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Extinct and living mammals of the island of Marettimo (Aegadian archipelago, Trapani), off the north-western Sicilian coast (Italy): a review of evidence and historical data

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ABSTRACT Marettimo island is the furthest of the Aegadian archipelago from the coast of north-western Sicily. Nevertheless, the presence of continental and non-endemic mammals on the island has been documented since the Mesolithic period. Over the course of historical times the introduction of mammals on the small island has continued without any apparent solution of continuity, even attempting to involve neo-Arctic species such as the Eastern cottontail. Recently, evidence has been found of the monk seal visiting some of the island's caves.

KEY WORDS Anthropocorus mammals, island ungulates, monk seal, Eastern cottontail.

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INTRODUCTION

Located off the northwestern coast of Sicily (Italy), the Aegadian archipelago consists of the three main islands of Favignana, Levanzo and Marettimo (Fig. 1). The latter (37°55'N, 12°04'E, 12 sq.km) is the furthest from Sicily, which is about 30 km away. Marettimo has separated from the mainland several millennia before the other two islands of the archipelago. The result is that there are some endemic plants, such as the *Brassica macrocarpa* Guss., and the fennel *Seseli bocconi* Guss., a shrub that grows on the cliffs around the Semaforo (cf. Pignatti, 1982). Along the coastal belt, typical plants of the Mediterranean garrigue vegetate, such as *Helichrysum pendulum* C. Prest, *Rosmarinus officinalis* Schleid., *Euphorbia dendroides* L., and *Euphorbia bivonae* Steud. At higher altitudes, *Erica multiflora* L., *Cistus incanus* L., *Ruta chalepensis* L., *Daphne oleifolia* Lam., *Quercus ilex* L., *Pinus halepensis* Mill., *Lonicera implexa* Aiton, *Buplerum* sp., *Scabiosa* sp., and *Dianthus* sp. thrive as for example around the highest peak of the island which culminates at 686 m above sea level, on Monte Falcone (Francini & Messeri, 1956) (Fig. 2).

In various times of the year, Marettimo is visited by numerous migratory ornithic species (Massa, 1973; Agostini et al., 2000; Massa et al., 2015), including herons and woodcocks, *Scolopax rusticola* L., 1758, while the resident species comprise wild pigeons, *Columba livia* Gmelin, 1789, ravens, *Corvus corax* L., 1758, Bonelli's eagles (Vieillot, 1822), peregrine falcons, *Falco peregrinus* Tunstall, 1771, yellow-legged gulls, *Larus michahellis michahellis* Naumann, 1840, and barn owls, *Tyto alba* (Scopoli, 1769). The island is also one of the few Italian territories to host a colony of the rare storm petrel, *Hydrobates pelagicus* (Linnaeus, 1758) (Brichetti & Fracasso, 2003), and of the Eleonora's falcon, *Falco eleonorae* Géné, 1834

(Premuda & Mellone, 2008). In medieval times, the circum-Sicilian islands were considered an important natural reservoir for the gathering of birds of prey for hunting activities (Bresc, 1980). Among them, the rocky solitudes of Marettimo represented one of the most interesting places for collecting falcons (Masseti, 2016).

MAMMALS OF THE PAST

In Late Pleistocene-Early Holocene times, the Aegadian Islands were populated by a very interesting mammalian fauna, including many continental species, as is also documented by the numerous artistic testimonies of the Grotta del Genovese on Levanzo (Graziosi, 1962; Masseti & Rustioni, 1990). Osteological remains of the common fox, *Vulpes vulpes* (L., 1758), the European onager, *Equus hydruntinus* Regalia, 1907, the wild boar, *Sus scrofa* L., 1758, the red deer, *Cervus elaphus* L., 1758, and the wild ox, *Bos primigenius* Bojanus, 1827, have been recorded from Favignana and Levanzo (Malatesta, 1957; Mannino et al., 2012; Graziosi, 1950, 1973; Cassoli & Tagliacozzo, 1982; Mannino & Thomas, 2010; Tusa et al., 2013), while the occurrence of the European water vole, *Arvicola amphibious* L., 1758, has been reported only from the latter island (Cassoli & Tagliacozzo, 1982). On Marettimo, the recent archeological exploration of the fossiliferous sand of Grotta del Tuono has provided remains of rayed Mediterranean limpets, *Patella caerulea* (L., 1758), and red deer (Antonioli et al., 2016a) (Fig. 3). Carbon 14 testing of these finds has resulted in the dating of 11, 617 +/-150 BP (Lo Presti et al., 2019), frankly placing them in Mesolithic or at least Pre-Neolithic times. According to Antonioli et al. (2016a), this would imply an important and novel interpretation for the history of seafaring that for the Mediterranean Sea seems to have started with the Neolithic (Mannino, 2015).

Figure 1. Map showing the location of the Aegadian Islands in western Sicily.

The dating of the Marettimo deer teeth would suggest that the large-sized mammals of the most distant of the Aegadian Islands was still present in fairly recent times (see also Antonioli et al., 2016b). Archaeological evidence suggests that these late Mesolithic deer may not have reached Marettimo by swimming, but may have been brought there by humans.

The Late Pleistocene-Early Holocene fauna was destined to disappear in the following epochs even if still in the 12th century AD, Idrisi, the famous Arab geographer at the court of Roger II, described Marettimo as without ports but rich in ungulates: "*… to the west of the island is Marettimo, situated opposite Tunis and Carthage and thirty miles from Favignana; it lacks ports and its fauna includes goats and gazelles*" (cf. Amari & Schapparelli, 1883; Rizzitano, 1994). The latter ungulates may have been introduced for hunting purposes. In fact, it has been an established technique since antiquity to release big game on remote islands in order to provide an always available supply of meat along the maritime routes. Afterwards, it seems that the reputation of Marettimo remained almost unchanged for some centuries since, in the first half of the 14th century, another Muslim geographer, Sahab Ad Din Abu al-Abbas Ahmad Ibn Yahya al-Umari, probably taking up what was already indicated by Idrisi, still reported in his *Masâlik 'al 'Absâr* that on *Gazirat Malîtima*, (= "island of Marettimo") "*There are some antelopes and wild goats*" (cf. Ruta, 2007). Unfortunately, it is not known whether these last ungulates described by the Arab scholars were really gazelles, which species of them, or some other type of bovid, but as a whole, it seems that the Aegadian archipelago has shown since ancient times its vocation as a territory to be reserved for game breeding (Masseti, 2016). Even in not so remote times, in its perfumed scrub, other large fauna must be experienced, such as the *ciervos y puercos* (= "deer and

Figure 2. View of the island of Marettimo (Aegadian Islands) from Pizzo Semaforo towards Punta Troia (photo by Vito Vaccaro).

Figure 3. Osteological remains and teeth of red deer, *Cervus elaphus* from Grotta del Tuono, Marettimo (from Antonioli et al., 2016a).

pigs") that in 1513 were decimated by the Spanish crews of Pietro Navarro's ships after they landed at Favignana (Di Marzo, 1858; Aricò, 1992; Maurici 1999; Bresc, 2010). Deer would thus have disappeared from the Aegadian Islands, in ancient times "*... as evidenced by the graffiti and bones of the Grotta del Genovese, but also by a toponym such as Portella del Cervo, on the Montagna Grossa of Favignana*" (Malaguzzi, 1989; cf. Riggio, 1976). Moreover, literary sources report the occurrence of herds of deer and rabbits on Favignana, from at least as far back as the beginning of the 18th century (Massa, 1709), while Amico (1757–1759) said that the island abounded in "*deer and rabbits*". In particular, Dùran (1928) stated without hesitation that the ancient fauna of Marettimo had long since disappeared, as had "*...the large African mammals, the boars imported by the Bourbons, and the deer of Philip IV*" (cf. Masseti, 2016). Together with the toponyms relating to the deer of Favignana and Marettimo, La Mantia & Cannella (2008) are however of the opinion that the references by Amico (1757–1759) and Dùran (1928) appear to be inconclusive.

Wild goats

Still according to Ibn Yahya al-Umari, another satellite island of Sicily, which unfortunately remains unnamed, must have had a population of wild goats. The already mentioned Idrisi had reported the presence of these ungulates even from the island of Vulcano, in the Aeolian archipelago, specifying at the same time that the even more distant Pantelleria was abundant: "*... of goats that have passed from the domestic to the wild state*" (Rizzitano, 1994; cf. Amari & Schapparelli, 1883). Populations of wild goats, *Capra aegagrus* Erxleben, 1777, have been present on the Mediterranean islands since time immemorial (Masseti, 2009, 2016). Referring to the past spread of these ungulates on Favignana, the Sicilian scholar Vito Amico (1757–1759) observed that: "*... in niun modo però combina col vero che sia stata la Capraria mentovata da Omero, famosa per le fiabe del gigante Polifemo e di Ulisse, come afferma Cluverio*" [… in no way, however, is it true that it was the Capraria mentioned by Homer, famous for the fables of the giant Polyphemus and Ulysses, as Cluverius states]". Since ancient times, the archipelago has also been called by the names of *Aegates, Aigatai*, *Aegades, Egadi* because of the "*... goats, which then as now abounded, called by Pliny* capraria" (cf. Amico, 1757–1759). All the names, like that of *Egusa* mentioned by Pliny the Elder (*Naturalis historia*, III: 92), recall the ancient Greek term *aix* (= "goat"), which is very common in island toponyms, both in its Greek and Latin (*capra*) forms (Barchiesi et al., 1982). In and around the Channel of Sicily, populations of wild goats survived on Lampedusa until about the middle of the 19th century and on the Tunisian island of La Galite until 1904, when they became extinct due to persecution by workers during the construction of the lighthouse on the nearby islet of Galitone (Lauvanden, 1924; Masseti & Zava, 2002; Masseti, 2009a, 2014) (Fig. 4). It is therefore no coincidence that the Arabs called La Galite as Djebel Mazzat or "mountain of goats" (Galbert, 1904).

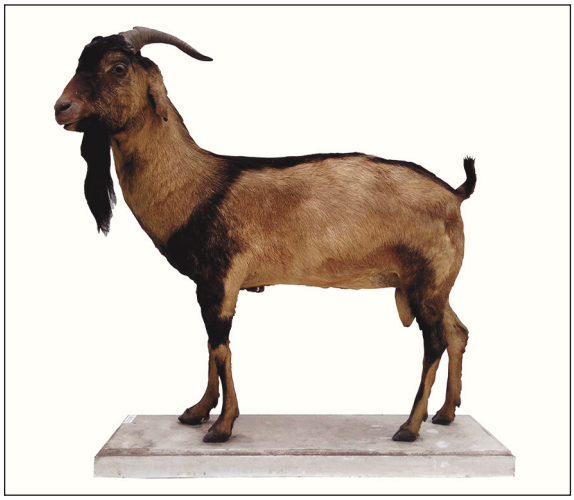

Figure 4. Stuffed specimen of subadult male goat, possibly obtained from the Tunisian island La Galite (photo by Gianni Insacco; courtesy Museo Civico di Storia Naturale, Comiso, Ragusa).

EXTANT MAMMALS OF MARETTIMO

In line with the wealth of wildlife in the past, even today Marettimo reveals an interesting presence of mammals within its territory. In general, these are zoological species of anthropochorous origin, introduced to the island for the most different purposes, including hunting and aesthetic reasons. Among these, some unintentional introductions cannot be excluded either, as in the case of some of man's most common commensal micromammals.

The terrestrial mammalian species currently reported for Marettimo are 10. They include three rodents (murids), three artiodactyls (one suid, one cervid and one bovid), one lagomorph (leporid), one representative of the Soricidae family, and at least two bats.

Aegadian shrew, Crocidura sicula aegatensis *Hutterer, 1991*

Krapp (1969) reported for the first time a taxonomic representative of the genus *Crocidur*a (Wagler, 1832), from the Aegadian archipelago, that he referred to *C. suaveolens* (Pallas, 1811). However, this shrew was later recognised as belonging to the species *Crocidura sicula* Miller, 1900, the Sicilian shrew (Figure 5). In fact, from a cytogenetic analysis of soricids found on Sicily and the island of Gozo (Maltese archipelago), it became evident that all the members of the *Crocidura* genus from the Siculo-Maltese archipelago actually belong to the same species *C. sicula* (Vogel et al., 1989, 1990; Sarà et al., 1990; Sarà & Vitturi, 1996; Lo Brutto et al., 2004). This *taxon* is endemic to Sicily, the Aegadian archipelago, Ustica, the already mentioned Gozo, and is considered as being extinct on Malta (Vogel et al., 1990; Sarà, 1995, 1996; Masseti, 2002; 2008). It is a probable survivor from the Pleistocene, but not related to the endemic *C. esuae* Kotsakis, 1986, living in the Middle Pleistocene of Sicily (Kotsakis 1986; Hutterer 1990; Sarà, 1995), and apparently replaced by *C. sicula* since the terminal Pleistocene (Bonfiglio et al., 1997). The Sicilian shrew has also been identified as a conspecific form of *C. canariensis* (Hutterer et al., 1987), endemic to the Canary islands (Sarà, 1995). According to certain authors (Vogel et al., 1990, Sarà, 1995, 1996, and 1998; Masseti, 2002 and 2008), *C. sicula* is to be comprised among the extinctions that took place also on the small island of Lampedusa in the Sicilian channel in the course of the Holocene. Hutterer (1991) found some morphological peculiarities in the Aegadian population so as to justify its inclusion in the new subspecies *C. sicula aegatensis* Hutterer, 1991. Previously, however, Krapp (1969) already expressed the view that sub-specific determination could not be made, but maybe the island of Marettimo had his own local race. More recently the occurrence of *C. sicula aegatensis* has been also reported from the Maltese island of Comino (Aloise et al., 2011).

Together with the Sicilian shrew very few other micromammals are now considered endemic to the Mediterranean islands. These are essentially represented by another species of Soricid, the Cretan white-toothed shrew, *C. zimmermanni* Wettstein, 1953, and two rodents, the recently discovered Cypriot mouse, *M. cypriacus*, and perhaps the Kerkennah islands dipodil, *Dipodillus zakariai* Cockrum, Vaughan & Vaughan, 1976, from the namesake Tunisian archipelago (Masseti, 2009b). These are the only mammals left from a completely vanished Pleistocene faunal world.

Bats

Until now, bats have been scarcely reported from the Aegadian Islands. Only the occurrence of

three species is known for the archipelago. In Favignana Krampitz (1957) described the presence of the Kuhk's pipistrelle, *Pipistrellus kuhli* Kuhl, 1817, that was later confirmed by Fiore et al. (1992) and Fornasari et al. (1997), while the present study recorded for the first time the greater horseshoe bat, *Rhinolophus ferrumequinum* (Schreber, 1774), *P. kuhli* and the free-tailed bat, *Tadarida teniotis* (Rafinesque, 1814), from Levanzo. In the course of the present study, *P. kuhli* and *T. teniotis* have been also observed for the first time on Marettimo, representing for the moment, the only bats so far recorded on this small Aegadian island.

Lagomorphs

The rabbit, *Oryctolagus cuniculus* (L., 1758), is the only leporid currently present on Marettimo (Massa, 1973; Flux & Fullagar, 1992; Vaccaro, 2016). Ist occurrence on the island is also documented by one specimen in the collections of the Museum of Zoology La Specola of the University of Florence (MZUF n. coll. 13170, 5.IV.1990).

Of the hares, *Lepus* sp., mentioned by Smyth (1824) there seems to be no more documentation.

Carnivores

A few authors, such as Pratesi & Tassi (1974), Racheli (1986) e Malaguzzi (1989), did not exclude the survival of feral cats, *Felis silvestris* Schreber, 1777, on Marettimo. The same information was also quoted by Masseti (2010).

Artiodactyls

As we have seen, the presence of ungulates on Marettimo is particularly abundant. It comprises at least three species, such as *Sus scrofa* L., 1758, the red deer, *Cervus elaphus* L., 1758, and the Asiatic mouflon, *Ovis orientalis* Gmelin, 1774.

The island seems to be populated by a kind of wild pig, introduced who knows how long ago (Dùran, 1928; Racheli, 1986; Sara, 1998; Sironi, 2004): "*... which the islanders call wild boars' but which 'are nothing more than pigs that have 'chosen freedom*" (Malaguzzi, 1989). Their presence has been reported at least since 1910 (Dùran, 1910), but according to Sarà (1998, 2008) some wild boar launches were also carried out in the second half of the 20th century, and more precisely in the 1980s, by private citizens for hunting purposes (Masseti, 2016a). According to Vaccaro (2016), real wild boars (from Maremma) would have been imported to Marettimo at the same time as mouflons were introduced, i.e. around the mid-1970s. The wild boars will certainly have interbred with wild pigs and at this stage it will be difficult to make meaningful taxonomic distinctions. Having caused a great deal of damage to the island's dense maquis, these suids seem to have become very rare, partly because of the local water shortage (Sironi, 2004).

In 1976, six Tyrrhenian mouflons, *Ovis orientalis musimon* (Pallas, 1811), from a Tuscan farm, were also introduced to Marettimo (Sacchi et al., 1994) (Fig. 6). In the spring of 1992, although their average growth rate was rather low, they had already

Figure 5. Aegadian shrew, *Crocidura sicula aegatensis* Hutterer, 1991 (photo by Paolo Agnelli).

Figure 6. Tyrrhenian mouflons, *Ovis orientalis musimon* (Pallas, 1811), from a Tuscan farm, were introduced onto Marettimo in 1976 (photo by Vito Vaccaro).

reached 51 individuals (Sacchi et al., 1994; Masseti, 2016a). The habitat study carried out by Sacchi et al. (1994) showed a use by these ungulates of all the different environmental types in proportion to their availability, while it seems that only the vegetation of the pulvinus shrub community, such as *Helichrysum rupestre* (Rafin.) DC. var. *messerii* Pignatti, *Senecio cineraria* DC., and *Polycarpon alsinifolium* (Biv.) DC.),, is avoided. The current estimate of the entire mouflon population on Marettimo could be around one hundred individuals (Vaccaro, 2016).

Some red deer escaped from an enclosure of the Marettimo Residence some twenty-five years ago and today eight or so individuals of the species are presumed to inhabit the island. The architecture of the antlers of some of them, such as the male over five years old shown in Fig. 7, is well structured, with the occurrence of both the brow and the bey (or bez) tines, but fairly simplified possibly due to the limited trophic resources available on the island.

Rodents

The island is characterised by the presence of the wild mouse subspecies *Apodemus sylvaticus dichrurus* (Rafinesque-Schmaltz, 1814) (Krapp, 1969; Amori, 1993; Sarà & Casamento, 1995; Amori & Masseti, 1996). This subspecies is considered to be native to Mediterranean Europe, and is therefore present not only in central and southern Italy, Sicily, Sardinia and Corsica, but also in Spain, southern France and much of the Balkan Peninsula (Capizzi & Filippucci, 2008).

The most common commensal murids, such as the black rat, *Rattus rattus* (L., 1758), and the house mouse, *Mus domesticus* Rutty, 1801, are also common there (Krapp, 1969; Amori, 1993; Amori & Masseti, 1996).

Eastern cottontail, *Sylvilagus floridanus* (J. A. Allen, 1890)

In relatively recent times, an attempt to introduce the Eastern cottontail, *Sylvilagus floridanus* (J.A. Allen, 1890) (Zava, 1992; Masseti, 2008; Angelici & Spagnesi, 2008; Masseti & De Marinis, 2008) was carried out on the island (Fig. 8). This is a small American leporid, whose primary distribution covers a vast area from southern Canada to north-western South America (Chapman & Ceballos, 1990). Eastern cottontails have been widely transplanted beyond the territories of their natural distribution in North America and Europe. In the Old World, the species has been introduced to France, where it is now extinct, and as well as to Italy (Lapini, 1999). In Italy, the earliest evidence of its occurrence dates back to 1966 (Doria, 1991; Spagnesi 2002 and 2008; Andreotti et al., 2001), and populations of cottontail are today dispersed in Piedmont, Friuli-Venezia Giulia and Tuscany (Lever, 1985; Lapini, 1999; Spagnesi, 2002; Masseti, 2003; Angelici & Spagnesi, 2008). The only known attempt for the introduction of the species onto Mediterranean islands seems to have been performed on Marettimo during the 1980s, but there is no evidence that these animals originated any local population (Masseti & De Marinis, 2008; cf. Zava, 1992). In fact, the result of this attempted release - which was even illegal - did not give rise to stable populations over time and independent from subsequent launches.

Monk seal,* Monachus monachus *(Hermann, 1779)

This species deserves a separate discussion, as it cannot be considered exclusively a marine mammal because it depends on terrestrial haul-out areas (typically found in marine caves) for giving birth and lactating its young. Over the period between 1998 and 2010, sightings have been reported in a somewhat repetitive manner in the Aegadian archipelago in particular in the years 2001, 2002, 2004, 2006, and 2010. The majority of sightings were reported in coastal areas of the island of Marettimo (Mo, 2011). About fifteen years ago, a squid fisherman spotted an individual between Cala Fredda and Cala Dogana (Levanzo) for a whole week (riferimento). According to Mo (2011), the repeated observations of seals over the years in wide geographic areas characterised by multiple sightings would suggest that the seals are not observed incidentally and that there may be a regular use of selected stretches of coast over time. Recent cave in-situ monitoring carried out by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) in collaboration with the Marine Protecte Area of the Aegadian islands has shown that seals have used a few caves of the island of Marettimo and Favignana as resting sites for several years from 2011 onwards (Giulia Mo 2021, pers. comm.).

Figure 7. A few red deer, *Cervus elaphus* L., 1758, escaped from an enclosure of the Marettimo Residence some 25 years ago and today eight or so individuals of the species are presumed to roam free on the island (photo by Vito Vaccaro).

Figure 8. Eastern cottontail, *Sylvilagus floridanus* (J.A. Allen, 1890), a small American leporid introduced in Marettimo but with no evidence of current populations (photo by Fabrizio Darmanin).

CONCLUSIONS

Since the late Pleistocene, the sequence of the mammalian fauna of the Aegadian archipelago is congruent with that of neighbouring Sicily, being exclusively characterised by continental elements. As in most of Sicily, this fauna would have been destined for extinction on the smaller islands, only to be replaced by anthropochorous species, introduced for various purposes, including food, hunting and perhaps even aesthetics. The extant occurrence of non-volant continental mammals on Marettimo is essentially linked to the introduction by man during the most recent Holocene.

It cannot be excluded that, in the past, deer, goats, hares and rabbits could have been released in a free-ranging state, while man exerted a control on the number of the animals through justified hunting, as occasion demanded. This could have been one way of simplifying management problems, considering Marettimo as a natural enclosure and allowing the phytophagous herds to derive their food supply directly from the carrying capacity of the environment. One cannot overestimate the importance of islands inhabited by free-ranging populations of herbivores, which represented living depositories of animal proteins available at any time along the marine routes of the Mediterranean Sea. Indeed, some of the herbivores most adaptable to peculiar environmental conditions, even of small islands, were brought by sailors and let loose on islands so that they could breed and provide a store of fresh meat that would be readily available for the passengers of ships (Masseti, 1998). Beyond this peculiar use as natural reservoirs of fresh meat, the European nobility often regarded many of the islands that would otherwise be unproductive, especially those located near the mainland coasts, simply as game preserves (Masseti & Zava, 2002).

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