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NOTES ON SOME ENDANGERED SPECIES OF SPANISH HERPETOFAUNA: I. *PODARCIS PITYUSENSIS* BOSCÁ

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ABSTRACT

The status of the populations of Podarcis pityusensis *on about 70 islets and small islands around Ibiza and Formentera (Balearic Islands) is examined, using data from our own observations, and, to a lesser amount, other publications. Lizard populations were found on 43 islets, but data are lacking for another 13. Only 10 sites (18%) have abundant and well-maintained populations. In 13 localities (23%), there is no geographic isolation between the populations, or this isolation is very poor and incomplete. The high probability of populations mixing, or actual observation of this mixing, in 19 islands (34%) is indicated. Human pressure on lizard populations is strong in 14 cases (25%). And finally, 18 populations (about one third) may be considered highly endangered or already extinct by elimination or genetic mixing with other populations. Among the subspecies which became extinct through mixing are* P.p. miguelensis, P.p. subformenterae, P.p. algae, P.p. sabinae *and* P.p. grueni. *The need for adequate protective measures aimed at the conservation of the remaining populations is emphasized.*

RESUMEN

Se examina en este artículo la situación de las poblaciones de Podarcis pityusensis *en unas 70 islas e islotes del archipiélago de Ibiza, a base de datos reunidos, en su mayoría, mediante observaciones propias. Se ha constatado la existencia de lagartijas en 43 islotes, si bien faltan datos acerca de otros 13. Sólo en 10 casos (un 18%) las poblaciones cuentan con efectivos numerosos. En 13 casos (un 23%) no existe aislamiento entre las poblaciones, o bien dicho aislamiento es mínimo e incompleto. Se ha señalado la facilidad de la mezcla de poblaciones, o se ha observado de hecho dicha mezcla en 19 poblaciones (34%). La presión humana es intensa en 14 islotes (un 25%). Por último, 18 poblaciones (aproximadamente un tercio del total)*

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pueden considerarse gravemente amenazadas o extinguidas por completo, bien a causa de su simple eliminación, bien a causa de mezcla con otras poblaciones. Entre las poblaciones que deben considerarse inexistentes, a causa de estos procesos, se cuentan P.p. miguelensis, P.p. subformenterae, P.p. algae, P.p. sabinae *y* P.p. grueni. *La necesidad de adoptar adecuadas medidas de proteción es evidente.*

INTRODUCTION

During the last 15 years we have made herpetological surveys in all parts of the Spanish territory. These years have seen intense change in the land and society of Spain, which has decisively influenced the status of many reptilian and amphibian populations. In nearly all instances the consequences for these animals have been negative, and their populations have decreased, often spectacularly. It is therefore appropriate to draw attention to the problems affecting these groups and their conservation. Because the total amount of data is very large, the present paper deals with only one endangered species.

The species studied during our survey were selected on the basis of their interest and present status. Of special interest are certain Spanish and Portuguese endemics which show important biological features. Their distribution is now restricted, and numbers have steadily declined in recent times. According to this definition, the forms needing urgent protection are:

Podarcis pityusensis (Boscá), several subspecies
Podarcis lilfordi (Gunther), several subspecies
Gallotia simonyi Steindachner
Bakaphryne muletensis Borja Sanchiz & Adrover
Salamandra salamandra almanzoris Müller & Hellmich
Triturus helveticus punctillatus Schimidler
Podarcis hispanica atrata Boscá
Algyroides marchi Valverde, both subspecies
Podarcis muralis rasquinetti Bedriaga
Bufo bufo gredosicola Müller & Hellmich
Chioglossa lusitanica Bocage
Lacerta monticola bonnali Lantz
Bufo viridis Laurenti
Chamaeleo chamaeleon (Linnaeus)
Testudo graeca Linnaeus

Although these taxa deserve special attention and protection, it does not mean that other forms of Spanish herpetofauna are not endangered. This paper and the following ones will deal mainly with those listed, but will also include additional data on the others.

PODARCIS PITYUSENSIS (BOSCÁ)

Scientific interest

This small lizard lives in Balearic Islands, specifically in Ibiza and Formentera, in the nearby small islands and islets, and in some parts of Mallorca, where the species has been introduced. There are several varieties, almost all probably deserving the same status of subspecies. All but two (those from Ibiza and Formentera islands) have a very small area of distribution, being limited to one or a few small islets and rocks. The scientific interest of this species is very high, because its populations form an excellent example of island microevolution.

The taxonomy of Mediterranean lizards has been the object of much interest, and there are many hypotheses about the origin of different forms. According to Mertens (1921, 1922), Muller (1927, 1928, 1929), Eisentraut (1928, 1930), etc., it seems clear that the initial factor of subspecies evolution was the separation of populations of the two main islands. However, we have found considerable variation within the population on Ibiza island, and this could be the beginning of future subspecific differentiation.

Small portions of land, each one with its own lizard population, could have been cut off from the main island as a consequence of climatic fluctuations during the Pleistocene and variation in sea level, combined with marine erosion of the coasts. The separation of small islands around Ibiza and Formentera began with some islets (Colom, 1957) at the Riss-Würm interglacial period. For the majority of islands, however, separation is not so old, occurring during the Post-glacial period, and there are some which have been detached and joined again, alternately, even in historic times.

The validity of some of the proposed subspecies is uncertain. Generally, a particular subspecific name has been ascribed to the population of a small island or group of islands, without serious examination of similarity or difference between the populations, nor of the importance or age of its isolation. Of the 35 described subspecies (Mertens & Wermuth, 1960) probably only about a dozen would remain valid after an adequate examination. Taxonomic problems, are still far from being solved, and deserve more study. We have limited ourselves here to the high scientific interest of the species, and to advise on the dangers this lizard now faces.

Threats to the species

Gulls sometimes hunt the lizards, but they have little, if any, effect on population numbers. On Porros island, north of Menorca, *Podarcis lilfordi* has often been attacked by the gulls which breed there, but the reptiles were almost always able to escape. In islets around Ibiza predation on lizards by birds is less intense.

Starvation may be a factor if there are few insects on the islets; however, lizards have become adapted to a mixed diet, including flowers and other vegetation, marine crustacea, snails, and even small vertebrates (the young of *Tarentola*

mauritanica). Competition for food is nevertheless very intense, and probably causes a high mortality among the young. Visitors to some islands may still be surprised to see lizards search in their bags for food, or even jump into a pan where the visitor's meal is cooking! We have also made some observations on probable cannibalistic behaviour in captive animals.

When German herpetologists began the study of this species, it was threatened by a new kind of problem. Generally, specimens were caught by local fishermen, and sold to an intermediate agent, who in turn sent the animals to specialists. This system is especially bad for reptiles as the fishermen knew which islands had abundant populations, and were able to catch hundreds of animals, because they were so tame.

The capture of lizards for scientific purposes continues but generally the number taken is moderate or low, and populations are probably not affected, except, perhaps, the smallest. Moreover, a favourable disposition to endangered species is spreading among biologists who are often satisfied by observing animals, or freeing them after capture.

During the 1950s, when almost all subspecies were already described, lizard hunting was heaviest on the small, remote islands where access was difficult and so which were not previously visited by herpetologists (Buchholz, 1954). As specimens from these localities were in greater demand, fishermen earned extra money by bringing lizards from islands with large populations to smaller islands with few or no specimens. These transported animals have been occasionally described as different subspecies! The artificial colonisation of virgin islands is regrettable but the mixing of populations, so that genetic barriers are broken can only lead to additional complications in the taxonomy of Balearic lizards. In 1962 we recorded two instances of this type, and local fishermen told us that they were by no means unusual.

In the 1960s interest in the taxonomy of *Podarcis pityusensis* declined. We then began our observations on small Balearic islands and identified a new danger to the lizard populations—the keepers of pet shops, mostly German or Dutch. Captures made for commercial purposes were very large, sometimes several hundred animals being taken from one locality. In the summer of 1966 we were able to confirm the capture of more than 500 specimens of *Podarcis lilfordi lilfordi* near the coast of Menorca; and, in 1979, more than 100 specimens of *P.p. maluquerorum* in Ibiza. With commercial captures on this scale, many populations will survive only with great difficulty. Although illegal it is not easy to prevent this unscrupulous behaviour.

Increased tourist pressure, previously limited to a few places on the coast of Ibiza, is now reaching the small islets. Pleasure boating, increase in domestic animals, disturbance by visitors, all interfere with the reptile populations. Some islets have been dynamited to ease navigation; in others the surface has been entirely levelled and covered with buildings; others serve as targets for warship firing practice; still

others are joined artificially to Ibiza, so breaking their isolation. Moreover, entire reptile populations have been poisoned and exterminated.

Status of subspecies (see Fig. 1 and Table 1 for place names)

Podarcis pityusensis pityusensis Boscá 1883: The type subspecies inhabits Ibiza island. It is still abundant in many places, specially in the walls of Ibiza town, but in other places a clear decrease in numbers has occurred between 1962 and 1978. Introduced populations, in the harbour of Palma de Mallorca, maintain themselves fairly well.

Podarcis pityusensis affinis Müller 1927: This form is localized on a small island, the Malví Pla, also known as Malví Nord, or Malví Petit, due south from Ibiza haven. The population is moderate, and may fluctuate widely in numbers. Eisentraut (1950) found few lizards in 1928, but E. Balcells (pers. comm.) found plenty in 1950. In 1964 (personal observations) the number was again low, and it was still as low in 1978. Specimens of another subspecies, *P.p. formenterae*, have been introduced quite recently, so we can expect genetic isolation to be broken. Although human pressure on the island is moderate and the lizard population is abundant, its subspecific characteristics are now at risk.

Podarcis pityusensis algae Wettstein 1937: This form lives on Pouet island, north of Formentera; the name given by Wettstein to this locality, Alga, may cause confusion with another islet, near the coast off Espalmador. Fluctuations in sea level and variations in submerged masses of seaweeds and sand have intermittently joined and disconnected Pouet islet and Formentera; for example, in 1962 we were able to walk the pass between Formentera and Pouet, as there was less than 1 m of water, and in 1975 both islands were joined by a very flat isthmus, only 20 m wide, so that the lizards were able to mix with those of the larger island (Rodríguez Ruiz, 1976). Today the pass is again submerged under 0·2 m of water, and there are no lizards on the smaller island. Every week dozens of tourists are brought from Formentera haven to picnic on Pouet island. The lizard population, there, which was never probably a well differentiated form, must now be considered entirely lost.

Podarcis pityusensis calaesaladae Müller 1928: This is the subspecies from the small island of Cala Salada, off the west coast of Ibiza, north of San Antonio. Although the island is not far from the coast, it is separated by a deep channel and has steep shores. For these reasons human pressure on the island is low, and the lizard population large, having no serious problems of survival. Until now the lizards have not been mixed with those of other islands but the island is vulnerable, and deserves some protection.

Podarcis pityusensis caldesiana Müller 1928: The lizard population is very abundant on Caldés, a small island only a few metres off the north coast of Ibiza, but because of its proximity to the coast it is vulnerable. If tourist pressures were heavier on the northern coast of Ibiza, survival of this subspecies would be seriously endangered.

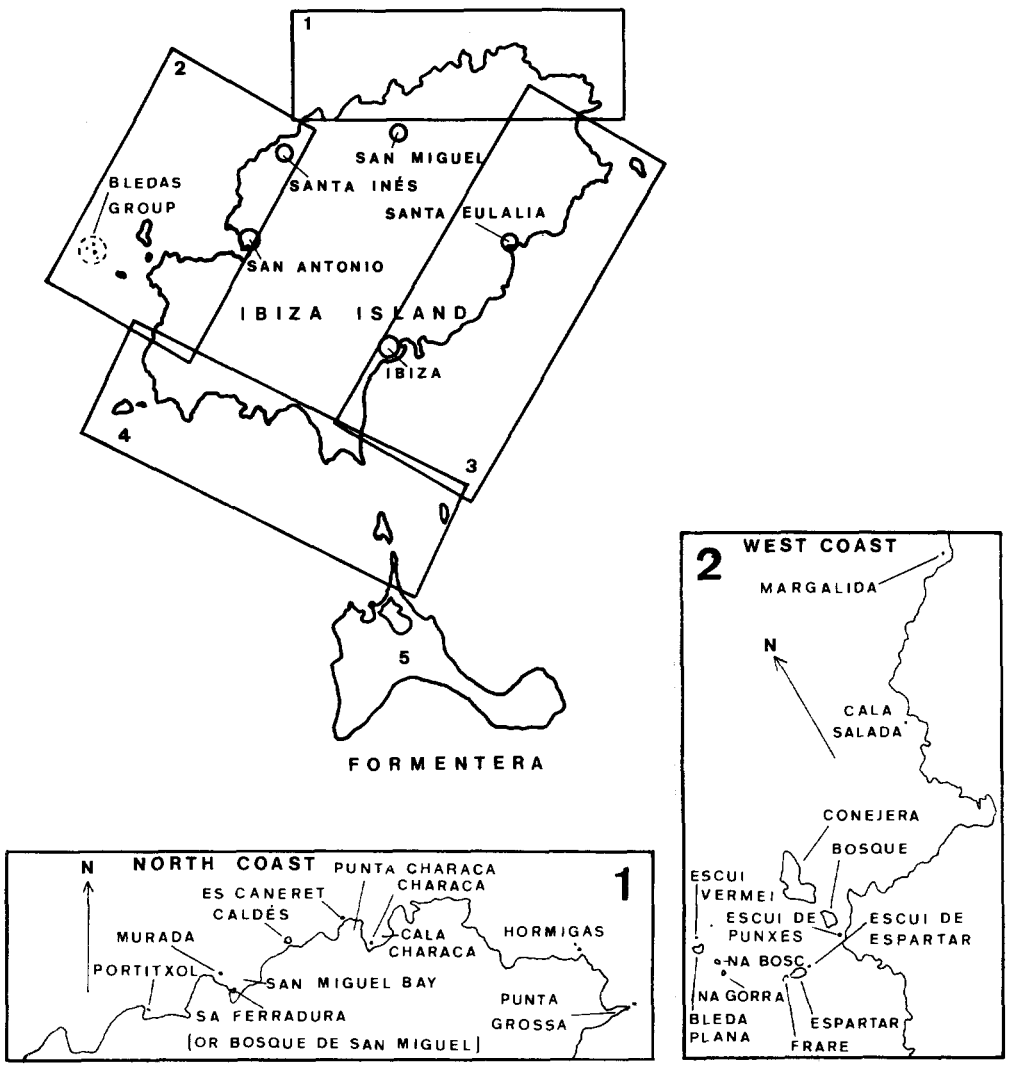
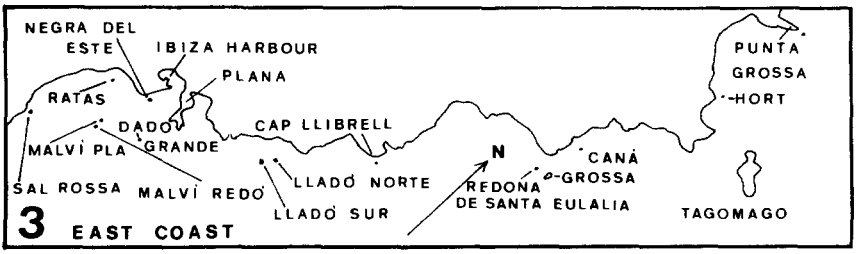


Fig. 1. Outline map of Ibiza and Formentera with detailed sections to show localities mentioned in the text.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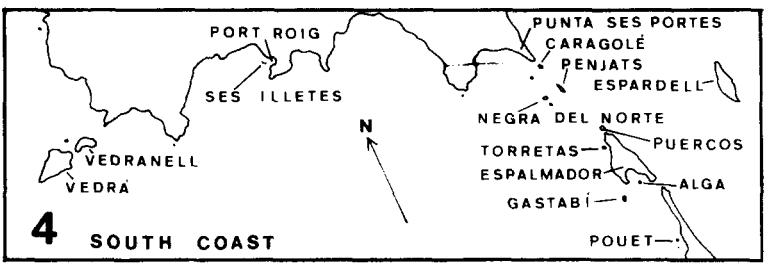
IBIZA HARBOUR
PLANA
RATAS
DADO GRANDE
CAP LLIBRELL
MALVI PLA
SAL ROSSA
MALVI REDO
LLADO NORTE
LLADO SUR
N
REDONA DE SANTA EULALIA
CANA
GROSSA
PUNTA GROSSA
HORT
TAGOMAGO
3 EAST COAST


PORT ROIG
SES ILLETES
VEDRANELL
VEDRA
N
PUNTA SES PORTES
CARAGOLE
PENJATS
ESPARDELL
NEGRA DEL NORTE
TORRETAS
PUERCOS
ESPALMADOR
ALGA
GASTABI
POUET
4 SOUTH COAST

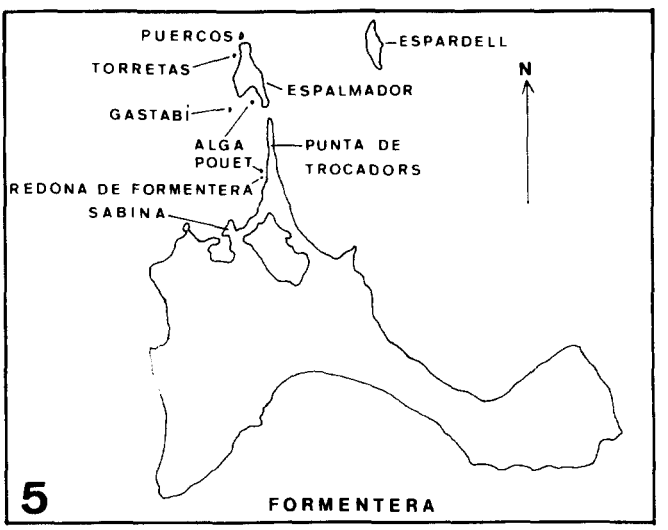

PUERCOS
ESPARDELL
TORRETAS
ESPALMADOR
N
GASTABI
ALGA
POUET
PUNTA DE TROCADORS
REDONA DE FORMENTERA
SABINA
5 FORMENTERA

Fig. 1—*contd.*

TABLE 1
P. pityusensis POPULATIONS

Island	*Position*	*Subspecies*	*Abundance*	*Isolation*	*Mixing*	*Action of man*	*Danger*
Alga (Cala Ses Algues)	38°46'45"N 1°25'25"E	*P.p. espalmadoris*	S	P	N	M	M
Bleda Na Bosc (Bleda Mayor o Nebosque)	38°58'15"N 1° 9'55"E	*P.p. maluquerorum*	M	C	N	W	L
Bleda Na Gorra (Bleda Gorra)	38°58' N 1° 9'55"E	*P.p. maluquerorum*	M	C	N	W	L
Bleda Plana	38°58'45"N 1° 9'35"E	*P.p. maluquerorum*	A	C	N	S	H
Bosque de Conejera	38°58' N 1°13' E	*P.p. carlkochi*	M	C	?	S	M
Bosque de San Miguel (Sa Ferradura)	39° 5'10"N 1°26'15"E	*P.p. miguelensis*	—	N	Y	M	?
Cala Salada (S'Illeta)	39° 40"N 1°17'35"E	*P.p. calaesaladae*	M	C	N	W	L
Caldés	39° 6' 5"N	*P.p. caldesiana*	M	P	P	M	M
Caná (Canyar)	39° N 1°27'20"E	*P.p. canensis*	M	C	N	S	M
Canneret	39° 6'30"N 1°29'55"E	—	A	C	N	W	L
Cap Llentrisca	38°51'40"N 1°14'35"E	—	?	C	?	W	?
Cap Llibrell	38°56'40'N 1°21'40"E	—	?	C	?	W	?
Caragolé (Negretta)	38°49'35"N 1°24'20"E	*P.p. caragolensis*	S	C	N	M	H
Conejera (Cunillera)	38°59' N 1°12'45"E	*P.p. carlkochi*	M	C	N	S	M

Conejo de Formentera	38°45′25″N 1°26′10″E	*P.p. subformenterae*	—	N	—	M	E
Characa (Sa Mesquida)	39° 6′ N 1°30′10″E	*P.p. characae*	M	C	N	W	L
Dado Grande	38°53′25″N 1°17′ E	—	S	C	Y	W	?
Escui de l'Espartar	38°57′30″N 1°12′ 5″E	*P.p. zenonis*	S	P	P	W	H
Escui de Punxes	38°57′50″N 1°13′ 5″E	—	?	C	?	W	?
Escui Vermei	38°58′57″N 1° 9′40″E	*P.p. maluquerorum*	S	C	N	W	H
L'Escullet	39° 5′55″N 1°35′30″E	—	?	C	?	W	?
Espalmador	38°46′55″N 1°25′25″E	*P.p. espalmadoris*	A	P	P	S	H
Espardell	38°47′25″N 1°28′35″E	*P.p. gastabiensis*	M	C	N	M	H
Espartar (Espartó)	38°57′30″N 1°11′45″E	*P.p. kameriana*	A	C	Y	S	M
Farallons de Punta Rama	38°49′40″N 1°22′10″E	—	?	C	?	W	?
Formentera	—	*P.p. formenterae*	A	C	P	S	L
Frare (Fraile)	38°57′20″N 1°11′20″E	*P.p. frailensis*	S	C	P	W	H
Gastabí	38°46′25″N 1°24′55″E	*P.p. gastabiensis*	S	C	N	W	M
Grossa de Sta. Eulalia	38°59′ N 1°34′50″E	*P.p. grossae*	A	C	N	M	M
Hormigas	39° 6′ N 1°35′20″E	—	?	C	?	W	?

TABLE 1—*contd.*

Island	*Position*	*Subspecies*	*Abundance*	*Isolation*	*Mixing*	*Action of man*	*Danger*
Hort (Sora)	39° 2′45″N 1°36′20″E	*P.p. hortae*	M	C	N	W	L
Ibiza	—	*P.p. pityusensis*	A	P	Y	S	L
Illetes (Purroige)	38°52′15″N 1°17′55″E	*P.p. purroigensis*	S	C	N	M	H
Lladó Norte	38°55′10″N 1°17′55″E	—	?	C	?	W	?
Lladó Sur	38°54′55″N 1°29′25″E	—	?	C	?	W	?
Malví Pla (Malví Petit, Malví Nord)	38°53′15″N 1°26′15″E	*P.p. affinis*	M	C	Y	M	H
Malví Rodó (Malví Gran, Malví Sur)	38°53′ N 1°26′ E	*P.p. schreitmuelleri*	M	C	P	M	H
Marguelida	39° 2′55″N 1°18′50″E	*P.p. hedwigkamerae*	M	C	N	W	L
Murada	39° 5′25″N 1°18′50″E	*P.p. muradae*	A	C	N	W	L
Negra del E. (Negra Norte de Ibiza)	38°54′ 5″N 1°26′25″E	*P.p. pityusensis?*	S	C	?	S	H
Negra Norte	38°47′55″N 1°23′30″E	*P.p. gastabiensis*	M	C	N	M	M
Penjats (Ahorcados)	38°48′ N 1°23′40″E	*P.p. gastabiensis*	M	C	N	M	M
Portitxol	39° 4′35″N 1°24′20″E	—	?	C	?	W	?
Pouet	38°45′10″N 1°25′55″E	*P.p. algae*	S?	N	Y	S	E?

Puercos (Pou)	38°45′10″N 1°25′10″E	*P.p. puercosensis*	S	P	P	M	H
Punta Grossa	39° 4′50″N 1°36′35″E	—	?	C	?	W	?
Ratas	38°53′45″N 1°25′20″E	*P.p. ratae*	S	C	P	S	H
Redona de Formentera	38°45′ N 1°25′50″E	*P.p. formenterae*	M	P	Y	S	M
Redona de Santa Eulalia	38°58′50″N 1°34′35″E	*P.p. redonae*	M	C	N	M	M
Sabina	38°44′ 5″N 1°24′50″E	*P.p. sabinae*	—	N	Y	S	E
Sal Rossa	38°52′15″N 1°24′20″E	—	M	C	N	W	L
Tagomago	38° 2′ N 1°38′35″E	*P.p. tagomagensis*	A	C	P	S	M
Torretas	38°47′45″N 1°25′ E	*P.p. torretensis*	S	P	P	M	H
Trocadors (Trucados)	38°45′45″N 1°26′ E	*P.p. grueni*	A	N	Y	M	H
Vedrá	38°52′ N 1°11′55″E	*P.p. vedrae*	M	C	N	M	M
Vedranell	38°52′ 5″N 1°12′40″E	*P.p. vedrae*	M	C	N	M	M

The main name and alternative names of islands used in publications are listed.
A, Abundant; M, Moderate; S, Scarce; ?, Unknown; —, non-existent form; C, complete isolation; P, Poor isolation; N, No isolation.
Mixing with other populations: Y, Yes; N, No; P, Probable; ?, Unknown; —, Non-existent form.
Human influences: S, Strong; M, Moderate; W, Weak.
Endangered status: H, High; M, Moderate; L, Low; ?, Unknown; E, Already extinct.

Podarcis pityusensis canensis Eisentraut 1928: This subspecies inhabits Caná island, near the eastern coast of Ibiza; it is a fairly small rock, located opposite a much used beach. The islet is often visited, and human influence is also shown by the presence of nitrophilous vegetation and by the lizards' fear of man. The population is moderately abundant, and the main threat is increased tourist pressure.

Podarcis pityusensis caragolensis Buchholz 1954: The locality given in the description of this subspecies is Caragolé islet, due south of Punta ses Portes, on the southern coast of Ibiza. Buchholz also gives it the name of Negretta island, an unfortunate mistake leading to confusion with other nearby islands. In some of these there are no lizards, which has led to the supposition that the subspecies does not exist. In fact Caragolé has a scarce population of lizards, clearly different from those of other islands. Local fishermen have told us that the sea entirely covers the islet in heavy storms, but they perhaps meant another place, because the vegetation on Caragolé does not indicate a heavy deposition of marine salt. This islet also deserves monitoring and protection.

Podarcis pityusensis carlkochi Mertens & Müller 1940: This subspecies lives on Conejera and Bosque de Conejera islands off the western coast of Ibiza. Conejera is fairly large (about 2 km across) and shows much evidence of human activities, there being permanent inhabitants and a small harbour. In addition to rabbits (after which the island is named), there are rats, and feral cats and goats, the first two of which may be efficient predators of lizards. The nesting colony of gulls may be an additional threat. All these factors together have maintained the lizard population at a lower level, although the island is large enough to support a greater number. Bosque island is located between Conejera and Ibiza, and human pressure is not so strong, although it served as a gun practice target from the coast of Ibiza—however, lizards seem entirely unaffected by this. The population is moderate and used to the proximity of man, being somewhat indifferent to visitors.

Podarcis pityusensis characae Buchholz 1954: Characa islet, the locality of this subspecies, lies near the bay of Cala Characa, on the north coast of Ibiza. There are in fact two islets, both with lizards, and we were unable to determine which islet was quoted by Buchholz as the locality. We have assumed that it is the western one, also named Sa Mesquida island. Like all islets off the north coast, Characa is little visited by tourists, but fishermen use it to store their equipment. Its population survives without difficulties, and is moderately abundant.

Podarcis pityusensis espalmadoris Müller 1928: This form is described from Espalmador island, due north of Formentera, and from the close-by Alga (not Pouet) island. Espalmador is the largest of the islets around Ibiza and Formentera and its separation from Formentera is relatively recent; in fact, both islands are now separated by a short channel with shallow water, never greater than 4 m. Undoubtedly, Espalmador was the northern point of Formentera, even in historic times. As we can expect from its situation and weak isolation, Espalmador harbours a lizard population hardly differentiated from, and very similar to, that of *P.p. formenterae*, its ancestor subspecies (Rodríguez Ruíz, 1976).

Conditions for Espalmador lizards are still adequate, but they are becoming rapidly worse; the island has been permanently occupied in recent times, by at least one family of farmers. Now the number of residents is growing, and more houses have been built (there are now four holiday homes); moreover, Espalmador is becoming a centre for pleasure boats and ships. A few years ago plans were put forward to make the island into a nature reserve, but they were not put into effect. Lizards do not seem affected by the increasing contact with man, and their number is still high, but the situation is dangerous, and will be more so if some tourist projects to buy the island and develop it entirely for holidaying go ahead.

Podarcis pityusensis formenterae Eisentraut 1928: The subspecies from Formentera is the most abundant even though it has been hunted in huge numbers, mainly for sale, but also for scientific purposes. Although scarce in many parts of the island, it is frequent near the harbour and on several other parts of the coast, along beaches and cliffs. Lizards are perhaps capable of finding more food near human settlements, where, of course, their capture is also easier. This is the only subspecies of *P. pityusensis* which does not present conservation problems, and which has, seemingly, an assured survival.

Podarcis pityusensis frailensis Eisentraut 1928: The locality of this subspecies is a small and steep rock named Frare, near Espartar island off the west coast of Ibiza. The lizard population, perhaps introduced from other islands, is very small, and has probably become extinct several times during its history, the rock being colonised again each time by specimens coming from the nearby Espartar or from the Bledes Is. If the subspecies is considered valid then its protection is urgently needed, because of its scarcity.

Podarcis pityusensis gastabiensis Eisentraut 1928: This lizard inhabits the islands of Gastabí, south-west of Espalmador, Penjats and Negra del Norte, due south of the southernmost point of Ibiza, and Espardell, 3·5 km east of Espalmador. It is of interest taxonomically that these four islands, quite widely separated, have the same subspecies of lizard (some authors, however, disagree, e.g. Buchholz, 1954). Other populations which Eisentraut considered to be this subspecies were later shown to be wrongly named. A further study of this form would perhaps show that it is very variable.

The four islands have populations of lizards of varying size, and their environmental conditions are also different. Gastabí is a small rock, less than 200 m diameter and has few lizards, which maintain themselves with some difficulty because of lack of food and excess salt (the sea covers the island during the storms). Penjats and Negra del Norte are somewhat larger, and not far from one another; the first has some sandy areas and supports a lighthouse, serving as anchorage for many fishing and pleasure boats; its lizards are abundant and do not fear man or marine birds, although both are frequent, and there is an increasing threat of human pressure, especially on Penjats. Negra del Norte is rocky, and has fewer lizards, but these are by no means scarce, and, like those from Penjats, are very tame. Espardell island, still larger (2000 × 400 m) is rocky, with sparse vegetation. It has a moderate

population of lizards. It is not on the path of ships going to and coming from Formentera, and is therefore less frequented, but offers exceptional conditions for submarine fishing, and it is possible that in the near future the island may be used by pleasure boats.

All four populations are somewhat vulnerable, and require protection.

Podarcis pityusensis grossae Müller 1929: This subspecies lives on the island of Grossa de Santa Eulalia, near Santa Eulalia on the eastern coast of Ibiza. The island is rocky and of moderate size, with some patches of nitrophilous vegetation, where rabbits gather. The lizard population is large, food is abundant and the lizards do not fear visitors. This last point makes them vulnerable because they could be captured in large numbers.

Podarcis pityusensis grueni Müller 1929: This form has been described from Trocados island, north of Formentera. It is not in fact an island, but a long flat peninsule (Punta de Trocadors) forming the northernmost part of Formentera. Lizards in this zone are rather different from those in other localities in Formentera, but there is no isolation between them. We must therefore perhaps consider *P.p. grueni* not as a subspecies, but only as an ecotype (see, however, Rodríguez Ruíz, 1976). The population is abundant and does not seem threatened, except by easy mixing with *P.p. formenterae*.

Podarcis pityusensis hedwigkamerae Müller 1927: The small island of Margalida, the locality for this subspecies, is an isolated and steep rock, off Santa Inés, northwest of Ibiza. It harbours an almost undisturbed population of moderate size, restricted to the higher parts of the rock. The difficulty of access gives the lizards an excellent protection, although some specimens can be taken on the low rocks, even from the sea.

Podarcis pityusensis hortae Buchholz 1954: From Hort island, on the northeastern coast of Ibiza. It is rather sandy, with a large lizard population. Access from Ibiza is easy, and the population would therefore be in danger if the nearby coast of the main island were opened to heavier tourist traffic.

Podarcis pityusensis kameriana Mertens 1927: This subspecies lives on Espartar (or Espartó) island, located off the western coast of Ibiza, due south of Conejera island. It suffers heavy human pressure. The esparto grass *Stipa tenacissima*, from which the island receives its name, is gathered by the peasants of Ibiza, causing disturbance to the lizards. Espartar also serves as a practice target for the guns of coastal batteries and warships, although the explosions have almost no effect on the lizard population, which is fairly large. Frequent visits to the island for recreation or grass-gathering seem to cause greater disturbance. In 1979 Cirer (in press) recorded specimens of *P.p. vedrae* and *P.p. maluquerorum* in the area where boats land and where lizards are abundant. A process of population mixing has therefore been started. It is still weak, and could be stopped if adequate protection were supplied; but unfortunately these measures do not seem very probable.

Podarcis pityusensis maluquerorum Mertens 1921: This was the first described

subspecies of *P. pityusensis*. It lives on the Bleda islands, a group of three islets and half a dozen rocks, located due west from Ibiza, and some distance from its coast. These islands were perhaps the first of the present-day islets around Ibiza and Formentera to become separated from the main island (Colom, 1964). Accordingly, their lizard population shows a more advanced differentiation, with a strong trend to melanism. The Bledas group is off the shipping routes and this has helped the survival of its lizards. However, the introduction of *P.p. maluquerorum* in Espartar island mentioned above, and the recent decline we have observed in the population of some of these islands, may indicate that the situation is beginning to change. Moreover, people have taken many specimens of this subspecies not only for scientific purposes, but also for private or public terraria.

The subspecies is still abundant in the island of Bleda Plana, although its numbers are lower than those we observed in 1962. The light-keepers have tried to poison the population several times, but have not succeeded in exterminating it. On the other islets, Na Bosc and Na Gorra, the number of lizards is rather smaller. There is a very small population in the largest of the nearby rocks, Escui Vermei.

Podarcis pityusensis miguelensis Eisentraut 1928: Eisentraut described this subspecies from the island Bosque de San Miguel, off the northern coast of Ibiza. Actually there is no island in the position given by him, only Murada, to which we shall refer below, which is not far away. The locality given by Eisentraut is probably not an island, but the peninsula or point of Sa Ferradura, also in San Miguel bay; this peninsula has nevertheless always been connected to the Ibiza coast through a strip of land about 100 m wide and 2 m high, and the population in this locality cannot therefore be considered as isolated from the Ibiza populations.

Podarcis pityusensis muradae Eisentraut 1928: Again, the locality data are ambiguous—though there is a Murada island, it is not in the position given by Eisentraut. These rather frequent errors are to be expected when authors work on material they have not captured themselves, and who do not know at first hand the places where subspecies live. Murada island is a very steep rock, off the northern coast of Ibiza, less than 1 km from Sa Ferradura point mentioned in the above paragraph. Accessible only with difficulty, its higher parts can only be reached by using ropes. The population of Murada island is large and has no problems of survival. Sometimes a few specimens can be captured in the lower parts of the rock, near the sea, but always with difficulty. Nevertheless, there is now a plan to build a pleasure harbour on the island and to join it to Ibiza.

Podarcis pityusensis puercosensis Buchholz 1954: This form inhabits the island of Puercos or Pou, a small piece of land located just north of Espalmador, between Ibiza and Formentera. Its lizard population is very small, and perhaps not isolated from that of Espalmador, as the distance between the islands is only about 100 m of very shallow water (3 m depth at most); there is a lighthouse on Puercos island and visitors are frequent. Thus accidental mixing with *Podarcis pityusensis espalmadoris* is very likely, but even if mixing does not take place, this subspecies cannot be very

different from the Espalmador form because both islands were connected in historic times.

Podarcis pityusensis purroigensis Buchholz 1954: Buchholz described this subspecies from Purroige island, a place name unknown in the Ibiza area. He undoubtedly meant two small islets, named Ses Illetes, off the southern coast of Ibiza, outside the harbour of Port Roig. The lizard population which lives in these islands has never been large, and seems recently to have suffered an important loss. In her last visit (1979) Cirer (in press) was only able to record two specimens.

Podarcis pityusensis ratae Eisentraut 1928: About 400 m off the Ibiza coast, and not far from a crowded beach due south of the town of Ibiza, Ratas island, the locality of this subspecies, has often been endangered by plans for tourism. The lizard population is only of moderate size, partly because of the activities of frequent visitors, and partly because of the introduction of rats some centuries ago. In the late 1960s it was planned to use the island for tourism: the surface was entirely levelled, a huge hotel built, and a wide road planned, joining the island with Ibiza. Unfortunately the project passed the first stages of development before it was stopped: the structure and the roof of the hotel have been built, and the island now serves as a storage place for building materials. The natural environment is completely destroyed. However, demands for the conservation of the lizard were among the protests and, to our knowledge, this is the only occasion when action has been taken, although too late, to protect a form of *Podarcis pityusensis* (see, however, Martínez Rica, 1976, and Rodríguez Ruíz, 1976, for instances of publicity for protective measures).

Podarcis pityusensis redonae Eisentraut 1928: This subspecies lives on the island of Redona de Santa Eulalia, off the eastern coast of Ibiza. This small rocky islet is very similar in appearance and size to Caná island, located further north. The Redona lizards are also used to visitors, and the population is abundant.

Podarcis pityusensis sabinae Buchholz 1954: This subspecies was described from Sabina island, near the harbour of Formentera; it is in fact not an island, but a small point which was formerly joined to the main island. The subspecies, if there was a true subspecies, has disappeared through mixing with *P.p. formenterae*.

Podarcis pityusensis schreitmuelleri Müller 1927: This lizard lives in Malví Redó island, also named Malví Grande, although its area is less than the area of the other Malví (see *Podarcis pityusensis affinis*). Both islands are located not far, and due south, from the town of Ibiza, and are frequented by fishing and pleasure boats. Malví Redó is an islet with rocky soil and sparse vegetation and harbours a lizard population of moderate size. Lizards, very accustomed to fleeing from gulls and visitors, are able to find refuge under the stones or in the many rock crevices.

Podarcis pityusensis subformenterae Buchholz 1954: This is another subspecies which we may now consider extinct; Buchholz described this form from the so-called Conejo de Formentera, which according to him, is a small island located between Trocados island and the northern point of Formentera. As already

mentioned (see *P.p. grueni*), the whole of this area forms an uninterrupted band of land joined to the north coast of Formentera; this connection is older than 1954, the date of Buchholz's description, and the maps published by Buchholz do not correspond to the fact, especially unfortunate when describing a new taxonomic form.

Podarcis pityusensis tagomagensis Müller 1927: This subspecies inhabits Tagomago island, off the eastern coast of Ibiza. Tagomago is a fairly large island, about 2 km across, very similar to Conejera in size and conditions. Until a few years ago the similarity of both islands was still greater, because Tagomago also had a lighthouse, with one family living on the island and farming some small plots; now there are no permanent inhabitants. Evidence of human activity are the paths on the island, the ruined walls of huts and old homes, patches of introduced vegetation, and the presence of introduced animals such as goats, rats and rabbits. Also like Conejera, Tagomago has a nesting colony of gulls.

In our first visit (1962) lizards were scarce, but on more recent visits the number was far higher. Perhaps this change is due to natural population fluctuation, but as the human population did not abandon the island until 1970, the increase in number of lizards may be due to this change in land-use.

Podarcis pityusensis torretensis Buchholz 1954: Torretas island, which is the locality of this subspecies, is situated near the western coast of Espalmador island. A shallow channel of sea, less than 1 m deep, lies between the islands. Torretas is very flat, entirely covered by waves even in moderate storms. Nevertheless, there is a small population of lizards on it, and even a few rabbits. The lizards and rabbits very probably come from nearby Espalmador, older populations on the island having no doubt disappeared many times during the recent past, new populations being built up each time by immigration from Espalmador.

Podarcis pityusensis vedrae Müller 1927: The island of Vedrá, the home of this subspecies, is an impressive rock, with cliffs in many places, towering to a height of about 400 m above sea-level. It is located near the southwest coast of Ibiza. At a distance of about 200 m is another island, Vedranell, smaller and lower than Vedrá, but still attaining a height of 125 m; the same subspecies of lizard lives on both islands.

In Vedrá there are very few flat areas; only in some parts of its northern side is the slope low enough to hold some soil and support a sparse vegetation, with a few introduced plants. In these places, where enough insects can be found, and perhaps on the summits, which we did not visit, lives a small population of lizards, apparently accustomed to man's presence (Vedrá is a popular objective for campers and climbers from Ibiza). In Vedranell, the average slope is lower, and the vegetation richer, supporting, as in Vedrá, a small number of wild goats; there is a small freshwater spring. In both islands visitors are frequent, but the rocky soil, full of crevices and refuges, makes lizards difficult to catch; the populations of these islands do not, therefore, seem endangered. Nevertheless, there is still the risk of

mixing with other populations, and finding of *P.p. vedrae* in Espartar island (see *P.p. kameriana*) is an indication of this.

Podarcis pityusensis zenonis Müller 1928: This subspecies inhabits Escui de l'Espartar, a very small and steep rock located next to Espartar island. It is difficult to believe that so small a place can support a population of lizards, but we can confirm their presence. They are clearly different from those of Espartar, and more like *P.p. maluquerorum*, the form from the Bledas group. Perhaps a few specimens from Bledas were introduced here, a suggestion made credible by finding *P.p. maluquerorum* on the nearby Espartar. However, whether introduced or natural, the population is very small, and, presumably will not be able to survive for many years without protective measures.

Other populations of P. pityusensis

In the preceding pages we have commented on the situation of several populations of *P. pityusensis* which have been described as different subspecies. We shall now comment briefly on the smaller islets around Ibiza, from which lizards seem to be absent; or where there are undescribed populations; or, which are still to be visited by scientists.

These islets are:

Escui de Tramontana, in the Bledas group: There are unconfirmed reports that some lizards live there.

I. Portitxol, between Cap Rubió and Punta Sa Creu, north of Ibiza: Unexplored.

Escui de Punxes, due south of Bosque island, west coast of Ibiza: Without lizards.

Es Bajel, in the Bledas group: Without lizards.

Es Porros, in the Bledas group: Without lizards.

Escui de Cala d'Hort, north of Vedrá, off the southwestern coast of Ibiza: Without lizards.

Sa Galera, next to Vedrá: Without lizards.

Farallons de Punta Rama, near Punta Rama, south of Ibiza: Unexplored.

I. Sa Sal Rossa, near the eastern coast of Ibiza saltmarshes, between Ibiza harbour and the southernmost point of Ibiza: With a small population of lizards, surely a new subspecies recently described (Cirer, in press).

I. Punta Ses Portes, next to Ibiza's southernmost point: Without lizards.

I. Negra Sur, next to Negra del Norte, due west from Penjats, between Ibiza and Formentera: Without lizards.

I. Redona de Formentera, next to Formentera, west of Punta Trocadors: It harbours a small population of lizards, seemingly the same subspecies as on Formentera.

I. Espardelló, next to Espardell, between Ibiza and Formentera: Without lizards.

I. Dado Grande, due southeast from Ibiza harbour, and east from Malví Norte; in spite of its isolation and small size (20 × 20 m), we found a specimen of lizard, presumably introduced.

I. Negra del Este, next to Ibiza town, has a moderate population of lizards, which seem of the same subspecies as those of Ibiza island.
I. Negra del Oeste, near the preceding one: Without lizards.
I. Grossa, north of the town of Ibiza, and connected now to the main island: Without a population of its own.
I. Plana, next to the preceding one: Both islands were artificially joined to Ibiza at the beginning of this century, and lost their lizard populations.
Llado Norte and Llado Sur: Two small islands due east from Ibiza town: Unexplored.
I. Cap Llibrell, next to Cap Llibrell, between Ibiza and Santa Eulalia del Rio: Unexplored.
I. Punta Grossa, next to Punta Grossa, northeastern coast of Ibiza: Probably without lizards.
Is. Hormigas, off the Ibiza coast, somewhat north of the preceding one: Probably without lizards.
L'Escullet, in the same place, between Hormigas and Ibiza coast: Without lizards.
I. Es Caneret, small island in the bay Caló d'es Pores, next to Punta Characa, north coast of Ibiza: With a fairly large population of lizards, recently undescribed (Cirer, in press).

In addition to the places listed, there are many other rocks and tiny islets around Ibiza. Their size is, however, so small that we have not considered them here. See Table 1 for a brief account of all the places having lizards, or where lizards can still be found.

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