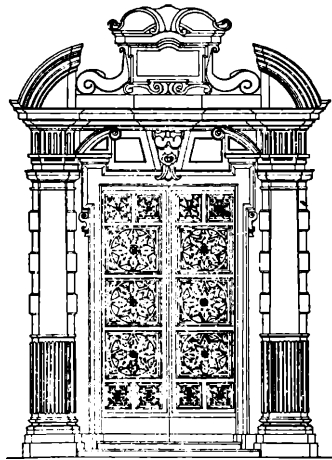


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A new species of *Liolaemus* of the
archeforus group from the
precordilleran valley of the Zeballos
river, Santa Cruz Province, Argentina
(Reptilia, Tropiduridae)

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ESTRATTO

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ABSTRACT

A distinct new species of *Liolaemus* endemic to the isolated tablelands south the glacial Lago Buenos Aires, Santa Cruz Province, Argentina, is described. It is a member of the Patagonian *L. archeforus* species group, in which it may be distinguished by its small size, exceptionally high number of scales at midbody, and a distinctive color pattern. *Liolaemus sarmientoi* and *L. gallardoii*, formerly recognized as subspecies of *L. archeforus*, and *L. baquali* and *L. somuncurae*, formerly recognized as subspecies of *L. kingii*, are elevated to full species.

INTRODUCTION

Liolaemus archeforus is a Patagonian iguanid lizard briefly described several years ago by Donoso Barros and Cei (1971). Its limited distribution extends on the isolated volcanic embossment of the Meseta de la Laguna del Sello (or Meseta of the Buenos Aires Lake), an almost circular tableland (1400-1500 m a.s.l.) south of the great and deep glacial lake lying at about 46°30'S and 71°30'W (Fig. 1). According to our present geological information, the summit of such a tableland, circumscribed by very high, sharpened and almost unsurmountable basaltic slopes, was uncovered by the ice during the last glaciation. Its poor, mostly lichenous or gramineous periglacial vegetation, surrounding scattered basaltic ravines, lodges a number of endemic forms of invertebrates

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and two endemic lizards, such as the specialized *Liolaemus* (= *Vilcunia*) *silvanae* Donoso Barros and Cei 1971 and *Liolaemus archeforus*. Altitudes of about 1300 m a.s.l. are the extreme lower boundaries of *L. silvanae*; *L. archeforus* can be found from about 900 m a.s.l. to the summit of the tableland, where several small lagoons and a major central circular lake (Laguna del Sello) lie.

Subsequent to the description of *Liolaemus archeforus* Donoso Barros and

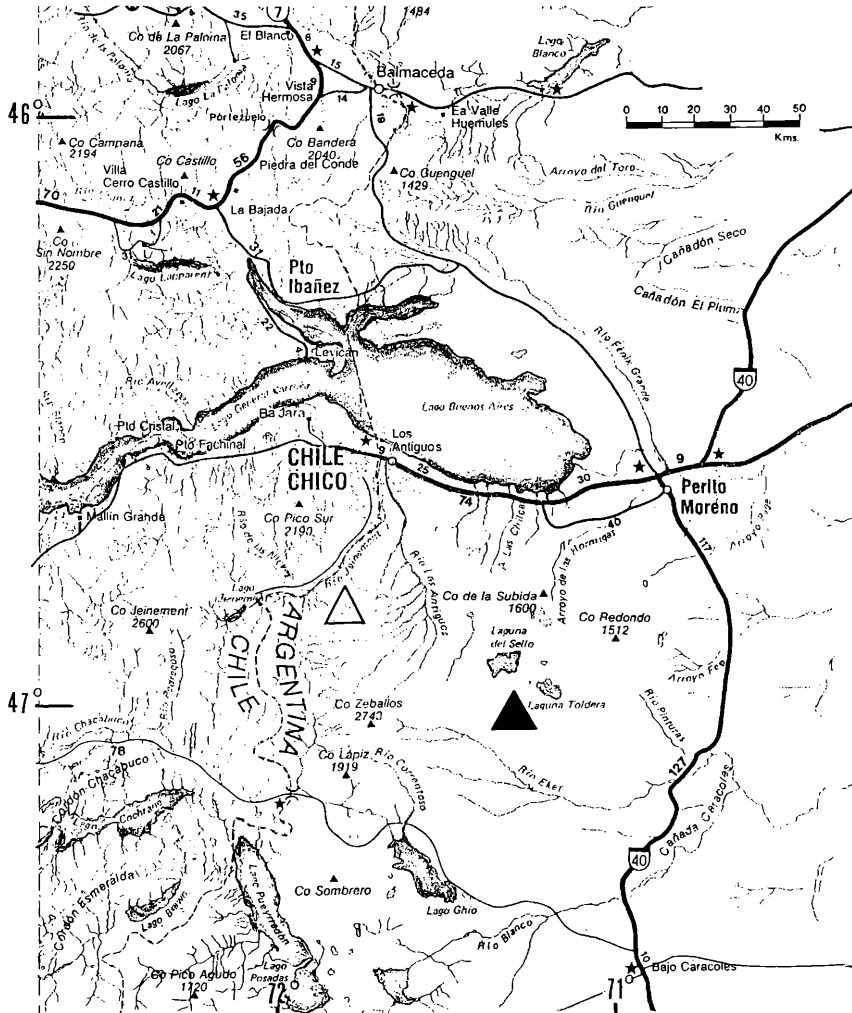


Fig. 1. - Map of the regions surrounding the glacial basin of Buenos Aires Lake. A black triangle indicates the approximate locality of the samples of *Liolaemus archeforus* on the basaltic Meseta de la Laguna del Sello. A white triangle indicates the approximate locality of the sample of *Liolaemus zullyi* from the Río Zeballos valley, alongside the Río Jeneinent and the Chilean frontier.

Cei, 1971, *L. sarmientoi* Donoso Barros, 1973 was referred to as a subspecies of *L. archeforus* by Cei (1975), and a third subspecies, *L. archeforus gallardoii*, was described by Cei and Scolaro (1982). Their subspecific status was retained in a recent work by Etheridge (1995), but “without reference to their status as unitary evolving entities”. However, these three forms, as well as the newly discovered form described below, are easily diagnosed and are all allopatric, and thus meet the criteria for evolutionary species, as defined by Frost and Hillis (1990), and Frost et al. (1992). These four taxa are therefore considered to be species, and because of their close phenetic resemblance, may be referred to collectively as the “*archeforus* group”.

MATERIALS AND METHODS

A sample of median-sized lizard morphologically related with *Liolaemus archeforus*, was obtained in February 1995 during field research in the subcordilleran area in the neighbourhood of the Buenos Aires lake, in order to establish the ecological effects on the animal life of the volcanic ashes ejected in 1991 by the nearby Chilean Hudson crater. These lizards were collected following a recently opened track from Los Antiguos southwards, along the Chilean-Argentine frontier, to the region of the Paso Roballos, which lies south west of the Cerro Zeballos mountains (2743 m), close to the western slopes of the Meseta de La Laguna del Sello (Fig. 1). They were found under stones or in the scattered grass bushes bordering small streams or rivulets in the deep valley of the Jeinement River, in a rocky, arid landscape, at altitude from 600 to 850 m a.s.l., which was explored until some 80 km south of Los Antiguos. Scattered relicts of the preglacial *Nothofagus* woods (*N. antarctica*) were observed on the slopes of the valley. They point out the great ecological diversity of their association from the cold, stepparian periglacial environments of the isolated tableland of the Meseta de la Laguna del Sello, eastwards (Color Plate 2, 3).

All the new specimens were carefully examined, measured with precision calipers and compared with the phenetically closest species of the genus. The measurements were taken on adult individuals whose maturity was established by the presence of ripe gonads and the functional development of secondary sex characters. Further discriminant analysis, to assess the reciprocal position of the new population sample with the population sample of three other species of the *archeforus* group, were also carried out using Foucart's method (1982). These were *Liolaemus sarmientoi* (N = 15; from Monte Aymond, terra typica, Strait of Magellan, Santa Cruz), *Liolaemus archeforus* (N = 20; from Meseta de la Laguna del Sello, near Buenos Aires lake, Santa Cruz) and *Liolaemus gallardoii* (N = 21; from Cerro Beltza, near Belgrano Lake, Santa Cruz). The specimens belong to the herpetological collections of the Museo Zoologico Università di Firenze (Italy), Museum National d'Histoire Naturelle, Paris (France),

Museum of Comparative Zoology, Harvard (USA), Museum of Natural History, University of Kansas (USA), Museo de la Plata (Argentina), Instituto de la Patagonia, Punta Arenas (Chile), J.M. Cei-Diagnostic Collection and J.A. Sclaro-Diagnostic Collection.

The 12 continuous and discontinuous variables reported for the previously described species of the *archeforus* group by Cei (1975), and Cei and Sclaro (1982), are compared with those of the new population in Table 1. A numerical evaluation of chromatic patterns in these species was added to the statistical treatment with discontinuous variables. The "ventral pigmentation" and "lateral red-scales percentage" were arranged to give a numerical value for the individual expression of chromatophore density, supported by gradual arbitrary scales, proposed by Sclaro and Cei (1987, 1991). Variables showing significant differences between groups were analyzed for normalcy by means of Snedecor's F Test. When normal Gaussian distribution were observed, the comparison between means was made by the Student t Test. When character distributions were not normal, the Mann-Whitney U Test or Z Test has been used.

Results of these analyses demonstrate that the recently discovered population possess a unique combination of metric and/or meristic characteristics, and justify its recognition as a distinct species.

Variables	<i>L. zullyi</i> (N = 11)	<i>L. archeforus</i> (N = 20)	<i>L. gallardoi</i> (N = 21)	<i>L. sarmientoi</i> (N = 15)
Snout-vent length (mm)	70.9 (3.7)	82.1 (6.8)	78.3 (9.1)	81.3 (3.8)
Head length (mm)	15.2 (1.1)	16.4 (1.7)	15.6 (2.1)	17.3 (1.4)
Head width (mm)	13.5 (0.9)	13.7 (1.5)	14.2 (2.1)	14.6 (1.3)
Fore limb length (mm)	23.7 (1.3)	26.0 (2.2)	25.2 (2.3)	27.2 (1.5)
Hind limb length (mm)	36.9 (3.0)	40.7 (3.1)	39.5 (4.5)	41.0 (3.5)
Axilla-groin length (mm)	33.9 (2.3)	41.8 (4.3)	38.5 (3.9)	39.5 (2.8)
Fourth finger lamellas	17.5 (0.7)	19.5 (2.2)	18.9 (1.4)	17.7 (0.8)
Scale number around midbody	86.8 (5.4)	72.8 (3.2)	70.3 (3.3)	65.4 (1.9)
Supralabial scale number	7.5 (0.8)	8.1 (0.8)	8.7 (0.7)	7.7 (0.6)
Infralabial scale number	5.3 (0.6)	5.2 (0.4)	5.6 (0.6)	5.5 (0.6)
Red scales percentage (%)	36.4 (23.3)	22.7 (26.6)	1.2 (5.5)	73.3 (24.0)
Ventral pigmentation (%)	61.4 (19.5)	81.2 (10.8)	54.8 (12.5)	90.0 (15.3)

Table 1. Comparative mensurable characters of the species analyzed. Values represent Mean and Standard Deviation (SD)

***Liolaemus zullyi* sp. nov.**

Holotype. MRSN R-1141-1 (male). From Rio Zeballos valley, in the Jeinement River basin, at 850 m a.s.l., in the neighbourhood of the ford of the river, lying on the track to Paso Roballós, some 80 km south of Los Antiguos, west of Perito Moreno, Santa Cruz Province, Argentina. Collectors: J.M. Cei and J.A. Scolaro, 24 February 1995.

Paratypes. Males: MRSN R-1141-2 to 8; J.M.C.-D.C. 1149; I.A.S.-D.C. 419 and 422; Females: MRSN R-1141-9, 10; J.M.C.-D.C. 1150 (all adults). Juven. MRSN R-1141-11, 12. The same collectors and data of the Holotype.

E t y m o l o g y . The species was dedicated to Mrs. Zully Ortega de Scolaro, for her constant careful assistance during repeated heavy field works of the authors in the poorly studied and depopulated southern Patagonian regions.

D i a g n o s i s . *Liolaemus zullyi* differs from all other species of *Liolaemus* except other members of the *archeforus* group and the *kingii* group, in having the characteristics of the *nitidus* and *signifer* groups as listed by Etheridge (1995: Appendix 2, Part A). Within the *archeforus* group *L. zullyi* differs from *L. archeforus*, *L. sarmientoi* and *L. gallardoi* in having a higher mean number of scales around midbody, a smaller adult snout-vent length, narrower scales in its dorsal scale rows, more irregular and heteromorphic lateral scale rows, and a very distinctive laterally red or yellow striped color pattern, uncommon in the other forms of the group. *Liolaemus zullyi*, along with other species in the *archeforus* group, may be distinguished from members of the *kingii* group by its larger forelimbs, the more strongly keeled dorsal or lateral scales, the prevailing presence of red and orange-red scales in dorsal and lateral patterns, and a generally stronger ventral pigmentation leading to a true condition of melanism.

Description of the Holotype. A slender lizard, snout-vent length (SVL) 72 mm; head length 17 mm; head width 15 mm; hindlimb 38 mm; forelimb 24.2 mm; axilla-groin distance 33.8 mm; scales at midbody 90; supralabials 6; infralabials 5; number of subdigital lamellae on the fourth toe of the right foot 25; number of subdigital lamellae on the fourth finger of the right hand 18; preanal pores 7. Cephalic scales rough and bulky; supraorbital semi-circles complete; 5 nearby equal supraoculars, separated by 1-2 rows of small irregular scales from the sharply keeled superciliaries; temporals smooth or very faintly keeled; rostral broader than high; nasals lateral, separated by 4 moderately enlarged scales; one row of nearby equal loreolabials; ear opening transversally enlarged with conical scales on its anterior border and very small granules behind; small lateral granules on the neck; a longitudinal fold behind the ear, obscured by deep transversal folds; prehumeral pocket large, very deep; parietals and interparietal rugous, irregular; nuchals small; heterogeneous, distinctly keeled; dorsals narrow, strongly keeled, in regular vertebral and median rows but irregular and smaller in the flanks, abruptly followed by triangu-

lar, smooth lateroventral scales; strongly keeled scales on tail and upper limbs; ventrals smooth, rounded; caudals ventrally smooth, subtriangular. Color in the living specimen as in the photography (Color Plate 1, 2, 3), dorsal and ventral view. On the vertebral region a longitudinal band of about 10 brown scales, mostly with depigmented yellowish points, is present. It is bordered by a narrow stripe of 2-3 red and brown scales, slightly entering the tail; a border of deep brown scales (10-12) follows, with scattered red scales prevailing in the lower latero-ventral region, which is marginated by a distinguishable red line (1 scale) between the axilla and groin. Ventrally pale orange, scattered with melanic pigmentation on a median line. Color in preservative: a blackish dorsal ground where the paler characteristic pattern is still distinguishable, still reddish on the latero-ventral region; ventrally grayish with scattered fine black points. Preanal pores orange, as in the living specimen.

Variation in Paratypes. The mean of SVL was 70.9 mm (N = 11; range = 65.0-77.5 mm) in males and 65.3 mm (N = 4; range = 62.0-67.0 mm) in females. Comparing with *L. archeforus*, we found a mean of SVL of 82.6 mm (N = 19; range = 70.0-90.1 mm) in males and 78.3 mm (N = 17; range = 70.0-90.0 mm) in adult females. The mean of the number of scales at mid-body was 86.8 (N = 11; range = 78-97) in males and 84.5 (N = 4; range 78-90) in females. While, *L. archeforus* showed a mean of 72.9 (N = 19; range = 66-78) in males and 73.5 in females (N = 17; range = 67-80). The head length is contained 4.23-4.86 times in the SVL in male specimens (N = 11) of *L. zullyi*, and its SVL 1.10-1.25 times in the tail length of 8 adult specimens of this species, apparently less autotomic than *L. archeforus*.

The variation of the chromatic pattern in *L. zullyi* is noticeable. In some specimens the brilliant red dorso-lateral and latero-ventral stripes and lines become yellow, or very faint, almost indistinguishable; different phenotypic expressions of the same character.

In other specimens, the black-yellow vertebral band is not so distinct: in a number of individuals, mainly in females, such a vertebral band is reduced and extensive series of transversal, broken, brown dorso-lateral marks are present. The moderately dark pigmentation of the holotype on the ventral line becomes much more extensive in other individuals but a true melanism is a very uncommon one.

Other remarkable interspecific differences in the variation of several metric and meristic characters are presented in the discriminant analysis.

Distribution. *Liolaemus zullyi* was only found in the rocky valley west the basaltic Meseta de la laguna del Sello, at altitudes from 600 to 850 m a.s.l., along the riparian environments of the basin of the Jeinement River, on the Chilean-Argentine boundaries. It was not found for a distance of 30-40 km from Los Antiguos northwards. Further collecting is necessary to determine its distribution southwards.

RESULTS OF THE DISCRIMINANT ANALYSIS

The discriminant analysis provided three significant canonic axes for the groups considered. Canonic axes I and II absorbing the 74.2% of the total variance, and canonic axis III the remaining 25.8%.

The canonic axis I associates positively variables as “snout-vent length”, “hind limb length” and “axilla-groin distance”; it associates negatively the variable “scale number around midbody”. Then, the axis I provides the separation of *zullyi* from the other species, associating in its negative sector the variables having a major expression in *zullyi* in comparison to the remaining taxa, such as “scale number around midbody” ($P < 0.001$), and by its minor expression for all the variables showing body measurements: “SVL”, “head length”, “axilla-groin distance”, “fore limb length”, “hind limb length” (all variables, $P < 0.01$). The canonic axis II associates positively the variables “red scales percentage” and “ventral pigmentation”, and negatively the variable “number of supralabials”. It provides in its positive sector the separation of *sarmientoi* by its major expression for “ventral pigmentation” ($P < 0.01$) and “red scales percentage” ($P < 0.01$), from *gallardoi*, showing minor expression for these variables, but major expression for “number of supralabials” ($P < 0.01$). The canonic axis III provides the separation of *archeforus* from the other species by its major numerical value for variables such as “number of finger lamellae” ($P < 0.01$) and its minor expression for “number of infralabials”. The canonic axis III provides then a clear cut biological separation between *sarmientoi*, *gallardoi* and *archeforus* species, having in mind the former clear cut separation of *zullyi* in this analysis (axis I).

Other variables also provide a consistent separation between the specific samples. *Liolaemus zullyi* shows a major expression of “red scales percentage” when it is compared with *archeforus* and *gallardoi* species ($P < 0.01$), but a minor expression when compared with *sarmientoi* ($P < 0.05$). *L. zullyi* shows a minor expression of “ventral pigmentation” when compared with *sarmientoi* and *archeforus* respectively ($P < 0.01$); when compared with *gallardoi* it likely shows a minor expression for “number of finger lamellae” and “number of supralabials” ($P < 0.01$). *L. sarmientoi* can be separated from *gallardoi* species by its minor numerical value of “scale number around midbody” ($P < 0.01$), “fourth finger lamellae” ($P < 0.01$) and by its minor expression for “red scales percentage” ($P < 0.01$), “head length” and “fore limb length” ($P < 0.01$, respectively), besides the mentioned variables associated to the axis II. Finally, *sarmientoi* is separated from *archeforus* by its major expression of “red scales percentage” ($P < 0.01$) and by its minor expression for variables such as “scale number around midbody” and “fourth finger lamellae” ($P < 0.01$), respectively). When *archeforus* is compared with *gallardoi*, a major numerical value is exhibited for the variables “scale number around midbody”, “red scales percentage”, “ventral pigmentation” and “axilla-groin distance” ($P < 0.01$, respectively); a minor numerical value is exhibited for “number of supralabials” ($P < 0.05$).

When the distance between centroids is analyzed, it appears evident that *L. zullyi* shows a major distance from the other species, *L. archeforus*, *L. gallardoii* and *L. sarmientoi*, in spite of their also remarkable equidistances. That is much more evident in a three-dimensional graphic expression; ellipses of equiprobability ($P < 0.01$; Sokal and Rohlf, 1979) for all specimens revealed no

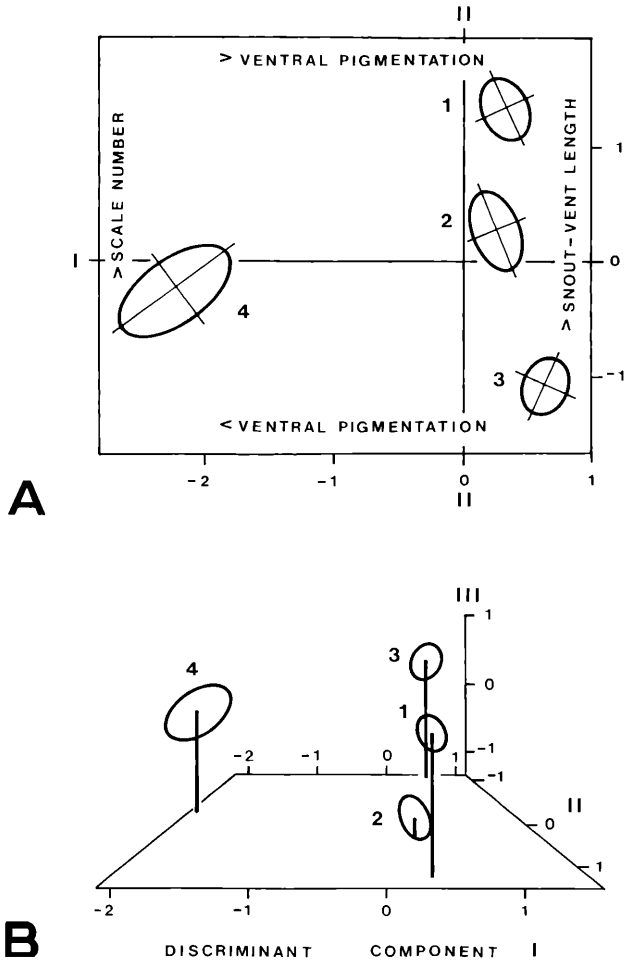


Fig. 2. - Ellipses of equiprobability for all the cases ($P < 0.01$), in their bidimensional (A) and three-dimensional (B) expressions. Number in the graphics indicate: 1.- *Liolaemus sarmientoi* ($N = 15$), 2.- *L. archeforus* ($N = 20$), 3.- *L. gallardoii* ($N = 21$) and 4.- *L. zullyi* ($N = 11$). Distances between the group centroids point out the major distance of *L. zullyi* from the other taxa that shows a relative equidistance between them.

overlap between these forms (Fig. 2). The measured distances between centroids support a noticeable independence between all the species. To test the fitness of our discriminant analysis all the data were grouped and checked against any individual case. It resulted in a very high percentage of correct classification (97%). Thus, in spite of the always necessary statistical caution, the analytical results here reported can stress a correct specific status for the new proposed taxon *Liolaemus zullyi*.

GENERAL CONSIDERATIONS AND CONCLUSIONS

The high number of scales at midbody is a somatic character state uncommon in any other known species of the *archeforus* group, but it is the most striking condition of the *Liolaemus zullyi* lepidosis. On the other hand, the high number of scales at midbody is the rule for the species belonging to the *kingii* group.

In fact, the average of the number of scales around midbody was 86.8 (N = 11; range 78-97) in *L. zullyi*, versus a mean of 72.8 (N = 20; range = 66-80) in *L. archeforus*, a mean of 70.3 (N = 21; range = 63-78) in *L. gallardoi* and a mean of 65.4 (N = 15; range = 63-70) in *L. sarmientoi* (Monte Aymond: terra typica). However, in the the *kingii* group, a mean of 80.4 (N = 27; range = 73-97) in *L. kingii* (Puerto Deseado: terra typica) and a mean of 76.5 (N = 16; range = 71-82) in a still undescribed population of the southern Deseado River (Santa Cruz), have been reported. In the other known forms of the group, averages of 79.6 (N = 16; range = 73-88) for *L. somuncurae* and of 80.1 (N = 16; range = 77-88) for *L. baguali* have been found. We believe to be appropriate, at this point, to state that the presently recognized subspecies of *Liolaemus kingii*: *L.k. kingii*, *L.k. somuncurae* and *L.k. baguali* (Etheridge, 1995), are easily diagnosable and are entirely allopatric (Ceï, 1986), and thus meet the criteria for evolutionary species as defined by Frost and Hillis (1990). For this reason they are here given the rank of full species. Because of their general phenetic resemblance they may be referred to collectively as the “*kingii* group”.

At the actual stage of our research it would be somewhat hasty any attempt to explain our sometime puzzling findings by means of phyletic speculations. Only some rational considerations can be therefore carried out. We are certainly dealing with an iguanian stock which underwent its evolutionary branching subject to the environmental selective pressures of climatic and geomorphological glacial events. During the most extensive expansion of the ice the primitive ancestral population of the present *archeforus* and *kingii* groups were likely pushed eastwards, to milder Atlantic habitats. Adaptive trends were acquired at the time by those periglacial populations which after the ice withdrew could occupy and remain in several of the most difficult environmental niches in the southern Patagonia biotopes today. That is the case, e.g., of the different forms of the *archeforus* group, often

endemic inhabitants of isolated volcanic tablelands on the border of the major glacial lakes. A wider distribution is shown by *L. kingii*, from the Atlantic shores to the subandean tablelands westwards, but also in the *kingii* species group isolated taxa are found, such as *L. somuncurae* and *L. baguali* from its northernmost and southernmost peripheral areas. About the origin of *Liolaemus zullyi*, of course, we could put forward only hypothetical inferences. Possibly a common primitive form could to have been the ancestor both of the endemic *archeforus* from the Meseta de la Laguna del Sello, or the smaller *zullyi* from the also isolated microclimatic habitat of the western valley.

Possibly a probable role of the "genetic drift" could be invoked. The taxo-genetic problem of these liolaemine lizards is open, and the aid of no morphological kinds of evidence should be undoubtedly necessary. To be pointed out for the peculiar habitat of *L. zullyi* are the relicts of the *Nothofagus* communities, a true unusual ecological environment for the other Patagonia taxa of the complex.

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RIASSUNTO

Si descrive una specie nuova e peculiare del gruppo *archeforus* che rimpiazza l'affine taxon *Liolaemus archeforus* endemico della Meseta della Laguna del Sello (Santa Cruz, Argentina), nella adiacente vallata post-glaciale che si stende ad ovest delle scarpate pendici della suddetta Meseta, accompagnando il corso del Rio Zeballos (Terra typica), lungo il più esteso e profondo Rio Jeinement sulla frontiera Argentina-Chilena. La nuova forma si riconosce facilmente per il suo elevato numero di squame intorno alla metà del corpo (il più alto in tutte le specie del gruppo), per la sua significativa minor lunghezza, per vari altri caratteri metrici o meristici, ma particolarmente per il suo inconfondibile disegno dorsale e la colorazione che lo accompagna. L'analisi discriminante che completa il lavoro per numerose variabili somatiche, conferma significativamente per i suoi risultati la posizione specifica assegnata a questo nuovo *Liolaemus*. I taxa sottospecifici finora assegnati ai gruppi *archeforus* e *kingii* del genere *Liolaemus* vengono adesso elevati al rango specifico secondo il presente concetto di "specie evolutiva".

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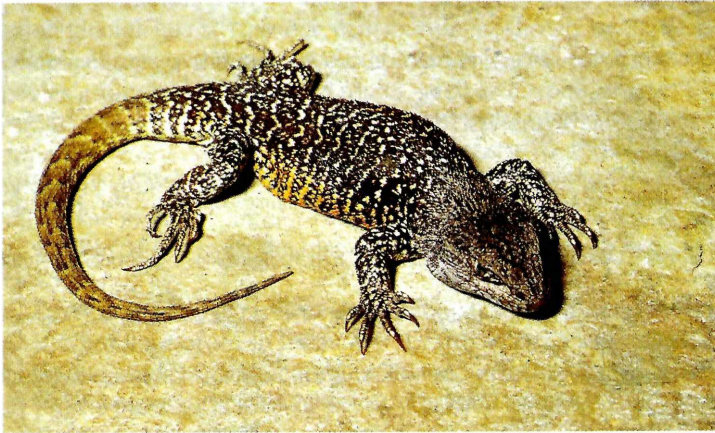


Fig. 1 - Adult male specimen of *Liolaemus archeforus* from the southeastern borders of the Meseta de la Laguna del Sello, at about the altitude of Laguna Honda (1250 m a.s.l.). (To be compared with the Fig. 2, dorsal view).

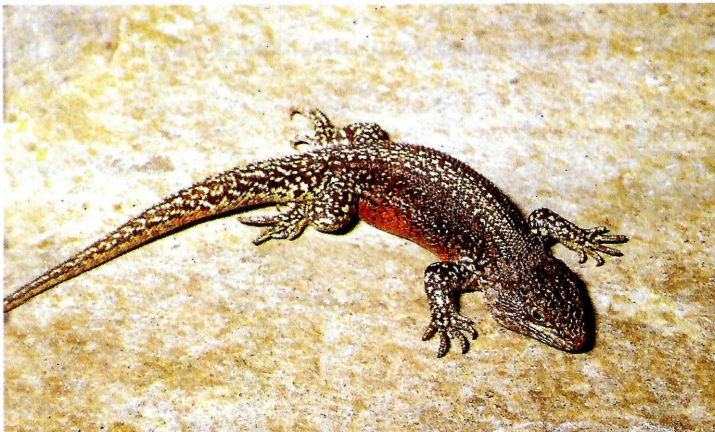


Fig. 2 - Holotype of *Liolaemus zullyi* (adult male): MRSN-R- 1141-1. From Río Zeballos (750-815 m a.s.l.), neighborhood of the ford on the road to Roballos Pass, at some 80 km south of Los Antiguos, Santa Cruz, Argentina. 24.02.1995.

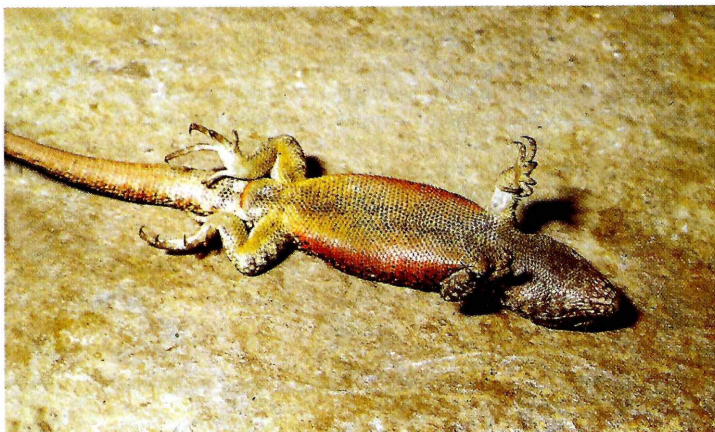


Fig. 3 - The same specimen and data. Ventral view.

Fig. 1 - Adult female of *Liolaemus zullyi* from the same locality and data as the Holotype.

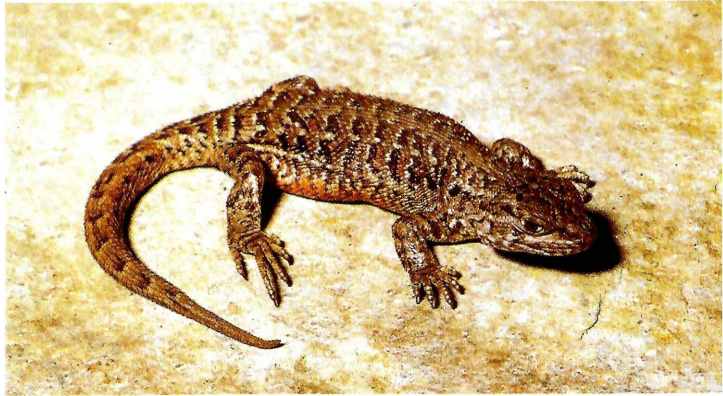


Fig. 2 - The same specimen and data. Ventral view.

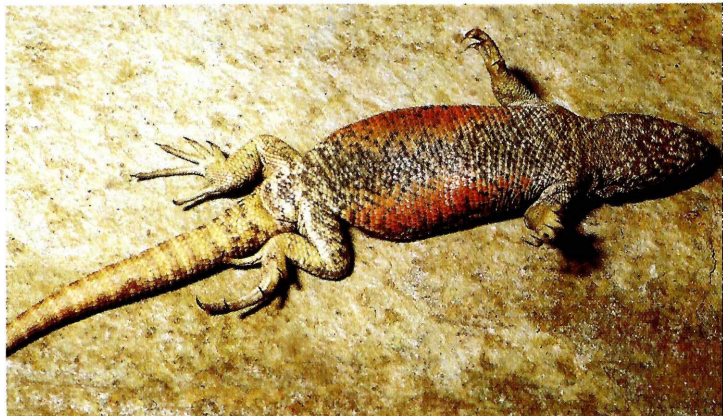


Fig. 3 - Landscape of the valley of Río Zeballos, near the Jeinement River, along the Chilean-Argentine frontier, on the new track from Los Antiguos-Paso Roballos (700-850 m a.s.l.), at some 70-80 km from Los Antiguos. Habitat of *L. zullyi*: on the bottom of the deep green relicts of the ancient *Nothofagus* forest.



