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NATURAL AND ANTHROPOCHOROUS SQUIRRELS AND DORMICE OF THE MEDITERRANEAN REGION

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ABSTRACT – In the Mediterranean Region, squirrels and dormice of natural and anthropochorous occurrence are today represented by 7 *taxa* on each. Palaeontological evidence suggests that Upper Pleistocene dispersal of the representatives of the Gliridae family seems to have occurred only on the islands of the western Mediterranean basin, whereas squirrels are not represented in insular environments. The former and present distribution of some of the extant species is discussed in the light of the human redefinition of the natural equilibrium which has been taking place since very ancient times.

Key words: squirrels, Sciuridae, dormice, Gliridae, Mediterranean Region

RIASSUNTO – ***Scoiattoli e ghiri a diffusione naturale ed antropocora della Regione Mediterranea.*** Attualmente, nella Regione Mediterranea, gli scoiattoli ed i ghiri a diffusione naturale ed antropocora sono rappresentati rispettivamente da 7 *taxa*. Il dato paleontologico suggerisce che la distribuzione insulare dei Gliridi nel corso del Pleistocene superiore abbia interessato solo il Mediterraneo occidentale, mentre gli scoiattoli non sembrano essere stati rappresentati in nessuno degli ambienti insulari. Si discute la diffusione passata e presente di alcune delle specie attuali nell'ottica della plurimillenaria ridefinizione antropica degli equilibri naturali dell'area mediterranea.

Parole chiave: scoiattoli, Sciuridae, ghiri, Gliridae, Regione Mediterranea

INTRODUCTION

The Sciuridae family represents a large and varied taxonomic group of rodents with many forms adapted for arboreal life, including the true squirrels. They occur today in all continents except Australia. Sciuridae appeared as early as the Lower Oligocene (38-37 millions years ago) both in Europe (genus *Palaeosciurus*) and in North America (genus *Protosciurus*) (Vianey-Liaud, 1985) and have evolved considerably, producing flying, arboreal and terrestrial forms, especially as regards the American ground squirrels (Mein *et al.*, 1993). In Europe, the genus *Sciurus* has apparently existed since the Miocene (26-7 millions years ago), and a form somewhat larger than *Sciurus vulgaris* L., 1758, described from Poland, has been referred to the late Pliocene chronologies and may have survived in the Villafranchian (cf. Kurtén, 1968).

Various other European records can only be determined as *Sciurus* sp. Remains referred to *Sciurus* sp. have also been provided by the palaeontological exploration of the Neogene site of Tung-gur, in China (Qiu, 1989). The earliest records of the Near Eastern form, *Sciurus anomalus* Güldenstaedt, 1785, are from the Late Acheulian period (about 150.000 years BC) (Tchernov, 1988). In North-West Africa, the genus *Atlantoxerus* is known since the beginning of the Miocene and it might have been a descendent of the genus *Heteroxerus*, known from Europe (Kowalski and Rzebik-Kowalska, 1991). The extant Barbary ground squirrel, *Atlantoxerus getulus* (L., 1758), is not known before the Pleistocene and does not seem to be a descendant of extinct species of that genus present in Maghreb in earlier periods. It might have originated from *taxa* inhabiting regions south of the Sahara (Kowalski and Rzebik-Kowalska, 1991).

The dormice form one of the most ancient rodent families, emerging in the Eocene (54-53 – 38-37 millions years ago) (Nadachoswji and Daoud, 1994). They are small to medium sized rodents, mostly arboreal, and are restricted to the Old World. In fact, the geographical range of the family (fossil and extant) is limited to Europe, Asia and Africa. The fossil record of this taxonomic group is relatively good, probably because these animals are frequently caught by owls so that their remains find their way into the deposits formed by owl pellets (Kurtén, 1968). The oldest record is from Europe, *Eogliravus wildi* Hartenberger, 1971 (Mas de Gimel, France, Early Eocene) (Daam and de Bruijn, 1994). Palaeontological evidence suggests that the dormice are of European origin and that they developed from the ischyromyoid branch of the Rodentia during a radiation that followed the opening of the North Atlantic during the Early Eocene (Daam and de Bruijn, 1994). The diversification of the Gliridae which began in the Early Eocene continued during the Oligocene and culminated in the Late Early Miocene of Europe, where they appear to have occupied many ecological niches (Daam and de Bruijn, 1994). The decline of this taxonomic group, in terms of diversity as well as of relative abundance in assemblages of fossil rodents, becomes apparent during the Late Middle Miocene, that is, before the arrival of the first Muridae in Europe (Daam and de Bruijn, 1994). From the Late Miocene onwards the Gliridae are represented in Europe, Asia and Africa by a few genera only, excluding the insular forms; a situation that has substantially persisted up to the present (Daam and de Bruijn, 1994). According to Kurtén (1968), the modern subfamily Glirinae arose in the Oligocene and is particularly well represented in the Miocene, when its first radiation took place. More modernized glirines evolved in the Pliocene and Quaternary, but relicts of the Miocene radiation survived locally in the Pleistocene, for instance on several of the Mediterranean islands.

1. The Holocene survival of endemic insular forms

From the Mediterranean islands

palaeontological evidence reports fossil remains of only the Gliridae taxonomic group, and not of squirrels. The archaeological exploration of Sicily, for example, provided remains of one endemic species of Villafranchian age (faunal stage of Monte Pellegrino), taxonomically attributed to *Maltamys* cf. *gollcheri* (de Bruijn, 1966) (Thaler, 1972). There is also evidence of the occurrence in the Middle/Upper Pleistocene of the Siculo-Maltese archipelago of at least three different dormice, such as *Leithia melitensis* (Adams, 1863), *Leithia carthei* (Adams, 1863), and *Eliomys wiedincitensis* (Zammit Maempel and de Bruijn, 1982), yielded by the archaeological investigation of the Middle/Upper Pleistocene faunal stages of Spinagallo and Maccagnone (Burgio, 1997). The first two *taxa* were originally included by Adams (1863 and 1870) in the same genus *Myoxus*, formerly referred to the extant edible dormouse, whereas the latter was initially described as belonging to the peculiar genus *Maltamys* (Alcover *et al*., 1999). The giant dormouse, *L. melitensis*, was twice the size of the extant edible dormouse, *Glis glis* (L., 1766) (Petronio, 1970). *L. carthei* was instead described as a form of smaller size, "… *but not differing in any other respect from the* Myoxus melitensis" (Adams, 1870). Among the characteristic features yielded by the Quaternary endemic faunas of the Mediterranean islands, rodents often display the tendency to become larger than their mainland counterparts (Azzaroli, 1971 and 1977; Sondaar, 1971, 1977 and 1986). This phenomenon is generally assumed to be primarily a consequence of the genetic isolation from continental populations, a quantitative and qualitative reduction in food supply, an alteration of intraspecific competition, the absence of large carnivores and perhaps also of endothermic adaptations (Masseti and Mazza, 1996).

Palaeontological evidence suggests that late Pleistocene dispersal of the representatives of the Gliridae family seems to have occurred only on the islands of the western Mediterranean basin (Fig. 1). According to Boekschoten and Sondaar (1972), glirids are in fact absent from the eastern islands where they were more or less replaced by diversified murids. This difference may be caused by faunal differences on the nearest mainland, and would lead us to assume a predominance of glirids in the western Mediterranean coastal areas and of murids in the eastern Mediterranean at the time of immigration. Some *taxa*, such as *Eliomys morpheus* (Bate, 1918) recorded from the Balearic islands of Mallorca and Menorca, are distinctly relics from the Tertiary, but survived up to late Pleistocene, and even Holocene chronologies (Alcover *et al*., 1999). Also this was a giant dormouse, initially described in the genus *Hypnomys* Bate, 1918, which was later on recognized as a subgenus of *Eliomys* by Zammit Maempel and de Bruijn (1982). The extinction of the Balearic dormouse is possibly linked to the appearance of man on the two islands, perhaps not before the 3rd millennium B.C. On Mallorca the most recent date for remains of *E. morpheus*, provided by the exploration of Cova Estreta is c.

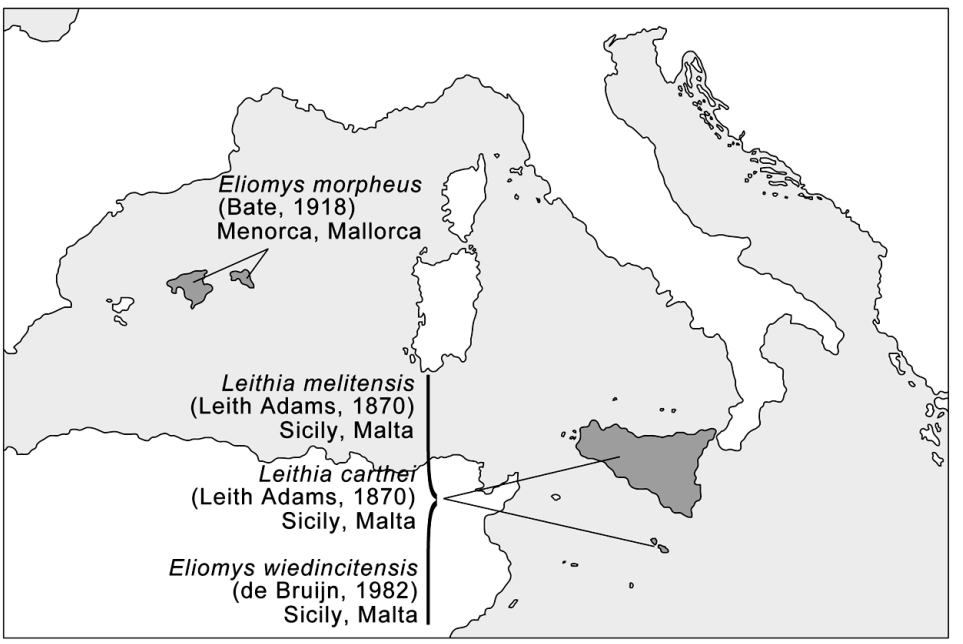

Figure 1 - Middle and Upper Pleistocene distribution of endemic glirids on the Mediterranean islands.

6.000 years bp (Encinas and Alcover, 1997). Human occupation layers dated to 4.000 years bp lack this species (Waldren, 1982; Sanders and Reumer, 1984; Lewthwaite, 1985), indicating that the extinction of the dormouse probably took place between these two dates (Alcover *et al.*, 1999). Also *E. wiedincitensis* has been included by Alcover *et al*. (1999) among the endemic forms that survived in the Holocene of Malta.

2. Present natural and anthropochorus distribution of squirrels in the Mediterranean region

Of the tree-squirrels, the genus *Sciurus* is represented by two species in the Palaearctic: the European red squirrel, *Sciurus vulgaris* L., 1758, in Europe and northern Asia and the Persian squirrel, *Sciurus anomalus* Gueldenstaedt, 1785, in southwest Asia. Together with the Barbary ground squirrel, *Atlantoxerus getulus* (L., 1758), dispersed in north-western Africa, the squirrels of natural - non anthropochorous - occurrence along the Mediterranean shores are today represented only by these 3 *taxa*.

2.1 Persian squirrel or golden squirrel, *Sciurus anomalus* Gueldenstaedt, 1785

This is a medium-sized arboreal squirrel, which occurs in Asia Minor, Northern Arabia, including Lebanon, Syria, Jordan and northern Israel, Transcaucasia and western Iran (Harrison and Bates, 1991; Gavish, 1993; Gavish and Gurnell, 1999;

Mendelsshon and Yom-Tov, 1999). The presence of this species has also been reported from the Mediterranean islands of Gökçeada (Imbros), Turkey (Özkan, 1995 and 1999; Gavish and Gurnell, 1999) and Lesbos, Greece (Ondrias, 1966; Hecht-Markou, 1994 and 1999; Gavish and Gurnell, 1999), has been introduced – the southern Urals and the Altai mountains in central Mongolia, to north-east China (Gurnell and Wauters, 1999b). Red squirrels are also found on the island of Sakhalin off the eastern coast of Russia, and on the most northerly Japanese island of Hokkaido. Perhaps with the exception

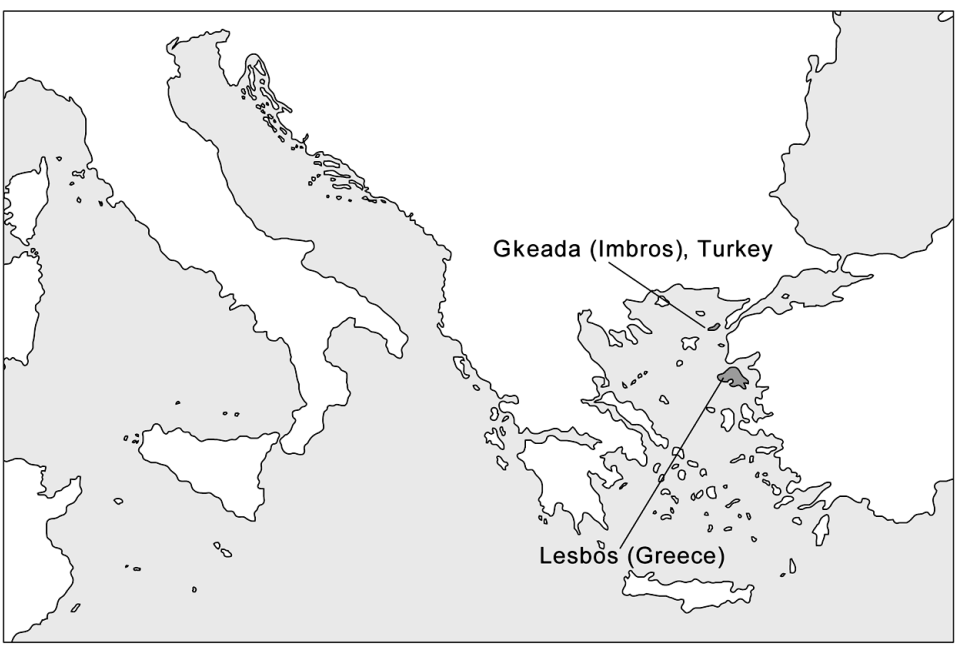

Figure 2 - Present occurrence of the Persian squirrel in the Mediterranean islands.

in the Eastern Aegean sea (Fig. 2). The natural colonisation of these two islands by the species cannot be excluded.

2.2 European red squirrel, *Sciurus vulgaris* L., 1758

This is a medium sized arboreal squirrel, essentially characterised by a palaearctic distribution, ranging from the British Isles in the west, south to the Mediterranean, the Caucasus – where it of Euboea, the natural occurrence of the species on Mediterranean insular environments is practically unknown, and their presence on some of these islands, such as Veli Brijuni (Croatia) (Scotti, 1980), is essentially regarded as a consequence of recent human intervention (Fig. 3).

2.3 Barbary ground squirrel, *Atlantoxerus getulus* (L., 1758)

This is a monotypic species native to

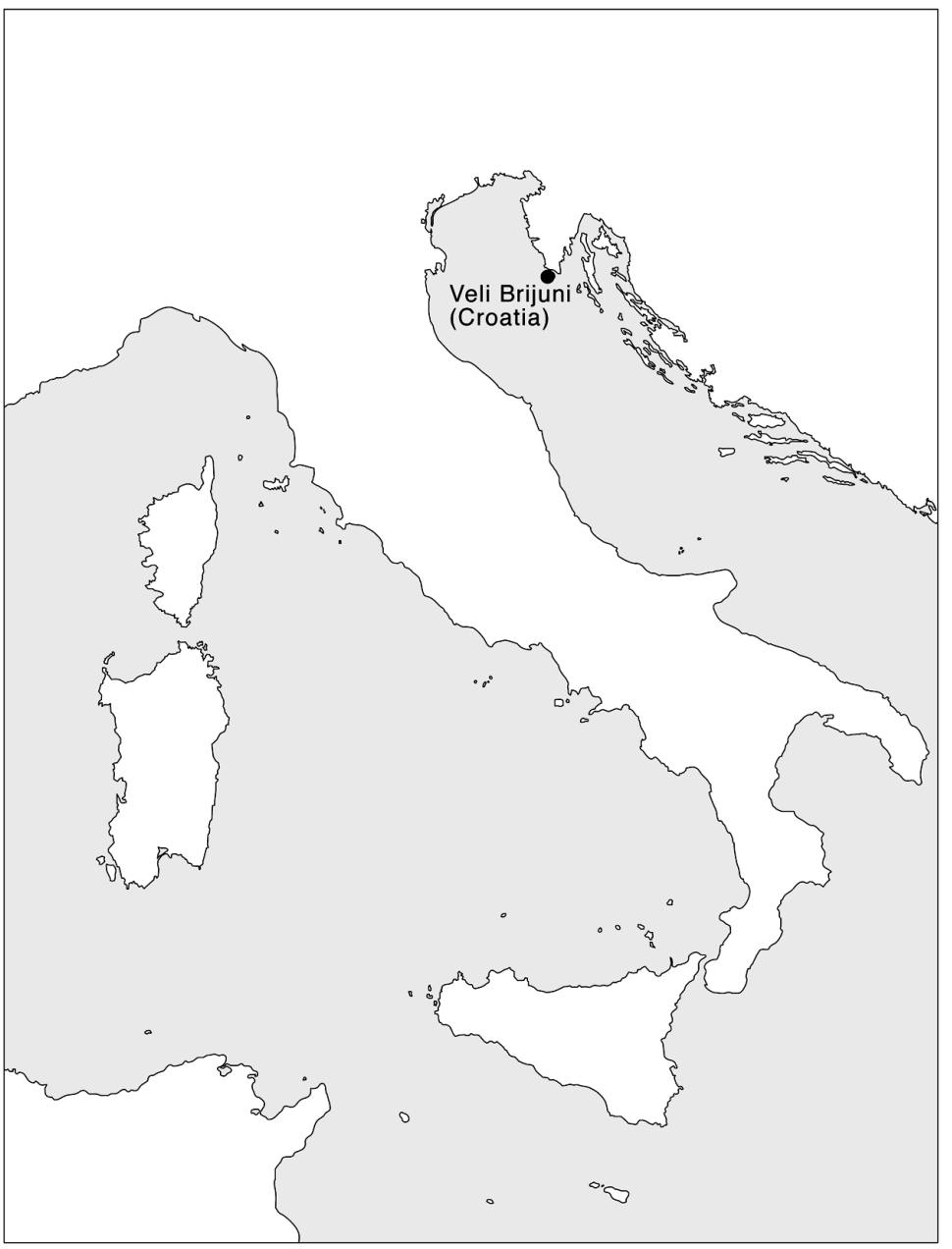

Figure 3 - Present occurrence of the red squirrel in the Mediterranean islands.

north-western Africa, where it is naturally widespread in Morocco, Grand and Middle Atlas (up to 4.000 m) south to Agadir and north-west Algeria up to El Abiod Sidi Cheikh in the east (Kowalski and Rzebik-Kowalska, 1991). From northern Maghreb this taxon has been introduced onto the Canary archipelago (Moreno, 1992), in 1965 on the island of Fuerteventura

(Machado Carrillo, 1985; Moreno, 1992; Rodriguez Luengo and Garcia Casanova, 2002), and later on in Gran Canaria (Calabuig, 1999; Rodriguez Luengo and Garcia Casanova, 2002).
Scientific travellers and other authors of the past have occasionally reported the diffusion on the Mediterranean islands of squirrels that are today completely unknown among the respective faunal assemblages. Werner (1928), for example, quoted the occurrence of a kind of squirrel on the island of Skyros, in the archipelago of the Northern Sporades (north-western Aegean sea, Greece), where he collected a specimen between the villages of Skyros and Linaria which he described as "*Sciurus lilaeus*". According to Ellerman and Morrison-Scott (1951), this *taxon* is used to define a Greek subspecies of the red squirrel, *Sciurus vulgaris lilaeus* Miller, 1907, characteristic of the region of Mount Parnassus in continental Greece. Nevertheless, the occurrence of the same species on Skyros was subsequently also recorded by other authors such as Wettstein (1942), followed in very recent times by Cheylan (1988). On the basis of the authority of Werner, and to an even greater extent that of Wettstein, it is very difficult to refute the truth of these reports, even if red squirrels are today completely unknown on Skyros and the other islands of the Aegean basin, perhaps with the exception of Euboea. Furthermore, it is interesting to recall that these rodents are also practically unknown in the majority of the remaining Mediterranean islands, where, as already observed, representatives of the genus *Sciurus* L., 1758, occur only on Lesbos and Gökçeada. As already observed, the latter two islands are, however, inhabited by another species of squirrel, the Persian squirrel, whose westernmost continental distribution extends to far-eastern Europe and western Anatolia. At the same time, however, there is no evidence to exclude the former diffusion of red squirrels on Skyros, where a population of the species could have existed up to the first half of the twentieth century, later becoming extinct. Red squirrels could have been imported by man into the island from Euboea, where their presence was reported by Lindermayer (1835) in the first half of the nineteenth century. In the light of modern ethnozoological enquiry, it would also appear that squirrels figure among those species of mammals which have been the subject of particular human attention for a variety of cultural purposes, and/or for food. In some areas of the southern Levant (Jordan), for example, people still eat Persian squirrels and live specimens are regularly sold in the markets (Mendelsshon and Yom-Tov, 1999).
Another four species of squirrels have been introduced, at least since the 19th-20th centuries, in several areas of the Mediterranean. These are as follows.

2.4 Grey squirrel, *Sciurus carolinensis* Gmelin, 1788

The original distribution of this nearctic species was restricted to eastern North America, where it ranged from the Gulf of Mexico north to the Great Lakes and the St Lawrence river, and west to the prairies (Lever, 1994). It has been intro-

duced in Australia (where it is now extinct), South Africa, Great Britain, Ireland and Italy (Lever, 1985; Gurnell, 1987). Records of the first importations to Europe are referred to those carried out from USA and Canada to Great Britain several times with translocations between 1876 and 1929 (Lever, 1994; Gurnell and Wauters, 1999a).
In Italy the species was introduced for the first time in the site of Candiolo (Torino) in 1948 (Currado *et al.*, 1987). From here the grey squirrel became progressively diffused until it occupied a range of several hundred square kilometres, and it is now present with a population of several thousand individuals (Bertolino *et al.*, 2000). The expansion recorded in recent years has led this population to colonise certain areas of the Alpine foothills, and at present a progressive expansion along the Alpine Arc is considered highly probable (Genovesi and Amori, 1999; Genovesi and Bertolino, 2000). The second Italian nucleus has developed around Genova Nervi following the release of five specimens which took place in 1966; the population currently present is estimated at around several hundred individuals distributed over a range extending between Nervi and Bogliacco (Currado *et al.*, 1997; Bertolino *et al.*, 2000). Finally, the third nucleus is of more recent origin, having been created through the release of three pairs in Trecate (Novara) in 1993; reports from some protected areas located within the administrative boundaries of the regions of Piedmont and Lombardy lead us to believe that this population too is spreading along the valley of the river Ticino (Currado *et al.*, 1997; Bertolino *et al.*, 2000).

2.5 Pallas's squirrel, *Callosciurus erythraeus* (Pallas, 1778)

The only free-living population known in Europe is that introduced to Cap d'Antibes (Alpes-Maritimes, France) in the early 1970s (Jouanin, 1986). The original distribution of this species ranges from Sikkim, Bhutan and Assam east through Burma to S. China, including Sichuan north of the Yangtze, and south to Indochina, Thailand and Malaya, as well as on Taiwan and Hainan (Corbet and Hill, 1992). It is however absent from much of central Thailand occupied by the co-generic *C. finlaysonii* (Horsfield, 1824).
The squirrels of Cap d'Antibes seem to belong to the subspecies *C. e. erythrogaster* Blyth, 1843, from the areas of Assam and Myamar (Burma) between the rivers of Brahmaputra and Chindwin (Gurnell and Wauters, 1999c).

2.6 Variable squirrel or Finlayson's squirrel or Thailand tree squirrel, *Callosciurus finlaysonii* (Horsfield, 1824)

The homeland of this species comprises Thailand, Cambodia and Laos, perhaps with an isolated population in Burma, east of the lower Irrawaddy (Corbet and Hill, 1992). Until a few years ago, the only known European population of the *taxon* was reputed to be that of Acqui Terme (Alessandria), in north-western Italy (Currado *et al.*, 1999; Bertolino *et al.*, 2000; Andreotti *et al.*, 2001). This was originated by the

release of two pairs of animals into an urban park in the early 1980s (Bertolino *et al.*, 2000). Recently, however, the presence of the species was recorded on the Tyrrhenian coast of Basilicata, where the current population is apparently derived from the release of several specimens by private citizens in the distric of Maratea, again in the 1980s (Aloise *et al.*, 2003; G. Aloise and M. Cagnin, *in verbis*) (Fig. 4).

2.7 Siberian chipmunk, *Tamia sibiricus* (Laxmann, 1769)

This is a *taxon* characteristic of the northern Palaearctic, where its natural distribution ranges from northern Russia across Asia as far as Siberia and China and the islands of Sakhalin, Hokkaido and S. Kurile (Corbet, 1978). It has been introduced by man to western Europe, where isolated populations are today present in Belgium, Germany, The Netherlands, France, Switzerland and Italy (Amori, 1999; Andreotti *et al.*, 2001). In Italy the population which has established itself along the Piave in the vicinity of Belluno originated in 1969-1970, following the escape of several individuals from a pet shop, expanding subsequently within a range of at least 3 km from the point of the escape (Dal Farra *et al.*, 1996). The chipmunk also proves to be recorded in certain districts of Piedmont, Liguria, Friuli-Venezia Giulia, Trentino and Lazio (Amori and Gippoliti, 1995; Dal Farra *et al.*, 1996). Several unsuccessful attempts at release in urban and suburban parks and gardens took place in the course of the 1970s in Tuscany, in the Florence-Prato area.

In the course of the last decade, the specie has been sporadically reported in Lombardy, for the park of the valley of Ticino (B. Valenti, pers. com.).

3. Present natural and anthropochorous distribution of dormice in the Mediterranean region

The Gliridae are a monophyletic family that is represented by only eight genera and some thirteen or fourteen species in the extant fauna (Daam and de Bruijn, 1994). In the Mediterranean Region this group comprises the following 7 species.

3.1 Edible dormouse, *Glis glis* (L., 1766)

Also known as fat dormouse or squirrel-tailed dormouse, it is dispersed in Europe, including several Mediterranean islands (in most of which it has been introduced by man in ancient times), northern Asia Minor, the Caucasus and north-western Iran (Storch, 1978). Outside its natural continental distribution it is naturalised in England (Lever, 1994; Yalden, 1999).

3.2 Common dormouse or hazel dormouse, *Muscardinus avellanarius* (L., 1758)

It belongs to a monospecific genus closely allied to *Glis*, characterised by a western Palaearctic distribution which comprises most of Europe – apart from south-western France and the Iberian peninsula – and northern Anatolia; as far as it is presently known, the Mediterranean island population includes only Sicily and Corfu (Greece) (Morris, 1999).

Figure 4 - Present distribution of the variable squirrel in Italy.

3.3 Asian garden dormouse or black-tailed dormouse, *Eliomys melanurus* Wagner, 1840

It occurs in North Africa from Morocco to Egypt, western Arabia and the Levant (Harrison and Bates, 1991;

Mendelsshon and Yom-Tov, 1999).

3.4 Garden dormouse, *Elyomis quercinus* (L., 1766)

This species is endemic to Europe where it is found from the western Iberian peninsula to the Urals; the species is today absent from the British Isles, where it was instead recorded in settlements of Roman age, probably as a result of human introduction (Filippucci, 1999). It is present, and has been recently recorded, on several western Mediterranean islands, such as Menorca, Mallorca, Formentera, Corsica, Sardinia, Capraia (Tuscan archipelago), Sicily, Lipari (Aeolian archipelago), and on the Croatian islands of Krk, Brač, Hvar, Šćedro, Korčula, and Lastovo (Corbet, 1978; Alcover, 1988; Filippucci, 1999; Amori and Masseti, 1996).

3.5 Forest dormouse, *Dryomis nitedula* (Pallas, 1778)

It is distributed from eastern Switzerland and north-eastern Italy, across eastern Europe and Asia Minor to the east as far as Mongolia and the Tien Shan mountains in China (Ondrias, 1966; Corbet and Hill, 1991; Harrison and Bates, 1991). There are some isolated populations in southern Italy (Basilicata and Calabria) (Lehmann, 1964; Toschi, 1965; Paolucci *et al.*, 1987; Cagnin and Aloise, 1994). While Kryštufek (1999) recorded this species as not occurring on European islands, Ondrias (1966) and Cheylan (1988) include it among the non-flying terrestrial mammals of Euboea. The occurrence of this species on the Cycladic island of Andros, recorded by Chondropoulos and Frageudakis-Tsolis (*in verbis*), is still to be confirmed.

3.6 Woolly dormouse, *Dryomis laniger* Felten and Storch, 1968.

Its range is restricted to south-western Asia Minor, from the Taurus Mts (Felten *et al.*, 1973) to eastern Anatolia (Mursaglolu, 1973; Kryštufek and Vohralik, 2001).

3.7 Mouse-tailed dormouse, *Myomimus roachi* (Bate, 1937).

It is distributed in the easternmost Balkan peninsula (Thrace and south-east Bulgaria) and Asia Minor (Kurtonur and Özkan, 1991; Filippucci and Peshev, 1999).

In considering the diffusion of several of these species of glirids in the Mediterranean region, and in particular on the islands, it is useful to cast further light upon the way in which the erroneous evaluation, or rather the inattentive reading, of the pages of authors of the past has given rise to cultural models which are still difficult to eradicate. Let us take, for example, the supposed former occurrence of *D. nitedula*. Erhard (1858) reported the diffusion of a species of glirid, similar in name to the forest dormouse, which he called *Myoxus nitela* Schreber, 1782, on the Cycladic islands of Andros, Naxos and Siphnos, where it occurred in orchards and orange groves; it was in fact believed that it fed on citrus fruits. This

report gave rise to the belief in the diffusion of this rodent on these islands, but in reality the taxonomic classification does not correspond to that of the forest dormouse. In fact, in Ellerman and Morrison-Scott (1951) *Myoxus nitela* Schreber, 1782, is indicated as one of the synonyms of *Eliomys quercinus* (L., 1766), that is of the garden dormouse, a species currently unknown in the Aegean area, being widespread, as already observed, in the central-western Mediterranean basin, where it is not found further east than Dalmatia and the north-western Balkan peninsula. As already observed, although according to Kryštufek (1999), *D. nitedula* does not occur on Mediterranean islands, Ondrias (1966) and Cheylan (1988) reported it from Euboea. Recently the presence of the forest dormouse has also been recorded from the island of Andros (Chondropoulos and Fraguedakis-Tsolis, *in verbis*), although this has yet to be confirmed. We have, on the other hand, known for some time of the presence of the edible dormouse on islands such as Crete (Zimmermann, 1953; Kahmann, 1959; Niethammer and Krapp, 1978), Euboea (Ondrias (1966), Corfu (Niethammer, 1962; Niethammer and Krapp, 1978), and Cephallonia (Niethammer and Krapp, 1978; Giagia-Athanassopoulou, 1998). On Cephallonia its occurrence has been recently confirmed by H. Pieper (*in litteris*), whereas Dimaki (1999) provided elements for the existence of the species on Andros. According to H. Alivitzatos and A. Lane (*in verbis*), the edible dormouse is also present on the island of Thassos, where some evidence for the occurrence of the species was found in the surroundings of the village of Panaghia, on August 2000. Another report of the occurrence of a type of dormouse, possibly the forest dormouse, is recorded by Wettstein (1942) from the island of Rhodes where, however, according to other authors the species was, and still is, unknown (cf. Festa, 1914; De Beaux, 1929; Zimmermann, 1953).

4. The forest dormice of Pyrgy central Italy (6th-5th century B.C.)

Let's now focus on the extant distribution of the forest dormouse in continental Italy. As we have already seen, this species is characterised by a very peculiar distribution, markedly fragmented and divided into two ranges, one in north-eastern Italy which represents the south-western border of the continuous European range (Paolucci *et al.*, 1987; Nappi, 2001) and the other with isolated nuclei located very far to the south of the peninsula, in Basilicata and Calabria (Lehmann, 1964; Toschi, 1965; Filippucci *at al.*, 1985; Cagnin and Aloise, 1994; Capizzi and Santini, 2002).

However, the indication of a much more extensive distribution of the species within the Italian peninsula in the past has been provided by the recovery of certain remains in the fossil layers of the Upper Pleistocene of the Grotta Breuil, on Monte Circeo (Latina) (Kotsakis, 1990-1991; Alhaique *et al.*, 1995), dating to the last glacial episode. Referring instead to much more recent chronologies is the singular discovery of *D. nitedula* in a well of the Etruscan sanctuary of Pyrgy,

near Santa Severa in Upper Lazio (Caloi and Palombo, 1980). The chronological span of this material has been comprised within the first half of the 6th century BC and the first half of the 5th century BC. (Colonna, 1970) (Fig. 5). More than being faced with the evidence of a broader natural distribution of the species in the Italian environment, in this case what we could actually be dealing with is evidence of an alteration of the range attributable to

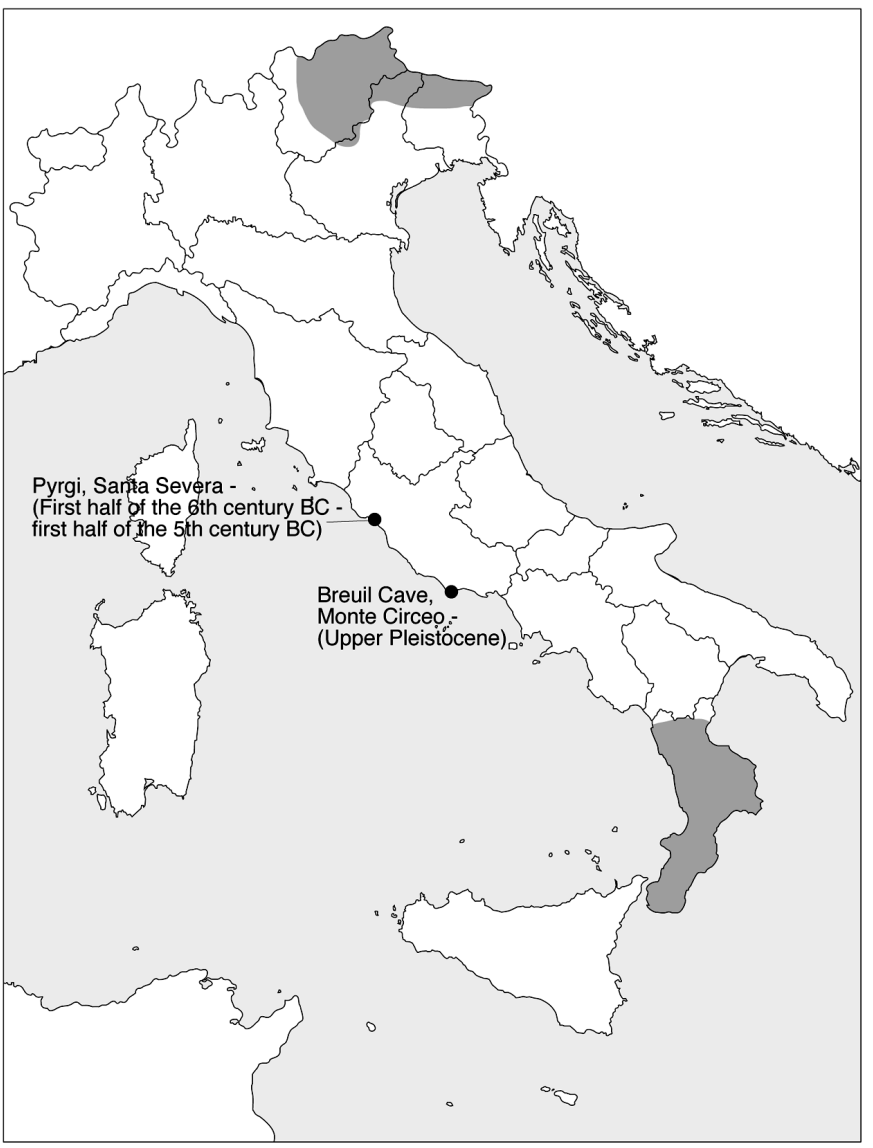

Figure 5 - Former (dots) and present (grey) distribution of the forest dormouse in Italy.

human action. As has been extensively documented by the investigation carried out by André (1981), Carpaneto and Cristaldi (1994) and Colonnelli *et al*. (2000), in the Mediterranean region a remarkable human impact on the geographical distribution of some dormouse species and their population density can be documented since antiquity through historical and biogeographical analyses, supported by paleontological and archaeozoological data. Furthermore, ethnozoological investigations document the utilisation of dormice for food or medicine in several areas of the Italian territory, through traditional captive-breeding techniques, up to very recent historical times. On several Italian islands, for example, the extant occurrence of some of these rodents, such as the edible dormouse on Elba, Corsica, Sardinia and Salina (Aeolian archipelago), and/or the garden dormouse on Corsica, Sardinia, perhaps Capraia (Tuscan archipelago), and Lipari (Aeolian islands) (cfr.: Cristaldi and Amori, 1982; Amori and Masseti, 1996), might be interpreted as the sole objective evidence that has survived of their ancient artificial diffusion (Masseti, 2002). In the specific case of the island of Capri, Gulf of Sorrento (south-western Italy), findings of garden dormice in a cave on the eastern slopes of Monte Solaro, within an archaeological context characterised by faunal remains of recent age, raise intriguing questions about the chronology of the appearance of this rodent on the island. This appearance has, in fact, been considered as contemporary with the introduction of the black rat, *Rattus rattus* (L., 1758), onto the island (Barbera and Cimmino, 1990), which is believed to have occurred on Capri not before the 5th century AD. (Albarella, 1992). The edibility of dormice was one of the major preoccupations of the Latin authors of the Classical Age, such as Varro (*Res rustica*, 3.15. 1-2), Pliny the Elder (*Naturalis historia*, 8.224), Apicius (9.1.1), and Petronius (31.10). According to King (2002), it seems however that small glirids, such as the common and the garden dormice, were not eaten, unlike *Glis glis*. In any case, ancient sources were imprecise about dormice and could be referring to any of the common species, although the edible dormouse probably attracted the most attention by virtue of its larger size and its consumption as a delicacy.

5. CONCLUDING REMARKS

Throughout most of the 19th and 20th centuries, it was common practice for the scientific explorers to bring home an excessive number of subspecies from their explorations of the Mediterranean islands. In fact, previous authors often classified many of the modern non-flying terrestrial mammals of these territories as subspecific and/or geographic forms, almost entirely on the basis of arbitrary criteria and the examination of scattered materials. Based on the data given in literature, the various subspecies are distinguished by the coat patterns, and by the size of body and skull. This leads us naturally to reconsider the great taxonomic proliferation to which the various populations of the Sciuridae and Gliridae of the Mediterranean islands have been subject, for the purposes of their classi-

fication at subspecies level. Regarding this, we ought to consider the taxonomic treatment, on the part of the international scientific community, of the edible dormice of the Tyrrhenian and Aegean islands (*Glis glis insularis* Barrett-Hamilton, 1898; *G. glis melonii* Thomas, 1907; *G. glis argenteus* Zimmermann, 1953), as well as the garden dormice of the Balearics, Corsica, Sardinia, and Lipari (*Eliomys quercinus gymnesicus* Thomas, 1903; *E. quercinus ophiusae* Thomas, 1925; *E. quercinus sardus* Barrett-Hamilton, 1901; or *E. quercinus liparensis* Kahmann, 1960) (Tab. 1). But, in the majority of cases, these populations originated from continental populations introduced by man, since the diffusion of their ancestors is not documented among the insular Quaternary faunal horizons. As is consequently understandable, this led to a multiplication of forms which now, however, demand better taxonomic and genetic definition. The examination of fossil materials helps to indicate the previous distribution of the different species on the basis of the location of the osteological deposits which contained their remains. However, to assess the original range of the species, earlier chronologies prior to the Neolithisation (end of 7th-6th millennium B.C.) of the Italian territories, for instance, should be considered, after which improved human sea-faring skills and the established commercial networks between the Mediterranean countries enabled the artificial exportation of faunistic species of cultural interest, together with those already involved in the process of domestication (Masseti 1998; Lorenzini *et al.*, 2002). Looking again at the former distribution of the squirrels and dormice in southern Italy, and in particular in the territories within the extant political boundaries of the regions of Basilicata and Calabria, it is almost impossible to find, for example, information about the original diffusion of *D. nitedula*. Data are in fact only available for the occurrence of the red squirrel (Bulgarelli, 1972), the edible dormouse

Table 1 - Subspecies of the present representatives of the families Sciuridae and Gliridae (Mammalia, Rodentia) described for the Mediterranean islands (E = endemic subspecies).

Taxon		Island	References
Sciurus vulgaris lilaeus		Greece and Skyros island	Miller, 1907
Glis glis insularis	E	Sicily	Barrett-Hamilton, 1898
Glis glis melonii	E	Corsica and Sardinia	Thomas, 1907
Glis glis argenteus	E	Crete	Zimmermann, 1953
Muscardinus avellanarius pulcher		Southern Italy and Sicily	Barrett-Hamilton, 1898
Muscardinus avellanarius zeus		Greece and Corfù	Chaworth-Musters, 1932
Eliomys quercinus gymnesicus	E	Mallorca and Menorca	Thomas, 1903
Eliomys quercinus ophiusae	E	Formentera (Balearics)	Thomas, 1925
Eliomys quercinus sardus	E	Corsica and Sardinia	Barrett-Hamilton, 1901
Eliomys quercinus liparensis	E	Lipari (Aeolian islands)	Kahmann, 1960

(Topa, 1933; Bulgarelli, 1972) and the common dormouse (Bulgarelli, 1972) (Tab. 2; Fig. 6). The forest dormouse does not appear to be represented among the Pleistocene fossil findings of these territories, giving rise to intriguing questions about its origin.

Table 2 - Fossil remains of squirrels and dormice provided by the exploration of some Würmian sites in Calabria region (southern Italy); MUW = Middle and Upper Würm, LW = Lower Würm

Taxon	Palaeontological site	Age	References
Sciurus vulgaris	Torre Nave, Praia a Mare (CS)	MUW	Bulgarelli, 1972
Glis glis	Grotte di Cirella, Diamante (CS)	LW	Topa, 1933
Glis glis	Torre Nave, Praia a Mare (CS)	MUW	Bulgarelli, 1972
M. avellanarius	Torre Nave, Praia a Mare (CS)	MUW	Bulgarelli, 1972

Given the lack of information about its distribution in southern Italy, in the present state of knowledge is it possible that this species was introduced for food or for other cultural purposes in ancient times? Effectively we ought to bear in mind the existence of considerable information regarding the translocation of different zoological *taxa* that was performed by man between northern and southern Italy in antiquity, such as, for example, the hypothesised introduction of the subspecies of asp viper, *Vipera aspis hugyi* Schinz, 1833, characteristic of southern Italy and Sicily, onto the island of Montecristo in the Northern Tyrrhenian sea (Bruno, 1985; Zuffi and Bonnet, 1999; Zuffi, 2001).

Or is the absence of the forest dormouse from the fossil horizons of southern Italy instead to be directly related to the evidence of palaeontological sampling biases? The invitation is to further study which, if conducted in the correct manner, integrating the information to be derived from the palaeontological, archeozoological, neontological and genetic ambits, will be bound to make a further illuminating contribution to a better understanding of the origin of *D. nitedula* in southern Italy, within the more general framework of the modern definition of Mediterranean mammal fauna.

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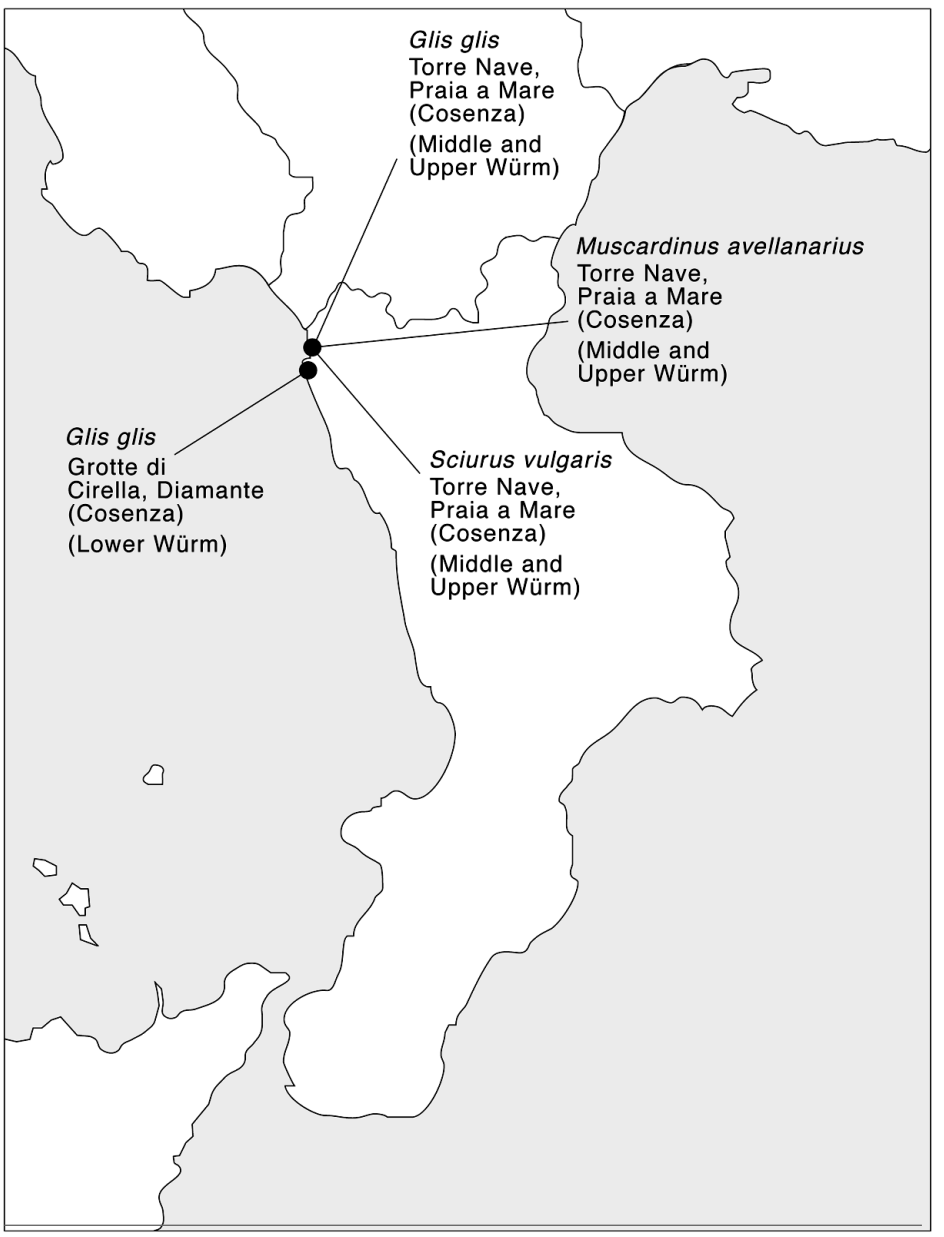

Figure 6 - Geographical location of the prehistoric sites of Calabria (southern Italy) that provided Würmian remains of squirrels and dormice.

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