

HELLENIC ZOOLOGICAL SOCIETY

Lacertids of the Mediterranean region

A Biological Approach

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R E P R I N T
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Edited by

E. D. Valakos

*University of Athens, Department of Biology, Section of Ecology & Taxonomy GR 157-71,
Panepistimioupolis, Ilissia Athens, Greece*

W. Böhme

*Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 150-164,
D-53113 Bonn 1, Germany;*

V. Pérez-Mellado

*Universidad de Alicante, Departamento de Ciencias Ambientales y Recursos Naturales,
Division de Biología Vegetal y Animal, Ap. Correus 99, E-03080 Alicante, Spain*

P. Maragou

*University of Athens, Department of Biology, Section of Ecology & Taxonomy GR 157-71,
Panepistimioupolis, Ilissia Athens, Greece*

Athens, Bonn, Alicante

1993

Valakos, Böhme, Pérez - Mellado, Maragou (eds), (1993)
Lacertids of the Mediterranean region, pp. 85-105

Chapter 7

A systematic survey of the Iberian rock lizard *Lacerta monticola* Boulenger, 1905

V. Pérez-Mellado¹, L. J. Barbadillo², F. Barahona²,
R. P. Brown¹, C. Corti³, F. Guerrero¹, B. Lanza³

¹ Department of Animal Biology, Universidad de Salamanca, Spain

² Unidad de Paleontología, Department of Biology, Universidad Autónoma de Madrid, Spain

³ Museo di Storia Naturale, Sezione di Zoologia "La Specola", Università di Firenze
50125 - Florence, Italy

Introduction

The Iberian rock lizard, *Lacerta* (*Archaeolacerta*) *monticola* is an endemic species which inhabits coastal and mountainous areas in the north and centre of the Iberian peninsula.

In spite of several ecological studies, no recent attempt has been made to review the systematic status of this species.

Populations of the Iberian rock lizard indigenous to Northern and Central parts of the Iberian Peninsula are grouped under the name *Lacerta monticola* (Boulenger, 1905) and assigned to the subgenus *Archaeolacerta* (Méhely,

1909) (considered a full genus by some authors [Lanza *et al.*, 1977; Guillaume and Lanza, 1982]). Taxonomic studies during the first half of this century designated four different subspecies: the nominal form, *Lacerta monticola monticola* from the westernmost part of the "Sistema Central" and the Serra da Estrela in Portugal (Lantz, 1927), *Lacerta monticola cyreni* from the rest of the "Sistema Central" range (see below) (Cyrén, 1934; Müller and Hellmich, 1937), *Lacerta monticola cantabrica* from the Cantabrian mountains (Mertens, 1929), and *Lacerta monticola bonnali* from Pyrenees (Lantz, 1927).

In spite of some recent contributions to the natural history of this species (Argüello, 1990; Braña *et al.*, 1990; Pérez-Mellado *et al.*, 1991; Salvador, 1984 and references therein) no attempts have been made to study the systematic status of these populations and the validity of different subspecies. As part of a wider investigation of the evolution and ecology of the Iberian rock lizards, we present here a taxonomic revision, complemented by two more papers, on multivariate analysis of scalation (Brown and Pérez-Mellado, in press) and biochemical systematics (Nascetti *et al.*, in prep.).

Material and Methods

1. Specimens

We have studied a total of 365 preserved specimens. Not all characters were studied for all specimens, so sample sizes are not necessarily equal. Specimens were from collections maintained at the Department of Animal Biology, Universidad de Salamanca, Collezione Museo Zoologico di Firenze, Italy (specimens nos. 1174-1179, B. Lanza leg.), and also from the private herpetological collection of Pedro Galán (see Galán, 1982 for a full account on Galicia localities).

Specimens were from seven locations within the Iberian peninsula and Lac Bleu de Bigorre (France), covering the entire known range of lizards assigned to *Lacerta monticola*. For analytical purposes we pooled specimens into the following seven geographical groups: 1. Gredos, 2. Candelario (samples from Sierra de Candelario pooled with the sample from Sierra de Francia), 3. Guadarrama, 4. Estrela, 5. Galicia (samples from 12 locations of coastal Galicia, from provinces of La Coruña and Lugo, see above), 6. Sanabria (Samples from Cantabrian mountains, Lugo and Zamora provinces), and 7. Pyrenees (samples from Cotatuero, Góriz and Lac Bleu de Bigorre, see below).

2. Characters

Measurements and counts were made according to Pérez-Mellado and Gosá (1988). We measured the following body dimensions: snout-vent length (SVL), length of the Pileus (LP), distance between the tip of the snout and the anterior

edge of forelimb (MMA), height of the head (HH), width of the Pileus (WP), length of the forelimb (LFL), length of the hindleg (LHL), length of the hindfoot (LHF).

Scalation characters were: number of dorsal scales (DOR), number of gular scales (GUL), number of ventral scales (V), number of collar scales (COLL), number of femoral pores on the left hindleg (FEM), number of subdigital lamellae on the fourth rear toe (LAM). Degree of contact between rostral and frontonasal shields was also recorded qualitatively.

Descriptions of adult and subadult coloration and colour patterns were made from fresh material, colour diapositive photographs, and preserved specimens with the aim of outlining (qualitatively) the principal differences among the populations.

A complete list of specimens studied is available from the senior author.

3. Statistical procedures

Males and females were separated for the body dimension analyses. One-way analyses of variance (ANOVA) tested for among-locality variation in SVL. One-way analyses of covariance (ANCOVA) tested for SVL-independent variation in the remaining characters. Thus, using SVL as the covariate and the remaining body dimensions as dependent variables (see more details in Sokal and Rohlf, 1981).

For scalation, sexual dimorphism is found only in the number of ventral scales (Brown and Pérez-Mellado, in press). Hence, among-locality variation was tested by computing ANOVAs on sexes-pooled data for all characters except V (sexes-separated). Differences were considered significant at $P < 0.05$.

Results

Historical account

Based on his earlier description of specimens from the Serra da Estrela (Boulenger, 1905), Boulenger (1920) postulated that *Lacerta muralis* var. *monticola* was closely related to *Lacerta muralis* var. *bocagii* (sic). He also pointed out the very close resemblance between this "variety" and the Caucasian forms *chalybdea* and *saxicola*, and also with the variety *horvathi* (see also Lantz, 1927). Lantz (1927) later described the variety *Lacerta* (*Podarcis*) *monticola bonnali* from 17 specimens captured in 1922 from the Lac Bleu de Bigorre (Central Pyrenees, France). He gave the following diagnosis: maximum body size 54.5 mm for males and 60 mm for a female; head and trunk more depressed than in the sympatric *Podarcis muralis*; rostral scale always without contact with the nasal opening; 6 to 7 supraciliary scales; 1 to 10 supraciliary

granules; masseteric shield present; 20 to 26 gular scales; 5 to 10 collar scales; 41 to 48 dorsal scale; 26 to 27 ventral scales in males and 27 to 29 in females; large anal plate surrounded by a single circle of scales; caudal annuli alternately wide and narrow; green-bluish tail in young specimens. Later, *Lacerta monticola cantabrica* was described from Rodiezmo, in the Cantabrian mountains of León (Mertens, 1929). Cyrén (1934) made the first full revision of the systematic status of Iberian rock lizards, including the three subspecies mentioned above. Finally, Müller and Hellmich (1937) described the fourth subspecies, *Lacerta monticola cyreni* from Puerto de Navacerrada (Sierra de Guadarrama) in the 'Sistema Central'. The named racial categories were maintained by subsequent systematic studies (Mertens and Müller, 1940; Mertens and Wermuth, 1960; Salvador, 1974, 1984).

Distribution

The Iberian rock lizard is present in the Cantabrian mountains (Asturias, León, Zamora, and Lugo provinces (Elvira and Vigal, 1982; Salvador, 1984, 1985)), Galicia region (Lugo, and La Coruña provinces, Galán, 1982) and the "Sistema Central" mountain range (Cyrén, 1934; Salvador, 1974), where *Lacerta monticola* has been cited from Serra da Estrela, Portugal, in the west (Crespo and Cei, 1975), Sierra de Francia and Sierra de Béjar or Candelario both south of the Salamanca province, Sierra de Gredos (Avila province), and Sierra de Guadarrama in the east (Segovia and Madrid provinces, Fig. 1).

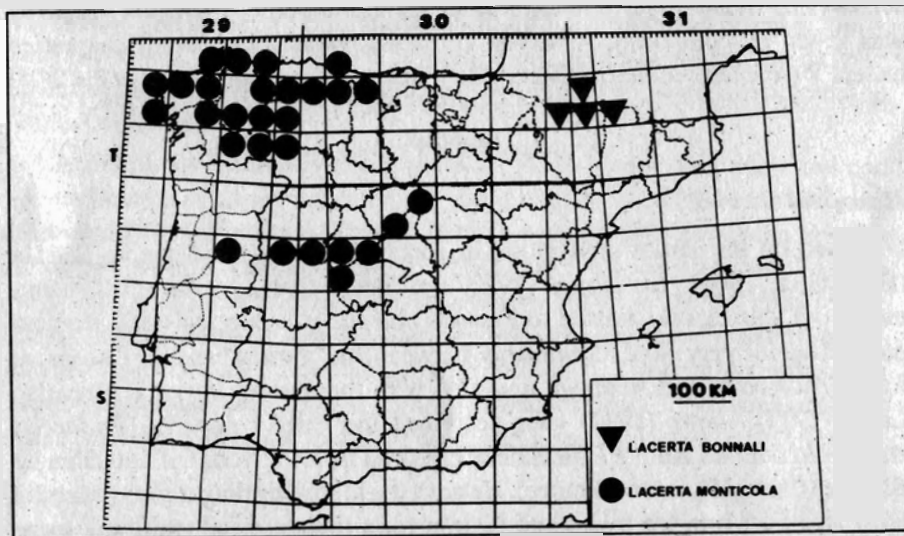


Fig. 1. Known distribution of the Iberian rock lizards recorded on 50 x 50 Km U.T.M. squares.
● *Lacerta monticola*, ▼ *Lacerta bonnali*.

It is a high mountain species, ranging from 1500 mts to the highest peaks in the "Sistema Central", e.g. Pico Almanzor, 2592 mts. (Melendro and Gisbert, 1976), and the Cantabrian mountains (VPM pers. obs.), but it is also found at much lower altitudes in Galicia, including some localities almost at the sea level (Galán, 1982; Braña *et al.*, 1990).

Regarding the Pyrenees population, it was recorded from Lac Bleu de Bigorre by Lantz (1927). On the French side of the Pyrenees it occupies an area of the southwestern extreme of the Atlantic and High Pyrenees in a region from Ossau valley to Aure valley (Beck, 1943; Lanza, 1963; Michelot and Martínez-Rica, 1989). In the Spanish versant it was cited by Martínez-Rica (1976) for the first time from Llanos de Góriz, Ordesa National Park (Huesca province), at 2500 m.a.s.l. (two specimens) and Aigües Tortes National Park (Lérida province). Its altitudinal distribution ranges from c. 2000 to 2750 m.a.s.l. (Martínez-Rica, 1979; Michelot and Martínez-Rica, 1989). Ten localities in the Central Pyrenees have been described:

1. Gran Encantat, Aigües Tortes, Lérida province, Spain (Martínez-Rica, 1977)
2. Muntanyó de Llachs, Aigües Tortes, Lérida province, Spain (Martínez-Rica, 1977)
3. Llano de Góriz, Huesca province, Spain (Martínez-Rica, 1976)
4. Llanos de Millaris, Huesca province, Spain (Martínez-Rica, 1977)
5. Pico de Marboré, Huesca province, Spain (Martínez-Rica, 1977)
6. Pic des Quatre Termes, Massif du Néouvielle, France (Beck, 1943)
7. Pic d'Arriel, France (Beck, 1943)
8. Lac Bleu de Bagnères -de-Bigorre (Type locality, Lantz, 1927)
9. Circo de Cotatuero, Ordesa, Huesca province (Pérez-Mellado, unpub.)
10. Liat, Lérida province (Vives-Balmaña, 1990)

Maximum abundance of Pyrenees lizards is found between 2000 and 2500 mts. It has been observed in sympatry with *Podarcis muralis* between 2000 and 2100 mts. (Martínez-Rica, 1976; VPM pers. obs.).

Body dimensions

Lowest adult mean SVL for both sexes is found in the Pyrenees population (Table 1) (multiple t-tests also indicated this was the only population whose mean SVL differed (for both males and females)).

Table 1. Snout-vent length of adult individuals of Iberian rock lizards from seven areas under study. N = number of lizards measured. Means \pm SE are given.

Population	N	Males	N	Females
Gredos	84	70.64 \pm 0.37	69	70.19 \pm 0.60
Candelario	12	66.45 \pm 1.59	5	73.32 \pm 3.14
Guadarrama	11	62.44 \pm 2.89	8	63.44 \pm 3.04
Estrela	17	70.98 \pm 1.12	11	74.88 \pm 1.09
Galicia	11	63.65 \pm 1.81	12	64.61 \pm 1.19
Sanabria	5	70.39 \pm 1.19	6	69.40 \pm 1.96
Pyrenees	12	53.56 \pm 0.64	8	57.24 \pm 0.60
one-way ANOVA				
F		30.807		13.855
P		<0.001		<0.001

Results of the ANCOVA analyses are given in Tables 2 to 8. Significant difference among slopes (Table 9) were found for several characters, i.e. LP, MMA, LFL and LHF for , and HH, LFL, LHL and LHF for so adjusted means for these characters might not give a totally accurate representation of among-group differentiation. This may also partially be the reason for the lack of any clear pattern of variation among the populations; no single population consistently shows strong differences in relative body dimensions from the rest. Specimens from the Gredos locality show lowest adjusted means for several, of the body dimensions measured, as do males (1 character) and females (3 characters) from the Pyrenees population. Greatest relative head height (Table 4) is found in the Serra da Estrela population, previously discussed as being related to a greater tendency for a ground-dwelling habit in this population (Pérez-Mellado, 1982).

Table 2. Length of the Pileus of Iberian rock lizards. N = number of lizard measured, mean and adjusted (adj. mean) \pm SE after ANCOVA analysis (SVL covariate) for males (M) and females (F) are given.

Population	N	Sex	Mean	Adj. mean
Gredos	84	M	15.17	14.66 \pm 0.08
	57	F	13.51	13.21 \pm 0.14
Candelario	7	M	16.61	15.43 \pm 0.29
	11	F	13.19	13.91 \pm 0.31
Guadarrama	10	M	15.39	14.93 \pm 0.24
	11	F	12.42	13.51 \pm 0.32
Estrela	27	M	13.61	15.05 \pm 0.15
	22	F	14.07	13.64 \pm 0.22
Galicia	11	M	15.50	15.35 \pm 0.23
	20	F	13.33	13.67 \pm 0.23
Sanabria	5	M	16.39	14.70 \pm 0.35
	7	F	13.47	12.67 \pm 0.39
Pyrenees	12	M	12.48	14.68 \pm 0.22
	7	F	11.69	12.54 \pm 0.39

Table 3. Distance between the tip of the snout and the anterior edge of forelimp (MMA) of Iberian rock lizards.

Population	N	Sex	Mean	Adj. mean
Gredos	84	M	23.45	22.74 \pm 0.18
	57	F	21.21	20.53 \pm 0.18
Candelario	7	M	26.86	25.11 \pm 0.64
	11	F	20.89	21.92 \pm 0.42
Guadarrama	11	M	24.43	23.72 \pm 0.51
	13	F	18.31	21.01 \pm 0.40
Estrela	27	M	21.78	24.08 \pm 0.33
	22	F	22.41	21.49 \pm 0.30
Galicia	11	M	24.17	24.00 \pm 0.51
	21	F	22.23	22.60 \pm 0.30
Sanabria	-	-	-	-
Pyrenees	5	M	20.06	23.96 \pm 0.76
	7	F	20.33	21.25 \pm 0.62

Table 4. Head height (HH) of Iberian rock lizards

Population	N	Sex	Mean	Adj. mean
Gredos	97	M	6.95	6.72 \pm 0.04
	94	F	5.84	5.68 \pm 0.03
Candelario	7	M	7.24	6.73 \pm 0.16
	11	F	5.55	5.91 \pm 0.11
Guadarrama	11	M	7.00	6.83 \pm 0.12
	13	F	4.93	5.78 \pm 0.10
Estrela	27	M	6.42	7.26 \pm 0.08
	22	F	6.63	6.43 \pm 0.08
Galicia	11	M	6.87	6.88 \pm 0.12
	21	F	5.60	5.76 \pm 0.08
Sanabria	2	M	7.64	6.45 \pm 0.29
	3	F	6.18	6.05 \pm 0.22
Pyrenees	5	M	5.43	6.82 \pm 0.19
	5	F	5.42	5.75 \pm 0.17

Table 5. Width of the Pileus (WP) of Iberian lizards.

Population	N	Sex	Mean	Adj. mean
Gredos	97	M	7.18	6.93 \pm 0.03
	94	F	6.26	6.12 \pm 0.03
Candelario	7	M	7.82	7.33 \pm 0.14
	11	F	6.25	6.58 \pm 0.08
Guadarrama	11	M	7.27	7.08 \pm 0.11
	13	F	5.60	6.36 \pm 0.08
Estrela	27	M	6.73	7.38 \pm 0.07
	22	F	6.87	6.70 \pm 0.06
Galicia	11	M	7.65	7.61 \pm 0.11
	21	F	6.55	6.70 \pm 0.66
Sanabria	4	M	8.17	7.46 \pm 0.18
	7	F	7.19	6.86 \pm 0.11
Pyrenees	15	M	6.14	5.15 \pm 0.09
	8	F	6.06	6.39 \pm 0.10

Table 6. Length of the left foreleg (LFL) of Iberian rock lizards.

Population	N	Sex	Mean	Adj. mean
Gredos	84	M	19.79	19.18±0.13
	57	F	17.75	17.14±0.18
Candelario	7	M	22.45	20.89±0.45
	11	F	18.03	19.89±0.41
Guadarrama	10	M	21.95	21.39±0.38
	13	F	16.13	18.63±0.39
Estrela	27	M	18.10	20.23±0.23
	22	F	19.60	18.79±0.29
Galicia	11	M	21.52	21.39±0.36
	20	F	19.44	19.79±0.30
Sanabria	2	M	18.40	15.54±0.85
	3	F	18.96	18.38±0.79
Pyrenees	5	M	18.22	21.85±0.54
	5	F	17.30	18.16±0.61

Table 7. Length of the left hindleg (LHL) of Iberian rock lizards.

Population	N	Sex	Mean	Adj. mean
Gredos	97	M	32.75	31.55±0.18
	94	F	29.13	28.42±0.20
Candelario	7	M	34.09	31.71±0.69
	11	F	26.35	28.07±0.59
Guadarrama	10	M	32.68	31.49±0.48
	13	F	24.11	28.10±0.56
Estrela	27	M	27.12	30.51±0.36
	22	F	28.67	27.78±0.41
Galicia	11	M	32.15	32.01±0.55
	19	F	28.04	28.77±0.44
Sanabria	5	M	31.31	27.81±0.82
	7	F	29.21	27.49±0.74
Pyrenees	14	M	25.18	30.37±0.50
	8	F	24.27	26.01±0.69

**Table 8.** Length of the left hindfoot (LHF) of Iberian rock lizards.

Population	N	Sex	Mean	Adj. mean
Gredos	97	M	16.01	15.42±0.04
	93	F	13.79	13.45±0.06
Candelario	7	M	16.57	15.42±0.18
	11	F	12.59	13.37±0.19
Guadarrama	11	M	16.22	15.77±0.14
	13	F	12.11	13.93±0.18
Estrela	27	M	13.54	15.12±0.09
	22	F	13.70	13.29±0.13
Galicia	11	M	16.02	15.93±0.14
	21	F	13.38	13.75±0.13
Sanabria	5	M	17.10	15.43±0.21
	7	F	14.46	13.66±0.24
Pyrenees	15	M	12.62	15.06±0.12
	8	F	12.18	12.97±0.22

Table 9. Results of ANOVA analysis on body measurements (SVL covariate). F values and probabilities for adjusted means and slopes of regressions for males (M) and females (F) of Iberian rock lizards. Comparison among all population.

Character	Sex	Adjusted means		Slopes	
		F	P	F	P
LP	M	5.6454	<0.001	1.1150	0.355
	F	3.0912	0.007	3.1700	0.006
MMA	M	5.1292	<0.001	0.6190	0.685
	F	7.5560	<0.001	3.7468	0.003
HH	M	5.5499	<0.001	2.9608	0.009
	F	12.0184	<0.001	2.1159	0.054
WP	M	10.2279	<0.001	1.0658	0.385
	F	25.0586	<0.001	1.4408	0.202
LFL	M	17.4289	<0.001	4.6371	<0.001
	F	11.2631	<0.001	2.5755	0.022
LHL	M	4.8858	<0.001	2.9186	0.010
	F	2.4601	0.026	1.3051	0.258
LHF	M	2.6381	0.018	2.4858	0.026
	F	2.6430	0.019	2.9819	0.009

Scalation

All scalation characters varied significantly among localities (Table 10). This differs slightly from Brown and Pérez-Mellado's (in press) finding of no significant among-population variation in collar scales; possibly due to a marginally greater number of specimens and the sexes-pooled approach in the current study. Lowest mean values for GUL, DOR, FEM, and LAM, and highest mean values for COLL are found in the Pyrenees population (Table 10). Specimens from Guadarrama show the lowest ventral scale counts (Table 11).

Coloration/colour pattern

Gredos

In adult males the back is greenish (65% of individuals studied) to brown-greenish (35%), with irregularly-shaped black spots covering the back and flanks. The flanks were clearly darker than back in 19% of males. The brown (53%) or greenish back pattern of adult females is less reticulated than in males, with flanks darker than the back in 44% of them. A vertebral stripe formed by unconnected black spots in the middle of the back was present in 33% of females

Tables 10. Descriptive data of scalation characters of Iberian rock lizards. GUL: Gularia, DOR: dorsalia, COLL: Collaria, FEM: Femoralia, LAM: Lamellae. Means \pm SE are given (number of lizards studied in parentheses).

	GUL	DOR	COLL	FEM	LAM
GRE (182)	24.63 \pm 0.15	51.27 \pm 0.14	9.70 \pm 0.06	18.11 \pm 0.11	23.01 \pm 0.10
CAN (28)	24.32 \pm 0.51	50.96 \pm 0.64	10.14 \pm 0.19	18.25 \pm 0.25	24.42 \pm 0.37
GUA (24)	22.33 \pm 0.33	47.79 \pm 0.22	18.33 \pm 0.22	18.33 \pm 0.28	24.08 \pm 0.23
EST (46)	23.19 \pm 0.29	51.65 \pm 0.36	9.78 \pm 0.22	17.08 \pm 0.20	23.47 \pm 0.19
GAL (32)	24.40 \pm 0.47	52.06 \pm 0.59	10.21 \pm 0.20	17.15 \pm 0.26	24.46 \pm 0.26
SAN (16)	23.81 \pm 0.52	52.43 \pm 0.86	10.43 \pm 0.30	17.50 \pm 0.42	23.37 \pm 0.48
PIR (20)	21.00 \pm 0.39	43.80 \pm 0.47	10.50 \pm 0.23	13.10 \pm 0.25	22.80 \pm 0.44
one-way ANOVA					
F	13.076	38.258	3.719	37.099	8.373
P	<0.001	<0.001	<0.0014	<0.001	<0.001

☆ ☆ ☆

Table 11. Ventral scales (V) of Iberian rock lizards. N = number of lizards measured, means \pm SE for males and females are given.

	N	Males	N	Females
Gredos	91	24.62 \pm 0.13	91	27.49 \pm 0.13
Candelario	17	25.00 \pm 0.42	11	26.00 \pm 0.42
Guadalarrama	16	21.75 \pm 0.26	8	22.87 \pm 0.39
Estrela	30	25.23 \pm 0.30	16	26.81 \pm 0.48
Galicia	16	23.50 \pm 0.32	16	25.56 \pm 0.33
Sanabria	8	23.50 \pm 0.46	8	27.62 \pm 0.49
Pyrenees	13	24.00 \pm 0.35	7	25.00 \pm 0.30
one-way ANOVA				
F		14.183		20.402
P		<0.001		<0.001

In subadult there is also a sharp contrast between uniformly brown flanks and brown spotted back, the limit between them formed by a line of isolated and small white spots, in 43% of specimens. Subadult specimens from both sexes possess a double vertebral stripe of black spots. Ventral parts whitish to bluish, as in the remaining populations of Sistema Central, Galicia and Cantabrian

mountains. 50% of adult males and 21.8% of adult females with blackish spots on the outer ventral scales (Fig. 2). 26.7% of adult males and 10.9% of adult females with greyish submaxillary lines or lined-up series of grey spots on submaxillary scales. Only in 5.8% of adult males did we observe some grey spots on outer gular scales. Ventral pigmentation almost completely lacking in juvenile specimens.

Sierra de Candelario

In contrast with the remaining populations of *Lacerta monticola*, the most common background colour of the back and flanks is greenish or bluish. Both, back and flanks, are reticulated with irregular black spots with a similar density in

adult males and slight darker pattern in flanks in adult females. Pileus heavily pigmented. In subadult and juvenile specimens background colour of back is brown with a sharp contrast between back and flanks. Complete absence of vertebral stripe, as well as ventral pigmentation in all sex and age classes.

Sierra del Guadarrama

Background colour of back is brown in almost all individuals. The pattern of back and flank spots is similar to the remaining populations of the Sistema Central above described. Greyish or blackish pigmentation on outer ventral scales in all adult males, two adult females and subadult individuals.

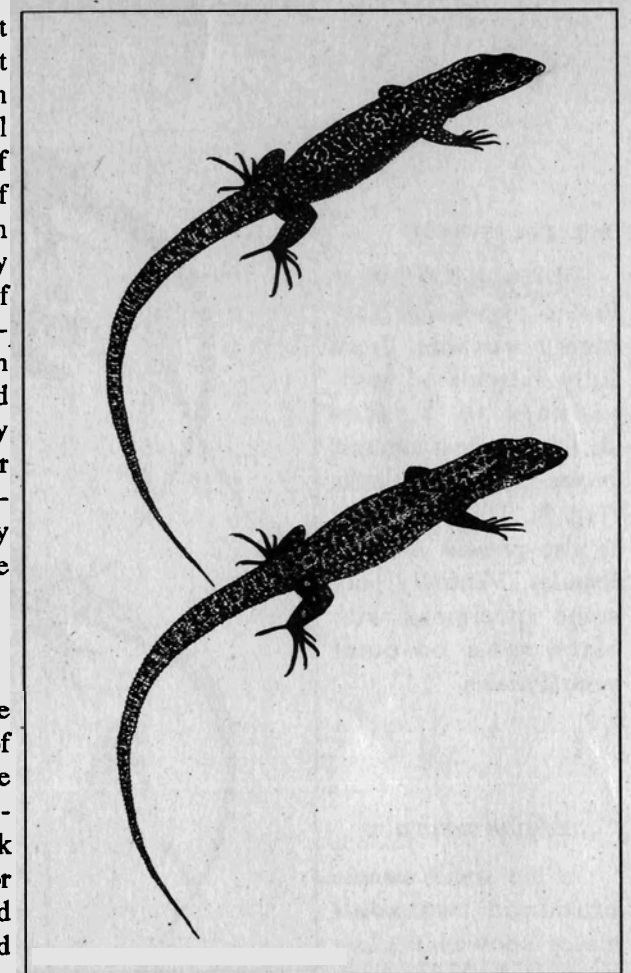


Fig. 2. Two different male dorsal patterns of *Lacerta monticola cyreni* from Sierra de Gredos, Sistema Central, Spain.

Sierra de Francia

The back pattern, as in Gredos population, is highly variable, from fully reticulated individuals to lizards showing a clear contrast between back and flanks (Fig. 3). This variability is also present in adult females. Ventrally only some specimens with black spots on outer ventral scales.

Cantabrian mountains

In the small sample examined two adult males showed a clear contrast between back and flanks, while the remaining individuals are reticulated. Adult females and subadult individuals of both sexes show a sharp contrast between back and flanks. Black spots on outer ventral scales. High variability regarding gular pigmentation that generally is confined to outer edges of the gular region.

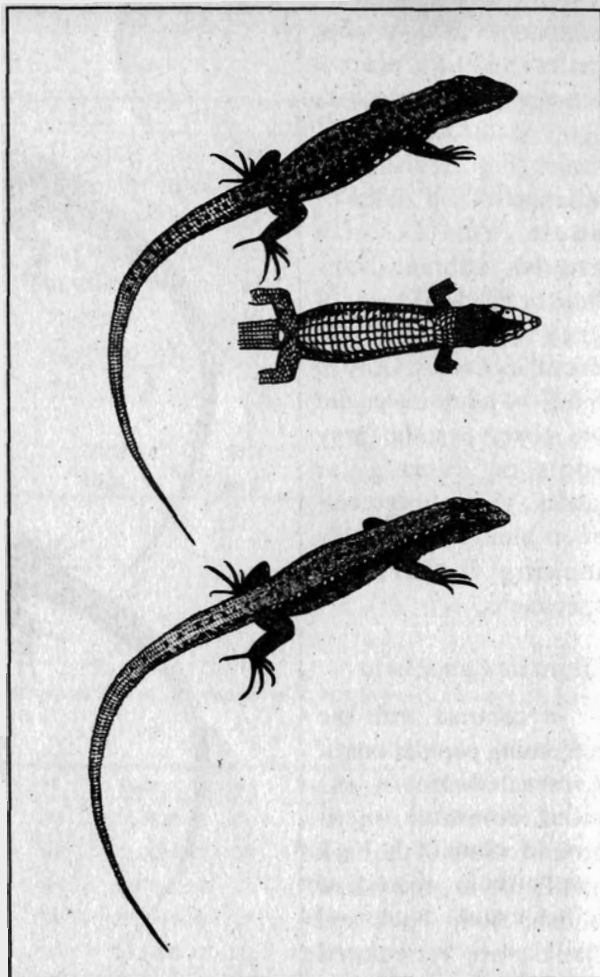


Fig. 3. Two different female dorsal patterns and a ventral pattern of *Lacerta monticola cyreni* from Sierra de Gredos, Sistema Central, Spain.

Serra da Estrela

The back of all females and 10% of adult males is brownish with large irregular blackish spots. The dark flanks / lighter back contrast is visible in all females and in 11% of males under study. In juvenile specimens flanks are uniformly brown with small white or yellowish spots and sharply contrasted with the back. Pileus is strongly pigmented in all adult specimens, while it lacks pigmentation in juveniles, subadult females and 65% of subadult males. All adult specimens with black spots in all ventral scales (Fig 4), normally the spot is in contact with the upper edge of the scale. In subadult individuals, at least some black spots on the outer ventral scales. Gular scales with some greyish and defined black spots in outer scales. In all individuals, blackish spots on submaxillary scales observed, but never arranged in lines.

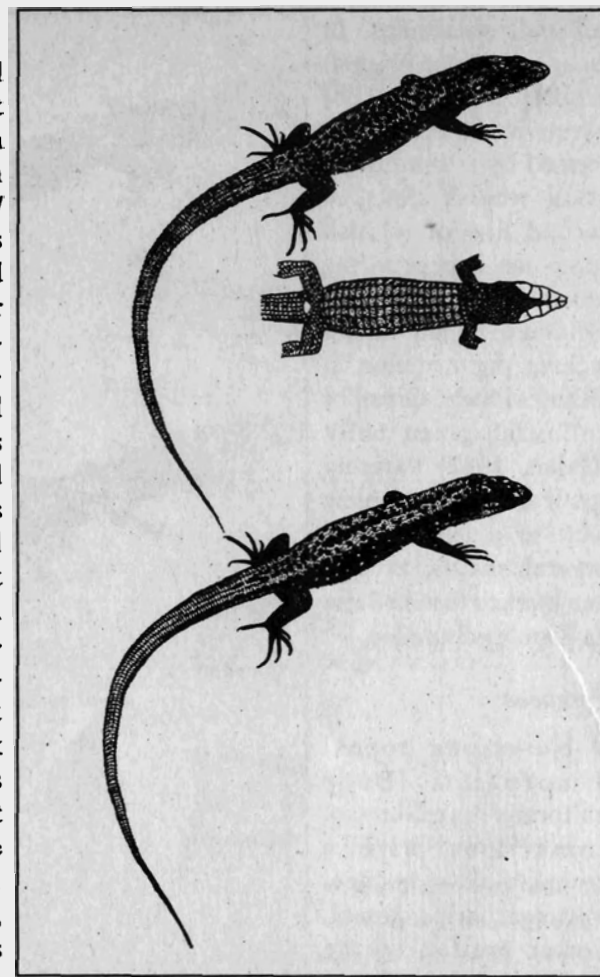


Fig. 4. Dorsal pattern of a male (above) and a female (below), and ventral pattern of a male of *Lacerta monticola* from Serra da Estrela, Beira Alta (Guarda province), Portugal.

Galicia

In these localities there is a highly variable back pattern. The majority (80%) of adult males examined showed contrast between back and flanks, with a slight vertebral stripe of lined-up black spots. Background colour variable from green-bluish (40%) to brown (60%). Pileus either slightly (30%) or devoid of pigmentation. Clear contrast between back and flanks in all females and

subadult specimens. In these groups we observe a sharp separation between back and flanks formed by a thin line of small whitish spots. A second line of whitish spots can appear in the lower half of flanks (Fig. 5). Gular region almost lacking pigmentation in all individuals. Green or yellowish-green belly (Galán, 1982) variably spotted, from a complete lack to a full spotted ventral scales, always less marked than in Serra da Estrela population.

Pyrenees

No strong sexual dimorphism. Back uniformly hazel-brown, sometimes with a greenish-olive nuance. Vertebral stripe absent. Lower portion of the flanks brown, finely spotted with small black spots in males and uniform in females, and often with a discontinuous slightly or fully developed blackish longitudinal central stripe. The above mentioned pattern usually extends caudally, at least to the basal portion of the tail, and is slightly more conspicuous in males than in females (Fig. 6). Pileus hazel-brown spotted with dark brown to black spots in all males and some females. Ventral parts off-white usually with a greenish or yellowish nuance. Outer ventral scales at least partially dark spotted in males, un- or only weakly spotted with greyish irregularly-shaped dots in females. Submaxillary scales often with some aligned dark spots. Gular region usually with a few isolated dark scales, sometimes with larger dark spots.

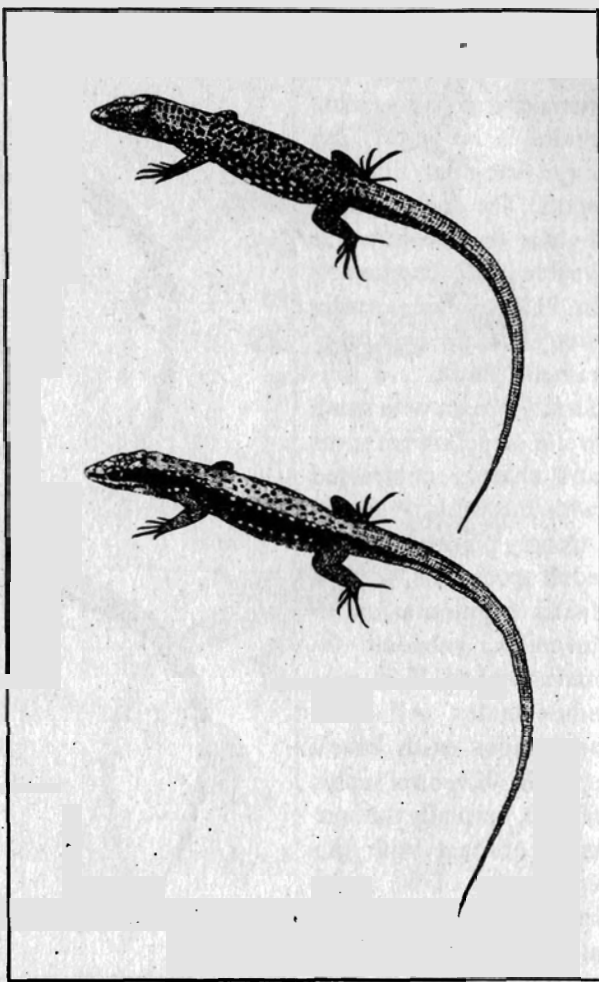


Fig. 5. Dorsal pattern of a male (above) and a female (below), and ventral pattern of a male of *Lacerta monticola cantabrica* from Sierra de los Ancares, Cantabrian mountains (Lugo province), Spain.

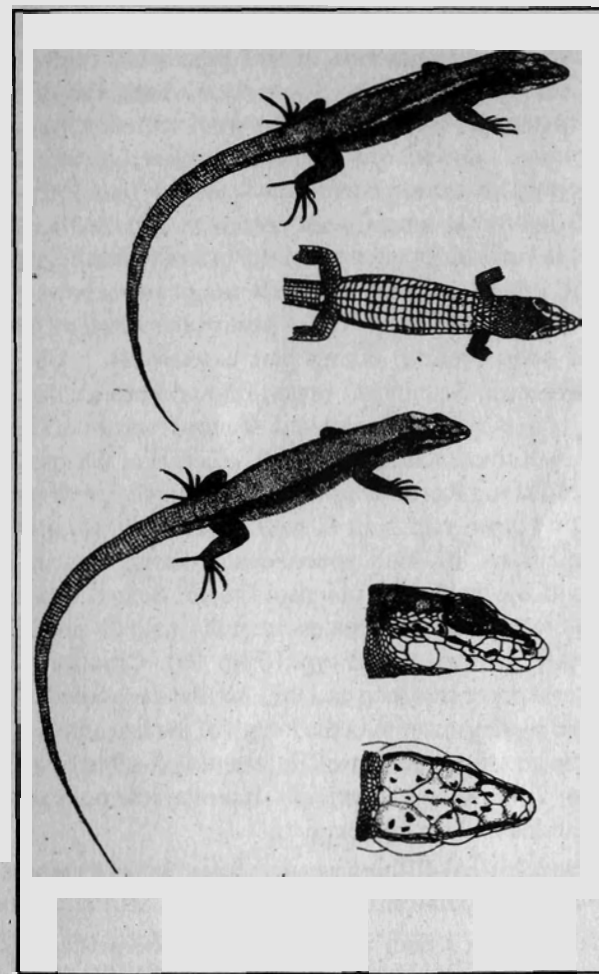


Fig. 6. Dorsal pattern of a female (above) and a male (below), and ventral pattern of a male, head dorsal and lateral view of an adult male of *Lacerta bonnali* from Circo de Goriz, Ordsa (Huesca province), Spain.

Osteology

Several osteological features are shared by the populations assigned to the subspecies: *L. monticola monticola*, *L. monticola cyreni* and *L. monticola cantabrica*. These are:

Cranial nasal opening small. Lack of contact between the posterior premaxillary process and frontal bones. Snout medial depression absent. Premaxillary bones fused. In adult specimens the posterior premaxillary process has an arrow-like shape, thus lateral margins are anteriorly divergent (Fig. 7a).

In adult specimens, 9 to 10 premaxillary teeth. Paired nasal bones. Unfused frontal bones. Short latero-anterior frontal processes, enclosing the dorsal process of the maxillary throughout a reduced area. Frontoparietal suture markedly convex in its anterior part in *L. monticola cyreni* populations and only slightly convex in *L. monticola monticola* and *L. monticola cantabrica* populations; the middle section of this suture has an interdigital pattern in its connection with the frontal bone. Cranial osteoderms extending to the posterior part of the parietal. Parietal foramen present. Lack of fusion between postfrontal and postorbital bones, so that both elements are always individually distinguishable. Anteromedial process of postorbital well differentiated (Fig. 8a). Postfrontal bone present, taking part extensively in the occlusion of supratemporal fenestra. Squamosal bone thin and keen along its full length. Quadratojugal process well differentiated. Ventral margin of the outer side of jugal not markedly inflected or stepped. The height of the maxillary posterior process is reduced along its full length in *L. monticola cyreni* populations and only reduced at its distal region in *L. monticola monticola* and *L. monticola cantabrica* populations. In adult specimens dentaries and maxillaries with greater number of bicuspid than unicuspid teeth. Sexual dimorphism in the number of presacral vertebrae. Females normally with 28 presacral vertebrae. Clavicles generally of the closed type (Fig. 9a). Cruciform interclavicle. Interclavicle lateral processes long and thin, so that the pooled length of lateral processes is equal to, or greater than the length of the last anterior process (Fig. 10a). Interclavicle anterior process well differentiated, often two- or threeforked in populations of *L. monticola monticola*. Interclavicle not expanded or only moderately expanded on its medial region.

Substantial osteological differences were found in the Pyrenees population, with respect to the aforementioned populations:

In adult specimens posterior premaxillary process with parallel margins (Fig. 7b). 7 premaxillary teeth in adult specimens. Anteromedial process of postorbital strongly reduced or absent (Fig. 8b). The height of the maxillary

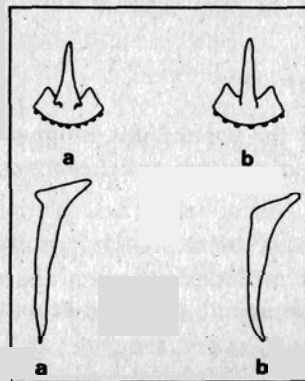


Fig. 7. Premaxillary bone of Iberian rock lizards. a. Premaxillary posterior process arrow-like shaped, 9 to 10 premaxillary teeth of *Lacerta monticola*; b. Premaxillary posterior process with parallel margins, 7 premaxillary teeth of *Lacerta bonnali*.

Fig. 8. Postorbital bone of Iberian rock lizards. a. anteromedial process well differentiated of *Lacerta monticola*; b. anteromedial process reduced or absent of *Lacerta bonnali*.

posterior process is reduced only in the distal region. In adult specimens dentary and maxillary bones with a greater number of unicuspid than bicuspid teeth. Females with 27 presacral vertebrae. The majority of clavicles of the open type (Fig. 9b). Interclavicle anterior process sometimes reduced or even absent. Interclavicle lateral processes short, so that their composite length is much shorter than the length of the last anterior process (Fig. 10b). Interclavicle markedly expanded in the region of the intersection between lateral processes with anterior and posterior processes.

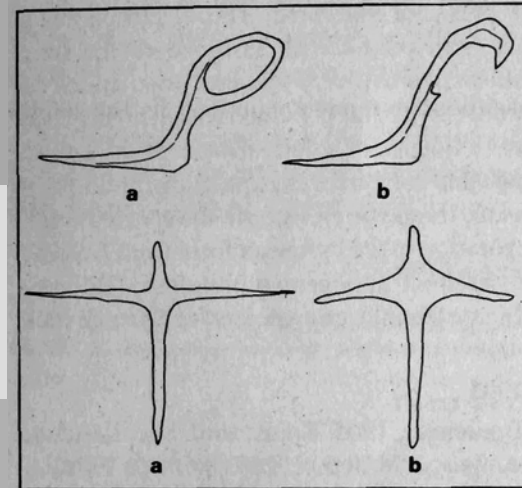


Fig. 9. Right clavicle of Iberian rock lizards. a. Closed type of *Lacerta monticola*; b. Open type of *Lacerta bonnali*.

Fig. 10. Interclavicle of Iberian rock lizards. a. Thin and long lateral processes of *Lacerta monticola*; b. Short and large lateral processes of *Lacerta bonnali*.

Discussion

The current distribution of *L. monticola* indicates that it is a climatic relict. Range changes, as opposed to changes in ecological tolerances, appear to have occurred in many species concurrently with the appearance of the Mediterranean climate in the Iberian peninsula during the Pleistocene (Di Castri, 1981). This is a feasible scenario for *L. monticola*. Its current distribution in the mountains ranges of northern Iberian peninsula and the wet and relatively cold regions of Galicia, probably resulted from post-Pleistocene range contraction as the Iberian climate became warmer and drier around 7000 BC (Font-Tullot, 1986). As found for scalation (Brown and Pérez-Mellado, in press), however, the patterns of population differentiation are not readily interpretable in terms of such a biogeographic scenario. The Serra da Estrela population for example appears quite well-differentiated in several character systems although it is clearly not the most isolated population.

The Pyrenees lizards can be clearly discriminated from the remaining populations on the basis of scalation characters (see also Brown and Pérez-

Mellado, in press), biochemical data (Nascetti *et al.*, in prep.), colour pattern/coloration, osteology, and to a lesser extent body dimensions. Unlike in other populations, Pyrenean animals are uniformly brownish or have olive-brown markings, show the lowest values for SVL, relative head length, and have divergent meristic character states for six of the seven characters studied here. Among other osteological peculiarities adult specimens have only seven premaxillary teeth in adult specimens, the anteromedial process of postorbital is strongly reduced or absent, dentary and maxillary hold more unicuspid than bicuspid teeth and have only 27 presacral vertebrae. The electrophoresis analysis carried out on individuals from populations assigned to the four subspecies currently recognized showed also that Pyrenees populations is genetically well differentiated (Nascetti *et al.*, in prep.). Such strong divergence in so many character systems is clear evidence of a deep-rooted phylogenetic differentiation. We therefore conclude that the Pyrenees population, previously described as *Lacerta monticola bonnali*, should be elevated to the species level, i.e. *Lacerta bonnali*. The specific separation of the Pyrenean form from *Lacerta monticola* is also supported by its different hemipenis epithelium (Böhme, 1971). Thus, we propose the following systematic arrangement for Spanish rock lizards:

Lacerta monticola Boulenger, 1905

Lacerta muralis var. *monticola* Boulenger, 1905. Trans. zool. Soc. London, 17:365. Terra typica restricta (Mertens and Müller, 1928): Serra da Estrela, Portugal.

Lacerta monticola Schreiber, 1912. Herp. europ. (2):409.

Lacerta muralis monticola Mertens and Müller, 1928. Abh. senck. naturf. Ges. 41:36.

Holotype: from Spain deposited at the Natural History Museum of London (Boulenger, 1920).

Lacerta monticola monticola Boulenger, 1905

Lacerta estrellensis Cyrén, 1928. Göteborg. Vetensk. Handl., (B)1:10. Terra typica: Lagoa Comprida, Serra da Estrela, Portugal.

Lacerta monticola cantabrica Mertens, 1929

Lacerta monticola cantabrica Mertens, 1929. Senckenbergiana, Frankfurt am Main, 11:284. Terra typica: Rodiezmo, province of León, Northwest Spain.

Lacerta monticola cyreni Müller and Hellmich, 1937

Lacerta monticola cyreni Müller and Hellmich, 1937. Zool. Anz., Leipzig, 117:67. Terra typica: Puerto de Navacerrada, Sierra de Guadarrama, Spain.

Lacerta bonnali Lantz, 1927

Lacerta (Podarcis) monticola bonnali Lantz, 1927. Rev. Hist. nat. appliq., Paris, (1)8:58. Terra typica: Lac Bleu de Bigorre, Pyrenees, France.

Lacerta muralis bonnali Mertens and Müller, 1928. Abh. senck. naturf. Ges. 41:35.

Lacerta monticola bonnali Mertens and Müller, 1940. Abh. senckenberg. naturf. Ges., Frankfurt an Main, 451:27.

Holotype: n° 1209 R. Coll. L.-A. Lantz.

In spite of our results and those of Brown and Pérez Mellado (in press) and Nascetti *et al.* (in prep.), it is clear that the differentiation is such that there is no reason to even expect that *Lacerta monticola* and *Lacerta bonnali* represent sister species. Hence, a deeper study of relationships between taxa grouped under the name *Archaeolacerta* is necessary to clarify the true position of the rock lizard inhabiting the Pyrenees.

Acknowledgements

We thank Pedro Galán Regalado for the loan of specimens of *Lacerta monticola* from coastal Galicia. An anonymous reviewer provided very useful suggestions on the manuscript.

Summary

In this work we analyse the colour pattern, body dimensions, scalation and some osteological characteristics of populations pertaining to each of the four named subspecies of the Iberian Rock lizard, *Lacerta monticola*. The results, complemented by a biochemical study (Nascetti *et al.*, in prep.) and also by a multivariate analysis of among population divergence in scalation (Brown and Pérez-Mellado, in press), indicate that the current taxonomical arrangement is not adequate for this species. Thus, the population of rock lizards from Pyrenees can be raised to the specific level.

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