

## Atlas of the continental Portuguese herpetofauna: an assemblage of published and new data

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**Abstract:** Records for the amphibian and reptile species of continental Portugal were plotted on maps using the 10 × 10 km squares of the UTM grid system. A total of 9394 observations were collected, from which 6485 records came from previous national atlases, 1790 from recent published and unpublished work, and 1119 correspond to new observations made by the authors and their collaborators. Overall 31.0% of the records are presented for the first time in a national atlas. Remarkable new records include those for *Tarentola mauritanica* and *Blanus cinereus*, enlarging their known range into areas where they were not thought to occur. We present and discuss amphibian and reptile species-density maps.

**Key words:** Amphibians, Distribution, Portugal, Reptiles, Species-density map.

**Resumen:** Atlas de la herpetofauna continental portuguesa: una recopilación de datos publicados y nuevos.- En este trabajo se compila la información disponible sobre la distribución de los anfibios y reptiles de Portugal continental en cuadrículas 10 × 10 km del sistema UTM. Fueron recogidas un total de 9394 observaciones de las cuales 6485 fueron publicadas anteriormente en atlas nacionales, 1790 provienen de artículos recientes y material de difícil acceso publicado en informes técnicos, presentaciones en congresos y tesis, y 1119 corresponden a nuevas observaciones realizadas por los autores y colaboradores. El 31.0% de las observaciones se presenta por primera vez en un atlas. Los nuevos datos aumentan el área de distribución de *Tarentola mauritanica* y *Blanus cinereus* para zonas donde no se conocía su presencia. Se presentan y discuten mapas de riqueza específica de los anfibios y reptiles de Portugal.

**Palabras clave:** Anfibios, Distribución, Portugal, Reptiles, Mapa Densidad-Especie

### INTRODUCTION

The organised recording of the Portuguese herpetofauna began in the last century with the pioneering works of BOCAGE (1863), BOSCA (1880, 1881), FERREIRA (1892) and VIEIRA (1896) and were followed by FERREIRA & SEABRA (1911), THEMIDO (1942) and FERREIRA (1943). However, systematic recordings of amphibians and reptiles only began after the 70' s with the works of CRESPO (1971, 1972, 1973, 1975) and MALKMUS (e.g.

1979, 1981, 1982, 1983). Additional information have been published, covering restricted areas (e.g. PARGANA *et al.*, 1996) or single-species (e.g. BRITO *et al.*, 1996), is assembled in technical reports (e.g. MARQUES *et al.*, 1995) or academic theses (e.g. SEGURADO, 1994) or is not documented altogether, including presentations at congresses (e.g. GODINHO *et al.*, 1994) and other unpublished material. Here we present all data on the distribution of the Portuguese herpetofauna that we could access, supplemented with new observations.

Portugal has an area of ca. 92.270 km<sup>2</sup> and is located between latitudes 3557' and 4210' N and between longitudes 612' and 929' E (Figure 1). The mountainous central and northern part of the country is influenced by an Atlantic climate (C.N.A., 1983), with predominantly mild temperatures and high levels of precipitation (average annual maximum rainfall exceeding 2800 mm.yr<sup>-1</sup> is recorded for the Gerês mountains, 1534m a.s.l.). In southern Portugal the relief is generally smooth with few, small and isolated mountains (maximum altitude 1027m a.s.l. – Serra de S. Mamede). Here the climate is much drier with long and hot summers (average annual minimum rainfall lower than 400 mm.yr<sup>-1</sup> was measured at Mértola; C.N.A., 1983), which can be considered as part of a Mediterranean climate. Along the western coast, the proximity of the ocean produces a climatic transition zone (Figure 1). Common and Pyrenean oak (*Quercus robur*, *Q. pyrenaica*) dominate the natural forests in the north, and Cork and Holm oaks (*Q. suber*, *Q. rotundifolia*) do so in the south. In some areas such as the Plateau of Miranda do Douro in the north and some bio-climatic “islands” in the south such as Serra de S. Mamede, species may locally be observed typical for the alternate climatic region.



**Figure 1.-** Major bioclimatic regions of Portugal. (modified from Malkmus, 1995a and C.N.A., 1983).  
**Figura 1.-** Principales regiones bioclimáticas de Portugal (modificado de Malkmus, 1995a y C.N.A., 1983)

## MATERIAL AND METHODS

New data were collected from 1990 onwards, coming from ad-hoc observations from the co-authors and collaborators mentioned in the acknowledgements, and represent the first published records for each cell. None of these observations is the result of active sampling and therefore an absence in a cell of a given map might be a consequence of a lack of prospecting and turn out to be a “false absence”. Interpretations of the maps should take in account this bias of the data. Exceptions to this bias are the species *Chioglossa lusitanica* (SEQUEIRA, *et al.*, 1996), *Emys orbicularis* and *Mauremys leprosa* (ARAÚJO *et al.*, 1999), *Archaeolacerta monticola* (MOREIRA *et al.*, 1996), and *Lacerta schreiberi* (BRITO *et al.*, 1998) which were monitored under the UE LIFE program, and also *Rana iberica* (TEIXEIRA *et al.*, 1996) and *Podarcis hispanica* (SÁ SOUSA, 2000) which were subject to intensive prospecting in all their distribution area.

Published distributional data were gathered from the following works: ARAÚJO *et al.* (1999), ARNTZEN (1999), BRITO *et al.* (1998), CRESPO & OLIVEIRA (1989), FARIA (1991), GALÁN (1986), GLANDT *et al.* (1998), GODINHO *et al.* (1994, 1996), LOUREIRO *et al.* (1996), MALKMUS (1995a, 1995b, 1996a, 1996b, 1996c, 1997a, 1997b, 1997c, 1998), MALKMUS & SAUER (1997), MARQUES *et al.* (1995), MOREIRA *et al.* (1994, 1996), PARGANA *et al.* (1996), PÉREZ-MELLADO (1981, 1986), PINTO (1997), SÁ SOUSA (1990, 1998, 2000), QUEIRÓS (1989), SCHWARZER (1997, 1998, 1999), SEGURADO (1994), TEXEIRA (1996), TEIXEIRA *et al.* (1996, 1999) and VICENTE (1985, 1998). The information is plotted in the 10x10km UTM (Universal Transversal of Mercator) grid system. Grid cells with less than 10 % of its area in Portugal were excluded (i.e. covering the Atlantic Ocean or Spain) leaving 967 cells to be considered.

Uncertain data –dubious localities signed with a question-mark on CRESPO & OLIVEIRA

(1989) and MALKMUS (1995a)– were omitted. Only one other data point was not considered (*Alytes cisternasii* from UTM 29S NP35, CRESPO & OLIVEIRA, 1989). We allocate this record to *Alytes obstetricans*, under consideration of: i) the bulk of distributional data; ii) the likelihood of erroneous identification (the popular single criteria ‘number of palmar tubers’ does not guarantee correct identification, BRITO-E-ABREU *et al.*, 1996), and iii) the differential ecological preferences of the species involved (ARNTZEN & GARCIA-PARIS, 1995)

In Portugal, and up to the present day, *Podarcis hispanica* and *Podarcis bocagei* were mostly treated as a complex (CRESPO & OLIVEIRA, 1989; MALKMUS, 1995a). In this paper we follow the identification criteria of SÁ SOUSA (1997), based on the head shape, dorsal pattern and coloration. While a rather complete distribution map of *Podarcis hispanica* is now available (SÁ SOUSA, 2000), for *Podarcis bocagei* there is still a scarcity of data.

Data for marine turtles are scanty, the character of their occurrence incidental and they were not considered here.

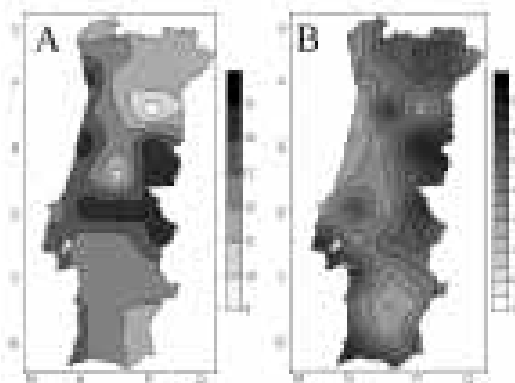
Species density maps are interpolation surfaces, using the kriging method. The data used was gathered in  $50 \times 50$  km UTM grid cells (Annex 1), in order to reduce the effect of uneven and incomplete sampling.

## RESULTS AND DISCUSSION

The collected data comprise 4681 records on 17 amphibian species and 4713 records on 27 reptile species. For amphibians 74.1% of the data were already published in atlases (CRESPO & OLIVEIRA, 1989; MALKMUS, 1995a) and 11.7% correspond to new observations. The remaining (14.2%) were gathered from all the other sources; for reptiles, 64.0% of the data were already published in atlases (CRESPO & OLIVEIRA, 1989; MALKMUS, 1995a) and 12.1% correspond to new observations. The remaining (23.9%) were gathered from all other sources.

The frog *Rana perezi* is probably the most widespread and abundant member of the Portuguese herpetofauna and the lizard *Archaeolacerta monticola*, restricted to the Estrela central plateau of Serra da Estrela (MOREIRA *et al.*, 1996), the most localised one. A trend was observed for higher proportions of new data to occur for rare and localised species (Tables 1 and 2).

As recorded for  $50 \times 50$  km sized cells (Figure 2), the highest amphibian species diversity was found along the north-western coast and in a narrow band that runs south and west of the central mountain system. This band appears to correspond to the transition zone among faunas reported by MALKMUS (1995a). Relatively high numbers of reptile species were found along the climatic transition zone described earlier, on the southwestern coast and on the ‘bioclimatic islands’ of S. Mamede and Monchique. Some values on this species density map are higher than those reported for Portuguese  $100 \times 100$  Km cells in the ‘Atlas of Amphibians and Reptiles in Europe’ (GASC *et al.*, 1997).



**Figure 2.-** Interpolation surfaces for the number of species of amphibians (A) and reptiles (B). Scale represents number of species.

**Figura 2.-** Superficies de interpolación del número de especies de anfibios (A) y reptiles (B). La escala representa el número de especies.

**Table 1:** Percentage of Portuguese UTM 10 × 10 km cells with records and percentage of these cells with new data for each amphibian species.

**Tabla 1:** Porcentaje de cuadrículas UTM 10 × 10 km con citas y porcentaje de estas cuadrículas con nuevas citas para cada especie de anfibio.

Species	Number of UTM 10 × 10 km cells with records	Percentage of UTM 10 × 10 km cells with records	Number of new records	Percentage of new data
<i>Chioglossa lusitanica</i>	206	21.3	0	0.0
<i>Pleurodeles waltl</i>	210	21.7	32	15.2
<i>Salamandra salamandra</i>	489	50.6	55	11.2
<i>Triturus boscai</i>	368	38.1	51	13.9
<i>Triturus helveticus</i>	18	1.9	5	27.8
<i>Triturus marmoratus</i>	371	38.4	39	10.5
<i>Alytes cisternasii</i>	244	25.2	18	7.4
<i>Alytes obstetricans</i>	189	19.5	11	5.8
<i>Discoglossus galganoi</i>	184	19.0	26	14.1
<i>Pelobates cultripipes</i>	233	24.1	34	14.6
<i>Pelodytes punctatus</i>	106	11.0	9	8.5
<i>Bufo bufo</i>	532	55.0	50	9.4
<i>Bufo calamita</i>	282	29.2	48	17.0
<i>Hyla arborea</i>	148	15.3	31	20.9
<i>Hyla meridionalis</i>	108	11.2	28	25.9
<i>Rana iberica</i>	245	25.3	23	9.4
<i>Rana perezi</i>	749	77.5	90	12.0

### Amphibian data (Figures 3-7)

New records for amphibians include the north-easternmost Portuguese occurrences of *Pleurodeles waltl* and *Discoglossus galganoi*. Other novelties are: i) four observations on the rarest Portuguese amphibian *Triturus helveticus* (UTM's 29S NG65, 29S NG43, 29S NG20 and 29S NF35); ii) five observations on *Rana iberica* close to the Atlantic, which might indicate that the species occurs in other areas of the NW coast; iii) the occurrence of *Pelodytes punctatus* in the lagoons of Quiaios (UTM 29S NE15), suggesting the presence of the species along the coast northwards to Mindelo (UTM 29S NF27).

### Reptile data (Figures 7-13)

The most significant new findings for reptiles are the following: i) the presence of *Coro-*

*nella austriaca* at Gardunha (UTM 29S PE33) enlarges the known range to the south; ii) the observation of *Anguis fragilis* at Azeitão (UTM 29S MC96) is the second record south of the Tagus river in the Iberian peninsula; iii) the occurrence of *Vipera seoanei* at Paredes de Coura (UTM 29S NG33) increases the known range to the west; iv) the single observation of *Blanus cinereus* (UTM 29S NG71) and the eight new observations for *Tarentola mauritanica* in the north-west, on several south facing slopes characterised by a mediterranean microclimate and its corresponding vegetation, increase their known range in Portugal; but not in the Iberian peninsula (BALADO *et al.*, 1995); v) the occurrence of *Mauremys leprosa* in the Minho river at Monção (UTM 29S NG45) may constitute an expansion of the known range but could also represent a human introduction similar to the

**Table 2:** Percentage of Portuguese UTM 10 × 10 km cells with records and percentage of these cells with new data for each reptilian species.**Tabla 2:** Porcentaje de cuadrículas UTM 10 × 10 km con citas y porcentaje de estas cuadrículas con nuevas citas para cada especie de reptil.

Species	Number of UTM 10 × 10 km cells with records	Percentage of UTM 10 × 10 km cells with records	Number of new records	Percentage of new data
<i>Emys orbicularis</i>	61	6.3	1	1.6
<i>Mauremys leprosa</i>	419	43.3	7	1.7
<i>Blanus cinereus</i>	111	11.5	23	20.7
<i>Chamaeleo chamaeleon</i>	12	1.2	0	0
<i>Hemidactylus turcicus</i>	29	3.0	8	27.6
<i>Tarentola mauritanica</i>	162	16.8	40	24.7
<i>Anguis fragilis</i>	88	9.1	26	29.5
<i>Chalcides bedriagai</i>	45	4.7	4	8.9
<i>Chalcides striatus</i>	166	17.2	19	11.4
<i>Acanthodactylus erythrurus</i>	51	5.3	8	15.7
<i>Timon lepidus</i>	389	40.2	46	11.8
<i>Archaeolacerta monticola</i>	4	0.4	0	0.0
<i>Lacerta schreiberi</i>	283	29.3	15	5.3
<i>Podarcis bocagei</i>	76	7.9	13	17.1
<i>Podarcis hispanica</i>	369	38.2	9	2.4
<i>Psammodromus algirus</i>	525	54.3	75	14.3
<i>Psammodromus hispanicus</i>	129	13.3	13	10.1
<i>Coluber hippocrepis</i>	151	15.6	21	13.9
<i>Coronella austriaca</i>	29	3.0	6	20.7
<i>Coronella girondica</i>	131	13.5	15	11.5
<i>Elaphe scalaris</i>	263	27.2	40	15.2
<i>Macroprotodon cucullatus</i>	61	6.3	11	18.0
<i>Malpolon monspessulanus</i>	432	44.7	48	11.1
<i>Natrix maura</i>	443	45.8	72	16.3
<i>Natrix natrix</i>	187	19.3	33	17.6
<i>Vipera latasti</i>	83	8.6	13	15.7
<i>Vipera seoanei</i>	13	1.3	4	30.8

one in south-western Galicia (FERNÁNDEZ DE LA CIGOÑA, 1989; GALÁN, 1999); vi) the marked data increase for *Hemidactylus turcicus* and *Anguis fragilis*.

#### Exotic species (Figure 14)

Two allochthonous species *Trachemys scripta* and *Teira dugesii* were recorded. *Trachemys scripta* was observed in various water reser-

voirs throughout the country: Sta Clara near Odemira (UTM 29S NB55), Albufeira lagoon near Sesimbra (UTM 29S MC96) (PLEGUEZUELOS, 1997) and the Azul lagoon near Sintra (UTM 29S MC69). *Teira dugesii* occurs in the port of Lisbon (UTM 29S MC88) where it was detected in 1992 suggesting accidental introduction through cargo (SÁ SOUSA, 1995).



**Figure 3.-** Presence of *Chioglossa lusitanica*, *Pleurodeles waltl*, *Salamandra salamandra* and *Triturus boscai* in Portugal (○ bibliographic data; ● new observations).

**Figura 3.-** Presencia de *Chioglossa lusitanica*, *Pleurodeles waltl*, *Salamandra salamandra* y *Triturus boscai* en Portugal (○ datos bibliográficos; ● nuevas observaciones).



**Figure 4.-** Presence of *Triturus helveticus*, *Triturus marmoratus*, *Alytes cisternasii* and *Alytes obstetricans* in Portugal (○ bibliographic data; ● new observations).

**Figura 4.-** Presencia de *Triturus helveticus*, *Triturus marmoratus*, *Alytes cisternasii* y *Alytes obstetricans* en Portugal (○ datos bibliográficos; ● nuevas observaciones).





**Figure 5.-** Presence of *Discoglossus galganoi*, *Pelobates cultripes*, *Pelodytes punctatus* and *Bufo bufo* in Portugal (○ bibliographic data; ● new observations).

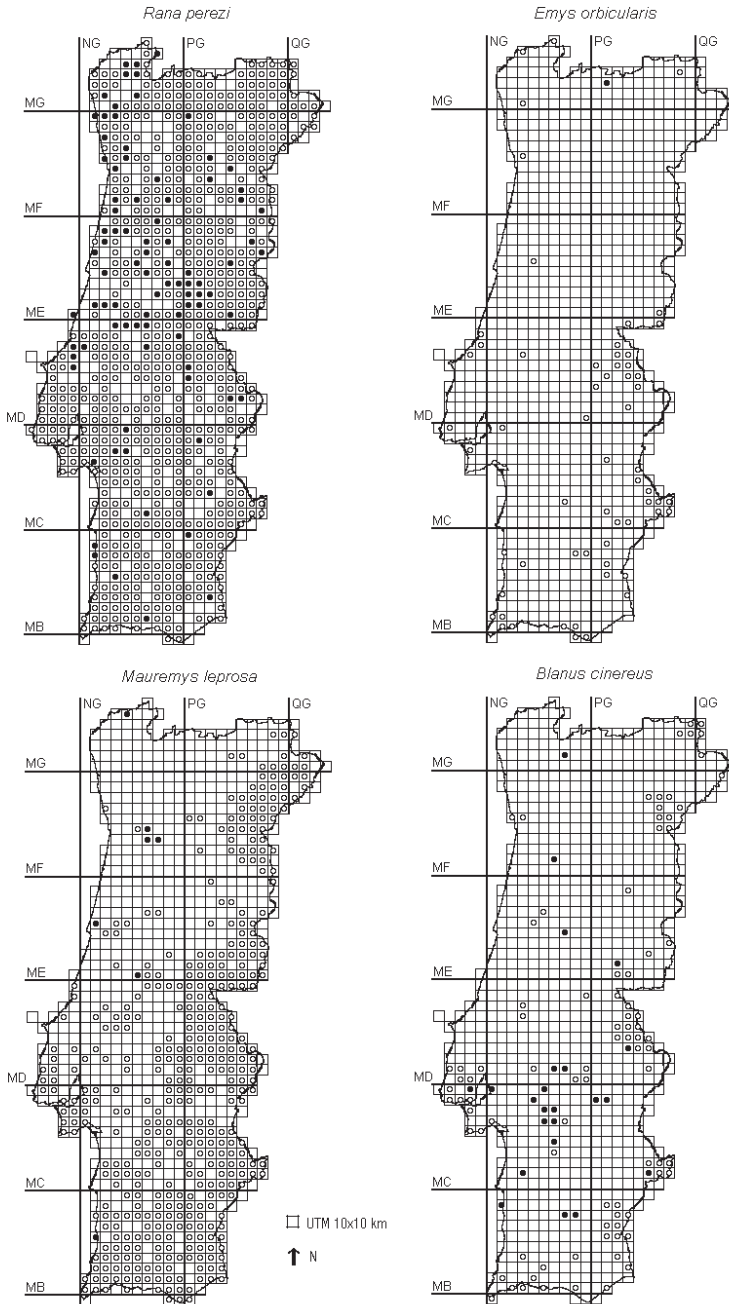
**Figura 5.-** Presencia de *Discoglossus galganoi*, *Pelobates cultripes*, *Pelodytes punctatus* y *Bufo bufo* en Portugal (○ datos bibliográficos; ● nuevas observaciones).





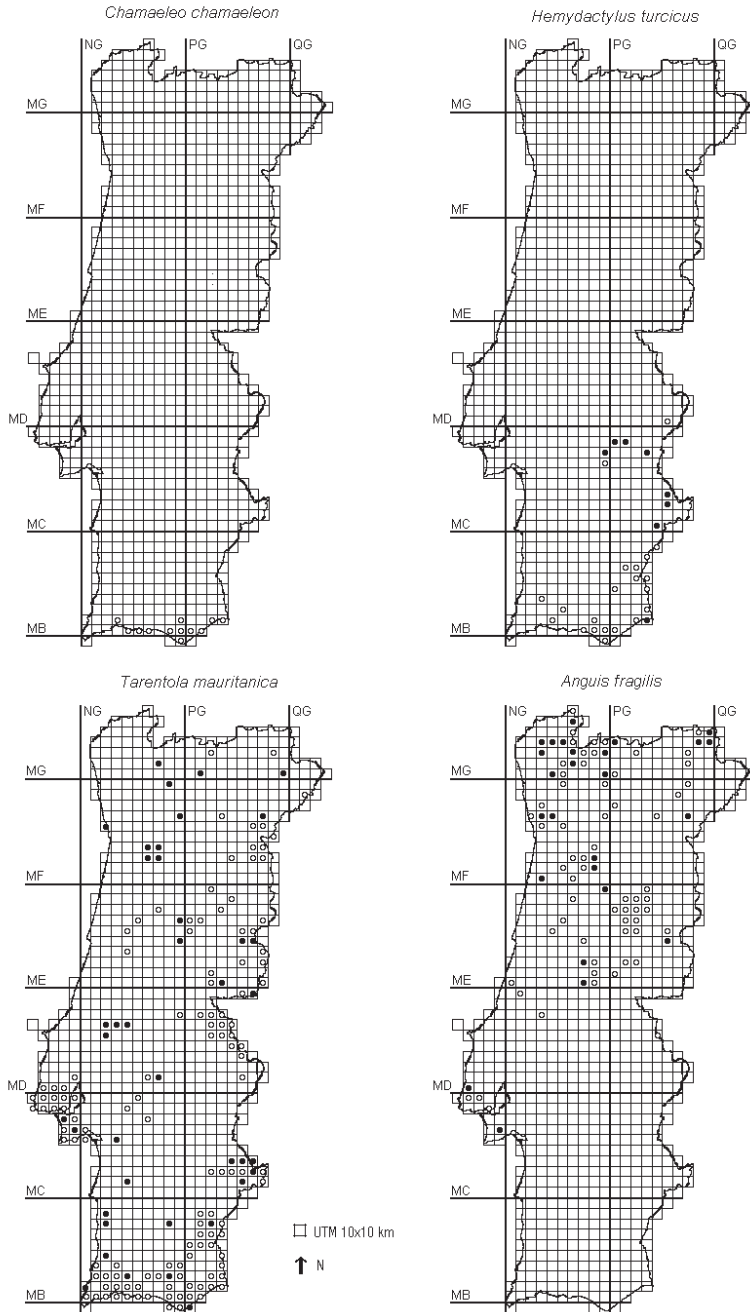
**Figure 6.-** Presence of *Bufo calamita*, *Hyla arborea*, *Hyla meridionalis* and *Rana iberica* in Portugal (○ bibliographic data; ● new observations).

**Figura 6.-** Presencia de *Bufo calamita*, *Hyla arborea*, *Hyla meridionalis* y *Rana iberica* en Portugal (○ datos bibliográficos; ● nuevas observaciones).



**Figure 7.-** Presence of *Rana perezi*, *Emys orbicularis*, *Mauremys leprosa* and *Blanus cinereus* in Portugal (○ bibliographic data; ● new observations).

**Figura 7.-** Presencia de *Rana perezi*, *Emys orbicularis*, *Mauremys leprosa* y *Blanus cinereus* en Portugal (○ datos bibliográficos; ● nuevas observaciones).



**Figure 8.-** Presence of *Chamaeleo chamaeleon*, *Hemydactylus turcicus*, *Tarentola mauritanica* and *Anguis fragilis* in Portugal (○ bibliographic data; ● new observations).

**Figura 8.-** Presencia de *Chamaeleo chamaeleon*, *Hemydactylus turcicus*, *Tarentola mauritanica* y *Anguis fragilis* en Portugal (○ datos bibliográficos; ● nuevas observaciones).



**Figure 9.-** Presence of *Chalcides bedriagai*, *Chalcides striatus*, *Acanthodactylus erythrurus* and *Timon lepidus* in Portugal (○ bibliographic data; ● new observations).

**Figura 9.-** Presencia de *Chalcides bedriagai*, *Chalcides striatus*, *Acanthodactylus erythrurus* y *Timon lepidus* en Portugal (○ datos bibliográficos; ● nuevas observaciones).



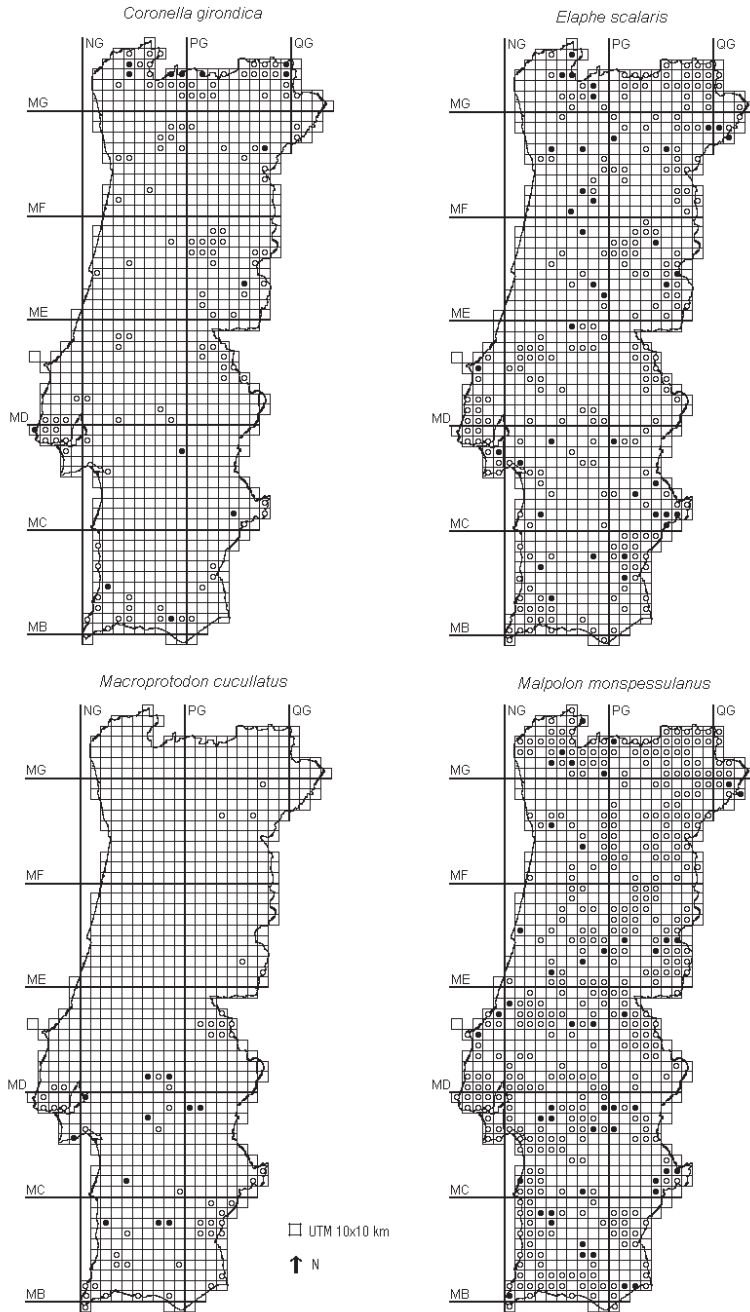
**Figure 10.-** Presence of *Archaeolacerta monticola*, *Lacerta schreiberi*, *Podarcis bocagei* and *Podarcis hispanica* in Portugal (○ bibliographic data; ● new observations).

**Figura 10.-** Presencia de *Archeolacerta monticola*, *Lacerta schreiberi*, *Podarcis bocagei* y *Podarcis hispanica* en Portugal (○ datos bibliográficos; ● nuevas observaciones).



**Figure 11.-** Presence of *Psammodromus algirus*, *Psammodromus hispanicus*, *Coluber hippocrepis* and *Coronella austriaca* in Portugal (○ bibliographic data; ● new observations).

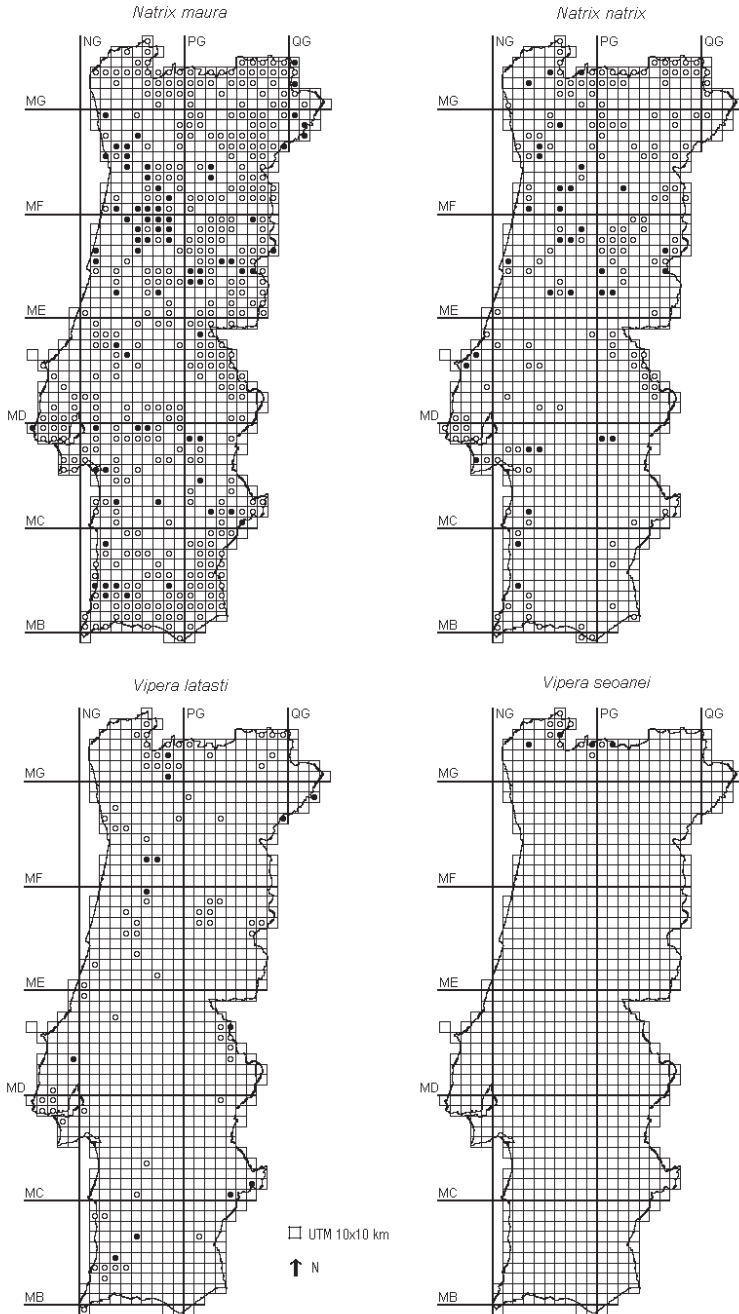
**Figura 11.-** Presencia de *Psammodromus algirus*, *Psammodromus hispanicus*, *Coluber hippocrepis* y *Coronella austriaca* en Portugal (○ datos bibliográficos; ● nuevas observaciones).



**Figure 12.-** Presence of *Coronella girondica*, *Elaphe scalaris*, *Macroprotodon cucullatus* and *Malpolon monspessulanus* in Portugal (○ bibliographic data; ● new observations).

**Figura 12.-** Presencia de *Coronella girondica*, *Elaphe scalaris*, *Macroprotodon cucullatus* y *Malpolon monspessulanus* en Portugal (○ datos bibliográficos; ● nuevas observaciones).





**Figure 13.-** Presence of *Natrix maura*, *Natrix natrix*, *Vipera latasti* and *Vipera seoanei* in Portugal (○ bibliographic data; ● new observations).

**Figura 13.-** Presencia de *Natrix maura*, *Natrix natrix*, *Vipera latasti* y *Vipera seoanei* en Portugal (○ datos bibliográficos; ● nuevas observaciones).

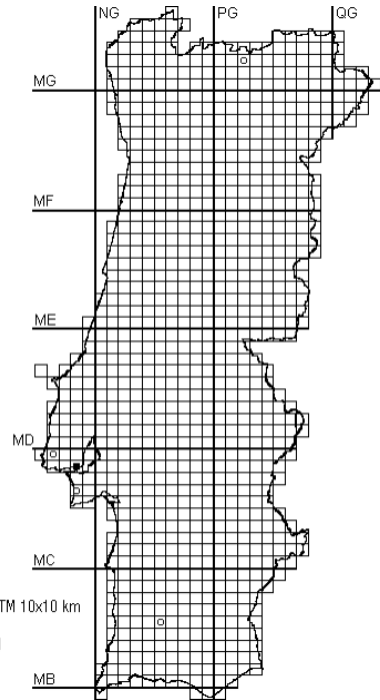
### General comments

The majority of new data came from the north and the centre, areas traditionally less surveyed. Interpretations of the maps should take this geographical bias into account. The species *Rana temporaria* has its known range edge close to the Spanish-Portuguese border (PLEGUEZUELOS, 1997), i.e. in the northern, less intensely surveyed part of the country, but their actual presence on Portuguese territory has not been recorded.

The north-west is the region in Portugal with highest level of precipitation, probably increasing its suitability for amphibians. In the climatic transition zone in central Portugal high numbers of species are also recorded, due to the joint presence of species with different ecological characteristics but nevertheless slightly overlapping distributions such as *Hyla* and *Alytes* pairs. For reptiles the transition zone between species of Atlantic and Mediterranean climate appears to be broader and less well defined. Some reptile species typical of Atlantic climate (e.g. *Lacerta schreiberi* and *Podarcis bocagei*) occur along the south-western coast. A low richness was found in the central south (Baixo Alentejo), an area characterised by a homogeneous and plain landscape, covered by cereal fields and with very few rocky outcrops.

For many species, e.g. *Discoglossus galganoi*, the maps show a more or less contiguous pattern of recordings, indicating that their ranges are reasonably well documented. For other species such as *Timon lepidus*, clustered grid cells with no records but obviously falling within the species range, highlight the areas that should be subject to more detailed surveying. A sharp increase in knowledge was already obtained for species that were given special attention under the EC 'LIFE' program or otherwise and relatively few or no new recordings were made for these species.

Mapping exercises, like other scientific investigations, are subject to type I and type II statistical errors. We have found little evi-



**Figure 14.-** Presence of exotic species in Portugal. (○ *Trachemys scripta*; ■ *Teira dugesii*).

**Figure 14.-** Presencia de especies exóticas en Portugal. (○ *Trachemys scripta*; ■ *Teira dugesii*).

dence that erroneous identifications (type I error) are frequent. The, as yet, unrecorded presence of amphibians and reptiles (type II error) on the other hand is commonplace, which precludes a correct perception of the abundance/rarity of some species. The scarcity of records for conspicuous species (such as that of *Hyla arborea* in the north) may point to regional rarity. However, many species are inconspicuous, and some other absences of possible concern (such as those of *Psammotriton hispanicus* and *Acanthodactylus erythrus* in the south) deserve more attention. There is a pressing need for more work, in order to achieve a thorough understanding of the actual presence or absence of a species within its range. Only then it will be possible to evaluate future changes in the distribution of the

Portuguese populations of amphibians and reptiles.

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**Annex 1:** Number of species of amphibians and reptiles in each UTM 50 × 50km cell.

**Anexo 1:** Número de especies de anfibios e reptiles en cada cuadrícula UTM 50 × 50km.

UTM 50 × 50km	Amphibians	Reptiles	UTM 50 × 50km	Amphibians	Reptiles
MC55	14	21	NF55	11	15
MD50	14	19	NG50	13	18
MD55	12	12	NG55	10	16
NB00	13	22	PB00	12	17
NB05	13	18	PB05	12	18
NC00	13	15	PC00	12	14
NC05	12	19	PC05	12	16
ND00	12	14	PD00	14	18
ND05	15	18	PD05	14	20
NE00	13	14	PE00	15	18
NE05	15	13	PE05	15	21
NF00	13	8	PF00	9	12
NF05	15	15	PF05	12	18
NG00	12	14	PG00	11	18
NB50	12	20	PC50	12	19
NB55	12	13	PD50	15	13
NC50	12	13	PE50	14	20
NC55	13	14	PE55	13	20
ND50	12	17	PF50	11	17
ND55	15	13	PF55	12	18
NE50	10	15	PG50	12	18
NE55	12	16	QF05	10	15
NF50	12	19	QG00	12	12