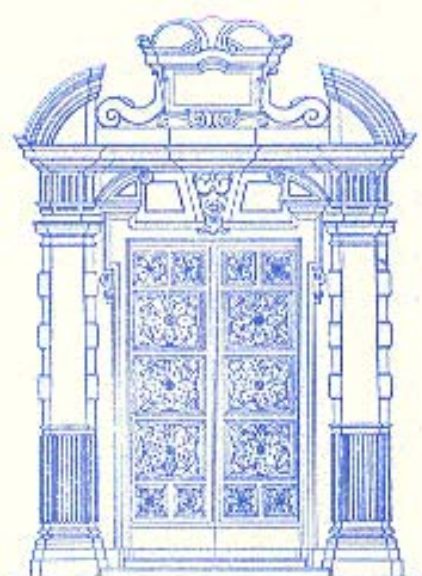


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Diagnosis and redescription of
Lacerta bonnali Lantz, 1927

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ABSTRACT

Lacerta bonnali (formerly known as *L. monticola bonnali* Lantz 1927), which inhabits the central Pyrenees from 1800 m to ca. 3000 m in alpine and subalpine environments is a full species: *L. bonnali* Lantz, 1927 (Perez Mellado et al., 1993; Arribas 1993a) due to strong differences in pholidosis, design, coloration, ecological (substrate) features, osteological and genetic (that distinguish it both from *L. monticola* Boulenger, 1905 and *L. horvathi* Méhely, 1904 its closest relatives geographically, as well from other *Archaeolacertae* from Europe and the Near East.

INTRODUCTION

Lacerta bonnali Lantz, 1927 was described as *Lacerta* (*Podarcis*) *monticola bonnali* from the "Lac Bleu", a glacial lake in the "Massif de Bigorre, Hautes Pyrénées", with a sample of 17 specimens collected by Count M. De Bonnal and sent to Lantz for study and description. Nothing is known about the mode of killing and conservation of these type specimens before they reached Lantz's hands (five years passed between the first Bonnal captures and Lantz's description), but it would be interesting to learn more about this, because some erroneous appreciations were given in the original description concerning coloration of the adults and juveniles (see below).

This taxon was ignored by Cyren (1928) in his description of *Lacerta estrelensis* (a young synonym of *L. monticola monticola* Boulenger, 1905), probably because the paper was finished before Lantz's publication. Mertens & Muller, influenced by Boulenger's point of view (Boulenger, 1920), include it as a mere subspecies of *Podarcis muralis* (*Lacerta muralis bonnali*) in the same year.

The following year, however, one of these authors (Mertens, 1929), in his description of *Lacerta monticola cantabrica*, restored *L. monticola* as a full species, including *bonnali* among its subspecies. An identical point of view was adopted by Muller & Hellmich (1936) in their description of *L. monticola cyreni*. It is possible that none of these authors had studied specimens of *L. bonnali*, because knowledge of this lizard remained limited to type locality

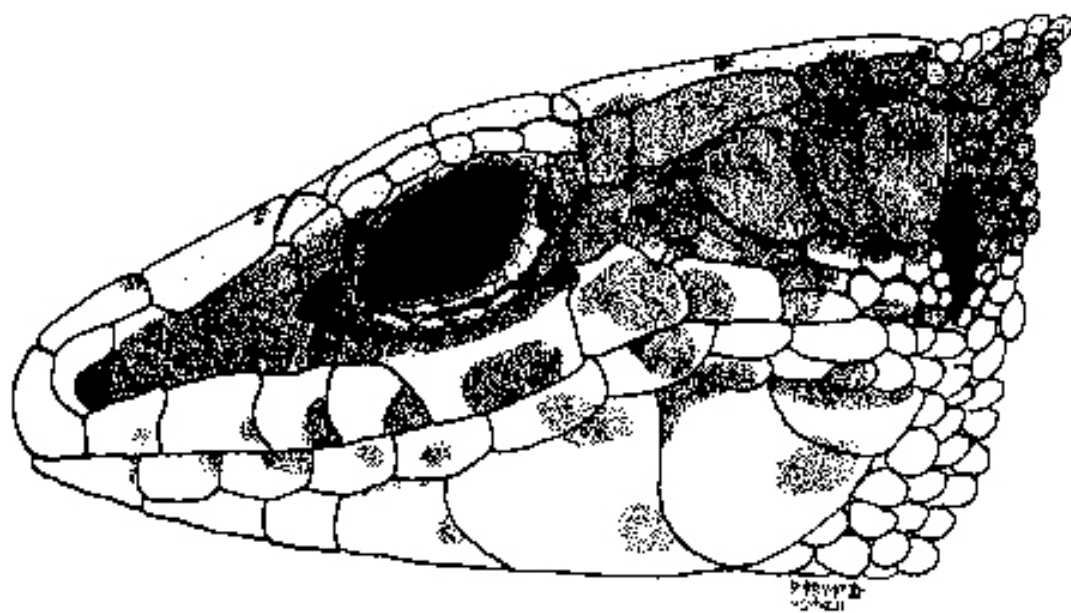


Fig. 1 - *L. bonnali*. Sierra de Guarbés (Lleida, Spain). Head in lateral view.

and description until 1943, when Beck (1943) added new localities in the French Pyrenees based on new Bonnal captures or citations.

Lanza (1963) reported new data about the Lac Bleu specimens, questioning some of Beck's localities because there are only citations without description of the specimens and could be not very rigorous. Apart from this lack of information on Beck's paper, suspicious heights in other species localities cast some doubt on the rigor of his data.

The principal contribution in the last few years was in the papers of Martínez Rica (1976, 1977) about thermoregulation, feeding, morphology and the first Spanish reports. Other contributions only add two new localities, one in the "Hautes Pyrénées" (Estaubé, France) (Naulleau, 1980) and the other in the Vall d'Aran (Liat, Spain) (Vives Balmaña, 1990). A good account of the known localities, although it excludes the later contributions, is given in Salvador (1984) and Michelot & Martínez Rica (1989).

MATERIAL AND METHODS

267 conserved adult specimens of *Archaeolacerta* from the Iberian Peninsula were studied, from the following sources: Collections of the "Centro Pirenaico de Biología Experimental, Jaca" (C.P.B.E.); Dep. of zoology, University of Barcelona (D.Z.U.B.); collection Estación Biológica de Doñana, Sevilla (E.B.D.); and the author's own collection (C.A.). Of these, 82 specimens belong to *L. bonnali* (44 exemplars of the Massif de Bigorre, 15 exemplars of Monte Perdido area and 23 from S^a de Guarbés). Equally, nearly a hundred

living *L.m.bonnali* of various localities were examined and released, in order to search for occasional variations in pattern or coloration. Specimens of other European and Caucasian species have been studied for comparative purposes. Characters are taken following Darevskii (1967) and Perez Mellado & Gosa (1988). Measurements were taken with a caliper (precision 0.05 mm).

RESULTS AND REDESCRIPTION OF *L. BONNALI*

It is surprising to see that some erroneous statements given in Lantz's original description (Lantz, 1927) and in Beck's paper (1943) about the belly coloration ("blanc jaunâtre ou verdâtre") and the "supposed" blue tail in juveniles, have been carried along by all successive authors referring expressly to the pyrenean rock lizard (Angel, 1946; Fretey, 1975, 1987, and others). These errors may be due either to the poor state of conservation of specimens or to the use of Ethyl Acetate to kill them, which changes their color to green in a few minutes.

Morphological description

Pholidosis: *L. bonnali* is a small lizard that reaches a maximum snout-vent length of 60.8 mm (max 60.8 - avg. 51.5 - min 38.2). The maximum size of males is 59.4 mm and of females 60.8 mm, which does not agree with the findings of Barbadillo (1987) who indicates larger size for both males and females (63 and 68.5 mm respectively), which is, in our opinion, at sight of the sample studied (the largest up till now), excessive.

Head is moderately short and wide, somewhat blunt, not very platycephalic (sensu Klemmer, 1957), not differing from that of *L. monticola* or *L. horvathi*. There is, however, a considerable variation in head proportions between the three populations studied here. Cephalic indexes are:

Head height / pileus length: 0.53 - 0.47 - 0.41.

Pileus length / pileus width: 2.51 - 1.98 - 1.83.

Pileus length / head width: 1.47 - 1.35 - 1.21.

Rostral and internasal scales meet along a fairly broad suture in all exemplars studied. Supranasal also meets with first loreal in 97% of specimens, the exceptions being by duplication of the supranasal, which leaves an apparently doubled postnasal. There is usually only one postnasal and two loreals (exceptionally two and three respectively). Narine is separated both from rostral scute and first supralabial scale.

There are four supralabials before subocular (occasionally three, very rarely five) and two after subocular (in a number of cases three, very rarely one).

Four to eight lower labials (mean six) and four to seven chin shields (mean six).

Gularia is represented by 17 to 25 granula (mean 21.6), and Collaria by 5 to 14 scales (mean 9.7).

There are four supraoculars, rarely three or up to six, by fusions or duplications of scales.

Supraciliar scales are usually in number of six (ranging for 4 to 7), and there is an ever interrupted row of supraciliar granula between supraoculars and these scales, composed of 0 to 9 (mean 4.17) granula.

Postocular scale usually in contact with parietal (78% of specimens), the latter being clearly emarginated by the first supratemporal clearly in only 4% of specimens.

Masseteric and tympanic scales are well developed and always present. There may be one or two masseterics. In topotypic and Spanish Central Pyrenean populations the usual number of masseteric scales is one (91.4%), but some specimens have two (8.6%). Towards the east, there is a tendency for a very large wedge-shaped scale to appear between masseteric and tympanic, which is usually as large as these two scales. This character appears in 100% of the Serra de Guàrdies specimens, but also, although in a lower percentage and at various degrees of development, in other Central Pyrenean Spanish populations, such as in Monte Perdido one, studied by us. The tympanic scale is clearly larger than in the nearest species, seemingly by coalescence of the tympanic with its nearest temporal scales. Forelimb is between 0.29 and 0.38 times the snout-vent length (mean 0.34).

Dorsalia values are low, 37 to 48 scales in a row in midbody (mean: 42.2), scales are granular, very convex and without any trace of keels.

Ventralia ranged in males from 23 to 27 (mean: 25.48) and in females from 26 to 30 (mean: 28.03). There is thus a slight overlap between sexes. Periventralia (number of dorsal scales that meet one of the lateral ventral ones at midbody) is usually two (rarely one or three).

Hindlimb is 0.39 to 0.54 the snout-vent length (mean: 0.47), and its relation to 4 th. digit is from 2.61 to 3.32 (mean: 2.94).

Femoralia show very low values, and ranges from 9 to 18, with a mean of 13.29. There are no significant differences between male and female values (mean: 13.27 and 13.3 respectively). Interfemoralia (number of scales between the two rows of femoral pores) is 4 to 9, with a mean of 6.06.

There are usually two or three preanal plates (mean: 2.4), and from 7 to 13 circumanal plates (mean: 8.98). Anal plate is big, specially in topotypic populations, being their width height ratio between 1.34 and 2.52 (mean: 1.7) in the whole sample.

Coloration and pattern characters

L. bonnali frequently lacks any trace of vertebral stripe (74.3%). Although it appears more frequently in males, this vertebral design is exceptional in the

Bigorre, moderately frequent in Spanish Central Pyrenees, and very frequent in the easternmost Pyrenean population studied (S^a de Guarbes). When there is a vertebral stripe, it is composed of a pair of paravertebral rows of small dots rather separated.

Vertebral design is reduced to a very brief rows of dots, usually covering only the nuchal area (74.3% of individuals with design, the rest being the cited population of S^a de Guarbes that usually has a complete one). These populations east of Garona river (S^a Guarbes), frequently cited as different in the text, have been described as a different subspecies: *L. bonnali aranica* (Arribas, 1993b) (specimens of Fig. 1, 2 and 3 belong to this subspecies).

Dorsal colour is brown (48.7%), grayishbrown (21.9%) or gray (20.7%), having greenish shadows depending of the light incidence in part of the clearer grayish (6.1%) and brownish (2.4%) specimens. Background tone is more or less dark depending upon the substrate they live, and frequently with a monochromatic but more darker stripe of background colour in the middle of dorsum. Exceptionally, two males and a female with malaquite greenish dorsum have been observed in the Aran Valley (Guarbes) (Figs. 2-3).

There are no dark dorsolateral stripes.

Temporal band is always uniform (100%) in *L. bonnali* without being decomposed in dots or the network patterns usually found in *L. monticola* or other *Arthaeolacertae* species (except *L. horvathi*), and their colour varies between clear brown and black, the most common being dark brown, almost black tones in all Pyrenean populations. Upper edge of this temporal band is always smooth.

Blue ocelli in the shoulder are not present in *L. bonnali*.

A band of clear ocelli is only present in some males of eastern populations (2.4% of total *bonnali* sample). Equally, a dark supramaxillar band is rare in *L. bonnali*.

Pileus frequently lacks any pattern (62.2%), although when it is present, it is more frequent in a few and large spots.

L. bonnali, despite the original descriptions of Lantz (1927) and Beck (1943) (who may only have seen conserved exemplars) and data taken by other authors from these, apparently without checking, is always white bellied, even in the breeding period.

A dark band in the submaxilar area is very common in *L. bonnali*.

Black punctuation of venter varies with the population studied. In *L. bonnali*, there is some degree of variation between populations, which are usually unpigmented although adult males frequently show well developed spots in the inner margin of scales, specially in eastern populations. As in other species of *Arthaeolacerta*, punctuation is more developed in hatchlings and juveniles, being more reduced when growing, by an allometric relationship between the clear part of scale and the black part. There are no blue spots on the outermost ventral scales.



Fig. 2 - *L. bonnali*. Sierra de Guarbés (Lleida, Spain). Adult male showing peculiar temporal disposition and design pattern.



Fig. 3 - *L. bonnali*. Same locality as fig. 2. Adult female.

On the underside on the calf, there is a slight yellowish pigmentation in some rare exemplars. A very interesting feature of *L. bonnali* is the lack of blue tail in hatchlings (almost never found in known populations), which show gray tails equal at dorsum colour.

DISCUSSION

Some morphological traits make *L. bonnali* one of the more peculiar European *Archaeolacerta*.

L. bonnali is the smallest European *Archaeolacerta*. Even *L. horvathi*, has longer snout-vent length, both on average and in absolute size (see De Luca, 1989).

Tympanic scale is clearly bigger in *L. bonnali* than in the nearest species, seemingly by coalescence of the tympanic with its nearest temporal scales.

The special arrangement in the temporal area characteristic of East Pyrenean populations (see description) is almost identical to *L. mixta* and very similar to *L. armeniaca* (see Darevskii, 1967: 238). This coalescence of temporal scales also appears in some hybrids between parthenogenetic and bisexual species (Danielyan, 1986), and would be a primitive or atavic arrangement of the temporal area.

Another characteristic of *L. bonnali* that distinguishes it from its nearest species is the always interrupted row of supraciliar granula, which is very rarely incomplete in *L. monticola* (between 5 and 9%) or other species such as *L. horvathi* (21.9%) (De Luca, 1989) and *L. mosorensis* (10%) (own data). Equally, *L. bonnali* usually has less than half the supraciliar granula of the other European species.

Dorsalia is very low in *L. bonnali*, although similar to *L. horvathi* values (mean: 43.9, max 51, min 39) (De Luca, 1989). Only *L. mosorensis* shows lower Dorsalia. Other species show slightly larger values such as *L. caucasica* or clearly larger, such as *L. monticola* and others.

High values of Interfemoralia with low value of femoralia clearly discriminates *L. bonnali* from all other *Archaeolacerta* species. Only *L. axycephala* has a great interfemoralia, but an equally large number of femoral pores. All other species, including Caucasian ones, show lower interfemoralia values.

Contact between rostral - internasal and supranasal - loreal is always present in *L. bonnali* (100% and 97%) and almost always in *L. horvathi* (99.04% and 66.9%) (De Luca, 1989), which discriminates these two related species from all other *Archaeolacertae*.

The coloration pattern is very simple in *L. bonnali*. The temporal band is always uniform (100%) without being descomposed into dots or network patterns, usual in other *Archaeolacerta* species. This kind of temporal band appears in some females and juveniles of *L. monticola* (ssp. *monticola* and ssp. *cantabrica*) and in all *L. horvathi* and some *L. caucasica* (sensu lato).

The upper edge of this parietal band is always smooth in *L. bonnali* and almost always scalloped in all other *Archaeolacerta*. This character is also of great diagnostic value in *L. bonnali*.

L. bonnali and *L. horvathi*, lack any trace of blue ocelli on the shoulder. Other balcanic species as *L. oxycephala* and *L. mosorensis* have network patterns but also lack developed blue ocelli.

Spots in gular area, used as a diagnostic character between *P. muralis* and *P. hispanica* (Perez Mellado & Galindo Villardon, 1986), are common in *L. bonnali*, and also appear in *L. horvathi*, *L. mosorensis*, *L. saxicola*, *L. parvula* and *L. caucasica daghestanica* (which like *L. caucasica alpina* would be a full species).

A very interesting feature in *L. bonnali* is the lack of blue tail in hatchlings. All the other *Archaeolacerta* species and some *Podarcis* have more or less bright coloured green or blue tails in hatchlings almost in their first year of life. This character as well as the adult pattern simplification should be regarded as a secondary loss.

CONCLUSIONS

These strong differences in coloration and pholidosis stress that the formerly known *L. monticola bonnali* is a good species: *L. bonnali* (see Arribas, 1993a). Perez Mellado et al., 1992, 1993, independently from the present work, arrived to the same conclusions.

The more diagnostic characteristics of this species are the small size, reduced design and coloration, especially of venter and tail of juveniles, the lack of blue ocelli and blue spots in outermost ventrals, the smooth uppermost edge in temporal band, the contacts between rostral-internasal and supranasal-loreal. The low counts of dorsalia, femoralia, supraciliaria (always interrupted rows), the characteristic arrangement of temporal scales and the high values of interfemoralia. Apart from this, Böhme (1971) has studied the hemipenis microsculpture finding finger-shaped microsculpture in *L. bonnali* (as in *L. bedriagae*, *L. graeca* and *Podarcis* spp.) whereas *L. monticola*, *L. horvathi* and other *Archaeolacerta* (except those mentioned above) and *Zootoca* have crown-shaped microsculpture in hemipenis.

Some characters approach *L. bonnali* to *L. horvathi*: Contacts between rostral-internasal and supranasal-loreal, general coloration pattern, low values of Dorsalia, shape of anal scale, etc., although *bonnali* is easily distinguished by the interrupted and low number of supraciliar granula, low femoralia, high interfemoralia, smooth upper edge of temporal band, lack of blue tail in hatchlings.

Lacerta bonnali inhabits the central Pyrenees from the Pic d'Arielle (= P. d'Arriel) (Basses Pyrénées) (Beck, 1943) and the Ibón do Arriel (Huesca) in the west, to the Vall d'Aran in the east, in calcareous or schistous mountains.

Its type locality, in the French Massif of Bigorre is an extreme locality, somewhat isolated from the axial Pyrenean populations.

In Spain, it is cited from the Monte Perdido area (near the citation of Estaubé, H. Pyr.; Naulleau, 1980) and from Gran alto de Pondiello (observation, without specimen) (Martinez Rica, 1976, 1977). Further East, it is documented from Liat (Lleida) (Vives Balmaña, 1990), the Gran Encantat (observation confirmed by us) and Muntanyó de Llacs (two exemplars in C.P.B.E. collection) both in Aiguestortes National Park.

It is also cited by Beck (1943) from Pic des Quatre Termes (Massif de Neouvielle) and Soum de Mariaude, a locality this later that we have not been able to find on our maps. Lanza (1963) doubts these localities of Beck, because specimens are not described. The locality of Neouvielle Massif should be confirmed because there are crystalline mountains in this region and one of the points in Pyrenean mountains where *Pinus uncinata* grows to greatest height, being thus more suitable for *P. muralis*, associated to this habitat, than for *L. bonnali* (altitudinal data provided by Beck are not reliable because he always gives the altitude of the highest point on the mountain). Prospections in suitable points of crystalline rock areas proved fruitless. In these areas, usually of granite, which constitutes the principal substrate in the axial part of the chain in Central Pyrenees, *Podarcis muralis* reaches great heights: almost 2300 m in the Sierra de Liena (Huesca, Spain); 2160 m in the Puerto de Ordiso (Huesca); 2100 m in the Ibón de Cregleña (Huesca); 2200 m in Estany Redó (Lleida); 2600 m in Portarró d'Espot, 2400 in Gran Encantat, 2200 in Col del Tourmalet and 2300 in Llac de Contraig (Aiguestortes National Park).

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