Man and herpetofauna of the mediterranean islands

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Abstract: This work deals with a synthesis of data on the late Quaternary occurrence of endemic herpetofauna on the Mediterranean islands, and evidence of appearance of taxa extraneous to the native faunas. Data recently reported, shed new light on the permanence and extinction of autochthonous species and the arrival of continental ones. Their arrival might be directly related to the progressive advent of human colonisation of the islands. Hence, the question is how is the present insular herpetofauna connected to human intervention? In this review we show the close connection between human occupation of Mediterranean islands and present-day herpetofauna.
Key words: Amphibia, Reptilia, Quaternary, Human intervention, Mediterranean Islands.

Resumen: El hombre y la herpetofauna en las islas mediterráneas.- El presente trabajo presenta una síntesis de los datos disponibles sobre la herpetofauna endémica de la islas mediterráneas y la evidencia sobre la aparición de taxones ajenos a las faunas nativas. La información recientemente adquirida arroja nueva luz sobre la permanencia y extinción de las especies autóctonas, así como sobre la llegada de las procedentes de los continentes. Su llegada a las islas pudo estar directamente relacionada con la progresiva colonización humana. Se plantea así, hasta qué punto la herpetofauna insular del Mediterráneo se halla relacionada con la intervención humana.
Palabras clave: anfibios, reptiles, cuaternario, influencia humana, islas mediterráneas.

INTRODUCTION

According to paleontological evidence, several of the late Quaternary faunas of the Mediterranean islands differ considerably from contemporary continental faunas (AZZAROLI, 1971, 1977; SONDAAR, 1977; SCHÜLE, 1993). This is particularly evident if one considers the mammalian faunas, most of which were characterised by common trends of endemisation. Examples from Balearics (Gymnesic and Pityusic islands), Corsica and Sardinia, the Tuscan Archipelago, Sicily, Malta, Crete, several Aegean islands, and Cyprus are significant. Each of these mammalian assemblages, even though they were represented by few *taxa*, is consistently present on most of the islands. They displayed peculiar endemic elements which differentiated extremely from one island to the other (MASSETI, 1993).

The turnover between the former and the present-day fauna took place during the Holocene, and is generally reputed to be an effect of the human occupation of the islands. It began in early Neolithic, or, at least, pre-Neolithic times. The present-day situation is quite different, with a supersaturated fauna with two to five times more species than in late Pleistocene times. This situation is generally recognised as the result of the importation by man of several allochthonous species from continental areas. The impact of foreign elements on the original ecological systems of islands can be identified and its chronology specified with sufficient precision. This identification is possible because of the evidence

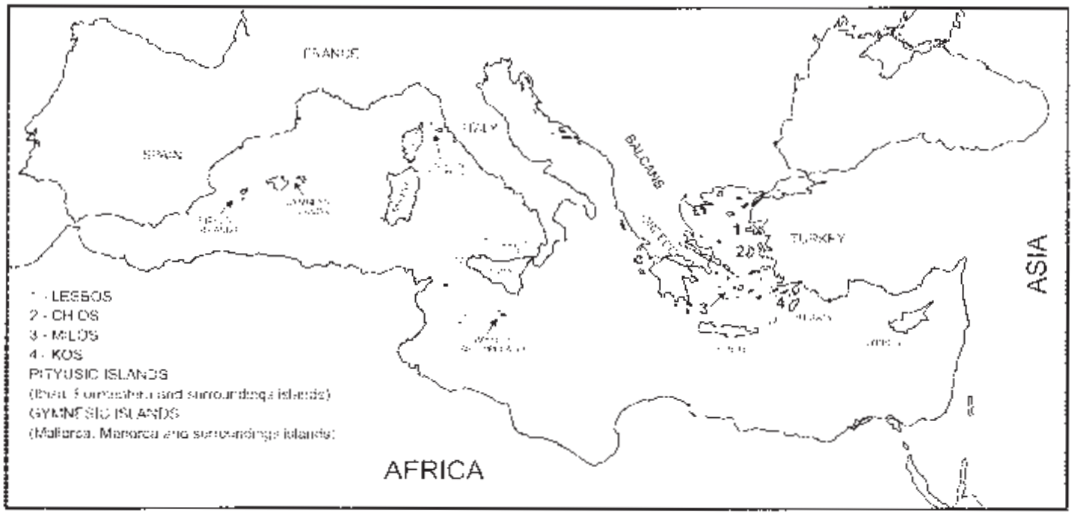

Figure 1.- Map of the Mediterranean Sea.
Figura 1.- Mapa del mar Mediterráneo.

that such impact left and, to the relative rapidity of the consequences it produced (cf. ELTON, 1958; AZZAROLI, 1977; WATSON *et al.*, 1977; DAVIS, 1984, 1987; VIGNE, 1992).

Along with the land mammals, the terrestrial herpetofauna is considered to be one of the main indicators of island faunistic population dynamics and of the relations with the continental faunas (cf. MAC ARTHUR & WILSON, 1967). In the whole Mediterranean region, the rate of endemicity for herpetofauna is higher than for mammals (25%), corresponding to 56% of the amphibians and 62% of the reptiles (SARÀ, 1996). The aim of this work was to check if insular herpetofauna had a similar behaviour. Whether the Mediterranean island herpetofauna behaved as the mammals at the Holocene turnover, whether it has undergone a redefinition process of its distribution carried out by man since prehistorical times and what may have been the role –if any– played by human cultures in this regard.

The herpetofauna of the Mediterranean islands

Thousands of islands and islets are located within the Mediterranean basin. For example, if one considers only the Greek islands, they are 9838 (HANDRINOS & AKRIOTIS, 1997), whereas the number of the Sardinian satellite islands amounts to more than 160 units (POGGESI *et al.*, 1996) (figure 1). In the present paper we consider only the following islands for which the complete herpetofaunal composition is available in literature. These are: Ibiza, Formentera, Mallorca and Menorca and related satellite islands, Corsica and related satellite islands, Sardinia and related satellite islands, Sicily and the Italian circumsicilian islands, Maltese Archipelago, Milos, Crete, Lesbos, Chios, Kos, Rhodes and Cyprus. This paper is based on a review of all previous knowledge on the Mediterranean herpetofauna, as well as on personal observations.

If we look at the present terrestrial herpetofauna of the Mediterranean islands, we can still find several endemic elements. Although with some exceptions constituted mainly by certain endemic *taxa*, for example, the genus *Euproctus* from Corsica and Sardinia and, *Speleomantes* from Sardinia, certain species of *Podarcis* from different islands, and also *Coluber cypriensis* from Cyprus, the island fauna however, displays virtually the same

species composition. Today the terrestrial herpetofauna of at least several of the Mediterranean islands displays a partially homogeneous composition of elements. It also consists of species that are more or less common to the present fauna of all the Mediterranean islands, and shows in part a generic continental origin (ALCOVER, 1981; SANDERS & REUMER, 1984; BLONDEL & VIGNE, 1993; MASSETI, 1993) influenced by the faunistic composition of the nearest mainland.

Of the 20 islands and group of islands of the Mediterranean considered in this study, 14 of them are still reputed to be inhabited by endemic species (70%) (tables 1a-b). This corresponds to 23,2% ca of the total (95) of all the species reported from the considered islands. The percentage might increase considerably, however, if one considers, for example, other representatives of the genus *Discoglossus* or some of the insular grass snakes, such as those from Sardinia, Corsica and Cyprus, as endemic species. The main concentration of endemisms is provided by Sardinia and Corsica, featuring 10 (7 amphibians and 3 reptiles) and 8 species (5 amphibians and 3 reptiles) respectively; (LANZA & VANNI, 1990; DELAUGERRE & CHEYLAN, 1992; POGGESI *et al*., 1996), while the Eastern Aegean islands, such as Lesbos, Chios, Kos and Rhodes, display no endemic species within their herpetofauna. The number of endemic species increases thanks in particular to *Podarcis*, it is noteworthy that these species are sometimes represented only on small and on satellite islands. *Podarcis* is the genus mainly characterised by endemic *taxa*. In fact, of the 18 species described from Europe, at least 9 have been reported as endemic of Mediterranean islands, including *P. atrata*, *P. filfolensis, P. gaigae, P. lilfordi, P. milensis, P. pityusensis, P. tiliguerta, P. wagleriana, P. raffonei* (GASC, 1997, CORTI *et al*., 1999; HARRIS, 1999). In the 13 islands and group of islands of the Western Mediterranean basin considered in the present study, the percentage of occurrence of endemism correspond to 33,9% ca of the herpetofaunistic species (52,4% ca of the amphibians and 22,9% ca of the reptiles, this data will increase if we consider also *Podarcis atrata* of the Columbretes islands, Spain, not considered in this paper), whereas in the Eastern Mediterranean islands it is only represented by 8,2% ca regarding exclusively reptiles species (we have also included *P. gaigae* of Skyros archipelago and the island of Piperi, Greece, not considered in this paper). It is noteworthy, for example, that the eastern Mediterranean islands have no endemic species of amphibians while these reach about 58% on the islands of the western basin (LANZA & VANNI, 1987, 1990). Apart from the representatives of the genus *Podarcis*, amphibians represent the majority of the herpetofaunistic endemisms of the Mediterranean islands. Islands that are nearer to the mainland, such as those of the Eastern Aegean sea, are mostly influenced by the continental faunistic composition, while the herpetofauna of islands such as Gymnesic, Pityusics, Corsica, Sardinia and, even, Cyprus, are all more or less characterised by the occurrence of endemic species. Exceptions are also registered, however, within the latter islands, as in the case of Crete where, despite its present distance and the long-term geological separation from the nearest landmasses, no endemic herpetological species has been reported whereas Quaternary endemic mammals are present there. However, it seems that this island had some Quaternary connections with the Asian mainland through an arch of islands and if this is confirmed in terms of antiquity, these islands could not be compared with the above mentioned ones.

Man influence on herpetofauna

Strong and extended effect of human activity is one of the distinctive features of the present day Mediterranean faunas. As far as is presently known, this effect has acted since the beginning of the Neolithisation of the Mediter-

Table 1a: List of amphibians and reptiles present on the Mediterranean Islands. N = present but not endemic; E = endemic.
Tabla 1a: Lista de los anfibios y reptiles presentes en las islas mediterráneas. N = presente pero no endémico; E = endémico.

	Ibiza	Formentera	Mallorca	Menorca	Corsica	Sardinia	Sicily	Melos	Crete	Rhodes	Kos	Lesbos	Cyprus	Chios
Euproctus montanus					E									
Euproctus platycephalus						E								
Speleomantes genei						E								
Speleomantes flavus						E								
Speleomantes imperialis						E								
Speleomantes supramontis						E								
Salamandra corsica					E									
Alytes muletensis			E											
Bombina pachypus							N							
Discoglossus montalentii					E									
Discoglossus pictus							N							
Discoglossus sardus					E	E								
Pelobates syriacus											N			
Bufo bufo							N					N		N
Bufo viridis	N	N	N	N	N	N	N		N	N	N	N	N	N
Rana dalmatina							N							
Rana esculenta complex					N	N	N							
Rana lessonae					N	N	N							
Rana levantina													N	
Rana perezi	N		N											
Rana ridibunda								N	N	N	N	N	N	N
Hyla arborea									N	N	N	N		N
Hyla intermedia							N							
Hyla meridionalis				N										
Hyla sarda					E	E								
Hyla savignyi													N	
Emys orbicularis			N		N	N	N					N		
Mauremys caspica								N	N	N	N	N	N	N
Testudo graeca	N	N	N	N		N	N					N		N

Table 1a *(Continuation)*/**Tabla 1a** *(Continuación)*

	Ibiza	Formentera	Mallorca	Menorca	Corsica	Sardinia	Sicily	Melos	Crete	Rhodes	Kos	Lesbos	Cyprus	Chios
Testudo hermanni			N	N	N	N	N							
Testudo marginata					N	N								
Cyrtopodion kotschyi								N	N	N	N	N	N	N
Euleptes europaea					N	N	N							
Hemidactylus turcicus	N	N	N	N	N	N	N	N	N			N	N	N
Tarentola mauritanica	N	N	N	N	N	N	N		N					
Laudakia stellio										N		N	N	N
Chamaeleo chamaeleon									N				N	N
Ablepharus kitaibelii								N	N	N		N	N	
Chalcides chalcides						N	N							
Chalcides ocellatus						N	N		N	N			N	
Eumeces schneiderii													N	
Mabuya aurata										N				
Mabuya vittata													N	
Acanthodactylus schreiberi													N	
Algyroides fitzingeri					E	E								
Lacerta (Archaeolacerta) bedriagae					E	E								
Lacerta bilineata							N							
Lacerta danfordi										N				
Lacerta laevis													N	
Lacerta perspicillata				N										
Lacerta trilineata								N	N	N		N		N
Ophisops elegans											N	N	N	N
Podarcis erhardii									N					
Podarcis milensis								E						
Podarcis pityusensis	E	E	N											
Lacerta oertzeni										N				
Podarcis sicula				N	N	N	N							
Podarcis tiliguerta					E	E								
Podarcis wagleriana							E							

Table 1a *(Continuation)*/**Tabla 1a** *(Continuación)*

	Ibiza	Formentera	Mallorca	Menorca	Corsica	Sardinia	Sicily	Melos	Crete	Rhodes	Kos	Lesbos	Cyprus	Chios
OphIsaurus apodus												N		N
Blanus strauchi										N	N			
Typhlops vermicularis										N		N	N	N
Eirenis modestus												N		N
Eryx jaculus											N	N		N
Coluber caspius												N		N
Coluber cypriensis													E	
Coluber gemonensis									N					
Coluber hippocrepis						N								
Coluber jugularis										N			N	
Coluber najadum										N		N		N
Coluber nummifer													N	
Coluber ravergieri										N	N			
Coluber viridiflavus					N	N	N							
Coronella austriaca							N							
Coronella girondica							N							
Elaphe longissima						N	N							
Elaphe quatuorlineata							N							
Elaphe scalaris				N										
Elaphe situla							N	N	N	N		N		N
Macroprotodon cucullatus			N	N										
Malpolon monspessulanus												N	N	N
Natrix natrix					N		N	N		N	N	N	N	N
Natrix maura			N	N	N	N								
Natrix tessellata									N			N		
Telescopus fallax								N	N	N			N	
Macrovipera lebetina													N	
Macrovipera schweitzeri								E						
Vipera aspis							N							
Vipera xanthina												N		N

Table 1b: List of amphibians and reptiles present on the Mediterranean Islands. N = present but not endemic; E = endemic.
Tabla 1b: Lista de los anfibios y reptiles presentes en las islas mediterráneas. N = presente pero no endémico; E = endémico.

	Circumbalearic	Circumcorsican	Circumsardinian	Tuscan Archipelago	Circumsicilian	Maltese Archipelago
Discoglossus pictus						N
Discoglossus sardus		E	E	E		
Bufo bufo				N		
Bufo viridis			N	N	N	
Rana esculenta complex				N		
Hyla sarda		E	E	N		
Emys orbicularis			N			
Testudo graeca			N			
Testudo hermanni			N	N	N	
Testudo marginata			N			
Euleptes europaea		N	N	N		
Hemidactylus turcicus	N		N	N	N	N
Tarentola mauritanica	N	N	N	N	N	N
Chamaeleo chamaeleon						N
Chalcides chalcides			N	N		
Chalcides ocellatus			N		N	N
Algyroides fitzingeri		E	E			
Lacerta (Archaeolacerta) bedriagae		E	E			
Lacerta bilineata				N		
Podarcis filfolensis					N	E
Podarcis muralis				N		
Podarcis lilfordi	E					
Podarcis pityusensis	E					
Podarcis raffonei					E	
Podarcis sicula	N		N	N	N	

Table 1b *(Continuation)*/**Tabla 1b** *(Continuación)*

	Circumbalearic	Circumcorsican	Circumsardinian	Tuscan Archipelago	Circumsicilian	Maltese Archipelago
Podarcis tiliguerta		E	E			
Podarcis wagleriana					E	
Psammodromus algirus					N	
Coluber algirus						N
Coluber hippocrepis			N		N	
Coluber viridiflavus		N	N	N	N	N
Coronella austriaca				*N*		
Elaphe scalaris	N					
Elaphe situla						N
Macroprotodon cucullatus					N	
Malpolon monspessulanus					N	
Natrix natrix				N		
Natrix maura			N			
Telescopus fallax						N
Vipera aspis				N	N	

PIEPER (1970), EWALD (1984); BRUNO (1985); MAYOL (1985); SCHÄTTI (1985); STUBBS (1985); CORTI *et al*. (1990, 1997);. LANZA & VANNI (1990); DELAUGERRE & CHEYLAN (1992); ESTEBAN *et al*. (1994); BALDACCHINO (1995); KASAPIDIS *et al*. (1996), POGGESI et al. (1996); SARÀ (1996); GASC (1997); SALVADOR (1998).

ranean region, and starting in the Near East, involved geographical areas such as Cyprus (BÖHME & WIEDL, 1994), Crete and the Aegean islands in the course of the 8th-7th millennium b.C., and extended westwards during the 6th millennium b.C. Since those times many of the characteristic elements of the biogeography of the region have undergone a process of exploitation which has continued into historical times. The voluntary and/or involuntary introduction of continental *taxa* has gradually replaced the autochthonous faunal elements, represented on the islands mainly by endemic forms (cf. ALCOVER, 1982; SANDERS & REUMER, 1984; VIGNE & ALCOVER, 1985; VIGNE, 1992; MASSETI, 1993).

Might the present relative occurrence of herpetofaunistic endemisms in several of the Mediterranean islands be explained as a consequence of the human colonisation, as it has been supposed for the mammalian fauna? In this regard, the example of the herpetofauna of the Gymnesic and the Pityusic islands (Balearics) has been considered as particularly significant. Only *taxa* such as *Alytes muletensis*, *Podarcis lilfordi* and *P. pityusensis* are considered as palaeoendemic of these islands, and, plausibly, they –or their predecessors– colonised the islands during the Messinian (KOTSAKIS, 1981; ALCOVER & MAYOL, 1981) (table 2). It is also very important to emphasise that the Messinian colonisation happened throughout land in a very long span of time involving therefore thousands of generations. All the remaining species of the present day herpetological biota must have immigrated to Balearics due to the intervention of man (ALCOVER & MAYOL, 1981). Moreover, according to HEMMER *et al.,* (1981), the microcomplement fixation of albumin relationship shows that the present *Bufo viridis* of Balearics is not an original, autochthonous member of the basically Miocene fauna of these islands, but a quite recent newcomer probably brought from the Tyrrhenian islands. On the other hand, the Iberian water frog, *Rana perezi*, seems to have been introduced to the Balearics from the west (HEMMER *et al.*, 1981). It can also be observed that the disappearance of *Podarcis lilfordi* from Mallorca and Menorca is probably due to the introduction, in relatively recent times, of allochthonous snakes, such as the false smooth snake (*Macroprotodon cucullatus* and *Elaphe scalaris*), on the islands (KOTSAKIS, 1981; MAYOL, 1985; PLEGUEZUELOS *et al.*, 1994) and carnivorous mammals like martens, genets or feral cats (PÉREZ-MELLADO, 1998).

At the other side of the Mediterranean basin, on the island of Cyprus, there are no more than one endemic species, *Coluber cypriensis*, perhaps immigrated in an early Pliocene or pre-Pliocene period (BÖHME & WIEDL, 1994). As in the case of the Balearics, the very oligotypic Quaternary mammalian fauna of the island seems to confirm the fact that also Cyprus was characterised by a very low rate of faunistic immigration from the nearest mainland (cf. DERMITZAKIS & SONDAAR, 1972; DAVIS, 1987). A recent zoogeographical analysis of the Cypriot herpetofauna, carried out by BÖHME & WIEDL (1994), revealed that most of its recent representatives must have reached the island by rafting or even by human transportation. The same authors also observed that the Cypriot herpetofauna is characterised by few well-differentiated subspecies (table 3), and that this may be in contrast with the fact that an early to midle Pleistocene immigration was possible. Why are so many forms inhabiting the opposite coast of both southeastern Turkey and Syria-Lebanon absent from Cyprus? Their absence from the island, if there were land connections in the relatively recent past, remains enigmatic. It has also been supposed that the origin of the Cypriot population of *Lacerta laevis* has originated from both the mainland populations of southern Turkey and of the Levant, the isolating mechanism between them having secondarily broken down in a newly colonised environment (BÖHME, 1996). Finally, some speculation also exists regarding the occurrence on Cyprus of the blunt-nose viper (*Ma-*

Table 2: Present terrestrial Amphibians and Reptiles of the Gymnesic and Pityusic islands: ○ endemic; ● non endemic.
Tabla 2: Anfibios y reptiles actuales de las islas Gimnésicas y Pitiusas: ○ endémico; ● no endémico.

species	IBIZA[1]	MALLORCA[1]	MENORCA[1]
Alytes muletensis		○	
Bufo viridis	●	●	●
Rana perezi	●	●	
Hyla meridionalis			●
Hemidactylus turcicus	●	●	●
Tarentola mauritanica	●	●	●
Podarcis lilfordi[(2)]		○	○
Lacerta perspicillata			●
Podarcis pityusensis	○	●	
Podarcis sicula			●
Elaphe scalaris			●
Macroprotodon cucullatus		●	●
Natrix maura		●	●
Emys orbicularis		●	●
Testudo hermanni		●	●
Testudo graeca		●	
Total of the species: 16	5	12	12
	1 ○	2 ○	1 ○
	4 ●	10 ●	11 ●

[1] MAYOL, 1985, ESTEBAN *et al.*1994.
[2] The occurrence of the Balearic lizard is today restricted to the circummallorcan and circummenorcan islets. The species is, infact, absent from the two main islands, from where its was extirpated by the historical diffusion of allochthonous predators, (EISENTRAUT, 1949; ALCOVER *et al*., 1981, 1984; KOTSAKIS, 1981; SANDERS, 1984; MAYOL, 1985; PÉREZ-MELLADO, 1998).

crovipera lebetina). This genus is represented on the Mediterranean islands only of the eastern basin, on Cyprus and on the sub-archipelago of Milos, where the species *Macrovipera schweitzeri* has been described from the islands of Milos, Kimolos, Polyaigos (ARNOLD & BURTON, 1978; STUBBS, 1985; PARASCHI & CHONDROPOULOS, 1992), and Siphnos (ARNOLD & BURTON, 1978; PARASCHI & CHONDROPOULOS, 1992). The taxonomic position of this species is, however, still debated, as well as whether it may or not be considered consequently as a true endemism of the latter islands. Though, as far as is presently known, any evidence for the appearance of *M. schweitzeri* is still unknown on the islands of the western Cyclades, only one dating, not calibrated, is available for the earliest occurrence of *M. lebetina* on Cyprus, where it has been referred to the 9th millennium b.C. (BAILON, 1999).

As the Quaternary mammalian fauna of Cyprus, as well as that of Milos, is oligotypic, and characterised by endemic forms, such as dwarf elephants, at least referable no earlier than to the middle Pleistocene (KOTSAKIS, 1990). This might implicate that also Milos must have had a long-term geological separation from the nearest landmasses, to justify the endemicity of its mammalian fauna. Thus, the representatives of the genus *Macrovipera* could have reached the two islands before they were eventually separated from the continent.

Table 3: Terrestrial Amphibians and Reptiles of the island of Cyprus: ○ endemic; ● non endemic.
Tabla 3: Anfibios y reptiles terrestres de Chipre: ○ endémico; ● no endémico.

species	Pre-Neolithic [1,2,5,6]	Neolithic [3]	Today [4]
Bufo sp.	●		
Bufo viridis	●	●	●
Hyla savignyi			●
Rana levantina			●
Hemidactylus turcicus			●
Cyrtopodion kotschyi			●
Laudakia stellio		●	●
Chamaeleo chamaeleon			●
Acanthodactylus schreiberi			●
Lacerta laevis			●
Ophisops elegans			●
Ablepharus kitaibelli			●
Chalcides ocellatus			●
Eumeces schneideri		●	●
Mabuya vittata			●
Typhlops vermicularis			●
Coluber cypriensis	?	?	○
Coluber jugularis	●	●	●
Coluber nummifer			●
Natrix natrix	●		●
Malpolon monspessulanus			●
Telescopus fallax			●
Macrovipera lebetina	●	?	●
Mauremys caspica			●
Testudo graeca	?		
Geochelone sp.	?		
Total of the species			23
Total of the endemisms			1

[1] BOESCHOTEN & SONDAAR,1972; BÖHME & WIEDL, 1994; SANCHIZ, 1984; SIMMONS, 1991.
[2] Osteological remains of *Macrovipera lebetina* have been provided by the excavations of the prehistorical site of Akrotiri-*Aetokremnos*. For them it is available the non calibrated datation of 8,500 years.
[3] WATSON *et al*., 1977.
[4] BOULENGER, 1910; WERNER, 1936; CLARK, 1973; EWALD, 1984; SCHÄTTI, 1985; BÖHME & WIEDL, 1994.
[5] BAILON, 1999.
[6] REESE,1999.

It cannot be excluded, however, that the occurrence of the vipers might also be related to the early human contacts in both the islands, that man has frequented since pre-Neolithic times. The evidence from the Franchthi Cave, for example, demonstrates clearly that the island of Milos was exploited as a source of obsidian in early Mesolithic times, and that human groups were already capable of undertaking sea voyages (MASSETI, 1998). From the early Mesolithic onwards, the Mediterranean Sea can be considered the privileged path of penetration

by navigation, for the process of colonisation from the Near East towards southern Europe (PAYNE, 1975; PERLÉS, 1979; CHERRY, 1981, 1992; SHACKLETON *et al.*, 1984). The available archaeological documentation, based still on quite fragmentary evidence, would tend to indicate that the first relocations by sea in the Mediterranean basin were already carried out by hunter-gatherers, in expression contexts of a Mesolithic type, probably as early as the 9th millennium b.C. (JACOBSEN, 1976; PERLÉS, 1979; CHERRY, 1981, 1992; SIMMONS, 1991). It cannot be excluded that, since early Neolithic times, some blunt-nosed vipers were imported occasionally on the Mediterranean islands, giving origin to allochthonous populations, the descendants of which persist until today. Evidence just from Milos and Cyprus indicate an improved seafaring capability.

According to VIGNE & ALCOVER (1985), the paleontological, archaeozoological and zoological data from the Gymnesics, Pityusics, Corsica (table 4) and Sardinia seems to show that man took a fundamental part in the extinction and immigrations of herpetofauna, selecting those species which were ecologically and culturally connected with him. Recently, however, this assumption has been contradicted by the results of a new research carried out by VIGNE *et al.* (1997). Their analysis of several late Pleistocene and Holocene faunal assemblages from Corsica improved the number of chronostratigraphic data-sets available for Amphibians and Reptiles, and eventually redefines the role which was supposed to have been played by man. At least, on Corsica, humans had little impact on the herpetofauna and was responsible only for a few introduction, essentially referable only to one species, and no extinctions.

CONCLUDING REMARKS

The at present well-known paleoherpetofauna of Corsica suggests that "the amphibians and reptiles appear to have successfully resisted both climatic changes and the influence of man" (VIGNE *et al*., 1997). Unfortunately, beside a few exceptions, the amphibians and reptiles fossil record is of little help in the area considered in this paper (VIGNE & ALCOVER, 1985; LANZA & VANNI, 1987, 1990) due to the scarcity and poor conservation of the remains. Moreover, the uncertain systematic position of several modern taxa (i.e.: *Hyla*, *Rana*) and the absence or paucity of osteological diagnostic traits in others (i.e.: *Discoglossus*, *Hyla*, Gekkonidae, Lacertidae), decrease the meaning of some of the available data. Regarding Corsica and Sardinia we must also take into account the wide range of habitats still available that in such broader extent allows the maintenance of a large species number.

HOLMAN (1995, 1998) has recently drawn attention on the high survival rate of the North American and European herpetological communities during the Pleistocene. While in the late Pleistocene mammals lost 73% of genera in North America and 29% in northern Eurasia, no extinction occurred in the herpetofauna either at the generic or specific level (the herpetofauna extinct species percentage is below 5% in each region for all the Pleistocene and is not influenced by the late Pleistocene events). Again, this could testify that amphibians and reptiles, if compared with mammals, display a surprising stability. The same author, analysing the reason of this stability points out the importance of low metabolic rates, aestivation, hibernation, small size, reproductive potentials and, food relationship with other vertebrates. Probably these characteristics also played a key role in high survival rates - with the exceptions, such as *Alytes talayoticus* on Menorca, and *Podarcis lilfordi* on Menorca and Mallorca –of the insular Mediterranean herpetofauna when man begun to redefine the islands' ecosystems and introduced allochthonous mammals. On the other hand we would like to point out that the above mentioned species are in fact the whole known herpetofauna

Table 4: Terrestrial Amphibians and Reptiles of the island of Corsica: ○ endemic; ● non endemic.
Terrestrial Amphibians and Reptiles of the island of Cyprus: ○ endemic; ● non endemic.
Tabla 4: Anfibios y reptiles terrestres de Córcega: ○ endémico; ● no endémico.

species	Pre-Neolithic [1] (late Pleistocene-Holocene)	Neolithic [1,4] Roman Age	Today [2,3]
Euproctus montanus	?	?	○
Salamandra corsica	?	?	○
Discoglossus sp.	●	●	
Discoglossus sardus	?	●	●
Discoglossus montalenti	?	?	○
Bufo viridis	●	●	●
Hyla sp.	●	●	
Hyla sarda	?	?	○
Rana esculenta complex		●	●
Tarentola mauritanica			●
Hemidactylus turcicus			●
Phyllodactylus europaeus			●
Algyroides fitzingeri	?	?	○
Lacerta (Archaeolacerta) bedriagae	○	○	○
Podarcis tiliguerta	○	○	○
Podarcis sicula			●
Coluber viridiflavus	●	●	●
Natrix maura	●	●	●
Natrix natrix			●
Testudo hermanni	?	?	●
Emys orbicularis	?	●	●
Total of the species			19
Total of the endemisms			7

[1] VIGNE & ALCOVER, 1985; VIGNE *et al*., 1997.
[2] CORTI *et al*.,1990; DELAUGERRE & CHEYLAN, 1992.
[3] LANZA & VANNI, 1990.
[4] CAMPS, 1988.

previous to the arrival of man in Balearics. The physiological features developed, in terms of surviving rate in very extreme conditions, allowed and still allow reptiles, and in particular lizards, to live where mammals are unable to survive. This may occur on the islets around Mallorca and Menorca, where they develop a higher variety of morphs, ecological and ethological variants that any other vertebrate group in the world. If we take into account only the specific level, our results could thus contain fundamental errors in evaluating the degree of endemicity that would be better identified with the evolution of populations characterised by development of various morphs, and ecological and ethological variants.

For groups, such as the reptiles, the effect of human activity has not always been a decrease in overall species richness (CHEYLAN, 1992; ARNOLD, 1987; BLONDEL & VIGNE, 1993), but in some cases a decrease in body

size (PREGILL, 1986) and more generally a change in community composition, with the settlement of species adapted to shrubby, arid and, in general, open habitats. In any case, human activity must be considered one of the main factors that explain present day composition of vertebrate communities, as well as the key factor that explains most of the recent island extinctions (WILLIAMSON, 1989).

Biogeographical data suggest that man has introduced some *taxa* on the Mediterranean islands. This may be the case among others, of *Bufo viridis* on the Gymnesic and Pityusics (HEMMER *et al.*, 1981), *Testudo marginata* on Sardinia (ARNOLD & BURTON, 1978), *Macroprotodon cucullatus* on Menorca and Mallorca (PLEGUEZUELOS *et al.*, 1994), *Vipera aspis* on Montecristo (BRUNO, 1985), *Chamaeleo chamaeleon* on Malta (BALDACCHINO, 1995), perhaps *Lacerta laevis* on Cyprus (BÖHME, 1996). But, as far as is presently known, the very well documented extinctions caused by man on some oceanic islands, such as these of *Brachylophus* on Tonga, *Chelonoidis* on Galapagos, *Dipsochelys* on Madagascar and Seychelles, and *Cylindraspis* on Mascarene, seem to have no counterparts on the Mediterranean islands (BOUR, 1984; PRITCHARD, 1986; PREGILL, 1989). Beyond the Mediterranean borders, there is evidence for human influence not only regarding the extinction of macroherpetofauna but also of microherpetofauna, such in the case of the Mascarene islands (ARNOLD, 1980).

Moreover it is convenient to note that, although traditionally studied together, amphibians and reptiles show marked differences. According to LANZA & VANNI (1987, 1990), the Eastern Mediterranean islands are poor in amphibian species and without endemic species due to their severe xerothermic conditions. Our analysis of the insular herpetofauna shows that Reptiles are quite abundant on the Eastern Mediterranean islands being less tied to the humid environment and favoured by the higher temperatures.

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