Parapatry of two lizard species (*Podarcis muralis, Lacerta bonnali*) at Circo de Piedrafita (Alto Aragón, Pyrenees, Spain)

ANTONIO PALANCA[1], JORGE REY[1], ANTONIO RIOBÓ[1] & MIGUEL VENCES[2]

([1]Laboratorio de Anatomia Animal, Facultad de Ciencias, Universidad de Vigo, E-36200 Vigo, e-mail: apalanca@uvigo.es; [2]Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 160, D-53113 Bonn)

Parapatrische Verbreitung von zwei Eidechsenarten (*Podarcis muralis, Lacerta bonnali*) im Bereich des Circo de Piedrafita (Alto Aragón, Spanische Pyrenäen)

Die Verbreitung der beiden Eidechsenarten *Podarcis muralis* und *Lacerta bonnali* am Circo de Piedrafita ist parapatrisch. Nur die S- und SW-Hänge werden von den Echsen besiedelt. Ein deutliches Zeichen, daß die Menge der täglichen Sonneneinstrahlung der wichtigste verbreitungsregulierende Faktor ist. Vorläufige Beobachtungen legen nahe, daß die Lebensräume von *P. muralis* durch feuchte Talwinde und die von *L. bonnali* durch trockene von den Hängen herabströmende Föhnwinde bestimmt werden.

At medium altitudes (above 1 100 m a. s. l.), the predominant lizard species in the Pyrenean mountain range is *Podarcis muralis* (MARTÍNEZ-RICA 1979). Its highest enclave, according to this author, is »Lac de Port Bieihl« at 2 280 m (probably an incorrect spelling, corresponding to a lake at 2 280–2 300 m altitude on the Spanish versant near Port Vell, W of Andorra, near the Spanish/French/Andorran border). At high altitudes, *P. muralis* is replaced by largely isolated populations of three allopatric and closely related lizard species, *Lacerta bonnali, L. aranica* and *L. aurelioi* (ARRIBAS 1993a, 1993b, 1994a). In the Monte Perdido massif, *L. bonnali* occurs between 2 050–2 500 m altitude (MARTÍNEZ-RICA 1977); it is known to occur up to 2 750 m (ARRIBAS 1994b) or 2 900 m (MARTÍNEZ-RICA 1979).

Beside generalized statements on vertical occurrence and habitat of *L. bonnali* and *P. muralis* (MARTÍNEZ-RICA 1977, 1979, ARRIBAS 1994b), few data are available on climatic and ecological factors affecting their distribution. Despite a contrary mention of ARRIBAS (1993a: 108), *L. bonnali* lives both on calcareous and cristaline, metamorphic soils (ARRIBAS 1994b: 206), generally in rocky areas. Records in »wet grasslands« (PÉREZ-MELLADO 1997) are based on a wrong quotation of MARTÍNEZ-RICA (1977: 106–107).

Circo de Piedrafita is a plateau between 2 120 m (dam of Respomuso) and ca. 2 500 m altitude, encircled by higher mountains reaching 3 151 m altitude (Balaitous peak), in the alpine domain and in the limits of the subalpine domain of the Aragonese Pyrenees in Huesca province, Spain. Geologically, soils are mainly granitic. We carried out field observations during four visits to the area, in June 1995 (MV), July/August 1996 and 1997 (AP, JR, AR) and August 1997 (AP, MV). The most intensive samplings were carried out from 15. July to 10. August 1996. Total person-hours spent in intensive lizard searching add up to 75, referring to a total of about 80 lizard sightings.

Lizards were located exclusively on rocky (granitic) sites on S- and SW-exposed slopes and plains, as schematically shown in fig. 1. No lizards at all were recorded on the largely shaded slopes (E-, NE-, N-, and NW-exposure) opposed to those figured. *P.*

muralis was recorded at two separate sites (here called PM1 and PM2). PM1: Slopes above the Aguas Limpias brook, up to an altitude of 1 940 m on the S-exposed slope. PM2: 100 m section of the path from the dam to the Respomuso refuge, at an altitude of 2 160–2 200 m. UTM grid 30TYN2144. *L. bonnali* was recorded at three separated sites (LB1–3). LB1: Path Ibones de Arriel to Respomuso, 2 140–2 280 m altitude. UTM grids 30TYN1944 and 30TYN2044. LB2: Pico del Cristal slopes, between the cliff of Respomuso and Ibón de Ranas, 2 140–2 260 m altitude. UTM grids 30TYN2144 and 30TYN2244. LB3: Pico del Cristal slopes from Ibón de Ranas to Campoplano, 2 260–2 280 m altitude. UTM grid 30TYN2244. A larger transect section (about 200 m) not populated by lizards was interposed between PM1 and LB1, whereas PM2 bordered sharply to LB2 and LB3, with a nearest distance between specimens of both taxa of ca. 30 m. No area of syntopic occurrence of both species, and no interspecific behavioural interactions were observed.

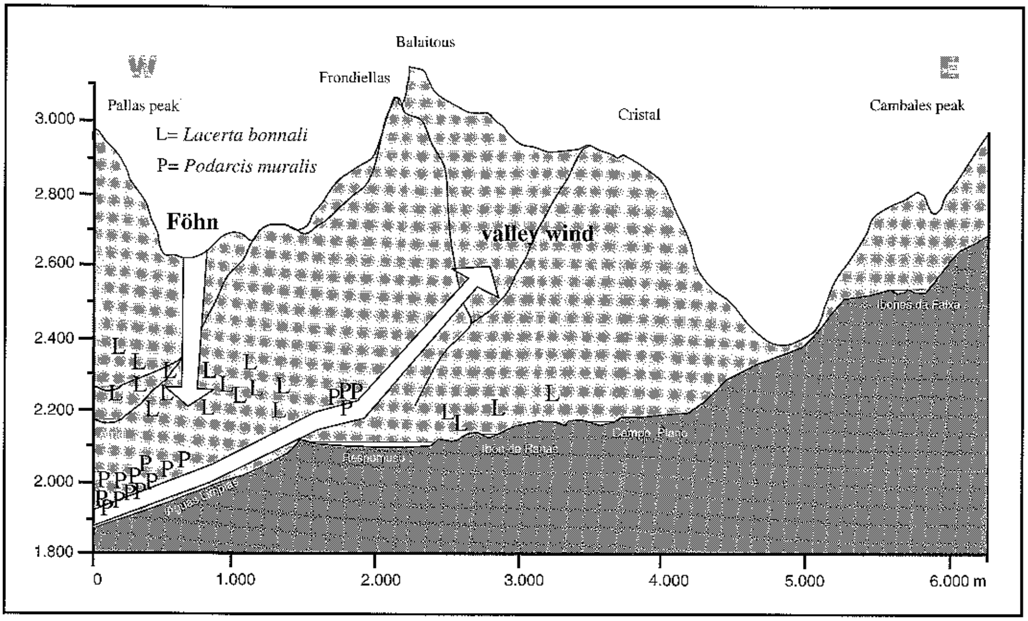

Fig. 1: Profile of Circo de Piedrafita, from the Ibones Da Faxa to the Aguas Limpias brook. Distribution of *Lacerta bonnali* (L) and *Podarcis muralis* (P) is schematically plotted on the sun-exposed slopes of the figured peaks. Plotted areas correspond to those described in the text (PM1–2 and LB1–3). Approximate altitudes and distances are expressed in metres. For exact altitudes and UTM grids see text. No lizards were recorded on the slopes opposed to those shown (E-, NE-, N-, and NW-exposure). Approximate direction and incidence of valley and Föhn winds is shown by white arrows.

Profil des Circo de Piedrafita von den Ibones Da Faxa zu dem Bach Aguas Limpias gesehen. Die Verbreitung von *Lacerta bonnali* (L) und *Podarcis muralis* (P) ist schematisch an den sonnenexponierten Hängen eingezeichnet. Die Bereiche entsprechen denen im Text beschriebenen (PM1–2 und LB1–3). Die ungefähren Höhen und Entfernungen sind in Metern angegeben. Für genaue Angaben, auch der UTM-Raster, siehe Text. Auf den entgegengesetzten Hängen (E-, NE- und NW-Exposition) wurden keine Eidechsen gefunden. Die weißen Pfeile kennzeichnen die ungefähren Richtungen der Tal- und Föhnwinde.

The overall distribution of lizards in the study area is clearly explained by temperature, caused by daily amount of solar radiation (only S- or SW-exposed slopes populated). No definite explanation for the parapatric distribution of both taxa is known.

Evidence may be found in the future by detailed analysis of microclimatic conditions caused by different winds shown in fig. 1. (1) Valley wind daily rises from the Aguas Limpias valley to the slopes of the Balaitous as indicated by direct observations and records of the Respomuso metereological station during four years (at average, only two to four days per month winds of contrary direction are recorded; A. MARTÍ, pers. comm.). Site PM1 is largely influenced by this wind. At higher altitude, it continuously looses strength. Passing the Respomuso reservoir it is probably charged with additional humidity which affects site PM2 as indicated by the occurence of single deciduous trees otherwise absent from Circo de Piedrafita. (2) Föhn winds commonly descend along parts of the S-exposed slopes as indicated by direct observations and typical banner-shape of trees (*Pinus uncinata*), where present. Occurence of *Festuca* grasses in the areas of major incidence (corresponding to LB1) shows that these winds are hot and dry as typical for Föhn.

The temperature and humidity effects caused by Föhn and valley winds may be decisive direct factors for lizard survivorship, or they may indirectly influence food availability and density as well as habitat structure. If a direct influence should exist, then *P. muralis* seems to be better adapted to humid plots, whereas *L. bonnali* prefers drier zones.

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