

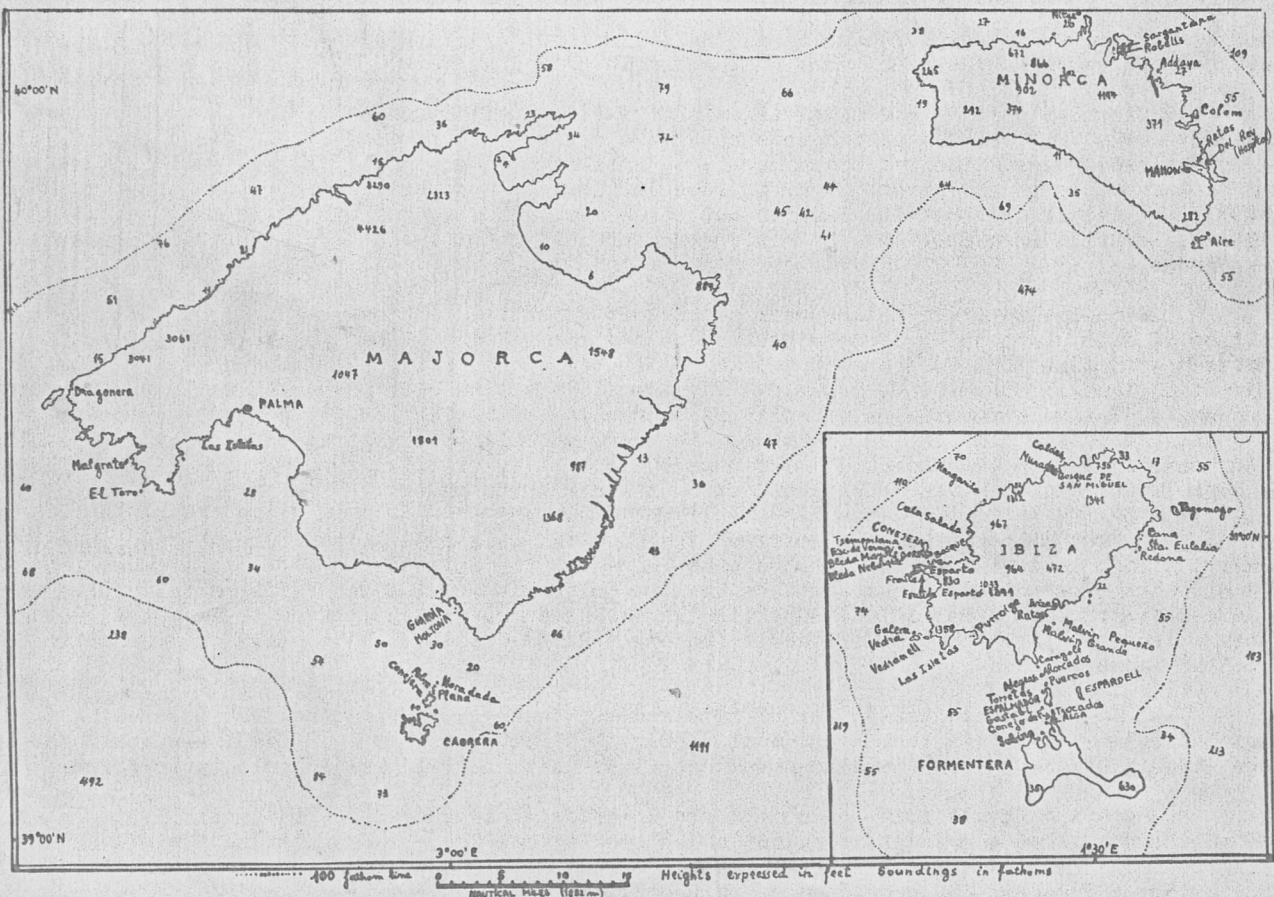
THE LIZARDS OF THE BALEARIC ISLANDS, WITH DISCUSSION OF THEIR EVOLUTION

by Robert Thorn

The Balearic Islands were separated from continental Spain in late Tertiary or during the beginning of diluvial times. Geologically, they are a continuation of the Andalusian Mountain chain (Betic Cordilleras). The Pityuses Islands were the first group to be isolated at a time when Majorca and Minorca were still united to each other. Many small rock islands along the coast were later formed by the erosive activity of the sea.

The subsoil of the islands is mostly light calcareous rocks. On the three main islands (Ibiza, Majorca and Minorca), the mediterranean type vegetation is well developed, and forests of *Pinus halepensis* are frequent. On the small islands the vegetation is sparse, composed of low, xeromorphic plants or of succulent halophytes. Everywhere the rocky subsoil appears bare, a humus layer being nearly nonexistent.

Separated from the continental population, the Balearic Islands lizards have evolved to form two species, *Lacerta lilfordi* and *L. pityusensis*, which split into many races on the smaller islands. *L. lilfordi* is endemic to the small islands around Majorca and Minorca, and has been introduced onto these two; *L. pityusensis* occurs on Ibiza and some of the smaller Pityuses, and was introduced onto Majorca. The closest relative of these species on continental Spain is *L. hispanica* (= *L. bocagei liolepis*). The evolution of these lizards is characterized by bipolarity: on one island a subspecies tends to gigantism, on another a race tends to nanism; one form tends to get stout, another is getting more slender; one is becoming more melanistic, another is getting lighter. However, melanism and the tendency to increase in size prevail. The causes of evolution of island races of lizards are still matters of supposition and are associated with the general problem of evolution of species, one of the most important problems of Biology.



Besides a few colonies undoubtedly introduced by fishing boats, no lacertas occur on the main islands of Majorca and Minorca. It seems possible that lizard-eating snakes (perhaps Macroprotodon cucullatus), without enemies on these islands, became very abundant at a certain time and exterminated formerly endemic populations. Macroprotodon occurs only on Majorca and Minorca; no snakes occur on any of the islands having a population of lilfordi or pityusensis. The hypothetical extinction of the Lacertidae on the major islands could be due to a broken equilibrium of island life. The Gekkonidae (Tarentola mauretana and Hemidactylus turcicus), common on Majorca and some of the other islands, are nocturnal and therefore better able to escape the nocturnal Macroprotodon, an opisthoglyphous colubrid quite active in hunting up diurnal lizards in their hiding places. Incidentally, Elaphe scalaris has been reported on Minorca, Natrix maura on Majorca, L. perspicillata on Minorca (introduced by boats from NW Africa), and L. sicula cetti on Minorca (introduced from Sardinia).

Small hereditary variations called mutations occur in any living organism. These mutations can be of positive, negative or indifferent value to the species concerned. The modern concepts of evolution maintain that through the play of natural selection the negative mutations are being eliminated whereas the positive ones tend to become definitely established in the species.

Many authors have pondered about melanism appearing in island forms and especially in Mediterranean lizards. One theory gives black a selective value. In warm regions, islands have a cooler climate than the continent. Black pigmentation absorbs more heat than light color. A dark color further provides protection against harmful ultraviolet rays. Increased size and stoutness diminish the relative area from which an animal loses heat. But a black animal is conspicuous on a light substratum. Melanistic populations can only establish themselves if enemies are absent, often the case in an impoverished island fauna. On the continent only strong animals without enemies can evolve toward melanism.

Eisentraut (1949) refuses to accept this theory as applying to the Mediterranean island lizards. It is not likely that any climatic difference exists between Ibiza, which has a typically colored population of L. p. pityusensis, and any of the neighboring small rock islands. (An island the size of Ibiza does not have island character for small animals such as lacertas.) Similarly, typical L. sicula is found on Capri, but on the nearby Faraglioni Rocks (three high, steep rock islands), there is a blue-black form on the middle and outer Rock.

Clinal variation along the islands of small archipelagoes is often the rule, the oldest, smallest rocks furthest out in the sea having the darkest population. These are characterized by an impoverished vegetation and consequently by an impoverished insect fauna. An investigation of the stomach contents of lizards captured revealed insects and snails, and plant parts (Eisentraut, 1949). The latter were mostly flowers, but there were also leaves, stems and berries. Marine animals and seaweeds were not found. Through lack of sufficient insect food the island lizards became omnivorous.

Eisentraut refers to the work of certain scientists who have shown that the chemical composition of skin pigments is closely related to the composition of end products of metabolism eliminated by animals. The food change imposed on these lizards would produce a greater amount of melanin, the other pigments being reduced. The animals adapting best physiologically to the change of diet would make melanophores as a result of metabolism of their food. The resulting color therefore is a secondary effect of the environment. He does not believe, lamarckistically, that the black color resulting from the change of diet became, with time, directly transmitted to the offspring. As a neodarwinist, he gives natural selection the directing power.

On the light calcareous rocks of the Balearic Islands only one race, L. p. grueni, has evolved toward lighter tinges. It occurs on Trocados, the only island with loose sand. Possibly the presence of enemies such as small hawks like Falco tinnunculus and F. naumanni, caused this form to adapt its color to that of the subsoil. These birds are not restricted to Trocados, but on the other islands the lizards can more easily escape beneath stones or into rock crevices which do not exist in loose sands.

In the tendency toward larger size and stoutness, Eisentraut sees an adaptation to elongated intestines. It is a known fact that a vegetable diet requires a longer intestine. Measurements taken by him of the small intestine show that it is relatively longer in melanistic forms.

Hartmann (1953) does not accept the theories of Eisentraut. He sees in the strong mutability of these lizards and in their isolation on the islands the main reason for their variability. This is sustained by the fact that the smaller the island, the more uniform the population appears. On the larger islands, the populations are remarkably variable.

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The future of these island forms is hopeless. The slow but continuous attrition of the sea will finally destroy the islands, and unless a geological uprising again connects them to the mainland, the lizards will not be able to transmit their hereditary values to future generations.

Description of races. From the continental L. hispanica the Balearic species of Lacerta (lilfordi and pityusensis) can be distinguished by the presence of a well-developed temporal plate (massetericum). The dorsal scales of pityusensis are slightly keeled and there are fewer than 70 scale rows at midbody. The dorsal scales of lilfordi are smooth and there are more than 70 scale rows at midbody. Descriptions are taken from Eisentraut (1949) unless otherwise indicated.

Lacerta lilfordi lilfordi (Günther, 1874).

Stout form, tail short, thick. Adults uniformly deep black above, steel or ultramarine blue beneath. Juveniles more brownish. Total length (t-l): 18-20 cm. Distribution: Island of Aire on SE coast of Minorca.

Lacerta lilfordi balearica Bedriaga, 1879.

Strongly built. Color variable: generally brown above, sometimes with dark dots; red or bluish beneath with a few dark dots. White superciliary and subocular dotted stripes along the trunk. T-l: 14-17 cm. Distribution: Isla del Rey, Addaya Islands, Sargantana and Robello Islands near Minorca.

Lacerta lilfordi brauni Müller, 1927.

Dorsum greenish gray-brown tending to blue on adults; sides olive brown with light dots; tail vivid green; belly whitish gray to reddish. T-l: 10-17 cm. Distribution: Isla del Colón (near Minorca).

Lacerta lilfordi conejerae Müller, 1927.

Stout, with neck broader than width of head. Completely melanistic. T-l: 14-16 cm. Distribution: Conejera Island (NE of Cabrera).

Lacerta lilfordi fahrae Müller, 1927.

Strongly built melanistic form. Dorsal parts deep black to blue-black; sides black; ventral parts ultramarine blue, sometimes black. T-l: 17-18 cm. Distribution: Horadada and Pobre Islands.

Lacerta lilfordi fenni Eisentraut, 1928.

Slender dwarf form. Dark olive green above; sides brownish with distinct reticulation; reddish brown beneath. T-l: 11-14 cm. Distribution: Island of Nitge (=del Porros) near Cabo Caballeria, N coast of Minorca.

Lacerta lilfordi giglioli Bedriaga, 1879.

Strong form of variable coloration: greenish to yellowish brown above; yellowish gray to brick red beneath; tail blue to green. The ♂♂ have four blue-green stripes along the back. T-l: 14-17 cm. Distribution: Island of Dragonera, near Majorca.

Lacerta lilfordi hartmanni Wettstein, 1937.

Strongly built melanistic form close to L. l. fahrae; tail thick. Deep blue-black above; belly dark ultramarine blue; small blue blotches laterally on the body. T-l: 20 cm. Distribution: Isla Malgrats (Bay of St. Ponza, SW coast of Majorca).

Lacerta lilfordi jordansi Müller, 1927.

Small melanistic form. Dorsal parts deep black to blue-black; sides black, sometimes with ultramarine blue blotches; belly deep ultramarine blue or black. T-l: 10-15 cm. Distribution: Islands of LaGuardia, Maltona, Isleta de Frailes (S coast Majorca).

Lacerta lilfordi kuligae Müller, 1927.

Medium size, but very stout. Coloration variable: brownish to blue-black above; belly light to dark cobalt blue. T-l: 16 cm. Distribution: Cabrera Island (S coast of Majorca).

Lacerta lilfordi planae Müller, 1927.

Small, melanistic form. Black above, with markings sometimes distinct; deep ultramarine blue beneath with cobalt blue blotches on marginal ventral plates. T-l: 16 cm. Distribution: Island of Plana (N of Conejera).

Lacerta lilfordi rodriguezi Müller, 1927.

Strongly built dark form of variable coloration: olive brown above to dark olive green tending to blue, longitudinal markings distinct; sides brownish with distinct reticulation; light to dark yellow red beneath. T-l: 14-16 cm. Distribution: Isla das Rates (Harbor of Mahon, Minorca).

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Lacerta lilfordi toronis Hartmann, 1953.

Stout, uniformly brown race. Some of the longitudinal dark markings on the back remain distinct (Hartmann, 1953). Distribution: Island of Toro near Majorca.

Lacerta pityusensis pityusensis Bosca, 1883.

Stouter and stronger than lilfordi, but relatively slender compared with other races of pityusensis. Dorsal parts dark green (♀ lighter) with three to five longitudinal rows of black blotches along the trunk. Whitish, pink, orange or brick red beneath with green-blue or cobalt blue dots on marginal ventral plates. T-l: 18+ cm. Distribution: Ibiza and nearby islands not inhabited by other races. Introduced on Majorca (Palma and Las Isletas).

Lacerta pityusensis affinis Müller, 1927.

Large form. Vivid green to yellow-green with three dark longitudinal stripes above; legs and tail brownish; sides reticulated; yellowish or reddish beneath. T-l: 17 cm. Distribution: Island of Malvin Pequeño (S of Isla Ratas E of Ibiza).

Lacerta pityusensis algae Wettstein, 1937.

Close to grueni. Dorsal parts green with distinct black markings; tail and sides of trunk brown; belly lilac to light violet, with some dark blotches. T-l: 19 cm. Distribution: Isla Alga (= Pouet, N of Formentera).

Lacerta pityusensis calaesaladae Müller, 1928.

Close to the nominate race, with same tendencies as schreitmülleri. Above vivid green; below brick red to the sides of the trunk. T-l: 15 cm. Distribution: Isla Cala-Salada (W coast of Ibiza).

Lacerta pityusensis caldesiana Müller, 1928.

Close to nominate race, with tendency toward darkening. T-l: 18 cm. Distribution: Caldes Island, very close to N coast of Ibiza.

Lacerta pityusensis canensis Eisentraut, 1928.

Large, strongly built form intermediate between redonae and tagomagensis. Darkened green to blue-green above; sides and limbs light to dark brown; greenish to turquoise blue beneath, sometimes red. T-l: 22 cm. Distribution: Isla Cana (E coast of Ibiza).

Lacerta pityusensis caragolensis Buchholz, 1954.

Slightly larger and stouter than nominate race. ♂♂: vivid blue-green to olive green above; superciliary stripe and sides brown, formed by a dark brown reticulation on a red brown ground color; yellow beneath. Upper parts of the ♀♀ are completely brown. Distribution: Island of Caragolé (Negretta) on S coast of Ibiza (Buchholz, 1954).

Lacerta pityusensis carlkochi Mertens and Müller, 1927.

Vivid green above (on certain animals a tendency toward blue or yellow can be noticed); sides bluish-green or brownish; yellow-green or blue-green to turquoise beneath. Dorsal markings remain distinct. T-l: 17-20 cm. Distribution: Islands of Conejera and Del Bosque close to W coast of Ibiza.

Lacerta pityusensis characae Buchholz, 1954.

Larger and stouter than nominate race. ♂♂: vivid blue-green above; sides red-brown; reddish gray beneath, with light blue-green toward throat and anus. ♀♀: dorsal parts of fore half of body are red-brown; belly is darker. Distribution: Isla Characa in the bay of Cala Characa on N coast of Ibiza (Buchholz, 1954).

Lacerta pityusensis espalmadoris Müller, 1928.

Close to gastabiensis; dorsal parts sometimes a lighter green. Distribution: Espalmador S of Ibiza.

Lacerta pityusensis formenterae Eisentraut, 1928.

Stout form. Vivid green to blue-green above, with markings interrupted but distinct; sides light blue between reticulated markings; light blue-green beneath. T-l: 17-19 cm. Distribution: Formentera Island.

Lacerta pityusensis frailensis Eisentraut, 1928.

Coloration variable with tendency to melanism. Blackish above with greenish or bluish sheen; sides ultramarine blue with dark reticulation; greenish ultramarine blue beneath. T-l: 17-21 cm. Distribution: Isla del Fraile on western extremity of Esparto (W coast of Ibiza).

Lacerta pityusensis gastabiensis Eisentraut, 1928.

Mertens and Wermuth (1960) subsume under this form the following races, described by Eisentraut in 1928: negrae, espardellensis, intermedia and ahorcadosi. Dark green to dark brown above; sides,

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limbs and tail dark brown; whitish gray to reddish yellow beneath. T-l: 20 cm. Distribution: Isla Negra, Gastabi, Ahorcados, Espardell.

Lacerta pityusensis grossae Müller, 1929.

Similar to schreitmülleri, but the dorsal green is darker and the belly more vividly reddish. Distribution: Isla Grossa E of Ibiza.

Lacerta pityusensis grueni Müller, 1928.

Small, slender form. The dorsum is light gray-brown to a darker red-brown, very similar to the color of the sand substratum. The sides are lighter with the dark markings almost completely absent. The belly is a metallic whitish gray, sometimes with a reddish sheen. T-l: 12-17 cm. Distribution: Trocados (near Espalmador). This is a small, elongated island with a sandy subsoil that may be completely washed over by the sea when strong winds are blowing. The vegetation is composed of dwarf pines, Ammophila arenaria, Agriopyrum junceum (sea coach grass) and similar grasses. Ants and multipedes [sic] were observed.

Lacerta pityusensis hedwigkammerae Müller, 1927.

Large melanistic form. Dorsum black or deep green-black with more or less distinct longitudinal rows of blue-green spots. Venter bluish gray or dark blue-green to blackish. Cloacal region and soles of feet pink. Marginal ventral plates dark cobalt blue with pink edges. Distribution: Margarita (NW Santa Inés, Ibiza). This is a very steep rock island with only a sparse vegetation of Crithmum maritimum, Salicornia and Statice. Almost no insects, but some snails present.

Lacerta pityusensis hortae Buchholz, 1954.

Still close to nominate race, similar length, but stouter. Mostly green above, with the back being sometimes a vivid violet blue. Vivid blue beneath, lighter in the middle. Distribution: Isla de Hort, NW of Tagomago (Buchholz, 1954).

Lacerta pityusensis kameriana Mertens, 1927.

A beautiful vivid blue above, the dorsal black markings interrupted or reticulating; turquoise beneath. T-l: 22 cm. Distribution: Isla Esparta on W coast of Ibiza. This island is about 1 km long, 69 m high. The southern shore is formed of steep rocks. Vegetation is low grasses (thistle, and halophytes such as C. maritimum).

Lacerta pityusensis maluquerorum (Mertens, 1921).

Strong form. Blue-black above; sides black with dark blue spots; dark ultramarine blue beneath. T-l: 19-22 cm. Distribution: Isla Bleda Plana (=Major), Isla Bleda Bosque, Bleda Gorra, Escui de Vermey - all very small rock islands.

Lacerta pityusensis miquelensis Eisentraut, 1928.

Very close to nominate race. Distribution: Isla del Bosque de San Miguel, on N coast of Ibiza. Very small island with vegetation of low shrubs; close to main island and only recently (relatively) separated from it.

Lacerta pityusensis muradae Eisentraut, 1928.

Strongly built, medium sized form. Blackish above but markings distinct; sides dark blue with black reticulation; head, limbs and tail lighter; light to dark ultramarine blue beneath. T-l: 20 cm. Distribution: Isla Murada on W coast of Ibiza. This is a huge tabular rock 200 m long, with steep shores. Vegetation sparse, of halophytes such as Suaeda, Statice. It is close to Ibiza but has probably been separated from it a long time as the depth of the channel between the two is to 50 m.

Lacerta pityusensis puercosensis Buchholz, 1954.

Length similar to that of nominate race, stouter. Coloration similar to that of torretensis but lighter. Distribution: Isla Puercos near Espalmador (Buchholz, 1954).

Lacerta pityusensis purroigensis Buchholz, 1954.

Slightly smaller but stouter than nominate race. Coloration variable, dark blue tinges predominating. Distribution: Isleta de Purroige on S coast of Ibiza (Buchholz, 1954).

Lacerta pityusensis ratae Eisentraut, 1928.

Strong form. Vivid yellow-green to green above, the markings much reduced; sides become gray-brown toward venter; top of head light brown with dark markings; tail yellow-gray; whitish gray to yellowish beneath. T-l: 21 cm. Distribution: Isla Ratas lying to the SW of the port of Ibiza.

Lacerta pityusensis redonae Eisentraut, 1928.

Stout form. Yellow green to vivid green above; sides, tail and limbs brownish; orange or yellow-green beneath. T-l: 23 cm. Distribution: Redona E of Ibiza. Very small rock island 20 m high, with a well-developed vegetation and insect fauna. Many snails are also present.

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Lacerta pityusensis sabiniae Buchholz, 1954.

Slenderer and slightly smaller than formenterae; color similar but less vivid. Distribution: Isla Sabina N of Formentera (Buchholz, 1954).

Lacerta pityusensis schreitmülleri Müller, 1927.

Much like affinis of nearby Malvin Pequeño. Color of venter more reddish and extending to the sides of the trunk. T-1: 17 cm. Distribution: Malvin Grande E of Ibiza; it is a very small rock island with a sparse vegetation and insect fauna.

Lacerta pityusensis subformenterae Buchholz 1954.

Smaller, more slender than formenterae but larger than nominate race. Coloration darkened: upper brown with a few green blue spots on the tail base and hind limbs; sides bluish-green with a reddish iridescence; venter dull blue. Distribution: Conejo de Formentera N of Formentera (Buchholz, 1954).

Lacerta pityusensis tagomagensis Müller, 1927.

Large strong form. Dorsum dark olive green, sometimes bluish or brownish, with markings reduced; sides lighter; venter yellow-gray or somewhat blue-green. T-1: 22.5 cm. Distribution: Tagomago E of Ibiza.

Lacerta pityusensis torretensis Buchholz, 1954.

Close to formenterae, more slender; color less vivid. Dorsal parts olive green to olive brown. Distribution: Isla Torretas W of Espalmador (Buchholz, 1954).

Lacerta pityusensis vedrae Müller, 1927.

Large strong form. Dorsum partly vivid yellow, partly dull yellow, becoming on neck and tail base dark green or blue green with black reticulations; sides vivid blue with black reticulations; venter turquoise to cobalt blue. T-1: 18-21 cm. Distribution: Islands of Vedrá and Vedranell. Vedrá is a huge, steep conical rock (1 km wide, 382 m high), relatively well covered by vegetation. Wild goats, insects and snails are present.

Lacerta pityusensis zenonis Müller, 1928.

Large strong form with a long, thick tail. Dark brown, bronzy green or brown tinges prevail on the back; flanks are lighter. Black markings are interrupted above, reticulated on the sides. Belly a vivid light turquoise blue. T-1: 20-24 cm. Distribution: Escollo de Espartó (=Escui de Espartó) on W coast of Ibiza. This is a steep, very small, rock island on which vegetation and insect life are scanty.

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