HERPETOZOA 28 (3/4): 149 - 165
Wien, 30. Jänner 2016

Distribution, habitat characterization and conservation status of *Iberolacerta martinezricai* (ARRIBAS, 1996), in the Sierra de Francia, Salamanca, Spain
(Squamata: Sauria: Lacertidae)

Verbreitung, Habitatcharakterisierung und Schutzstatus von *Iberolacerta martinezricai* (ARRIBAS, 1996) in der Sierra de Francia, Salamanca, Spanien
(Squamata: Sauria: Lacertidae)

JAVIER CARBONERO & PABLO GARCÍA-DÍAZ & CARMELO ÁVILA & OSCAR ARRIBAS & MIGUEL LIZANA

KURZFASSUNG

Auf der Iberischen Halbinsel leben sieben Arten Felseidechsen der Gattung *Iberolacerta*. Diese werden als vom Aussterben bedroht angesehen, wobei *Iberolacerta martinezricai* (ARRIBAS, 1996) eine der gefährdetsten Reptilienarten Europas ist. Es mangelt allerdings an Informationen über Gefährdung, Verbreitung und Ökologie.

Die Felderhebungen der Autoren in den Jahren 2007 und 2008 zielten auf die Klärung der Verbreitung dieser Eidechse in Zentralspanien, wobei 63 UTM-Raster von jeweils einem Quadratkilometer Größe begangen und die Dichte und Verteilung sowie die Habitatpräferenzen der Eidechsen untersucht wurden. *Iberolacerta martinezricai* wurde in 23 der 63 UTM-Quadrate (36,5 %) in Dichten von 25 bis 50 Individuen je Hektar gefunden. Statistische Untersuchungen zeigten, daß das Vorhandensein dieser Felseidechse mit der Höhenlage, der Dichte des Flechtenbewuchses und der Felsblockgröße in Zusammenhang stand. Danach ist die Art in ihrem Vorkommen auf felsige Hänge (Geröllhalden) des Peña de Francia Gebirgszuges beschränkt. Die Ergebnisse zeigen deutlich, daß das Verbreitungsgebiet der Art sehr eng begrenzt und der bewohnte Lebensraum höchst spezifisch ist, aber auch daß ihre Populationsgröße im Vergleich zu der anderer *Iberolacerta* Arten sehr klein ist. Aufgrund dieser Befunde wird *I, martinezricai* nach den Kriterien der International Union for the Conservation of Nature (IUCN) als "Critically Endangered" (CR) eingestuft.

ABSTRACT

Seven species of the rock lizard genus *Iberolacerta* are represented on the Iberian Peninsula. These lizards are considered to be under threat of extinction, with *Iberolacerta martinezricai* (ARRIBAS, 1996), being one of the most endangered reptiles in Europe. There is however, lack of knowledge about its conservation status, distribution and ecology.

The authors' surveys in 2007 and 2008 aimed at clarifying the distribution status of the species in Central Spain, where 63 UTM squares (1 km x 1 km in size) were sampled and the density of the lizards, their distribution and habitat preferences studied. *Iberolacerta martinezricai* was detected in 23 out of the 63 UTM squares (36.5 %), with densities ranging from 25 to 50 lizards/ha. The statistical analysis revealed that the presence of the rock lizards was associated with altitude, lichen cover and rock/boulder size. Accordingly, the species is restricted to rocky slopes of the Peña de Francia mountain range. The results clearly indicate that the range of the species is highly restricted, that the habitats occupied are very specific, and that the population size is low compared with other species of the genus *Iberolacerta*. Based on these findings, the species is categorized as Critically Endangered (CR) under the criteria of the International Union for the Conservation of Nature (IUCN).

KEY WORDS

Reptilia: Squamata, Sauria: Lacertidae, *Iberolacerta*, *Iberolacerta martinezricai*, chorology, habitat, conservation status

INTRODUCTION

The genus *Iberolacerta* ARRIBAS, 1997, is currently formed by eight lizard species from the Iberian Peninsula, the Pyrenees, the Alps and the northern Dinaric Mountains. The genus is particularly well represented on the Iberian Peninsula, where seven species are recognized using external morphology, osteology and karyotype as discriminant criteria (Odierna et al. 1996; Arribas 1997, 1999a, 1999b; Mayer & Arribas 2003; Arribas & Odierna 2004; Carranza et al. 2004; Crochet et al. 2004; Arribas & Carranza 2004, 2007; Arribas et al. 2006; Arnold et al. 2007).

The genus seems to be adapted to, and now cornered in the main mountain ranges of the northern and central regions of Iberia, even though there are populations inhabiting similar shady and fresh places at sea level on the coast of Galicia and Asturias (NW Spain). All the species use similar habitat types, the specific characteristics of which vary somewhat between sites, mainly regarding the composition of the vegetation and bioclimatic characteristics. Considerable areas of these lizards' mountainous habitats are formed by bedrock, which, after alteration due to geological and climatic processes, produced landslides of rock boulders (screes, Spanish "canchal"). Wherever the soil is sufficiently deep, some vegetation is sustained. Roughly speaking, these areas can be described as supraforestal zones covered by a layer of cushion-shaped shrubs such as brooms (*Cytisus* spp.) intermixed with high-mountain pastureland (short grass species). Landslides and scrubland are the most common habitats of the Iberian mountain lizards, perhaps because these areas are favorable to detect the arthropods that form their diet.

Iberolacerta martinezricai (Arribas, 1996), the lizard of the Peña de Francia Mountain, also called Batuecan Lizard in reference to the Batuecas valley, is a medium-sized lizard with a dark dorsal coloration, usually duller than in other Iberian *Iberolacerta*, generally brown or grayish with a reticule in black, sometimes greenish or bluish in adults, especially in males (Figs. 1A, 1B). Most individuals show between one and three brilliant-blue axillar ocelli; these are more numerous (up to eight) in adult males and yellowish in juveniles (Arribas et al. 2008).

This species is endemic to this mountain of central Spain and the only lizard species endemic to the region of Castile and León (Fig. 2). Initially, the presence of the species was considered restricted to the summit of the Peña de Francia mountain (between 1,600-1,723 meters a.s.l.; Pérez-Mellado 1982, 1983; Arribas 1996), its reduced range being the consequence of unsuitable habitat in the surrounding low altitude area. The most optimistic estimates of its abundance were around 45 specimens/ha, with only five to six hectares of adequate habitat available, consisting of bedrock, rock boulders interspersed with grass and broom vegetation (Arribas 1999a).

Subsequent surveys (Arribas 2004) revealed the presence of *I. martinezricai* in the nearby Puerto del Portillo mountains (La Alberca, Salamanca), at 1,000-1,400 meters, where localized abundant populations were recorded in typically Mediterranean environments (Supramediterranean and Mesomediterranean vegetation belt areas). Additional sightings were made in the nearby Pico de la Hastiala mountain (Hastiala peak; 1,730 meters) and on the northern slopes of the Sierra de las Mestas mountain. Thus, the known area occupied by the species covered only two 10 km x10 km UTM grids (29TQE48; 29TQE38) of fragmented habitat. Accordingly, the most recent estimate of the complete distribution area was only 12-15 km^2 (Arribas 2004)

The locations of *I. martinezricai* featured a marked Mediterranean character (Arribas 2004), in contrast to those of other species of *Iberolacerta* found in nearby mountain ranges, such as *Iberolacerta cyreni* (Müller & Hellmich, 1937), which live in high or very high mountain environments (Oro- and Crioromediterranean altitudinal/bioclimatic zones) in the Spanish Central System (mainly in the Sierras de Guadarrama, Gredos and Béjar) (Pérez-Mellado 1982; Lizana et al. 1991; Arribas 2010).

By contrast, the distribution of *Iberolacerta monticola* (Boulenger, 1905) follows the Atlantic climate type in ranging from sea level to more than 2,000 m (mostly 600 - 1,400 m), i.e., from colline, montane and subalpine zones up to the alpine belt (Argüello & Salvador 1988; Galán 1999; Moreira et al. 1999). Sea-level populations are relicts and scattered in rocky areas near rivers (Galán et al. 2007a, 2007b) whereas the isolated Portuguese populations of the Central Iberian System (Serra da Estrela) are strictly oromediterranean. Also, the recently described *Ibero-*

lacerta galani ARRIBAS, CARRANZA & ODIERNA, 2006, inhabiting areas above the forest belt in the Montes de León (northwestern Iberian Peninsula), is restricted to oromediterranean and cryoromediterranean altitudinal zones (ARRIBAS et al. 2006).

Knowledge about the ecology of many *Iberolacerta* species increased in the last decades, but not so of the Batuecan Lizard. Its biology remained almost unknown, with only a few notes on its distribution and coloration summarized by ARRIBAS (2009). Only very recently, a broad volume of natural history data was added to the current knowledge about the species (ARRIBAS 2013, 2014).

Owing to its restricted known range, the lizard, was considered Critically Endangered since 2006 (CR B2ab[v]; C2a[ii]) in the IUCN Red List (CARBONERO et al. 2008; PÉREZ-MELLADO et al. 2009b). The first steps towards a targeted conservation strategy for *I. martinezricai* had to include the assessment of its ecological requirements, mainly with respect to its habitat (PRIMACK 2008); this was done in the present paper.

MATERIALS AND METHODS

Study area

The study was mainly carried out in within the boundaries of the Batuecas - Sierra de Francia Natural Park (Fig. 2) (Province of Salamanca; Central Spain; coordinates of the central point of this study area: 40°31’3” N, 6°10’12” W), although some sites outside the Park were also sampled, searching for new localities. This area has a typical Mediterranean mountain climate: dry (15 mm rain in August) and hot in summer (mean temperature in August: 23 °C), cold in winter (6 °C in December) (RIVAS-MARTÍNEZ et al. 1987; HIJMANS et al. 2005). Maximum altitude is 1,727 m at the peak of the Peña de Francia. Three bioclimatic zones characterized by different vegetation and climate types are represented: the Oromediterranean belt (>1,600 m a.s.l.) at the summits of the mountain range, with a typical broom shrub vegetation (mainly *Cytisus oromediterraneus*); the Supramediterranean belt (approximately 1,000-1,600 m a.s.l.), with an original vegetation of deciduous oak forest (*Quercus pyrenaica*), a shrub stratum of heather (*Erica arborea* and *E. australis*) and some pine plantations (*Pinus nigra* and *P. sylvestris*) interspersed. The lower altitudes are occupied by the Mesomediterranean belt (400-1000 m a.s.l.) called “dehesas”, savannah-like areas harboring evergreen oaks (*Quercus ilex*) and cork oaks (*Quercus suber*). The azonal vegetation includes saxicolous and riparian species.

The bedrock of the area is mainly Paleozoic, with granitic quartzite and slate outcrops. The relief is mainly gentle but with very active weathering phenomena, which produced slopes of large boulders and loose rocks (Spanish “canchales”) (Fig. 3) and deep valleys with fast streams flowing during the winter. The basal granite and quartzites appear at the surface of peaks and crests, whereas large areas of boulders cover the slopes of the valleys, where slates are more common.

Field surveys

Samplings occurred in 2007 and 2008 from April to October (CARBONERO et al. 2008) covering the activity period of the lizard (ARRIBAS 2009, 2013). Rocky areas, main habitat of these lizards, were the preferred study sites; transects set up therein were inspected between 8:00 h to 13:00 h GMT. This sampling design was chosen to optimize successful locating of the animals. In some areas *I. martinezricai* shares its habitat with *Podarcis guadarramae* (BOSCÁ, 1916) and other lizard species (for a discussion of identification problems in the field see, e.g., ARRIBAS 2009).

To estimate the overall distribution of the species and its threat status in the potential range area (unsuitable low altitude and hot temperature regions were *a priori* excluded), 63 UTM squares, each 1 km x 1 km in size, were selected (Fig. 2), assuming that they contained all the types of habitats pres-

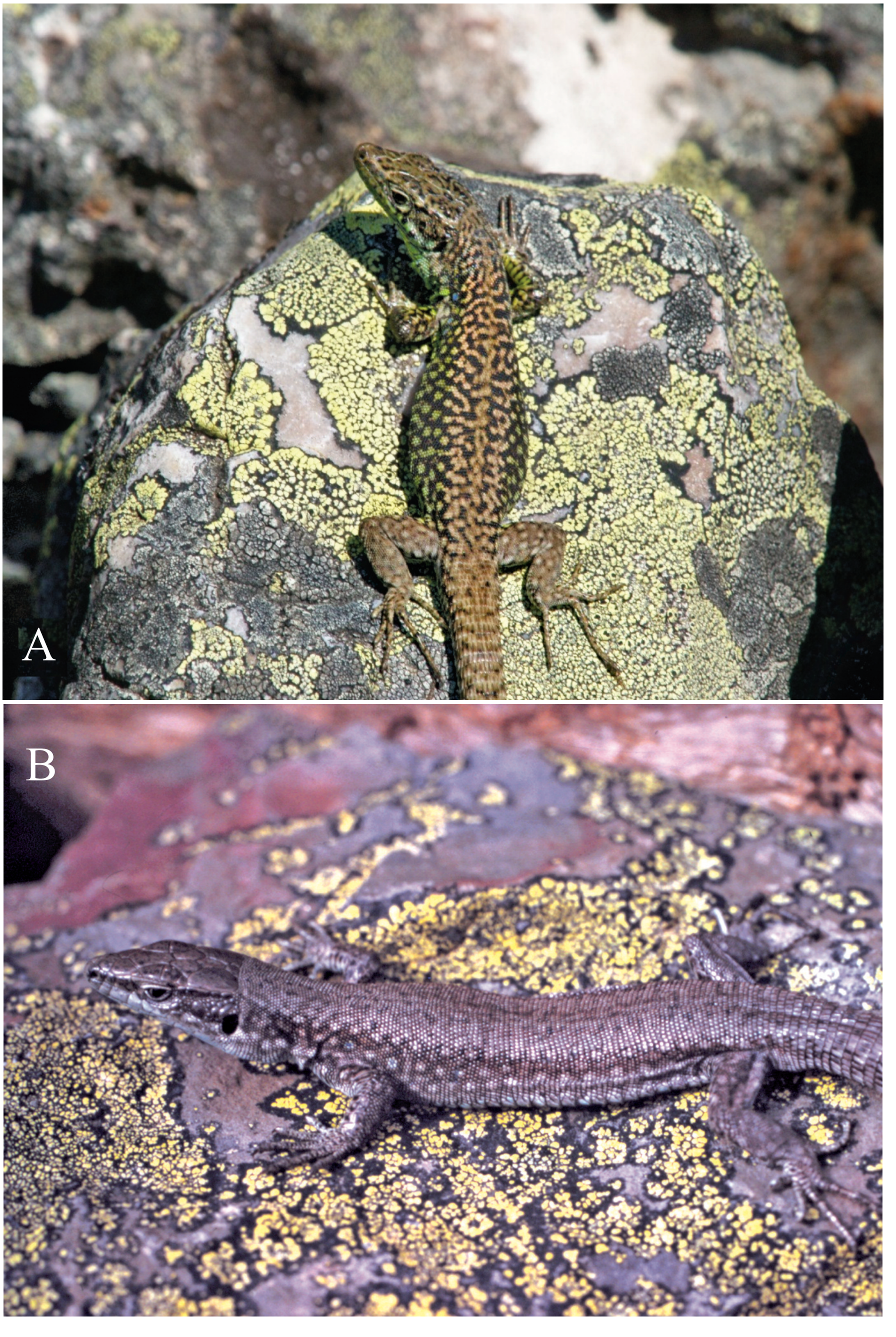

Fig 1: *Iberolacerta martinezricai* (Arribas, 1996). A – male; Peña de Francia (Photo: M. Lizana); B – female; Peña de Francia (Photo: O. Arribas).

Abb 1: *Iberolacerta martinezricai* (Arribas, 1996). A – Männchen; Peña de Francia (Photo: M. Lizana); B – Weibchen; Peña de Francia (Photo: O. Arribas).

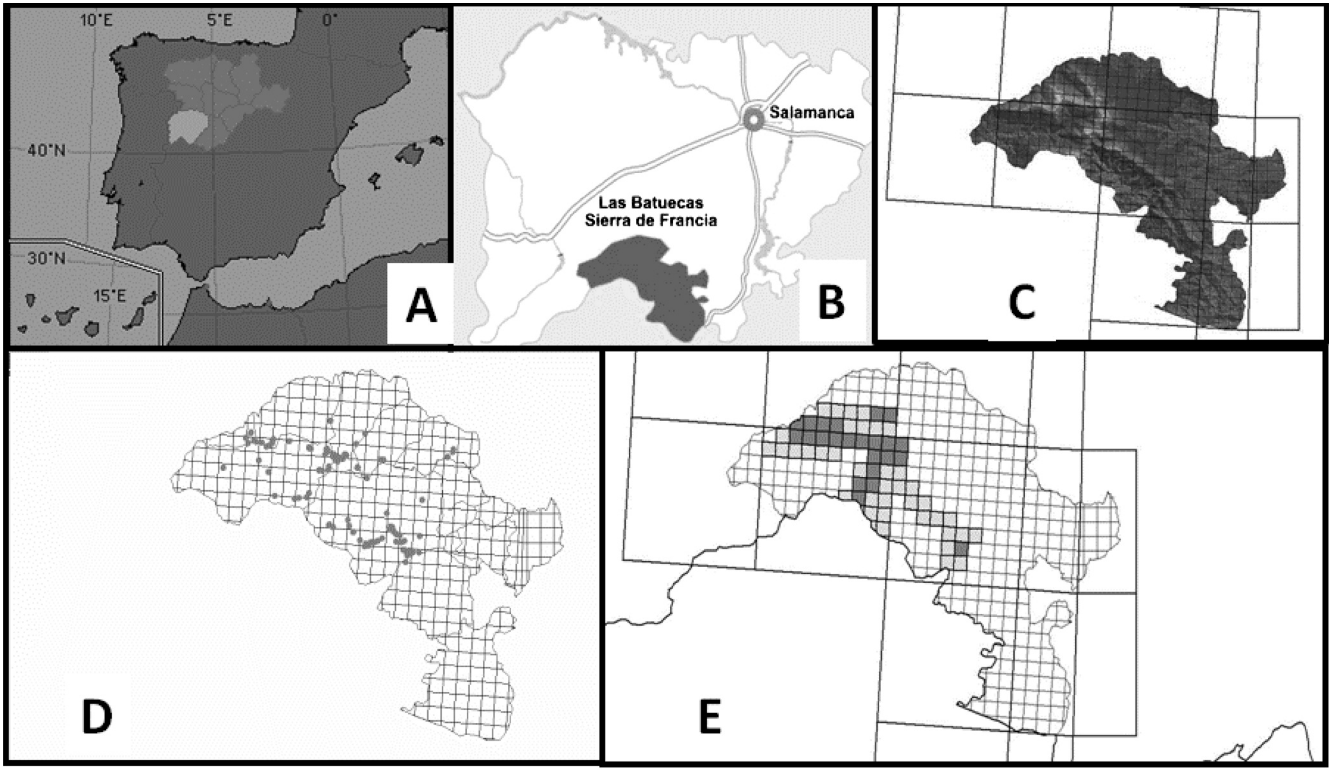

Fig. 2: The study area. A – Spain, the region of Castile & León, and the Province of Salamanca; B – Province of Salamanca and Las Batuecas – Sierra de Francia Natural Park; C – map of altitudes in the Natural Park; D – localities sampled in the Natural Park; E – bold outline 1 km x 1 km UTM squares selected and surveyed for the potential presence of *Iberolacerta martinezricai* (ARRIBAS, 1996). Dark squares: records present, light gray squares: records absent.

Abb. 2: Das Untersuchungsgebiet. A – Spanien, die Region Kastilien und León sowie die Provinz Salamanca; B – Provinz Salamanca und das Las Batuecas – Sierra de Francia Naturschutzgebiet; C – Höhengliederung des Naturparks; D – Untersuchungsstellen im Naturpark; E – ausgewählte und im Hinblick auf mögliche Vorkommen von *Iberolacerta martinezricai* (ARRIBAS, 1996) begangene, durch fette Randlinien bezeichnete 1 km x 1 km UTM-Raster. Dunkle Quadrate: Nachweise, hellgraue Quadrate: keine Nachweise.

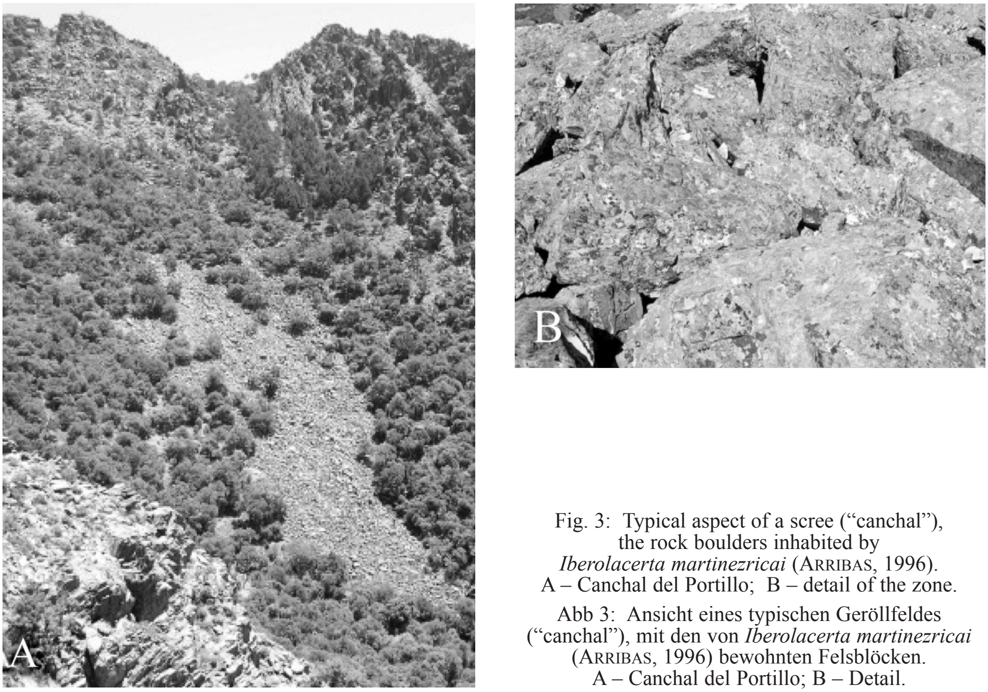

Fig. 3: Typical aspect of a scree ("canchal"), the rock boulders inhabited by *Iberolacerta martinezricai* (Arribas, 1996). A – Canchal del Portillo; B – detail of the zone.

Abb 3: Ansicht eines typischen Geröllfeldes ("canchal"), mit den von *Iberolacerta martinezricai* (Arribas, 1996) bewohnten Felsblöcken. A – Canchal del Portillo; B – Detail.

ent in the zone such as forest, shrubland, pastures, streams, and especially rocky areas, regardless of their altitude, sun exposure, compass orientation or vegetation stages. In each 1 km^2 square, at least one sampling site was selected. At each site, searches were performed along linear transects of 100 meters, in randomly located square-patches of 25 m x 25 m (625 m^2) including visual surveys with binoculars of 15 minutes duration each (Sutherland 2006).

The abundance of the lizards was estimated by counting the number of animals in the 625 m^2 squares. The surface encompassed by the squares was sampled in a zigzag fashion to avoid double counts. A dataset on environmental characteristics that could well reveal microclimatic aspects fundamental for the presence or density of the species studied was also recorded for each locality: UTM coordinates; maximum altitude in meters [MAXALT in the Multivariate Analysis; see Fig. 4 and Table 5]; minimum altitude [MINALT]; compass orientation [CARDIR] divided in eight categories (N, NE, E, SE, S, SW, W, NW); average inclination of the slope [AVSLOPE] in degrees; average size of the rocks at the sites [AVROCKSIZ] considering three categories: 1 (< 50 cm), 2 (50-100 cm), 3 (> 100 cm); maximum percentage of moss (Bryophyta) coverage on the rocks [MXCOVBRY]; average coverage of lichens on the rocks [AVERCOVLIC]; and surface of the boulder area in hectares (ha) [SCREEAR]. Meteorological data was not assessed and information on rainfall, humidity, mean temperature or hours of insolation from a meteorological station in the area was not used because these would not allow to distinguish microclimatic differences at the study sites. The data for each locality sampled are shown in Table 1. An explanation of these variables can be found in Table 4. These environmental and geographical variables provide sufficient information for a detailed study of habitat use by the lizards, and also for drawing inferences about the patterns of active habitat selection (Morris 2011).

Statistical analyses

To characterize the microhabitat of *I. martinezricai,* a Categorical Principal Components Analysis (CATPCA) was carried out to reduce the dimensionality of the dataset (De Leeuw 1973; Gifi 1991). The selection of this method was motivated by its ability to process variables of different types (numeric, ordinal and nominal) and non-linear relationships. The authors aimed to demonstrate similarities/dissimilarities among groups of categorical variables (i.e., representative of the localities surveyed) to identify those variables that characterize the lizards' microhabitat, regarding their presence/absence.

This largely descriptive technique quantifies the data, allowing the variables to be placed on a factorial plane defined by the first two axes or factors, where samples (localities) with similar categorical values (e.g., the presence of lizards) cluster, whereas those with different values appear separated from them. The graphic representation on the factorial plane would reveal patterns in the use of the microhabitat by individuals or populations, even atypical individual patterns. This technique was applied using SPSS™ version 21 Statistical Package (SPSS 2012), with the "categories" module programmed by the DTSS group (Data Theory Scaling System, University of Leiden, Netherland), using the PRINCALS algorithm to analyze mixed datasets, which are difficult to discriminate using other standard statistical procedures (De Leeuw 1973).

RESULTS AND DISCUSSION

Distribution

During the fieldwork, 42 areas covered with boulders were sampled intensively: 18 (42.9 %) were occupied by *I. martinezricai* (Tables 1 and 3, Fig. 2E). In this study, 85 individuals were sighted on 23 UTM squares, representing 36.5 % of 63 UTM squares covered by the survey. Presence/absence data in the populations sampled shown in Table 1 revealed two relatively independent areas with lizards present (Fig. 2E).

One is located in the north of the Natural Park and corresponds to sites of medium and high altitudes in the Sierra de Francia. This area surrounds the Peña de Francia peak (1,723 m) and extends northwards to the Robledos peak (1,611 m) and adjacent areas: to the northeast, up to the Sierra del Guindo (Hastiala peak, 1,735 m; Alto del Copero peak, 1,560 m); to the south to the Mesa del Francés (1,640 m) and to the southeast to the northern slopes of the Sierra de la Grajera (Rongiero peak 1,627 m).

The area can be inscribed into a polygon that encompasses the valley of the river Agadón. In this area (Fig. 2E), the lizard was found in 22 of 41 UTM squares sampled (53.7 %) and its presence there was always linked to unstable terrain of boulders and stones, mainly of quartzites and granite, located at altitudes above 886 m a.s.l.. The lizard's presence in the high-altitude peaks was merely sporadic, with densities below 10 individuals/ha at the few sites where it was found. The range of altitudes in which the species was detected (Tables 1 and 2) was between 886 and 1,692 m a.s.l.. The average slope of the localities is 25º, being 33° at most.

At moderate altitudes of this area, the Batuecan Lizard is more abundant, with densities of up to 60 individuals/ha (Table 1). Here, in the Supramediterranean bioclimatic zone, the lizard was always linked to dispersed rock boulders among deciduous oak forests (*Quercus pyrenaica*), and formed small metapopulations in each of these stony areas on the mountain slopes.

The second range area of the Batuecan Lizard is located on the southern slope of the mountain range Sierra de la Alberca and at El Portillo, the mountain pass which descends to the Batuecas Valley. The authors detected the lizards only in one out of 23 sites sampled. This population was already described (Arribas 2004) from the zone close to El Portillo (840-1,400 m a.s.l.). This population exclusively occupies rocky sites along the mountain slopes at the edge between the Mesomediterranean and Supra-

Table 1: Observed presence (1) and absence (0) of *Iberolacerta martinezricai* (ARRIBAS, 1996) at the 42 study sites, including population density, maximum and minimum altitude of the scree ("canchal")(m a.s.l.), its orientation (1 - North, 2 - Northeast, 3 - East, 4 - Southeast, 5 - South, 6 - Southwest, 7 - West, 8 - Northwest) and size of sampled area (ha).

Tab. 1: Beobachtete An- (1) und Abwesenheit (0) von *Iberolacerta martinezricai* (ARRIBAS, 1996) an den 42 Untersuchungsstellen. Die Populationsdichte, obere (Maximum altitude), untere (Minimum altitude) Höhengrenze des jeweiligen Geröllfeldes "canchal" (m ü. M.), seine Hangrichtung (1 - Nord, 2 - Nordost, 3 - Ost, 4 - Südost, 5 - Süd, 6 - Südwest, 7 - West, 8 - Nordwest) und Fläche (ha) der Untersuchungsgebiete sind angegeben.

Locality / Untersuchungsstelle	Presence/Absence An-/Abwesenheit	Population density Populationsdichte	Maximum altitude	Minimum altitude	Orientation / Hangrichtung	Area / Fläche
Batuecas 1	0	0	1001	886	3	0.29
Batuecas 2	0	0	1219	999	3	6.58
Monasterio Peña Francia	1	2.8	1707	1632	4	0.47
Peña Francia 1	1	4.2	1692	1657	3	1.14
Peña Francia 2	0	0	1643	1618	3	0.37
Peña Francia 3	1	32.0	1691	1546	8	4.41
Peña Francia 4	0	0	1441	1266	5	4.71
Viacrucis	1	12.5	1614	1522	2	1.36
Buitrera	1	53.3	1579	1544	7	0.29
Paterno	1	57.6	1505	1321	2	3.44
Peña Francia 5	0	0	1365	1320	2	0.14
Lobos 1	1	48.0	1504	1276	1	5.80
Leras 1	0	0	1497	1321	2	2.31
Peña Carbonera 1	0	0	1359	1210	1	1.84
Peña Carbonera 2	0	0	1219	1164	8	0.33
Monsagro 1	1	24.0	1529	1258	7	12.43
Monsagro 2	1	32.0	1457	1163	6	7.71
Monsagro 3	1	4.0	1424	1317	5	1.02
Monsagro 4	0	0	1458	1192	5	6.04
Monsagro 5	0	0	1515	1191	5	19.57
Monsagro 6	1	11.1	1444	1257	4	4.35
Monsagro 7	0	0	1465	1189	5	5.32
Monsagro 8	0	0	1296	1140	6	3.71
Monsagro 9	0	0	1326	1133	6	2.31
Monsagro 10	0	0	1213	1126	6	0.78
Monsagro 11	0	0	1411	1104	5	13.51
Monsagro 12	0	0	1341	1099	4	6.49
Monsagro 13	0	0	1246	1042	5	5.87
Copero	1	2.8	1558	1483	2	9.60
Copero 1	1	26.7	1427	1269	1	5.21
Copero 2	1	4.2	1425	1191	1	5.72
Hastiala 1	1	36.0	1553	1299	8	16.21
Hastiala 2	1	12.0	1676	1293	7	16.39
Robledo 1	1	37.5	1425	1193	2	15.22
Robledo 2	0	0	1458	1394	4	0.58
Rongiero 1	0	0	1338	1197	8	2.24
Rongiero 2	0	0	1367	1242	8	1.85
Rongiero 3	1	3.2	1325	1220	1	0.50
Rongiero 4	0	0	1357	1254	1	0.46
Portillo 1	1	25.6	1116	993	8	1.36
Portillo 2	0	0	1280	1069	8	2.37
Portillo 3	0	0	1156	905	8	12.92
Herguijuela 1	0	0	1177	1135	2	0.28

mediterrean zones, characterized by evergreen and deciduous oak and pine forests in the neighborhood. The densities found here varied between 25-30 individuals/ha.

Considering the whole distribution area of the species, the newly found populations extend the known range of the species (Fig. 2), formerly considered to be restricted to only two UTM squares of 10 km x 10 km (29TQE48; 29TQE38), to a third one: UTM 29TQE39. *Iberolacerta martinezricai* is not uniformly distributed across the area, but rather as a spatially structured metapopulation (HANSKI & GAGGIOTTI 2004), with subpopulations isolated from one another and confined to boulder areas on the slopes

Table 2: Summary statistics for altitude (m a.s.l.) and size (ha) of the 42 screes ("canchales") studied for the potential presence of *Iberolacerta martinezricai* (ARRIBAS, 1996).

Tab. 2: Zusammenfassende Statistiken bezüglich Höhe (m ü. M.) und Flächenausdehnung (ha) der 42 Geröllfelder ("canchales"), in denen nach Vorkommen von *Iberolacerta martinezricai* (ARRIBAS, 1996) gesucht wurde.

Variable	*N*	Minimum	Maximum	Mean / Mittel	SD / Standardabweichung
Maximum altitude (m a.s.l.) Obere Höhengrenze (m ü. M.)	42	1001.3	1691.9	1407.919	158.8
Minimum altitude (m a.s.l.) Untere Höhengrenze (m ü. M.)	42	885.7	1657.1	1237,971	173.5
Scree area (ha) Fläche der Geröllhalde (ha)	42	0.140	19.570	5.0721	3.0

and/or summits of the mountains. The estimated size of the total area occupied ranges between 20-25 km^2 and the estimate of the total population ranges between 1,200-1,500 individuals (estimate based on observed densities applied to the *a posteriori* estimated size of suitable sites) in a discontinuous and fragmented habitat.

The highly specific environmental conditions where the species is found in the Batuecas-Sierra de Francia Natural Park and its habitat specificity seem to reduce the probability of finding this species in nearby areas of the Sierra de Gata, a possibility suggested by PEREZ-MELLADO (2002) and ARRIBAS (2005). Subsequent sampling in the highest altitudes (1,700-1,800 m) of this sierra conducted in summer 2012 (LIZANA, pers. obs.) confirmed the presence of an unusually colored/patterned population of *Podarcis guadarramae* (BOSCÁ, 1916) but not *I. martinezricai*.

Habitat characterization

The analyses showed that the main habitat of *I. martinezricai* are rocky and stony areas, mainly on slopes or in valley axes between the sierra spurs. The rocky areas with the presence of the lizards feature quartzites, granites and slate blocks, usually larger than 50 cm in diameter. These stony areas with large rocks provide abundant crevices and cavities that form a complex net of subterranean passages at different depths in which the lizards rest, move and den (Fig. 3). These subterranean areas are important because they maintain optimal conditions of temperature and humidity during the dry and hot mountain summers (usually approaching 40 °C at midday). Also, arthropods on which the rock lizards can prey are abundant at these sites (ARRIBAS 2004, 2009). The reason why some of the highest densities of the species occur in these areas is due to the presence of underground water circulating below these rock boulders, providing fresh air and moisture both for lizards and their prey.

The optimal situation for *I. martinezricai* as regards the size of rocks and boulders is found in the isolated range area of the Batuecas valley, where both environmental conditions and altitude *a priori* seem to be the least adequate for the presence of the lizards, mainly because of the comparatively high summer temperatures and low humidity. In other areas of the lizard's range, similar abundances are typically found in less weathered rocky areas at medium and high altitudes. Although the rock boulders are smaller, thus less adequate there, the lizards are locally plentiful because the environmental conditions (lower average temperatures and higher humidity) favor their presence.

In the CATPCA analysis of the microhabitat, variables were eliminated that did not contribute information or show variability and thus, were redundant or introduced noise into the model. Also, variables with less than three valid data points were eliminated to fulfil the assumptions of the statistical model. A preliminary CATPCA analysis detected these useless or redundant variables. Only eight variables (Table 4) proved to be adequate for analysis: MAXALT, MINALT, AVCOVLIC, AVROSI, MXCOVBRY, AVSLOP, CARDIR and SCREEAR. The variables SITE (number

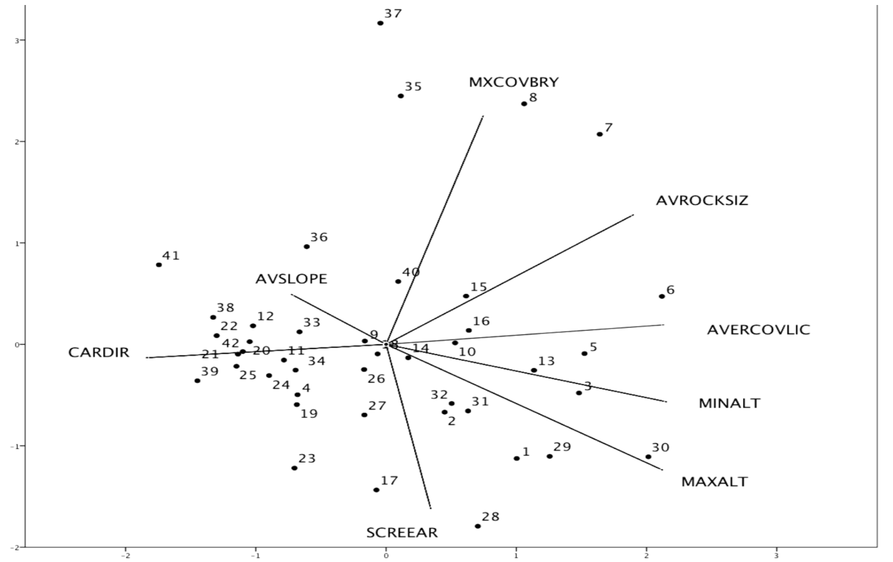

Fig. 4: First factorial plane derived from CATPCA in which localities (represented by points) and variables (represented by vectors) are superimposed. The two first axes are the most discriminatory for the localities studied and their descriptive variables.

Abb 4: Aus der Kategorialen Hauptkomponentenanalyse (CATPCA) abgeleitete erste faktorielle Ebene, in der Fundorte (Punkte) und Variablen (Vektoren) einander überlagernd dargestellt sind. Die ersten beiden Achsen trennen die Fundorte und die sie beschreibenden Variablen am besten auf.

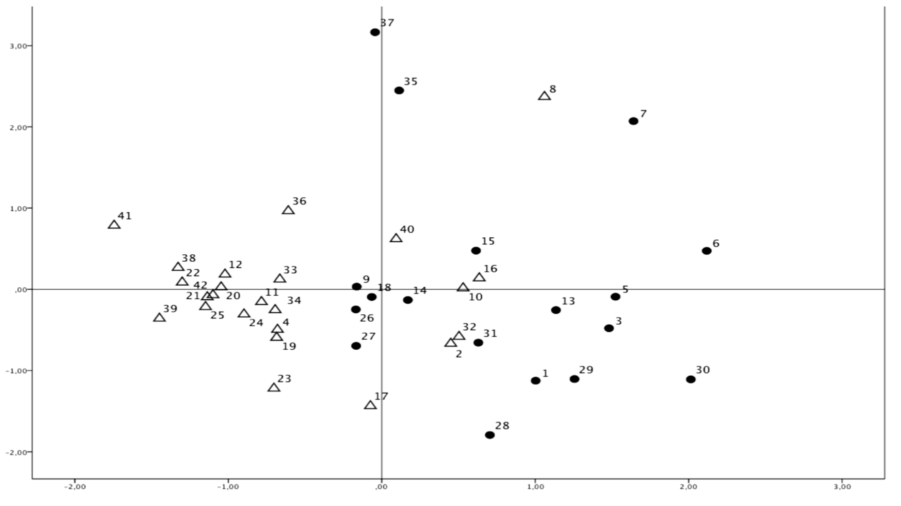

Fig. 5: First factorial plane derived from CATPCA representing the different localities (rock boulders; labelling as in Table 3). Triangular symbols represent localities where *Iberolacerta martinezricai* (Arribas, 1996) was not found, black dots identify localities where the lizard was present.

Abb 5: Aus der Kategorialen Hauptkomponentenanalyse (CATPCA) abgeleitete erste faktorielle Ebene, in der die Fundorte (Felsblöcke; Numerierung wie in Tab. 3) repräsentiert sind. Dreiecke bezeichnen Stellen, an denen *Iberolacerta martinezricai* (Arribas, 1996) nicht gefunden wurde, schwarze Punkte verweisen auf Vorkommen der Eidechse.

identifying the places), LOCALITY (population/location name) and PRESABS ("presence-absence") did not enter the analyses, but were used as supplementary variables for interpretation of the above "active" variables in the final results.

CATPCA reduces the multidimensionality of the original data to two meaningful dimensions (variables). The variance explained (amount of information encompassed by the first factorial plane spanned by the two new multivariate dimensions) is 58.2 % of the total variance (Table 6). Table 5 shows the loadings of the original variables on these two new variables and Fig. 4 depicts the first factorial plane defined by the two new dimensions.

Table 5 represents the loadings of the variables in CATPCA. The variables minimum altitude (MINALT), maximum altitude (MAXALT), average cover of lichens (AVCOVLIC) and average rock size (AVROCKSIZ) have positive loadings on this first axis dimension (the most informative dimension, accounting for 38.2 % of total variance). Conversely, the variable "cardinal direction" (CARDIR) standing for compass orientation is negatively loaded on this first axis. This first dimension indirectly explains the absence or presence of the Batuecan lizard (Table 6, Fig. 5). The abundance of lichens suggests that these rock boulders are old and stable (geologically inactive). These are therefore the most important variables for discriminating the rocky areas in the analysis represented in Fig. 4.

With respect to the second dimension (that explains 20 % of the total variance), the differences among the localities (rock boulders) are mainly derived from the maximum coverage of bryophytes (MXCOVBRY) and size of the locality (SCREEAR). Solely the average slope (AVSLOPE) variable is not adequately represented on this factorial plane, offering but little explanation for the differences among the localities.

The typology and arrangement of the localities are shown in Figures 4 and 5, in which the site names are replaced by numbers (Table 3) for clear graphic representation. The majority of localities at which the lizards were absent appear at the left and nearly all localities where lizards were present on the right side of the graphic (Fig. 5). The presence of *I. martinezricai* is associated with high altitude (MINALT, MAXALT) and big-sized rocks (AVROCKSIZ) with abundant lichen coverage (AVCOVLIC), the latter being due to the presence of mild temperatures, considerable environmental moisture and stable conditions regarding the proper motion of rocks and boulders. Negative loading of the variable orientation (CARDIR) indicates more northerly exposed sites and is linked to the absence of the lizard.

Figure 6 shows the scores of the localities marked with presence/absence symbols of *I. martinezricai* and grouped within continuous/dashed ellipsoids. The first axis is the most discriminatory for the localities studied, and their variables (Fig. 4 and Table 5) are the most explanatory for the presence of the species. From the statistical point of view, the localities close to the origin of the coordinates are less-defined and, thus comprise both localities with and without *I. martinezricai*. This reveals a transition zone between the two groups of localities where, especially in the overlap zone of the ellipsoids (Fig. 6), the conditions seem to be intermediate or suboptimal, although just tolerable for *I. martinezricai*. These populations at the brink of their preferential climate are the most habitat-sensitive populations.

The second axis has only poor discriminatory power regarding presence or absence of the lizard. The two variables linked to this axis are rock/boulder size and extent of intermediate moss cover, both of which are inversely related among each other. This inverse relationship may be due to increased humidity in the vicinity of small boulders because of the proximity to vegetation and reduced exposure to direct sunlight, both of which favor the presence of mosses among the rocks. In this second dimension, localities 7, 35 and 37 have lizards, but these are absent at locality 8, probably because of its low altitude and small size.

To analyze and understand the typological differences among the localities with respect to the presence or absence of the Batuecan Lizard, the first axis is represented in a panel diagram (Fig. 7) in which the variables orientation (compass direction, in columns) and average size of the rocks/boulders (in rows) are shown. The lizards

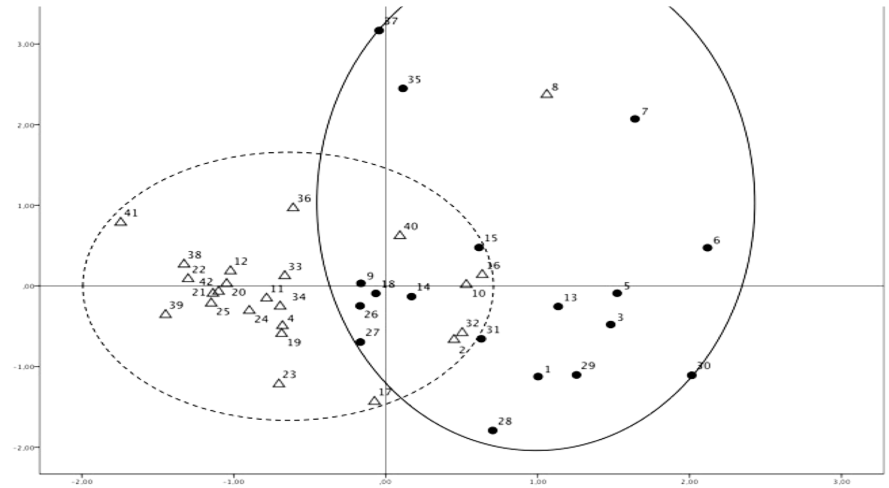

Fig. 6: First factorial plane derived from CATPCA representing the different localities (labelling as in Table 3). A solid outline ellipse encloses the localities where *Iberolacerta martinezricai* (Arribas, 1996) was present, whereas a dashed outline ellipse surrounds localities where the lizard was not found.

Abb 6: Aus der Kategorialen Hauptkomponentenanalyse (CATPCA) abgeleitete erste faktorielle Ebene, in der die Fundorte (Numerierung wie in Tab. 3) repräsentiert sind. Eine durchgehende Ellipse umschließt die Stellen, an denen *Iberolacerta martinezricai* (Arribas, 1996) vorhanden war, eine strichlierte Ellipse Orte, an denen diese Eidechsen nicht gefunden wurden.

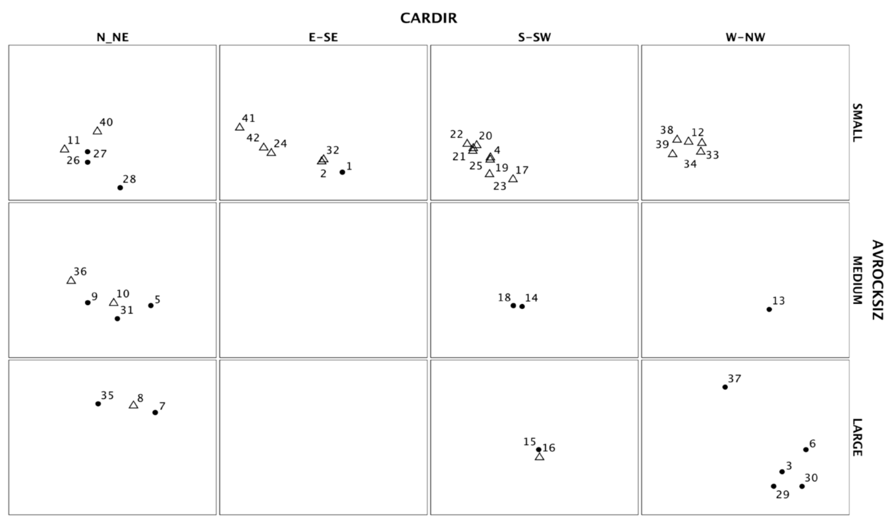

Fig. 7: Panel diagram classifying the study sites by average rock size (AVROCKSIZ) and orientation (CARDIR) as represented on the first factorial plane derived from CATPCA (labelling as in Table 3). Records of *Iberolacerta martinezricai* (Arribas, 1996) are distinguished by dots, lack of records by triangular symbols.

Abb. 7: Tafeldiagramm mit den nach mittlerer Felsblockgröße (AVROCKSIZ) und Hangausrichtung (CARDIR) gruppierten Untersuchungsstandorten in der aus der Kategorialen Hauptkomponentenanalyse (CATPCA) abgeleiteten ersten faktoriellen Ebene. Nachweise von *Iberolacerta martinezricai* (Arribas, 1996) sind durch gefüllte Kreise, fehlende Nachweise durch Dreiecke gekennzeichnet.

Table 3: Names and IDs of the 42 screes ("canchales") studied using Categorical Principal Component Analysis (CATPCA).

Tab. 3: Namen und Numerierung der 42 Geröllfelder ("canchales"), die unter Verwendung der Kategorialen Hauptkomponentenanalyse (CATPCA) untersucht wurden.

Site ID/ Nr.	Site Name Untersuchungsstelle	Site ID / Nr.	Site Name Untersuchungsstelle	Site ID / Nr.	Site Name Untersuchungsstelle
1	Peña Francia 1	15	Monsagro 3	29	Hastiala 1
2	Peña Francia 2	16	Monsagro 4	30	Hastiala 2
3	Peña Francia 3	17	Monsagro 5	31	Robledo 1
4	Peña Francia 4	18	Monsagro 6	32	Robledo 2
5	Viacrucis	19	Monsagro 7	33	Rongiero 1
6	Buitrera	20	Monsagro 8	34	Rongiero 2
7	Paterno	21	Monsagro 9	35	Rongiero 3
8	Peña Francia 5	22	Monsagro 10	36	Rongiero 4
9	Lobos 1	23	Monsagro 11	37	Portillo 1
10	Leras 1	24	Monsagro 12	38	Portillo 2
11	Peña Carbonera 1	25	Monsagro 13	39	Portillo 3
12	Peña Carbonera 2	26	Copero 1	40	Herguijuela 1
13	Monsagro 1	27	Copero 2	41	Batuecas 1
14	Monsagro 2	28	Copero	42	Batuecas 2

were found mainly at sites facing W-NW and N-NE directions, with the exception of only four localities with medium and large rocks; nevertheless the sites characterized by the lizards' absence essentially had E-SE and S-SW orientations. This suggests that the lizards, living in low altitude habitats climatically extreme for a mountain lizard, prefer northern orientations and their milder summer temperatures. The thermal characteristic of certain combinations of geographic orientation and rock/ boulder size seems to be a key habitat attribute that determines the presence of the Batuecan Lizard.

Table 4: Environmental variables recorded during the fieldwork. In bold are those recognized as meaningful in the Categorical Principal Component Analysis (CATPCA).

Tab. 4: Im Zuge der Feldbeobachtungen registrierte Umweltvariablen. In Fettschrift sind jene dargestellt, die in der Kategorialen Hauptkomponentenanalyse als aussagekräftig erkannt wurden.

Variable name / Variablenname	Variable label / Variablenkennzeichnung
SITE	Site/Population ID Untersuchungsstellen-/Populationsnummer
LOCALITY	Site/Population name Untersuchungsstellen-/Populationsname
PRESABS	Presence/absence of *Iberolacerta martinezricai* Vorhandensein/Fehlen von *Iberolacerta martinezricai*
MAXALT	Maximum altitude of scree Obere Höhengrenze des Geröllfeldes (m ü. M.)
MINALT	Minimum altitude of scree Untere Höhengrenze des Geröllfeldes (m ü. M.)
CARDIR	Cardinal direction of the slope (8 directions) Hangausrichtung (8 Himmelsrichtungen)
AVSLOPE	Average slope (°) Mittlere Hangneigung (°)
AVROCKSIZ	Average rock size (3 size classes) Mittlere Felsblockgröße (3 Größenklassen)
SCREEAR	Area of the scree (ha) Fläche des Geröllfeldes (ha)
MXCOVBRY	Maximum coverage of Bryophytes (%) Maximales Ausmaß der Moosdecke (%)
AVERCOVLIC	Average coverage of Lichens (%) Mittleres Ausmaß der Flechtenbedeckung (%)

Table 5: Loadings of the original variables on the two new variables "Dimension 1" and "Dimension 2" from the Categorical Principal Component Analysis (CATPCA). Within each variable the higher loading value is marked in bold.

Tab. 5: Die Ladungen der ursprünglichen Variablen auf die beiden neuen Variablen "Dimension 1" und "Dimension 2" aus der Kategorialen Hauptkomponentenanalyse (CATPCA). Bei den Variablen ist der jeweils höhere Ladungswert durch Fettschrift gekennzeichnet.

Component Loadings Komponentenladungen	Dimension 1	Dimension 2
MAXALT	**0.793**	-0.463
MINALT	**0.804**	-0.212
CARDIR	**-0.688**	-0.050
AVROCKSIZ	**0.709**	0.477
SCREEAR	0.128	**-0.605**
MXCOVBRY	0.279	**0.841**
AVCOVLIC	**0.796**	0.072

Figure 7 shows the close relationship between the presence of the lizards and the presence of medium and large rocks. The presence of boulders, preferably geologically inactive, intact and of medium to large average size, seems to be crucial for the lizards' existence. Rock size is an important variable because large boulders can provide refuge for the lizards, offer a more humid environment and probably higher prey densities than smaller rocks and stones. Lizards are all but absent from sites covered by small rocks only.

These geomorphological conditions seem to be related to the ability of the species to survive in such extreme, i.e., high temperature and low altitude habitats. Most absences of rock lizards (except for four of the 42 sites sampled (sites 10 and 36 in medium-sized rocks, and sites 8 and 16 in large-rock areas) were determined from sites covered by small-sized boulders, whereas almost all the observed lizards were found at sites characterized by medium- or large-sized boulders (except for sites 1, 26, 27 and 28).

Other *Iberolacerta* species, such as *I. cyreni*, *I. monticola* and *I. galani* Arribas, Carranza & Odierna, 2006, occupy environments other than rocky outcrops or boulders. These lizards are found on mountain pastures, areas with broom or heathlands above the timberline (even if stony or with rocks nearby), where fresh and moist conditions permit their presence in a broad spectrum of habitats. This is not the case for *I. martinezricai* because its distribution is constrained by a certain minimum altitude suitable for this species and the limited size of the area inhabited.

Conservation

This study indicates a slightly larger distribution range (two to three 10 km x 10 km UTM squares) and abundance of *I. martinezricai* as compared with previous reports (Pérez-Mellado 1982; Arribas 1996, 1999b, 2004). Abundance is one of the key parameters in ecology and conservation. Comparison of the present data of *I. martinezricai* with abundance estimates from other species of rock lizards is hampered by the fact that comparative population density data was acquired using different estimation methods. The density of *I. martinezricai* was 23.71 ± 18.04 individuals/ha (mean ± standard deviation; range: 2.8-57.6; N = 43; raw data in Table 1) in this study. For *I. monticola* much higher densities were reported, ranging from 10 to 200 individuals/ha, depending on the site (Delibes & Salvador 1986; Moreira et al. 1999; Galán et al. 2007b; García-Díaz 2011). Likewise, research on *I. cyreni* indicated high population densities of 220-328 individuals/ha in Guadarrama and 424 individuals/ha in Gredos (Martín & Salvador 1997; Pérez-Mellado et al. 1991). The contrast between these species is conspicuous, given that the density of *I. cyreni* and *I. monticola* is up to 10-fold higher than of the Batuecan Lizard. The low density of the latter species is remarkable and can be ascribed to the suboptimal living conditions and the small size of suitable habitat avail-

Table 6: Summary statistics of the Categorical Principal Component Analysis (CATPCA). The table shows the eigenvalues for and the percentage of variance explained by each dimension as well as the cumulative totals for both dimensions.

Tab. 6: Übersicht über das Ergebnis der Kategorialen Hauptkomponentenanalyse (CATPCA). Die Tabelle zeigt die Eigenwerte und die erklärten Prozentanteile an der Gesamtvarianz für die Dimensionen 1 und 2 sowie deren Summen.

Dimension	Eigenvalue	% of total variance
1	3.053	38.162
2	1.602	20.023
Total	4.655	58.185

able to the lizards as compared to the habitat size of other rock lizard species in other mountain ranges.

Small population size is a major shortcoming with a high potential to affect any ecology, evolution or conservation parameters of this endangered species (MORRIS & LUNDBERG 2011). For example, low population densities mean a low capacity of adaptation to changing environmental conditions (MORRIS & LUNDBERG 2011), such as climate change, and a high susceptibility to stochastic localized extinctions (PRIMACK 2008), which, within a metapopulation framework (HANSKI & GAGGIOTTI 2004), would lead to high probabilities of species extinction. From the conservation point of view, the authors wish to emphasize the fact that according to IUCN categories (PÉREZ-MELLADO et al. 2009a, 2009c) the other two species of rock lizards in these comparisons are also considered endangered, despite their higher densities reported.

The new data suggests that, in spite of the small extension of the known range and low number of individuals, the worldwide IUCN and Spanish Red List categorizations should be maintained. According to this rating *I. martinezricai* is Critically Endangered (CR) because the total range area is extremely reduced (12-15 km^2 in total) as is the population size in relation to other endangered rock lizards (PÉREZ-MELLADO et al. 2009a, 2009c). *Iberolacerta martinezricai* is one of the rarest, if not the rarest, continental vertebrate and reptile in Europe. From the present assessments, the total number of specimens can be estimated to range between 1,200 - 1,500. Moreover, the low maximum altitude of the territory inhabited by the species disqualifies the area from being a potential refuge during periods of global warming.

There is increasing leisure activity in the area (anticipated by PÉREZ-MELLADO 1983): the summit of the Peña de Francia receives large numbers of visitors (a hotel at the summit was recently subject to extension), and the Batuecas Valley area from trekkers (ARRIBAS 1999a, 2009, 2013).

Early in 1997, the uppermost parts of the road to the Peña de Francia summit received a new asphalt cover. In April, several adactylous specimens of *I. martinezricai* were seen close to the road. They possibly lost their digits due to necrosis after being covered by hot asphalt (ARRIBAS 2009). Also, during the summer of 2000, the hotel facilities were expanded and the associated work covered some marginal parts of the lizard habitats. In 2013, repair work and widening of the road to the summit started (ARRIBAS unpublished). Corrective measures such as the construction of passages under the road for lizards (?) were proposed by the Environmental Impact Assesment (EIA) of the new road (Government of Castile and Leon), but with little effect as regards the preservation of the population of the peak. Populations at other summits or close to rocks/boulders in other areas of the Park were not affected, and it seems that there are almost no threats to them now. In the long run, increasing temperatures due to climate change should be taken into consideration because of their effects on *I.martinezricai.* These may include habitat loss and competition/predation by Mediterranean species able to occupy higher altitudes, e.g., *Podarcis guadarramae* (BOSCÁ, 1916), *Coronella girondica* (DAUDIN, 1803) and *Vipera latastei* BOSCÁ, 1878.

ACKNOWLEDGMENTS

The study was financed by the "Fundación Patrimonio Natural" of the Regional Government of the Junta de Castilla y León, Spain. Thanks are due to Isabel Mateos for her help in the field work and to the current Director of the Natural Park of Batuecas - Sierra de Francia, Juan Carlos Velasco, the former Director, Alejandro del Amo and the Head of the Species Service of Salamanca, Teresa Tarazona, for their valuable support. The second author (PG-D) is funded by a scholarship from the Commonwealth Government of Australia.

Nick S. D. Skinner reviewed the English of the manuscript. The contribution is dedicated to the memory of our friend Gwyn J. Jenkins.

REFERENCES

Argüello, J. A. & Salvador, A. (1998): Actividad, selección de hábitat y temperaturas corporales de *Lacerta monticola* en una localidad de la Cordillera Cantábrica (Sauria, Lacertidae).- Revista Española de Herpetologia, Salamanca; 3: 29-40.

Arnold, E. N. & Arribas, O. & Carranza, S. (2007): Systematics of the Palaearctic and Oriental lizard tribe Lacertini (Squamata: Lacertidae: Lacertinae), with descriptions of eight new genera.- Zootaxa, Auckland; 1430: 1-86.

Arribas, O. (1996): Taxonomic revision of the Iberian 'Archaeolacertae' I: A new interpretation of the geographical variation of '*Lacerta*' *monticola* Boulenger, 1905 and '*Lacerta*' *cyreni* Müller & Hellmich, 1937.- Herpetozoa, Wien; 9 (1/2): 31-56.

Arribas, O. J. (1997): Morfología, filogenia y biogeografía de las lagartijas de alta montaña de los Pirineos. Ph. D. Thesis. Universidad Autónoma de Barcelona. (Bellaterra), 353 pp. (8 pp and microfiche).

Arribas, O. J. (1999a): Phylogeny and relationships of the Mountain lizards of Europe and Near East (*Archaeolacerta* Mertens, 1921 sensu lato) and their relationships among the Eurasian lacertid radiation.- Russian Journal of Herpetology, Moskva; 6 (1): 1-22.

Arribas, O. (1999b): New data on the Peña de Francia Mountain Lizard '*Lacerta*' *cyreni martinezricai* Arribas, 1996.- Herpetozoa, Wien; 12 (3/4): 119-128.

Arribas, O. (2004): Nuevos datos sobre la distribución de la lagartija batueca: *Iberolacerta martinezricai*.- Boletín de la Asociación Herpetológica Española, Salamanca; 15 (2): 96-97.

Arribas, O. J. (2009): Lagartija batueca – *Iberolacerta martinezricai* (Arribas, 1996). In: Salvador, A. & Marco, A. (Eds.): Enciclopedia virtual de los vertebrados Españoles. Madrid, Museo Nacional de Ciencias Naturales. WWW document available at < http://www.vertebradosibericos.org/reptiles/pdf/ibemar.pdf > (last accessed: March 15, 2015).

Arribas, O. J. (2010): Intraspecific variability of the Carpetane Lizard (*Iberolacerta cyreni* [Müller & Hellmich, 1937]) (Squamata: Lacertidae), with special reference to the unstudied peripheral populations from the Sierras de Avila (Paramera, Serrota and Villafranca).- Bonn Zoological Bulletin, Bonn; 57 (2): 197-210.

Arribas, O. J. (2013): Thermoregulation, activity and microhabitat selection in the rare and endangered Batuecan Rock Lizard, *Iberolacerta martinezricai* (Arribas, 1996).- Herpetozoa, Wien; 26 (1/2): 77-90.

Arribas, O. J. (2014): Growth, sex-dimorphism and predation pressure in the Batuecan Lizard, *Iberolacerta martinezricai* (Arribas, 1996).- Butlletí Societat Catalana Herpetologia, Barcelona; 21: 147-173.

Arribas, O. & Carbonero, J. & Lizana, M. (2008): Sobre el dicromatismo ventral verde/azul en la lagartija batueca, *Iberolacerta martinezricai* (Arribas, 1996).- Boletin de la Asociación Herpetologica Española, Madrid; 19: 51-54.

Arribas, O. J. & Carranza, S. (2004): Morphological and genetic evidence of the full species status of *Iberolacerta cyreni martinezricai* (Arribas, 1996).- Zootaxa, Auckland; 634: 1-24.

Arribas, O. & Carranza, S. & Odierna, G. (2006): Description of a new endemic species of mountain lizard from Northwestern Spain: *Iberolacerta galani* sp. nov. (Squamata: Lacertidae).- Zootaxa, Auckland; 634: 1-24.

Arribas, O. J. & Odierna, G. (2004): Karyological and osteological data supporting the specific status of *Iberolacerta* (*cyreni*) *martinezricai* (Arribas, 1996).- Amphibia-Reptilia, Leiden; 25: 359-367.

Carbonero, J. & Lizana, M. & García, P. & Arribas, O. (2008): Distribución, estado de conservación y medidas de gestión para la lagartija serrana de la Peña de Francia (*Iberolacerta martinezricai*) en el parque natural de Batuecas-Sierra de Francia. Unpublished report. Fundación Patrimonio Natural-Junta de Castilla y León. Salamanca, pp. 118.

Carranza, S. & Arnold, E. N. & Amat, F. (2004): DNA phylogeny of *Lacerta* (*Iberolacerta*) and other lacertine lizards (Reptilia: Lacertidae): did competition cause long-term mountain restriction?- Systematics and Biodiversity, London; 2: 57-77.

Crochet, P. A. & Chaline, O. & Surget-Groba, Y. & Debain, C. & Cheylan, M. (2004): Speciation in mountains: phylogeography and phylogeny of the rock lizards genus *Iberolacerta* (Reptilia: Lacertidae).- Molecular Phylogenetics and Evolution, Orlando; 30: 860-866.

De Leeuw, J. (1973): Canonical analysis of categorical data. Ph. D. Thesis. University of Leiden. Leiden, pp. 200.

Delibes, A. & Salvador, A. (1986): Censos de lacértidos en la Cordillera Cantábrica.- Revista Española de Herpetología, Salamanca; 1: 335-361.

Galán, P. (1999): Declive y extinciones puntuales en poblaciones de baja altitud de *Lacerta monticola cantabrica*.- Boletín de la Asociación Herpetológica Española, Madrid; 10: 47-51.

Galán, P. & Ferreiro, R. & Naveira, H. F. (2007a): Sobre la distribución y supervivencia de la lagartija cantábrica (*Iberolacerta monticola*) en los montes del Pindo (A Coruña).- Boletín de la Asociación Herpetológica Española, Madrid; 18: 53-58.

Galán, P. & Vila, M. & Remón, N. & Naveira, H. (2007b): Caracterización de las poblaciones de

Iberolacerta monticola en el Noroeste ibérico mediante la combinación de datos morfológicos, ecológicos y genéticos.- Munibe, Donostia-San Sebastián; (Suplemento/Gahigarria) 25: 34-43.

García-Díaz, P. (2011): Presencia de *Iberolacerta monticola* en la sierra del Sueve (Asturias).- Boletín de la Asociación Herpetológica Española, Madrid; 22: 120-122.

Gifi, A. (1991): Nonlinear Multivariate Analysis. Chichester (John Wiley & Sons), pp. 602.

Hanski, I. & Gaggiotti, O. E. (2004): Ecology, genetics and evolution of metapopulations. Burlington (Elsevier Academic Press), pp. 696.

Hijmans, R. J. & Cameron, S. E. & Parra, J. L. & Jones, P. G. & Jarvis, A. (2005): Very high resolution interpolated climate surfaces for global land areas.- International Journal of Climatology, Maiden; 25: 1965-1978.

Lizana, M. & Ciudad, M. J. & Gil, M. & Guerrero, F. & Pérez-Mellado, V. & Martín-Sánchez, R. (1991): Nuevos datos sobre la distribución de los anfibios y reptiles en el macizo central de la Sierra de Gredos.- Revista Española de Herpetologia, Salamanca; 6: 61-80.

Martín, J. & Salvador, A. (1997): Microhabitat selection by the Iberian rock-lizard *Lacerta monticola*: effects on density and spatial distribution of individuals.- Biological Conservation, Barking; 79: 303-307.

Mayer, W. & Arribas, O. (2003): Phylogenetic relationships of the European lacertid genera *Archaeolacerta* and *Iberolacerta* and their relationships to some other 'Archaeolacertae' (sensu lato) from Near East, derived from mitochondrial DNA sequences.- Journal of Zoological Systematics and Evolutionary Research, Berlin; 40: 157-161.

Moreira, P. L.& Almeida, A. P.& Delgado, H. & Salgueiro, O. & Crespo, E. G. (1999): Bases para a conservação da lagartixa-da-montanha (*Lacerta monticola*).- Estudos de Biologia e Conservação da Natureza, nº 25. Lisboa (Instituto da Conservação da Natureza, Ministerio do Ambiente), pp. 68.

Morris, D. W. (2011): Adaptation and habitat selection in the eco-evolutionary process.- Proceedings of the Royal Society, London; (B) 278: 2401-2411.

Morris, D. W. & Lundberg, P. (2011): Pillars of evolution. Fundamental principles of the eco-evolutionary process. Oxford (Oxford University Press), pp. 280.

Odierna, G. & Aprea, G. & Arribas, O. J. & Capriglione, T. & Caputo, V. & Olmo, E. (1996): The karyology of the Iberian rock lizards.- Herpetologica, Lawrence; 52 (4): 542-550.

Pérez-Mellado, V. (1982): Datos sobre *Lacerta monticola* Boulenger, 1905 (Sauria, Lacertidae) en el Oeste del Sistema Central.- Doñana Acta Vertebrata, Sevilla; 9: 107-129.

Pérez-Mellado, V. (1983): La herpertofauna de Salamanca: Un análisis biogeográfico y ecológico.- Revista Provincial de Estudios, Salamanca; 9-10: 9-78.

Pérez-Mellado, V. & Bauwens, D. & Gil, M. & Guerrero, F. & Lizana, M. & Ciudad, M. J. (1991): Diet composition and prey selection in the lizard *Lacerta monticola*.-Canadian Journal of Zoology, Quebec, 69: 1728-1735.

Pérez-Mellado, V. & Cheylan, M. & Martínez-Solano, I. (2009a): *Iberolacerta cyreni*. In: IUCN 2011. IUCN Red List of Threatened Species.Version 2011.2. WWW document available at < http://www.iucnredlist.org > [last accessed: April 25, 2012].

Pérez-Mellado, V. & Márquez, R. & Martínez-Solano, I. (2009b): *Iberolacerta martinezricai*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. WWW document available at < http://www.iucnredlist.org > [last accessed: April 25, 2012].

Pérez-Mellado, V. & Sá-Sousa, P. & Márquez, R. & Martínez-Solano, I. (2009c): *Iberolacerta monticola*, In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. WWW document available at < http://www.iucnredlist.org > [last accessed: April 25, 2012].

Primack, R. B. (2008): A primer of conservation biology. 4th edition. Sunderland (Sinauer Associates Inc.), pp. 363.

Rivas-Martínez, S. & Fernández-González, F. & Sánchez, D. (1987): El Sistema Central Español. De la Sierra de Ayllón a la Serra da Estrela; pp. 419-452. In: Peinado & Rivas-Martínez, S. (Eds.): La vegetación de España. Alcala de Henares (Universidad de Alcalá) [Colección Aula Abierta].

SPSS 21 (2012): IBM SPSS Statistics 21 Documentation. Online manual available at < http://www-01.ibm.com/support/docview.wss?uid=swg27024972 >.

Sutherland, W. J. (2006): Ecological census techniques: A handbook. Cambridge (Cambridge University Press), pp. 432.

DATE OF SUBMISSION: September 08, 2014 Corresponding editor: Heinz Grillitsch

AUTHORS: Javier Carbonero [1)] & Pablo García-Díaz [1, 4)] & Carmelo Ávila [2)] & Oscar Arribas [3)] & Miguel Lizana (Corresponding author < lizana@usal.es >) [1)]

[1)] Departamento de Biología Animal. Universidad de Salamanca, Spain
[2)] Departamento de Estadística. Universidad de Salamanca, Spain
[3)] Avda. Fco. Cambo 23, 08003 Barcelona, Spain
[4)] School of Earth & Environmental Sciences and the Environment Institute, The University of Adelaide, North Terrace SA 5005, Australia