spot; venter yellowish or orange, black spotted, usually not melanic.....*kingii*  
b. Deep velvet black dorsal ground, with bright vertebally chevron-like white or yellowish bands: venter fully melanic .....*baguali*

4. a. Females larger than males; no dimorphic, dorsal color ground brownish, with faint transversal whitish streaks: venter pale greyish, scattered with fine dark marks .....*somuncurae*  
 b. Males larger than females; dimorphic; dorsal color pattern dark brown, scattered with whitish marks, more regularly and notoriously in females; paler dorsolateral narrow longitudinal stripes in females: venter whitish, centrally black and yellow spotted.....*tristis*
5. a. Dorsal color pattern dimorphic, with light vertebral stripe, wide and bright yellowish in males, faint in females; dark short dorsolateral bands more evident in females, almost confused in males; longitudinal reddish strikes on flanks usually recognisable, often confused by a ventrolateral reddish or red coloration, stronger in males: venter reddish orange, moderately black spotted centrally .....*zullyi*  
 b. Dorsal color pattern not as above.....6
6. a. Dark brown or blackish dorsal ground, with thinly transversal black-bordered whitish marks, more distinct in females, fainter in males where often they appear ventrolaterally included in a bright reddish coloration; vertebral stripe indistinct: venter melanic in males, heavily black-spotted or melanic in females .....*archeforus*  
 b. Dorsal color pattern not as above.....7
7. a. Dark or blackish dorsal ground, with white or yellowish rounded spots more or less arranged in linear rows: venter heavily spotted or pigmented, almost melanic .....*gallardoii*  
 b. Dorsal color pattern not as above.....8
8. a. Brownish dorsal ground with light vertebral stripe almost indistinct; transversal, more or less regular, white minute marks on the dorsolateral region: reddish or red scales very scarce and faint; ventrolateral region yellowish with alternate black and white bands: venter mostly fully melanic .....*escarchadosi*  
 b. Dorsal color pattern not as above.....9
9. a. Dorsal background blackish, with wide bright yellowish vertebral stripe, faintly distinct dorsolateral black band, accentuated in females, longitudinally scattered with evident, rounded red spots; ventrolateral red, white or black scales, alternately arranged; occipital region brownish; mostly melanic venter .....*sarmientoi*  
 b. Dark brown dorsal ground with a wide but not too distinct whitish or yellowish vertebral stripe; almost indistinct dorsolateral dark bands scattered with very minute whitish marks, but longitudinally showing a series of bright black-bordered red spots from the shoulder to groin, some times included in a diffuse red coloration; ventrolateral region scattered with

red, white or black scales; occipital region with dark, bulky scales: central, wide longitudinal black band on the venter, as a peculiar form of melanism .....*tari*

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#### RESUMEN

Se presenta una breve discusión general del conjunto *archeforus-kingi* considerado en obras recientes como estadio primitivo de la evolución del género *Liolaemus*, en la línea filética de Liolaeminae (Tropiduridae). Se describe como nuevas especies, según los conceptos actuales de especies evolutivas, los taxa *Liolaemus tristis*, *L. tari* y *L. escarchadosi*, a cuyo estudio morfológico que incluye amplia documentación fotográfica de sus patrones cromáticos, se adjunta también significativos aportes del análisis discriminante.

#### RIASSUNTO

Si presenta una concisa discussione generale del congiunto *archeforus-kingi* del genere *Liolaemus*: congiunto ritenuto recentemente uno stadio evolutivo primitivo per la polarità dei suoi caratteri nella grande linea filética dei Liolaeminae della famiglia iguanidea Tropiduridae. Si descrivono tre nuove specie del genere, sulla base dell'attuale concetto di specie evolutiva: *Liolaemus tristis*, *L. tari*, *L. escarchadosi*, il primo del gruppo *kingi*, gli altri del gruppo *archeforus*. Analisi discriminanti accompagnano e completano lo studio morfologico e la documentazione iconografica dei nuovi taxa.

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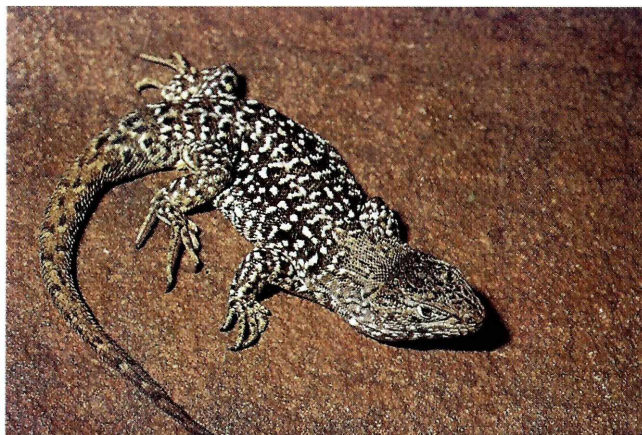
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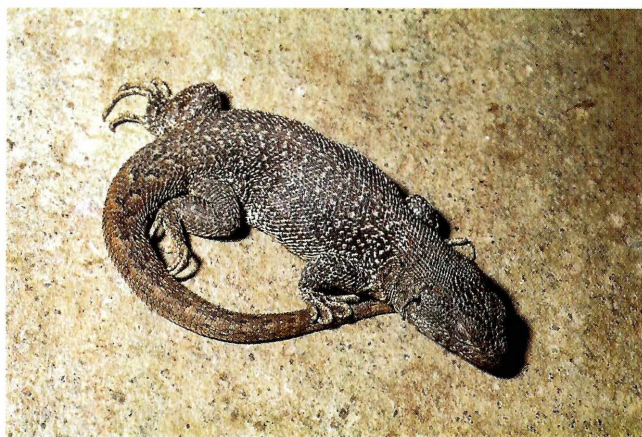


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**1** - *Liolaemus kingii*, adult male, from Terra Typica (Puerto Deseado, Santa Cruz Province). 13 December 1980.  
Photo. J. M. Cei



**2** - *Liolaemus tristis*, adult male, from Terra Typica (about 100 km south Las Heras, Santa Cruz Province). (Holotype MRSN R-1204-1). 28 January 1981.



**3** - The same specimen and data (ventral view).  
Photo. J. M. Cei

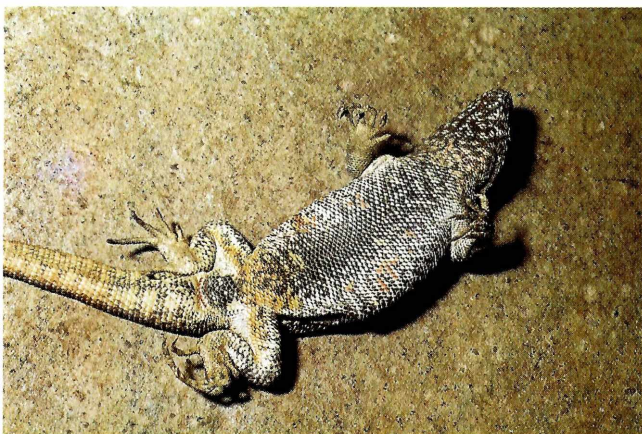
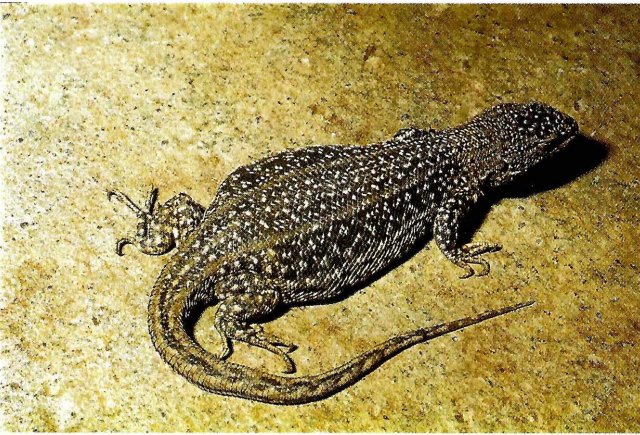




PLATE 2



1 - *Liolaemus kingii*, adult female from Terra Typica (Puerto Deseado, Santa Cruz Province), 13 December 1980.  
Photo. J. M. Cei

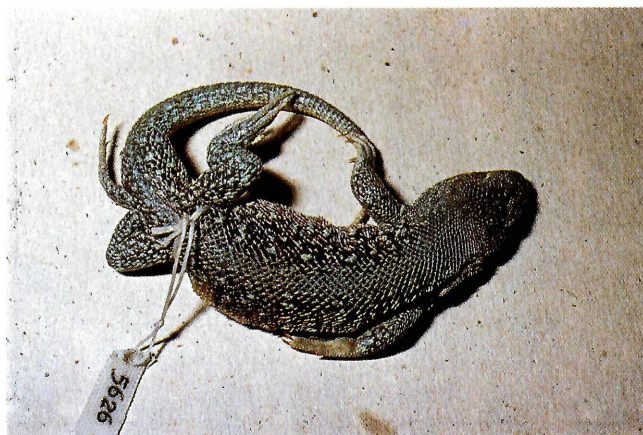


2 - *Liolaemus tristis*, pregnant adult female, from Terra Typica (about 100 km south Las Heras, Santa Cruz Province). (Paratype MRSN R-1204-4). The same data of the Holotype.  
Photo. J. M. Cei



3 - The same specimen and data (ventral view).  
Photo. J. M. Cei

1 - Holotype of *Liolaemus sarmientoi*, adult male, from Terra Typica: Monte Aymond, near Magellanic Channel, Chile. (Holotype 5626: MZUC-11795).  
Photo. J. M. Cei



2 - The same specimen and data (ventral view).  
Photo. J. M. Cei

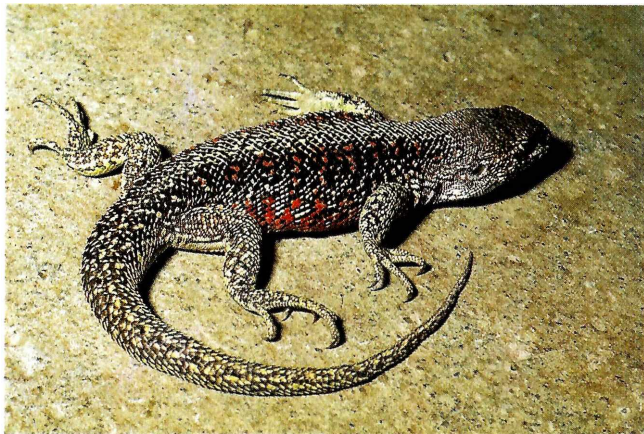


3 - Living specimen of *Liolaemus sarmientoi* from Terra Typica (near Monte Aymond: Chile-Argentina frontier). 10 March 1985.  
Photo. J. M. Cei

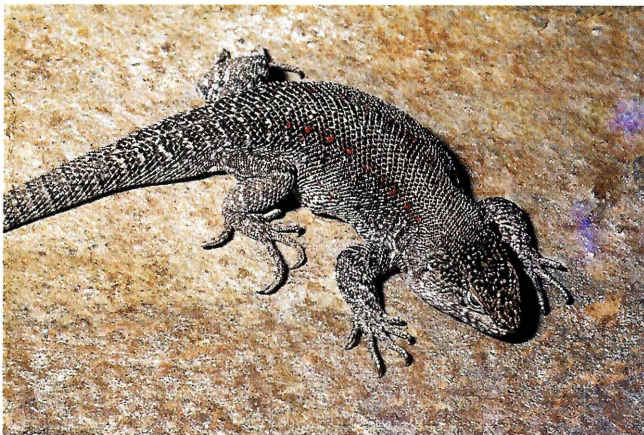




PLATE 4



1 - *Liolaemus sarmientoi*, adult male, from road to Cabo Vírgenes, 25 km SE Río Gallegos, Santa Cruz Province (near Mt. Aymond). 4 February 1981.  
Photo. J. M. Cei



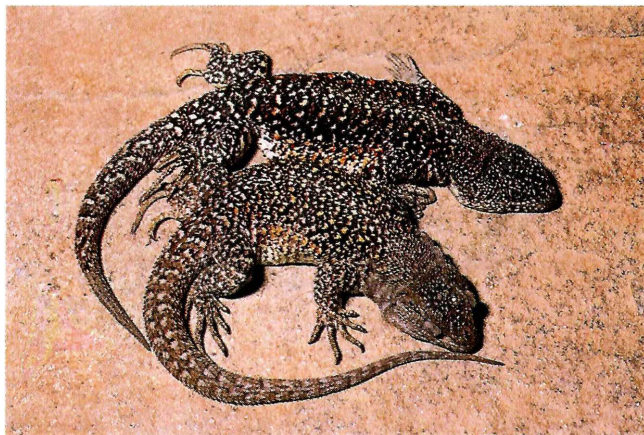
2 - *Liolaemus tari*, adult male, from Terra Typica (Meseta del Viento, 1150 m a.s.l., 20 km SW Lago Tar, S. Cruz Province). (Holotype MRSN R-1202-1). 15 March 1982.  
Photo. J. M. Cei



3 - The same specimen and data (ventral view).  
Photo. J. M. Cei



**1** - Polymorphism of *Liolaemus tari* from Meseta La Siberia, Estancia San Adolfo, 1000 m a.s.l., Santa Cruz Province, February 1985.  
Photo. J. M. Cei



**2** - Newborns of *Liolaemus tari* from Meseta La Siberia (the same data of anterior). The presence of red coloration in the lower specimen can be observed.  
Photo. J. M. Cei



**3** - Extreme polymorphism in males of *Liolaemus tari* from Meseta La Siberia (the same data of 5, 1). The total melanism of the lower specimen can be pointed out.  
Photo. J. M. Cei

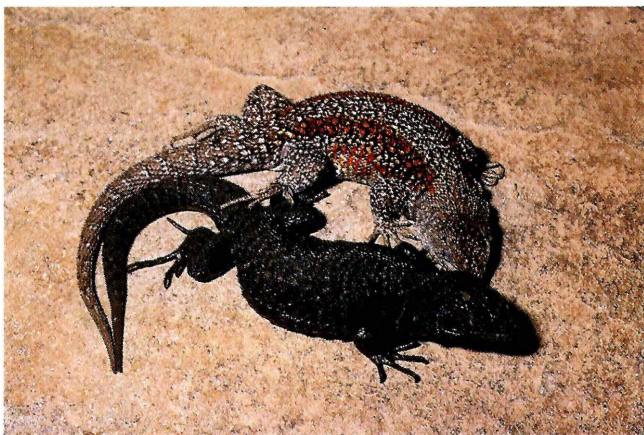
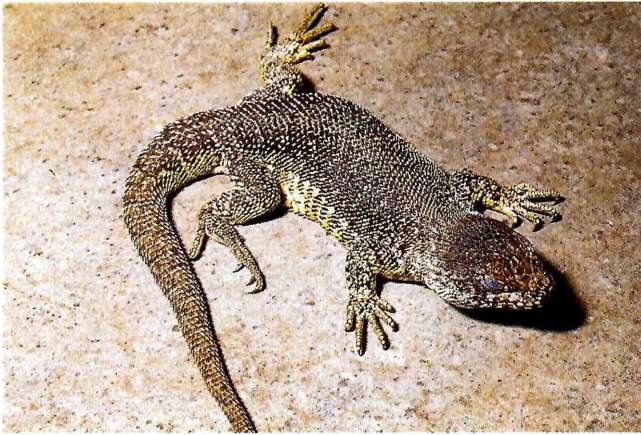


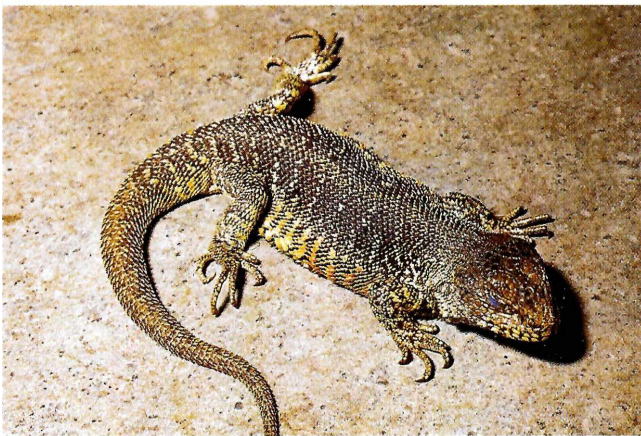


PLATE 6



**1** - *Liolaemus escarchadosi*, adult male, from Terra Typica (Cordón de los Escarchados, 850 m a.s.l., S. Cruz Province). (Holotype MRSNR-1203-1). 26 January 1985.

Photo. J. M. Cei



**2** - *Liolaemus escarchadosi*, adult male (same data of the Holotype). (Paratype MRSN R-1203-2). The homeomorphic color pattern can be observed.

Photo. J. M. Cei



**3** - The same specimen and data (ventral view).

Photo. J. M. Cei