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MONOGRAPH

The endemic fauna of the sicilian islands

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ABSTRACT In this survey we propose an analysis of the endemic fauna (Mollusca, Arthropoda, Chordata) present in the 14 major circum-sicilian islands and in Lampione islet (Strait of Sicily, Pelagie Islands). Overall, 111 endemic taxa between species and subspecies have been identified. The largest taxonomical groups are Tenebrionid Beetles and Curculionids (respectively 18 and 16 taxa) and Gastropods (20 taxa), due to their strong inclination to insular differentiation, which is inversely proportional to their vagility. The number of endemic taxa per island is positively associated to the extent of the surface but not to the distance from the closest continental mass or altitude or geological origin. The most important connection is with the complex paleogeographic history pertaining the different insular complexes.

KEY WORDS Endemism; circum-sicilian islands; paleogeography.

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INTRODUCTION

Small islands and archipelagoes have always raised the interest of biologists, especially due to the peculiar flora and fauna which inhabits them (Pasta, 2008; Minelli, 2012). The Mediterranean is a sea basin gathering one of the largest insular groups in the world with approximately 5000 islands. This number raises up to approximately 11,879 if we consider the numerous minor islands as well (Blondel et al., 2010). The coastline of these islands extends for approximately 18,000 km, including 39% of all the Mediterranean coastal areas (cf. ANPA, 2001). The islands of the Mediterranean are, for the most part, strips of land above sea level which have latterly isolated themselves from the nearby continental masses. Other islands are of volcanic origin and have never had contacts with other lands. In the first case we speak about continental or "chersogenic" islands; in the second one, about "talassogenic islands" (see also Troia, 2012 and corresponding bibliography).

The organisms actively or passively colonizing the islands undergo a severe selective pressure triggered by both isolation and environmental characteristics; as an adaptative response, they develop more or less pronounced biological peculiarities, favouring the formation of endemic species (cf. Zunino & Zullini, 1995) (Figs. 1–4).

Several factors contribuite to the birth of these endemic species: paleogeography (a few have remained isolated for a long time, others have not), distance from the nearest continental mass (source area), size of the island (between a few square metres and 25,700 square km as is the case of Sicily, for instance), height above sea level, substrate, morphology. These factors, as a whole, have determined the high rates of endemism that have been observed

in these islands (See ANPA, 2001). Endemic insular species are usually divided into two main categories: abandoned (paleoendemic species) or of new formation (neoendemic species). The first ones are formed by populations in ancient times common on ample areas, successively relegated in confined, separated areas detached from the original continental populations. On the contrary, neoendemic species are relatively recent taxa, appeared as a result of the colonisation of the islands in successive periods (Zunino & Zullini, 1995).

In this note we propose an analysis of the endemic fauna, known today, present in the circum-sicilian islands. Field and bibliographical research carried out have allowed us to identify as a whole 121 endemic taxa between species and subspecies (see Figs. 5, 6). The taxonomical status of certain entities, however, has not been confirmed by recent molecular analysis, or is nevertheless considered uncertain by several researchers; for this reason we have considered appropriate to exclude a few taxa, considering a total of 111 entities (see notes to Fig. 6). It is nevertheless an extremely important value considering that in Sicily, based on the data reported by Minelli et al. (2005), integrated by the contributions published until 2015 (Magrini et al., 2006; Aliquò et al., 2006; Magrini, 2007; Sparacio, 2007, 2014; Magrini et al., 2007; Magrini et al., 2008; Švihla, 2009; Arnone & Massa, 2010; Bonavita & Vigna Taglianti, 2010; Baviera, 2010; Baviera & Liberti, 2010; Baviera & Magnano, 2010; Hertach, 2011; Jordana et al., 2011; Kapp, 2010 ; Kleukers et al., 2010; Lo Cascio & Sparacio, 2010; Malicky, 2010; Magrini et al., 2010a; Magrini et al., 2010b; Rapuzzi & Sama, 2010; Stuben, 2010; Bellò & Baviera, 2011; Haitlinger, 2011, 2012; Magrini & Baviera, 2011; Magrini et al., 2011; Pagliano, 2011; Rigato, 2011; Colomba et al., 2012; Giannuzzi-Savelli et al., 2012; Liberto et al., 2012; Müller, 2012; Pantaleoni & Badano, 2012; Rapuzzi & Sparacio, 2012, 2015; Sabella et al., 2012; Gardini, 2013; Lourenço & Rossi, 2013; Magrini et al., 2013; Poggi & Baviera, 2013; Pellizzari, 2013; Arnone et al., 2014; Magrini & Paladini, 2014; Baviera, 2015; Colonnelli & Paladini, 2015; Magrini & Degiovanni, 2015; Magrini & Paladini, 2015; Magrini & Uliana, 2015) an overall of 850 endemic species are present, 13% of which is exclusive of the circum-sicilian islands.

Hints on the history of the faunistic exploration of circum-sicilian islands

Circum-sicilian islands have, over the centuries, been the destination of several scientific explorations, thanks to which a remarkable bulk of data has been gathered, which has constituted the basis for important contributions. For a detailed summary of the naturalistic exploration of Pelagie Islands and Pantelleria see Baccetti et al. (1995a); for the Aeolian Islands Lo Cascio & Navarra (2003). Particularly relevant has been the research coordinated by Edoardo Zavattari in 1950 in Linosa and Lampedusa islands, whose results have flowed for the most part in the volume "Biogeografia delle isole Pelagie" (Zavattari, 1960), still considered a landmark for the study of biogeography of the circum-sicilian islands (Baccetti et al., 1995b). In particular, Zavattari and his partners found 415 species of insects in the two islands. For Pantelleria a significant push to entomological research has been given by the Museo Civico di Storia Naturale of Venice with three different gathering campaigns led between 1983 and 1986, followed by a number of contributions published by the Museo itself (see Ratti, 1986). Particularly important, between the seventies and the nineties, was the research carried out jointly by Palermo University and "Consiglio nazionale delle Ricerche". The results to this survey have constituted the basis to the monograph "Arthropoda di Lampedusa, Linosa e Pantelleria", reporting a whole of 1718 species of arthropods (Lo Valvo & Massa, 1995). In particular, to the known 855 species, another 863 (several of which were new for science) are added to the checklists reported in the volume. This work makes the explorative level of the three islands satisfactory as a whole, even though not thorough, also due to the fact that in the sole Lampedusa island, between 1995 and 2012, another 71 species have been cited (Goggi, 2004; Li Causi et al., 2013). Between 1994 and today, 4 new species have been described for Pantelleria (*Pseudomeira cossyrica* Pierotti et Bellò, 1994; *Probaticus cossyrensis* Sparacio, 2007; *Echinodera diottii* Stuben, 2010; *Pseudoapterogyna euphytus lamantiai* Sparacio, 2014), 4 for Lampedusa (*Torneuma clandestinum* Magnano et Mifsud, 2001; *Torneuma extinguendum* Magnano et Mifsud, 2001; *Physetopoda silviae* Pagliano, 2011; *Neumatora annamariae* Magrini, Abbazzi et Petrioli,

Island	acronym	Area (km²)	Origin	Geographic coordinates	m.s.l.m.	Distance to mainland (km)	Endemic and subendemic taxa	Number of taxa for km²
Eolie Stromboli	ST	12.2	Volcanic	Lat: 38.80º N; Long: 15.25º E	924	54	11	0.9
Panarea	PA	3.4	Volcanic	Lat: 38.63º N; Long: 15.07º E	420	41	10	2.94
Vulcano	VU	21	Volcanic	Lat: 38.42º N; Long: 14.98º E	499	20	12	0.57
Lipari	LI	37.3	Volcanic	Lat: 38.45º N; Long: 14.97º E	602	27	14	0.38
Salina	SA	26.4	Volcanic	Lat: 38.57º N; Long: 14.87º E	962	38	17	0.64
Filicudi	FI	9.5	Volcanic	Lat: 38.58º N; Long: 14.58º E	773	45	10	1.05
Alicudi	AL	5.1	Volcanic	Lat: 38.55º N; Long: 14.37º E	675	53	6	1.18
Ustica	US	8.1	Volcanic	Lat: 38.72º N; Long: 13.20º E	266	51	4	0.49
Egadi Levanzo	LE	5.6	Sedimentary	Lat: 37.59° N; Long: 12.20° E	278	13	6	1.07
Favignana	FA	19.5	Sedimentary	Lat: 37. 55° N; Long:12.19° E	302	8	6	0.25
Marettimo	MA	12.3	Sedimentary	Lat: 37°58° N; Long: 12.3° E	686	35	18	1.46
Pantelleria	PN	83	Volcanic	Lat: 36.80º N; Long: 12.00º E	836	67	20	0.24
Pelagie Linosa	LN	5.4	Volcanic	Lat: 35.88º N; Long: 12.38º E	195	165	7	1.29
Lampione	LA	0.036	Sedimentary	Lat: 35.57º N; Long: 12.33º E	36	100	9	250
Lampedusa	LM	20	Sedimentary	Lat: 35.52º N; Long: 12.62º E	133	120	27	1.35

Table 1. Geographic coordinates of the circum-Sicilian islands, number of known endemic taxa and density.

2013) and 1 for Lampione (*Otiorhynchus* (*Aramichnus*) *poggii* Di Marco, Osella et Zuppa, 2002).

We also have a good overall level of the faunistic knowledge for the Aeolian Archipelago and for the Island of Ustica, systematically investigated especially from the sixties with the project "Piccole Isole" promoted by CNR (Lo Cascio & Navarra, 2003). The conspicuous material gathered has been published in the conference proceedings to the "XVIII Convegno della Società Italiana di Biogeografia", whose subject was "The animal and vegetal population of circum-sicilian islands" (AA.VV., 1973). In recent times several contributions have updated the knowledge on many Aeolian populations of invertebrates (Gridelli, 1972; Ratti, 1987; Aliquò 1993, 1995; Lo Cascio & Magrini, 1998; Cecchi & Lo Cascio, 1999, 2000; Cecchi et al., 1999; Arnone et al., 2001; Dapporto & Lo Cascio, 2001; Lo Cascio et al., 2006) and vertebrates (Lo Cascio, 1994, 2000, 2009, 2010; Deidun et al., 2011; Lo Cascio et al., 2001, 2005; Scalera et al., 2004) as well as the discovery of a few new species (*Pseudomeira aeolica* Bellò, Pesarini et Pierotti, 1997; *Ocys beatricis* Magrini, Cecchi et Lo Cascio, 2000; *Nalassus pastai* Aliquò, Leo et Lo Cascio, 2006; *Anthaxia* (*Haplantaxia*) *flaviae* Lo Cascio et Sparacio, 2010; *Firminus massai* Arnone, Lo Cascio et Grita, 2014).

Differently from the other circum-sicilian islands, the Egadi islands have been the subject for deeper zoological surveys only starting from the end of the sixties; these surveys have been carried out by CNR (project "Piccole Isole") (Reverberi & Riggio, 1971). The results to these surveys have mainly pertained some groups of invertebrates (Matic, 1968; Focarile, 1969; Strasser, 1969; Marcuzzi, 1970; Magistretti, 1971; Alicata, 1973; Caruso, 1973; Tamanini, 1973), Amphibians and Rectiles (Bruno, 1970; Lanza, 1973). From that moment until today other contributions have been added, which favoured a widening of the available knowledge, particularly for tenebrionid beetles (Aliquò, 1993, 1995) and terrestrial molluscs (Beckmann, 1992; 2003; Cianfanelli et al., 2004;

Fiorentino et al., 2010; Manganelli et al., 2007; Liberto et al., 2012; 2015), as well as the description of some interesting endemic species (the ortopheran *Acinipe galvagnii* Cusimano et Massa, 1977; the coleoptera *Otiorhynchus* (*Arammichnus*) *aegatensis* Magnano, 1992; *Typhloreicheia* (*Typhloreicheia*) *berninii* Magrini, Bastianini et Petrioli, 2003; *Malthinus egadiensis* Švihla, 2009; *Alaocyba ientilei* Baviera, 2010; *Danacea* (*Danacea*) *hierena* Baviera et Liberti, 2010; *Entomoculia hieratica* Poggi et Baviera, 2013; the Phasmatodeo *Bacillus grandii maretimi* Scali et Mantovani, 1990; the mollusc *Schileykiella bodoni* Cianfanelli, Manganelli et Giusti, 2004.

MATERIAL AND METHODS

Geographical placement

The circum-sicilian islands are a totality of 105 (between major islands, islets, rocks and sea stacks) detected by the Sicilian Island Award (S.I.A.) as valid islands (Islands acknowledged by IOTA regulation -www.dxawards.com/Lists/sicilianisawd.htm [accessed 24 Agosto 2015]) which as a whole constitute approximately 1.11% of all the regional surface (about 285.4 km² on a total of 25,711 km²). For the most part they are rocks or islets, generally of scarce naturalistic interest and perimetral to the major islands. In this analysis the 14 biggest islands have been taken into consideration (Stromboli, Panarea, Vulcano, Lipari, Salina, Filicudi, Alicudi, Favignana, Levanzo, Marettimo, Ustica, Pantelleria, Lampedusa, Linosa) and the islet of Lampione, while the Maltese Archipelago has been excluded as administratively not bond to Sicily. These islands can be gathered into three main archipelagoes: the Aeolian Islands (Volcanic), the Egadi (Sedimentary), the Pelagie Islands (both volcanic and sedimentary); the remaining two islands, Ustica and Pantelleria (both volcanic) are rather isolated (see Fig. 5). All of these islands are characterized by an ample latitudinal extension, running

Figure 1. *Acinipe galvagnii* from Marettimo; Figure 2. *Siciliaria scarificata* from Marettimo.
Figura 3. *Gryllotalpa cossyrensis* from Pantelleria. Figure 4. *Heliopates avarus donatellae* from Pantelleria.

from 35° 30'N of Lampedusa, in Pelagie islands, to the 38° 50'N of Strombolicchio, in the Aeolian archipelago. The strait of Messina (approximately 3 km of length in the narrowest point) currently separates Sicily from Eurasia, while the portion which is closest to the African Continent (Tunisia), is about 70 km distant from the island of Pantelleria.

Data gathering and elaboration

To propose a thorough summary we have analyzed the ample bibliography available today on the circum-sicilian islands. In particular, we have made reference to the works included in Zavattari (1960), Francini Corti & Lanza (1973), Massa (1995a), Sparacio (1995, 1997, 1999), to the management plans of the natura 2000 sites "Isole Egadi", "Isole Eolie", "Isole Pelagie", "Isola Di Ustica", "Pantelleria" (AAVV, 2009a, b, c, d), as well as to the dossiers of the checklist of Fauna d'Italia (Minelli et al., 1993–1995) and to the exquisite though incomplete Ckmap 5.4.1 (Stoch, 2006) (for the list of the refence from which the taxa distribution has been drawn, see Fig. 6). As long as possible, we have consulted the original description of the considered species bearing in mind the successive chronological, taxonomical and nomenclatural updates. The reference nomenclature follows the checklist of Fauna d'Italia (Minelli et al., 1993–1995), updated case by case. We have attempted to sum up data related to all the metazoans. However, only advisory of endemic species referable to Arthropoda, Mollusca and Chordata have been taken into consideration. Research related to other groups are now partial and incomplete. Some species present exclusively in the small islets that are perimetral to the major island have been included among these last ones. In particular, *Anaspis akaira*, known solely for the Conigli islet, has been included among the species of Lampedusa; *Passalozetes paucesculptus*, known for Basiluzzo, among the ones of Panarea. The data has been organised in a database created in a Microsoft Access 2007 environment, and elaborated with Microsoft Excel 2007.

DISCUSSION

All the insular population, as effectively isolated, may show more or less pronounced characteristics which, in time, may lead to the formation of endemic taxa. It is a complex process, influenced by a multiplicity of factors, above all taxa vagility and paleogeographic evolution of the islands. (Whittaker, 1998). Generally, since the a drop in the dispersive capacities raises the possibilities of genetic isolation, groups of animals with scarce dispersive capacities show higher levels of endemism in confrontation with others with higher dispersive capacity (Minelli et al., 2005).

By observing figure 5, as a confirmation to this hypothesis, we can observe the absence of Diptera, Odonata, Neuroptera and generally of groups characterized by a marked vagility among the 111 endemic taxa of the fauna of circum-sicilian islands. Well represented are the Gastropod Molluscs (20 taxa, 18%), whose scarce dispersive capacity is well-known. As it is legitimate to expect, of the 111 taxa taken into consideration, about 50% is made up by Coleoptera, by far the most ecologically diversified group on a global level, constituting alone over 20% of Italian fauna (Ruffo & Stoch, 2005). Among Coleoptera, as in figure 6, the largest families are made up by Tenebrionids (18 taxa, 33%) and Curculionids (16 taxa, 30%), two groups characterised by a strong tendency to insular differentiation (Massa, 1995b).

The level of endemism in insular populations, furthermore, is positively correlated to surface, habitat diversity, age and distance of the island from the continent (Whittaker, 1998).

To verify how much these factors influence the endemic contingents in the circum-sicilian islands, the number of endemic taxa of every island has been correlated to

1) the distance from the nearest continental mass (Sicily/Northern Africa)

2) maximum height (indirect index of habitat diversity)

3) surface. On the basis of the variable as in figure 6, a regression has been carried out, using the Pearson index of correlation. From the results obtained, we observe that neither the distance from the continent ($r = 0.198$) nor height ($r = 0.235$) are correlated to the number of endemic taxa (the Pearson coefficient "r" is a measure of the correlation between the two viariables: it can variate between +1 or -1 and it acquires these extreme levels if the correlation - positive or negative - is perfect, while it acquires values close to zero if the two variables are independent). A weak correlation has emerged

by relating the number of endemic species with the area of the islands (Linear function model data: y =0.1608x + 8.9845; R = 0.3209; Pearson correlation index r = 0.54, see figure 8).

Also, no relations seem to exist between the number of endemic species and the geological structure of the islands (volcanic or sedimentary). Alicudi and Favignana, for instance, show the same number of endemic taxa (6) but they are characterised by a profoundly different lithology (see figure 6).

The complex paleogeographic history (see further on) of the circum-sicilian islands, together with the dispersive features typical of every taxa, seem to have been the most incisive factors determining the endemic population, and it does not seem possible to hypothesize a unique colonisation and speciation model. Quite certainly, the different islands (or at least the different archipelagoes), have had different population means, whose vicariantist and dispersalist models overlap.

Considerations on the endemic populations and paleogeography of the circum-sicilian islands

Aeolian Archipelago

The Aeolian Islands are of relatively recent formation: the most reliable radiometric dating estimate that the archipelago formed approximately 1.3 million years ago (in reference to the disappeared apparatuses), while the most ancient rocks above sea level, present in Filicudi, date back to about 600,000 years ago (De Rosa et al., 2004; Lucchi et al., 2013). They are separate from Sicily by a sea area which is up to 2000 m. deep and have always been isolated, even during the marine regressions in Pleistocene. Considering the relatively young age of the archipelago, the high number of endemic species found today (30) and its relative faunistic richness are surprising (cf. Lo Cascio & Navarra, 2003). Based on this interpretative model, the entire Aeolian fauna should be of recent acquisition as entirely formed by propagules of high vagility species which rapidly differentiated on the spot thanks to the well known phenomena of the "bottleneck" and the "founder effect". We should as well consider that during the phases of marine regression the distance between Sicily and these islands was undoubtedly shorter (though not annulled due to the sea depth in this coastal area), so that even the colonization of scarcely vagile insects, as the Tenebrionids, was made easier in these periods (Fattorini, 2001). This way, species belonging to groups with a high tendency to speciation have had the possibility to reach the Aeolian islands and rapidly differentiate (Fattorini, 2011). This might be the case of the disderid spiders, present in Lipari with two endemic taxa - *Harpactea aeoliensis* Alicata, 1973 and *Dysdera flagellifera aeoliensis* Alicata, 1973 (Alicata, 1973); of the Curculionid Beetles *Otiorhynchus* (*Arammichnus*) *meligunensis* Magnano, 1992 and *Pseudomeira aeolica* Bellò, Pesarini et Pierotti, 1997; of the Blattaria, present with three exclusive species (*Ectobius aeoliensis* Failla et Messina, 1974, *E. filicensis* Failla et Messina, 1974 ed *E. parvosacculatus* Failla et Messina, 1974) or of the gastropods of the *Oxychilus* type Fitzinger, 1833, *O.* (*Hyalocornea*) *alicurensis* (Benoit, 1857) of Alicudi and *O.* (*Oxychilus*) *lagrecai* Giusti, 1973 of Filicudi. A likely hypothesis to explain the genesis of some endemic species reconnects to the high degree of environmental instability typical of the Aeolian islands: continuous eruptions allegedly determined the nullification of the present fauna, repeatedly causing "bottleneck" effects, triggering and quickening the birth of many of the endemic species present on these islands (Lo Cascio & Navarra, 2003; Fattorini, 2009; Lo Cascio & Sparacio, 2010). This might as well be the origin of some taxa such as *Anoxia* (*Mesanoxia*) *matutinalis moltonii* Sabatinelli, 1976, exclusive of Vulcano but present with the nominal subspecies in the nearby Lipari and Salina, *Anthaxia* (*Haplantaxia*) *flaviae* Lo Cascio et Sparacio, 2010 known for Panarea, Salina and Lipari but sympatric in the latter with the akin *A.* (*Haplantaxia*) *scutellaris* Genè, 1839 probably for a process of "double invasion" (Lo Cascio & Sparacio, 2010) and especially the Lacertid *Podarcis raffoneae* (Mertens, 1952) and its subspecies. In particular, for *P. raffoneae*, it would be otherwise difficult to explain the supposed "antiquity", considering that the molecular clocks that have been used for the datations confer it an age between 2 and 13 million years, well before the formation of the "present" Aeolian islands (see Lo Cascio & Navarra, 2003). Its current distribution, limited to a few peripheral islets and Vulcano, is interpreted as relictual in the field of an original area which probably involved the whole archipelago; the most

part of the populations have allegedly faced local extinctions as a result of the processes of competitive exclusion derived by the colonisation of the archipelago by the lizard *P. siculus* (Rafinesque-Schmaltz, 1814) (Lo Cascio, 2010).

However, to the antique datation of the molecular clock for *P. raffoneae* we need to add the difficulty to explain the presence of terrestrial molluscs with high preference for calcium. Among these ones *Hypnophila incerta* (Bourguignat, 1858), present in many of these islands, *Oxychilus* (*Hyalocornea*) *alicurensis* of Alicudi and *O.* (*Oxychilus*) *lagrecai* of Filicudi. As such, the genesis of Hygromiidae *Helicotricha carusoi* Giusti, Manganelli et Crisci, 1992, is hard to interpret as it belongs to a genus that is endemic of the Aeolian and implies a very long time for its differentiation.

Giusti (1973) hypothesizes the existence of ancient groups of territories above sea level which left groups of paleo-endemic species to the new Aelioan islands of formation. These territories might have been situated further north, and even derived by the fault of Tyrrhenian microplates in their shift towards their present position, or further south, in contact with the Sicilian coast line.

A different biogeographical explanation was proposed for *Ocys beatricis* Magrini, Cecchi et Lo Cascio, 2000: a small carabid, endemic in Lipari and rather isolated in the field of its genus and only akin to another specie, *Ocys inguscioi* Magrini et Vanni, 1992, localised in southern Puglia. Considered that these are winged species, potentially capable of highly dispersive capacities, it is possible to suppose a climate or ecological change to have caused the disappearance in the original distribution area of a common hypothetical ancestor, and the distance between the surviving population to have triggered a differentiation on a species level (Magrini et al., 2000; Lo Cascio & Navarra, 2003). The endemic sub species of garden dormouse present in Lipari, *Eliomys quercinus liparensis* Kahamann, 1960, differentiated, according to several authors (see Angelici et al., 2009) starting from nuclei originally introduced in the Roman age for dietary.

Egadi Archipelago

The three major islands of the Egadi are of sedimentary origin, different from the geological and paleogeographic history. Favignana and Levanzo are, as a matter of fact, a fragment of Sicily, to which they alternately remained connected during the eustatic variation in Pleistocene, and from which they are separated by a sea bed only 40 m. deep (Ruggieri, 1973; Agnesi et al., 1993), the last time durind Würmian glaciation (until about 12,000 years ago) (Massa, 1973; Ruggieri, 1973). On the contrary, Marettimo originated almost exclusively from Triassic sediments that show no similarities to the Sicilian territory as they are correlated to surfacing present in northern Africa and Iberian Peninsula (Ruggieri, 1973). Furthermore, it is separated from the two other islands by a channel ("Marettimo Channel") whose maximum depth is 350 m, enough to prevent connections with the Sicilian territory during Pleistocenic regressions (Agnesi et al., 1993). These pronounced differences also reflect, as it is right to expect, on faunistic populations of the three islands. Marettimo, as pointed out by several authors (Alicata, 1973; Bordoni, 1973; Caruso, 1973; Lanza, 1973; Magnano & Osella, 1973), is characterized by a pre-quaternary population with predominant similarities with the western Mediterranean. Favignana and Levanzo show poorer endemic populations and generally with Sicilian affinities (Canzoneri, 1968). As a whole, 20 endemic entities are known in the archipelago, 18 of which are present in Marettimo alone. Levanzo has scarcer endemic contingents (6 taxa, only one of which - gastropod *Rupestrella rupestris coloba* (Pilsbry, 1918) - exclusive of the island) and Favignana (6 taxa, all in common with the other islands of the archipelago). Two endemic vertebrates are present - the Soricid *Crocidura sicula aegatensis* Hutterer, 1991, present in all of the three islands, and the lacertid *Podarcis waglerianus marettimensis* (Klemmer, 1956) in Marettimo alone - whose taxonomic status, besides, is considered rather doubtful (Capula, 1994; Sarà, 1995). Invertebrates make up the largest endemic element under the biogeographical profile. In the field of the endemic fauna of Marettimo we need to highlight the presence of interesting paleoendemic species, such as the underground Coleoptera *Typhloreicheia* (*Typhloreicheia*) *berninii* Magrini, Bastianini et Petrioli, 2003 and *Alaocyba ientilei* Baviera, 2010; the Gastropods *Oxychilus* (*Hyalofusca*) *denatale* (Pfeiffer, 1856), *Siciliaria scarificata* (Pfeiffer, 1856), *Marmorana insularis* (Benoit, 1857) and *Schileykiella bodoni* Cianfanelli, Manganelli et Giusti, 2004; the Tenebrionid

Coleoptera *Odocnemis ruffoi ruffoi* (Canzoneri, 1970). This last species belongs to a sub family of Tenebrionidae, the Elopinae, which in the Mediterranean area enumerate several elements with a circumscribed geonemy and numerous endemic species. *Odocnemis ruffoi* has an exclusively insular Tyrrhenian distribution: nominal form is found in Marettimo, while another subspecies (ssp. *osellai* Gardini, 1979) was described for the Island of Montecristo, in the Tuscan Archipelago. This fact, together with the peculiar, systematic position of the species, inspires the hypothesis of an area of relictual distribution, which might have shrunk in comparison to the original one for unspecified (maybe ecological) reasons. Both the islands were allegedly refuge-posts for *O. ruffoi*, while the isolation might have determined a successive differentiation in the two sub-specific forms presently known (AA.VV. 2009a; Aliquò & Soldati, 2010). The case of *Allophylax costatipennis godenigoi* Canzoneri, 1970 is different. The species has a northern-african type of distribution and it is present on the island of Lampedusa (see Aliquò& Soldati, 2010) while it seems to be lacking in Sicily. The differentiation of the population of Marettimo at an infraspecific level seems to be due to its geographical isolation in comparison to the ones of the rest of the area of distribution of the species (AA.VV., 2009a). Other important paleoendemic species of Marettimo are the Isopod Crustaceans *Bathytropa ruffoi* Caruso, 1973 and *Spelaeoniscus lagrecai* Caruso, 1973. The genus *Bathytropa* Budde-Lund, 1885 encompasses 8 species diffused in different point areas in the Mediterranean water basin: a distribution which, according to Caruso (1973), suggests a pre-Pliocenic origin. To the hypothetical fragmentation of the Tyrrhenid of the tertiary period is to be connected the origin of Spelaeoniscidae *Racovitza*, 1907 (Caruso, 1973), a family present, for Italy in the sole Sicily with 5 endemic species, 3 of which in the circum-sicilian islands (Argano et al., 1995; Caruso & Lombardo, 1995). Other entities which are exclusive of the archipelago belong to genera which are rich in point-schizo-endemic species, such as the Coleoptera *Otiorhynchus* (*Arammichnus*) *aegatensis* Magnano, 1992 (present in all of the three islands), *Entomoculia hieratica* Poggi et Baviera, 2013 (Marettimo), the Chrysomelidae Coleoptera *Pachybrachis osellai* Daccordi et Ruffo, 1975 (present in Levanzo and Marettimo). The apparently disassociated distribution of the Issid Homoptera *Conosimus malfanus* Dlabola, 1987, until now known only for Marettimo and Salina. A future deeper look of the research might reveal the presence of this species also alongside the northern Sicilian coastlines.

Island of Ustica

The Island of Ustica, as the Aeolian Island, is a talassogenic island. It is the highest tip of a vast undersea volcanic apparatus, whose base is over 2000 meters below the sea level. The intense volcanic explosive activity that took place starting from Pliocene is accountable for the continuous accumulation of igneous and pyroclastic material on the sea bed which, in medium Pleistocene (approximately 350 million years ago) led to the emersion of the island (AA.VV., 2009a; Bonomo & Ricci, 2010). Ustica is separated from Sicily by a wide and deep sea area and it has probably always remained isolated, even during pleistocenic regressions. The young geological age of Ustica, together with its isolation, are the main conditions making its faunistic populations (prevalently of a Sicilian or southern Italian type) not particularly relevant. (cf. Francino Corti & Lanza, 1973). Only 5 endemic species, probably all of new formation, are pointed out for the island. The most interesting element is the Cave Isopod *Spelaeoniscus vandeli* Caruso, 1974, apparently well differentiated by the congeneric species (Caruso & Lombardo, 1995). Interesting is the presence of *Oxychilus* (*Hyalocornea*) *nortoni* (Calcara, 1843), a specie belonging to the subgenus *Hyalocornea* Monterosato, 1892, in a particolar distribution with *O.* (*H.*) *alicurensis* typical of Alicudi, *O.* (*H.*) *canini* (Benoit, 1843) of northwestern Sicily, *O.* (*H.*) *egadiensis* Riedel, 1973 of Favignana and Levanzo and probably also *O.* (*H.*?) *pomelianus* Bourguignat, 1867 of NW-Algeria and the Galite Island in Tunisia (Riedel, 1980). The Blattaria *Ectobius usticaensis* Failla et Messina, 1974, according to Failla et al. (1973) and Failla & Messina (1974) who minutely studied the anatomy of the glandular dimples, allegedly belongs to a different evolutionary line if compared to *Ectobius* Stephens, 1835 Sicilian and Aeolian. *Opatrum* (*Colpophorus*) *validum marcuzzii* Canzoneri, 1972 is part of a Northern African chorotype present, other than in insular Sicily with the nominal sub-

species, in the islet of Lampione (ssp. *rottembergi* Canzoneri, 1972) and in Tunisia, Pantelleria and Sardegna (ssp. *schlicki* Gebien, 1906).

Pelagie Islands

The Pelagie Islands are connected to each other only from a geographical (and not geological) point of view. Lampedusa and Lampione are two continental carbonate (Agnesi & Federico, 1995). Differently, Linosa formed between one million and 500,000 years ago during three different stages of volcanic activity (see Tranne, 2002). The difference in their birth reflects also on the size of their populations and on the level of endemism. While Linosa has only 8 endemic species, Lampedusa has 25; 9 are found on Lampione. Lampedusa and Lampione are the last emerged outpost of the African plate and until the last glaciation they have been connected to continental Africa. They therefore own a rich amount of species revolving around northern Africa, arrived via land during this period which, with the sea level rise, have successively remained trapped in the two islands. Here they have undergone more or less marked speciations. Linosa, moreover, has never had contact with other land, therefore the origin of its population is to be searched only on active or passive colonisations that happened during some hundreds of thousands of years. This partially explains the scarcity of species in Linosa in confrontation to Lampedusa (1021 species, between Molluscs e Arthropods, were found in Lampedusa, only 349 in Linosa: AA.VV., 2009d). This faunistic poverty is attributable not only to the different origin of the islands, but also to their different extension (Lampedusa is 20.2

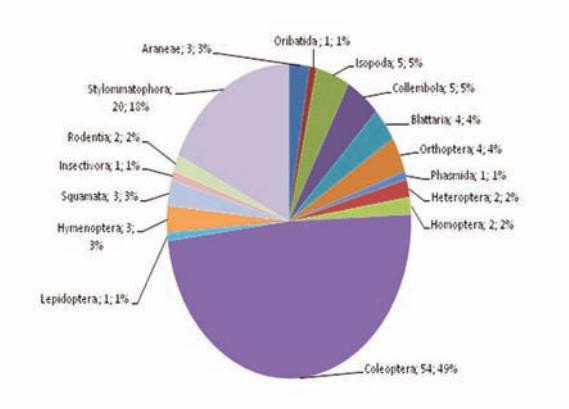

Figure 5. Number of endemic taxa per island. Some taxa are present in more than one island.

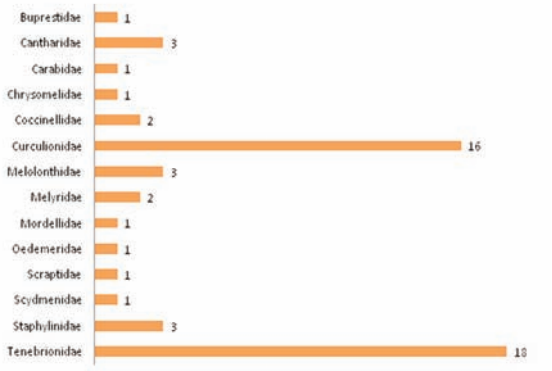

Figura 6. Number of endemic species per Coleoptera family

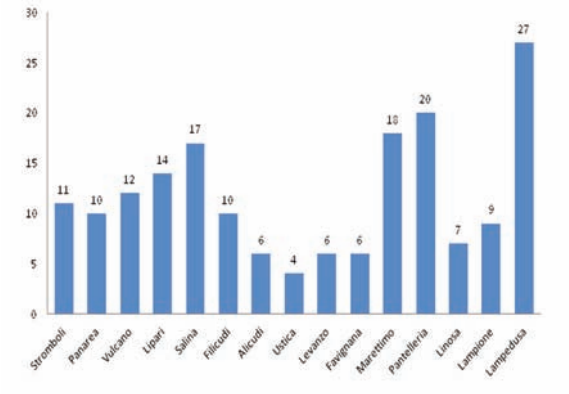

Figure 7. Number of endemic taxa per island. Some taxa are present in more than one island.

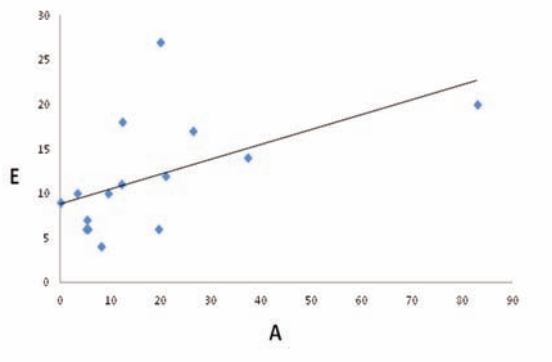

Figure 8. Regression curve for the relationship Island area in km^2 (A)-number of endemic taxa present (E) (see text).

square km wide, while Linosa is only 5.43) whose calcareous nature seems to offer higher colonization possibilities to several species of Arthropods (Massa, 1995b) and land Molluscs. This last point is evident if we consider that on 5 endemic taxa present on the Italian island in the Strait of Sicily - *Lampedusa lopadusae lopadusae (*Calcara, 1846) [Lampedusa], *L. lopadusae nodulosa* Monterosato, 1892 [Lampione], *Oxychilus* (*Oxychilus*) *diductus* (Westerlund, 1886) [Lampedusa], *Trochoidea cumiae* (Calcara, 1847) [Lampedusa and Linosa], *Cernuella metabola* (Westerlund, 1889) [Lampedusa] - none is present in Linosa and Pantelleria. The paleogeographic vicissitudes lead to the inevitable conclusion that the endemic fauna of Lampedusa and Lampione is prevalently relictual, while that of Linosa is invasive. In both cases, they are neoendemic species of recent formation, evolved from species characterized by a high colonizing capacity and a marked evolutionary speed. This phenomenon is observed, as formerly said, in Tenebrionids, present in the islands with 9 endemic species (see figure 5) on 37 known ones, with a rate of endemism of 24.3% (Lo Cascio, 2002). In particular, the presence in Lampione of 4 endemic taxa, with 2 exclusive subspecies *Opatrum* (*Colpophorus*) *validum rottenbergi* Canzoneri, 1972, *Alphasida puncticollis moltonii* Canzoneri, 1972 - and a species being described (*Tentyria* n. sp., see Lo Cascio & Pasta, 2012), is symptomatic both of the differentiation speed of some species of this family from the founding population and of their capacity to colonise isolated and insular territories (Aliquò, 1995). The insular differentiation is certainly a rather quick phenomenon also among Curculionoidea if, as Osella & Riti (1995) have observed, they are present in Pelagie with 9 endemic species. Of these, 1 species from Lampedusa (*Torneuma clandestinum*) and 1 of Linosa (*Otiorhynchus* (*Arammichnus*) *linussae* A. Solari et F. Solari, 1922) have connections with Tyrrhenian species, while 4 of Lampedusa (*Alaocyba lampedusae* Dodero, 1916; *Neumatora annamariae (*Magrini et al., 2013; *Torneuma extinguendum*; *Otiorhynchus* (*Arammichnus*) *lopadusae* A. Solari et F. Solari, 1922), 1 of Linosa (*Chiloneus* (*Chiloneus*) *solarii* Pesarini, 1970) and 1 of Lampione, *Otiorhynchus* (*Arammichnus*) *poggii* Di Marco, Osella et Zuppa, 2002, show northern African affinities. From relictual populations witnessing the ancient connection between Lampedusa and Northern Africa, too, derive the Orthoptera Brachyptera *Omocestus lopadusae* (La Greca, 1973) and *Pamphagus ortolaniae* Cusimano & Massa, 1977 (Massa, 1995b; Massa, 2011) and the Buprestid Beetle *Julodis onopordi lampedusanus* Tassi, 1966. Particularly interesting under the biogeographical profile is *Leptotyphlopsis lopadusae* Bordoni, 1973, an underground Staphylinidae belonging to a group revolving around the Northern Mediterranean but also present is Tunisia, and well differentiated both from African and Italian congeners. According to Bordoni (1973) it is a species belonging to a very old phyletic lineage, which differentiated after the climate changes of the Quaternary.

For the terrestrial molluscs, it is of particular biogeographical importance the presence of the genus *Lampedusa* Boettger, 1877 including *L. lopadusae* (Calcara, 1846) endemic of Lampedusa island, *L. lopadusae nodulosa* Monterosato, 1892 endemic of Lampione island, *L. imitatrix* Boettger, 1877 e *L. melitensis* (Caruana-Gatto, 1892) endemic of Maltese Island. *Lampedusa* is akin to *Muticaria* Lindhol, 1925 of South-eastern Sicily and Maltese Islands. Both these genera have affinities with species of groups which are originated in the Balkans and in north-eastern Mediterranean, and colonized these more western territories probably during Messinian Age (Giusti et al., 1995).

Here, the only endemic vertebrate is *Podarcis filfolensis laurentiimulleri* (Bedriaga, 1876) which, according to recent molecular and biochemical survey, differentiated from stocks of populations of *Podarcis sicula* which colonised Pelagie Islands and Maltese Islands during pleistocenic regressions (see La Mantia & Lo Cascio, 2008; Sciberras & Schembri, 2008 - see also note 16 of figure 6)

Island of Pantelleria

Pantelleria is a volcanic island, emerged approximately 324,000 years ago, and since then it has never had contacts with emerged land (Agnesi & Federico, 1995). The most relevant event, which determined the actual faunistic composition, was the eruption that about 45 thousand years ago entirely covered the island with a layer of stone 5 metres thick ("green ignimbrite"). It is highly likely that this destroyed the most part of the existent flora and fauna. Most of the endemic species of Pantelleria

(20 taxa pointed out) are then neoendemic species, which differentiated in relatively recent times starting from some founding propagules that re-colonized the island following two main lines: from Sicily and Northern Africa (cf. Francini Corti & Lanza, 1973; Massa, 1995b). Endemic species akin to Northern African species are allegedly the Isopod *Spelaeoniscus vandeli* Caruso, 1974, the Orthoptera *Gryllotalpa cossyrensis* Baccetti et Capra, 1978 (Baccetti et al., 1995a), the Buprestid Beetle *Acmaeodera bipunctata romanoi* Sparacio, 1992 (Sparacio, 1992; Sparacio & Ratti, 1995), the Curculionid Beetle *Alaocyba separanda* Dodero, 1916 (cf. Massa, 1995b) and *Echinodera diottii* (Stuben, 2010), and Melolonthid Coleoptera *Pseudoapterogyna euphytus lamantiai* (Sparacio, 2014). The Curculionid Beetles *Otiorhynchus* (*Arammichnus*) *cossyrensis* Magnano, 1992 e *Pseudomeira cossyrica* (Osella & Riti, 1995) have uniquely Tyrrhenian affinities. The Pselaphid *Tychomorphus cossyrensis* (Dodero, 1919) is part of a genus of strictly West-Mediterranean diffusion (Poggi, 1995), while to a species with Mediterranean Geonemy belongs the only heteropter endemic of Pantelleria, *Apterola* (*Apterola*) *kuenckeli focarilei* Tamanini, 1964. The biogeographical interpretation of the Oedemerid Coleoptera *Stenostoma cossyrense* Bologna, 1995. This species belongs to a genus that includes 3 endemic species found, other than in Pantelleria, in Madera and Maltese Islands, as well as a very diffused Western-Mediterranean-Atlantic species. It is likely, then, that it belongs to a very ancient genus, with paleomediterranean distribution, whose original area fragmented more recently in the present islands where it rapidly evolved for the founder principle (Bologna, 1995; Massa, 1995b). Hardly explainable is also the presence of *Leptanilla poggii* Mei, 1995, a hymenoptera formicidae included in a genus with scarce dispersive capacities. The most likely hypothesis is, according to Mei (1995), the introduction for anthropic cause from Northern Africa in an unspecified moment of the recent history of the island. To anthropic reasons, too, is connected the presence of the Muridae mammal *Apodemus sylvaticus hermani* Felten et Storch, 1970 and of *Crocidura pachyura cossyrensis* Contoli, 1990 (Sarà & Zanca, 2008; Angelici et al., 2009).

Figure 1. Aeolian Archipelago: Panarea Island.

Figure 2. Aeolian Archipelago: Salina Island, Pollara.

Figure 3. Egadi Archipelago: Favignana Island with Levanzo Island in the background.

Figure 4. Egadi Archipelago: Levanzo Island, Cala Minnola.

Figure 5. Island of Ustica, Mount Guardia dei Turchi.

Figure 6. Island of Ustica, Cala Sidoti and Punta Spalmatore.

Figure 7. Island of Pantelleria, Montagna Grande.

Figure 8. Island of Pantelleria, Lake of Venus.

Figure 9. Island of Pantelleria.

TAXON	FA	LE	MA	US	LI	VU	ST	SA	AL	FI	PA	LM	LN	LA	PN	REFERENCES
A R T H R O P O D A																
ARACHNIDA ARANEAE DYSDERIDAE																
Dysdera flagellata Grasshoff, 1959												X				Grasshoff, 1959*; Pesarini, 1995; Pantini & Isaia, 2015
Dysdera flagellifera aeoliensis Alicata, 1973					X											Alicata, 1973*; Pantini & Isaia, 2015
Harpactea aeoliensis Alicata, 1973					X											Alicata, 1973*; Pantini & Isaia, 2015
SALTICIDAE																
Aelurillus lopadusae Cantarella, 1983*												X				Cantarella T., 1983*; Azarkina & Loguov, 2006; Pantini & Isaia, 2015
ORIBATIDA PASSALOZETIDAE																
Passalozetes paucesculptus Bernini, 1973											X					Bernini, 1973*
PSEUDOSCORPIONIDA CHTHONIDAE																
Chthonius (*Ephippiochthonius*) *aegatensis* Callaini, 1989*			X													Callaini, 1989*; Stoch, 2006; Gardini, 2013
HEXAPODA BLATTARIA ECTOBIDAE																
Ectobius aeoliensis Failla et Messina, 1974						X		X		X						Failla et al., 1973*; Failla & Messina, 1974; Stoch, 2006
Ectobius filicensis Failla et Messina, 1974								X								Failla & Messina, 1974*; Stoch, 2006
Ectobius parvosacculatus Failla et Messina, 1974											X					Failla et al., 1973*; Failla & Messina, 1974; Stoch, 2006
Ectobius usticaensis Failla et Messina, 1974				X												Failla et al., 1973*; Failla & Messina, 1974; Stoch, 2006
COLEOPTERA BUPRESTIDAE																
Acmaeodera bipunctata romanoi Sparacio, 1992															X	Sparacio & Ratti*, 1995; Stoch, 2006
Anthaxia (*Haplantaxia*) *flaviae* Lo Cascio et Sparacio, 2010					X			X			X					Lo Cascio et al., 2006*; Lo Cascio & Sparacio, 2010
Julodis onopordi lampedusanus Tassi, 1966												X				Tassi, 1966*; Sparacio & Ratti, 1995; Stoch, 2006
CANTHARIDAE																
Malthinus egadiensis Švihla, 2009			X													Švihla, 2009*
CARABIDAE																
Carabus morbillosus lampedusae Born, 1925												X				Rapuzzi & Sparacio, 2015
Ocys beatricis Magrini, Cecchi et Lo Cascio, 2000					X											Magrini et al., 2000*; Lo Cascio & Navarra, 2003
Typhloreicheia berninii Magrini, Bastianini et Petrioli, 2003			X													Magrini et al., 2003*

Table 1/1. Endemic taxa of circum-sicilian island listed by alphabetic order and relative distribution. For the abbreviation of the islands see Table 2. The species followed by * have not been taken into consideration for the elaboration of the Tables.

TAXON	FA	LE	MA	US	LI	VU	ST	SA	AL	FI	PA	LM	LN	LA	PN	REFERENCES
CHRYSOMELIDAE																
Pachybrachis osellai Daccordi et Ruffo, 1975		X	X													Daccordi & Ruffo, 1975*; Stoch, 2006
COCCINELLIDAE																
Scymnus (*Scymnus*) *caprai* Canepari, 1983															X	Canepari, 1983*, 1995
CURCULIONIDAE																
Alaocyba ientilei Baviera, 2010			X													Baviera, 2010*
Alaocyba lampedusae Dodero, 1916												X				Dodero, 1916*; Osella & Riti, 1995; Stoch, 2006;
Alaocyba separanda Dodero, 1916															X	Dodero 1916*; Osella & Riti, 1995; Stoch, 2006
Chiloneus (*Chiloneus*) *solarii* Pesarini, 1970													X			Pesarini, 1970a, b*; Osella & Riti, 1995
Echinodera diottii Stuben, 2010															X	Stuben, 2010*
Neumatora annamariae Magrini, Abbazzi et Petrioli, 2013												X				Magrini et al., 2013*
Otiorhynchus (*Arammichnus*) *aegatensis* Magnano, 1992	X	X	X													Magnano, 1992*; Baviera & Magnano, 2010; Stoch, 2006
Otiorhynchus (*Arammichnus*) *cossyrensis* Magnano, 1992															X	Solari & Solari, 1922a*; Magnano, 1992; Stoch, 2006
Otiorhynchus (*Arammichnus*) *linussae* Solari et Solari, 1922													X			Solari & Solari, 1922b*; Magnano 1992; Baviera & Magnano, 2010
Otiorhynchus (*Arammichnus*) *lopadusae* Solari et Solari, 1922												X				Solari & Solari, 1922a*; Magnano, 1992; Stoch, 2006
Otiorhynchus (*Arammichnus*) *meligunensis* Magnano, 1992					X	X	X	X	X	X	X					Solari & Solari, 1922a*; Magnano, 1992; Stoch, 2006
Otiorhynchus (*Arammichnus*) *poggii* Di Marco, Osella et Zuppa, 2002														X		Di Marco et al., 2002*; Lo Cascio & Pasta, 2012
Pseudomeira cossyrica Pierotti et Bellò, 1994															X	Pierotti & Bellò, 1994*; Osella & Riti, 1995; Stoch, 2006
Pseudomeira aeolica Bellò, Pesarini et Pierotti, 1997						X	X	X	X	X						Bellò et al., 1997*; Stoch, 2006; Bellò & Baviera, 2011
Torneuma clandestinum Magnano et Mifsud, 2001												X				Osella & Riti, 1995; Magnano & Mifsud, 2001; Stoch, 2006
Torneuma extinguendum Magnano et Mifsud, 2001												X				Osella & Riti, 1995; Magnano & Mifsud, 2001; Stoch, 2006
MELOLONTHIDAE																
Anoxia (*Mesanoxia*) *matutinalis moltonii* Sabatinelli, 1976						X										Sabatinelli, 1976; Lo Cascio & Navarra, 2003
Firminus massai Arnone, Lo Cascio et Grita 2014					X		X	X			X					Arnone et al., 2014*
Pseudoapterogyna euphytus lamantiai Sparacio, 2014															X	Ragusa, 1875*; Sparacio, 2014

Table 1/2. Endemic taxa of circum-sicilian island listed by alphabetic order and relative distribution. For the abbreviation of the islands see Table 2. The species followed by * have not been taken into consideration for the elaboration of the Tables.

TAXON	FA	LE	MA	US	LI	VU	ST	SA	AL	FI	PA	LM	LN	LA	PN	REFERENCES
MELYRIDAE																
Danacea (*Allodanacaea*) *caneparii* Liberti, 1985															X	Liberti, 1995
Danacea (*Danacea*) *hierena* Baviera et Liberti, 2010	X	X	X													Baviera & Liberti, 2010*
MORDELLIDAE																
Mordellistena (*Mordellistena*) *irritans* Franciscolo, 1991												X				Franciscolo, 1991*; Massa, 1995
SCRAPTIIDAE																
Anaspis (*Larisia*) *akaira* Franciscolo, 1991												X				Franciscolo, 1991*; Lo Cascio et al., 2002; Massa, 1995a, b
SCYDMAENIDAE																
Pseudoeudesis sulcipennis lampedusae Binaghi, 1948												X				Massa, 1995a, b; Sparacio, 1995
STAPHYLINIDAE																
Entomoculia hieratica Poggi et Baviera, 2013			X													Poggi & Baviera, 2013*
Leptotyphlopsis lopadusae Bordoni, 1973												X				Bordoni, 1973*; Massa, 1995a, b; Sparacio, 1995
Tychomorphus cossyrensis (Dodero, 1919)															X	Sparacio, 1995
TENEBRIONIDAE																
Alphasida (*Glabrasida*) *puncticollis moltonii* Canzoneri, 1972														X		Canzoneri, 1972*; Aliquò & Soldati, 2010; Stoch, 2006
Alphasida (*Glabrasida*) *puncticollis tirellii* Leoni, 1929												X				Canzoneri, 1972; Aliquò & Soldati, 2010; Stoch, 2006
Allophylax costatipennis godenigoi Canzoneri, 1970			X													Canzoneri, 1970*; Aliquò & Soldati, 2010
Asida (*Asida*) *minima* Reitter, 1917												X				Aliquò & Aliquò 2000; Stoch, 2006
Erodius (*Erodius*) *audouini destefanii* Failla Tedaldi, 1887												X				Aliquò & Soldati, 2010
Heliopathes avarus donatellae Canzoneri, 1970															X	Ragusa, 1897; Canzoneri, 1968; Aliquò & Soldati, 2010
Machlopsis doderoi Gridelli, 1930												X		X		Gridelli, 1960; Aliquò & Aliquò, 2000; Osella & Riti, 1995
Nalassus pastai Aliquò, Leo et Lo Cascio, 2006						X										Aliquò et al., 2006*
Odocnemis ruffoi ruffoi (Canzoneri, 1970)			X													Canzoneri, 1970*; Aliquò, 2010
Opatrum (*Colpophorus*) *validum marcuzzii* Canzoneri, 1972				X												Riggio, 1885*; Gridelli, 1960, Aliquò & Soldati, 2010
Opatrum (*Colpophorus*) *validum rottenbergi* Canzoneri, 1972														X		Canzoneri, 1972; Goggi, 2004
Pachychila (*Pachychilina*) *dejeani doderoi* Peyerimhoff, 1927													X			Canzoneri, 1972; Aliquò, 2010; Stoch, 2006

Table 1/3. Endemic taxa of circum-sicilian island listed by alphabetic order and relative distribution. For the abbreviation of the islands see Table 2. The species followed by * have not been taken into consideration for the elaboration of the Tables.

TAXON	FA	LE	MA	US	LI	VU	ST	SA	AL	FI	PA	LM	LN	LA	PN	REFERENCES
TENEBRIONIDAE																
Phaleria (*Phaleria*) *bimaculata marcuzzii* Aliquò, 1993					X	X	X	X								Aliquò, 1993; Marcuzzi, 1996; Aliquò, 2010
Probaticus (*Pelorinus*) *cossyrensis* Sparacio, 2007															X	Sparacio, 2007
Stenosis brignonei Koch, 1935												X	X			Aliquò & Soldati, 2010; Stoch, 2006;
Tentyria grossa sommieri Baudi, 1874													X	X		Canzoneri, 1972; Aliquò, 2010; Stoch, 2006;
Tentyria grossa angustata (Kraatz, 1896)															X	Canzoneri, 1972; Aliquò, 2010
Trachyscelis aphodioides lopadusae Koch, 1935												X				Failla, 1886*; Luigioni, 1929; Goggi, 2004
COLLEMBOLA ENTOBRYIDAE																
Pseudosinella aeolica Dallai, 1973								X								Dallai, 1973*
Seira dagamae Dallai, 1973					X	X	X									Dallai, 1973*
ISOTOMIDAE																
Folsomides meridionalis Dallai, 1973					X	X	X	X	X	X	X					Dallai, 1973*
NEANURIDAE																
Friesea lagrecai Dallai, 1973						X	X	X	X	X	X					Dallai, 1973*
ONYCHIURIDAE																
Onychiurus lampedusae Dallai, 1978												X				Dallai, 1973*
HETEROPTERA LYGEIDAE																
Apterola (*Apterola*) *kuenckeli focarilei* Tamanini, 1964															X	Tamanini, 1964*; Carapezza, 1995
Plinthisus (*Isioscytus*) *minutissimus meridionalis* Mancini, 1935*															X	Carapezza, 1995
MIRIDAE																
Tuponia (*Chlorotuponia*) *hippophaes liparensis* Tamanini, 1973*						X		X								Tamanini, 1973*; Ippolito, 1986
Phytocoris (*Ktenocoris*) *cossyrensis* Carapezza, 1995			X												X	Carapezza, 1995*
HOMOPTERA CICADELLIDAE																
Adarrus aeolianus D'Urso, 1984					X			X								D'Urso, 1984*; Stoch, 2006
ISSIDAE																
Conosimus malfanus Dlabola, 1987			X					X								Lo Cascio & Pasta, 2004
HYMENOPTERA FORMICIDAE																
Leptanilla poggii Mei, 1995															X	Mei, 1995*
Tetramorium pelagium Poldi in Mei, 1995													X			Mei, 1995*

Table 1/4. Endemic taxa of circum-sicilian island listed by alphabetic order and relative distribution. For the abbreviation of the islands see Table 2. The species followed by * have not been taken into consideration for the elaboration of the Tables.

TAXON	FA	LE	MA	US	LI	VU	ST	SA	AL	FI	PA	LM	LN	LA	PN	REFERENCES
MUTILLIDAE																
Physetopoda silviae Pagliano, 2011												X				Pagliano, 2003*, 2011
LEPIDOPTERA SATYRIDAE																
Hipparchia leighebi Kudrna, 1976					X	X	X	X			X					Kudrna, 1976*; Kudrna & Leigheb, 1988; Stoch, 2006
ORTHOPTERA ACRIDIDAE																
Omocestus lopadusae (La Greca, 1973)												X				Baccetti et al., 1995a, b; Stoch, 2006; Massa, 2011
GRYLLOTALPIDAE																
Gryllotalpa cossyrensis Baccetti et Capra, 1978															X	Baccetti & Capra, 1978; Baccetti et al., 1995a, b; Stoch, 2006; Massa, 2011
PAMPHAGIDAE																
Acinipe galvagnii Cusimano et Massa, 1977	X	X	X													Cusimano & Massa, 1977*; Stoch, 2006; Massa, 2011
Pamphagus ortolaniae Cusimano et Massa, 1977												X				Cusimano & Massa, 1977; Stoch, 2006; Massa, 2011
PHASMIDA BACILLIDAE																
Bacillus grandii maretimi Scali et Mantovani, 1990			X													Berni, 1996
MALACOSTRACA ISOPODA ARMADILLIDAE																
Armadillidium hirtum pelagicum Arcangeli, 1955														X		Caruso & Lombardo, 1995
BATHYTROPIDAE																
Bathytropa ruffoi Caruso, 1973			X													Schmalfuss, 2003
SPELAEONISCIDAE																
Spelaeoniscus costai Caruso et Lombardo, 1976				X												Caruso & Lombardo, 1995
Spelaeoniscus lagrecai Caruso, 1973			X													Caruso & Lombardo, 1995
Spelaeoniscus vandeli Caruso, 1974															X	Caruso & Lombardo, 1995
C H O R D A T A																
MAMMALIA INSECTIVORA SORICIDAE																
Crocidura sicula aegatensis Hutterer, 1991*	X	X	X													Hutterer, 1991; Angelici et al., 2009; Sarà, 1995; Stoch, 2006
Crocidura pachyura cossyrensis Contoli, 1990															X	Angelici et al., 2009; Stoch, 2006
RODENTIA GLIRIDAE																
Eliomys quercinus liparensis Kahamann, 1960					X											Angelici et al., 2009; Stoch, 2006
MURIDAE																
Apodemus sylvaticus hermani Felten et Storch, 1970															X	Angelici et al., 2009; Stoch, 2006

Table 1/5. Endemic taxa of circum-sicilian island listed by alphabetic order and relative distribution. For the abbreviation of the islands see Table 2. The species followed by * have not been taken into consideration for the elaboration of the Tables.

TAXON	FA	LE	MA	US	LI	VU	ST	SA	AL	FI	PA	LM	LN	LA	PN	REFERENCES
REPTILIA SQUAMATA LACERTIDAE																
Podarcis filfolensis laurent-mulleri Fejervari, 1924												X	X	X		Capula,1994; Sindaco et al., 2006; Stoch, 2006
Podarcis raffoneae alvearioi (Mertens, 1955)						X		X		X						Capula, 2006; Sindaco et al., 2006; Stoch, 2006
Podarcis raffoneae antoninoi (Mertens, 1952)*						X										Capula, 2006; Sindaco et al., 2006; Stoch, 2006
Podarcis raffoneae raffoneae (Mertens, 1952)							X									Capula, 2006; Sindaco et al., 2006; Stoch, 2006
Podarcis raffoneae cucchiarai Di Palma, 1980*										X						Capula, 2006; Sindaco et al., 2006; Stoch, 2006
Podarcis sicula liscabiancae (Mertens, 1952)*											X					Corti & Lo Cascio, 1999; Sindaco et al., 2006; Stoch, 2006
Podarcis sicula trischittai (Mertens, 1952)*											X					Corti & Lo Cascio, 1999; Sindaco et al., 2006; Stoch, 2006
Podarcis waglerianus maret-timensis (Klemmer, 1956)*			X													Lo Cascio & Pasta, 2008; Sindaco et al., 2006; Stoch, 2006
SQUAMATA SCINCIDAE																
Chalcides ocellatus linosae Boulenger, 1920*													X			Corti & Lo Cascio, 2002; Sindaco et al., 2006; Stoch, 2006
Chalcides ocellatus zavattarii Lanza, 1954*												X				Corti & Lo Cascio, 2002; Sindaco et al., 2006; Stoch, 2006
M O L L U S C A GASTROPODA ARCHITAENIOGLOSSA COCHLOSTOMATIDAE																
Cochlostoma paladilhianum pirajnaea (Benoit, 1878)	X															Manganelli et al., 1995; Bank, 2011
STYLOMMATOPHORA CLAUSIILIDAE																
Lampedusa lopadusae lopadusae (Calcara, 1846)												X				Calcara, 1846*; Liberto et al., 2010
Lampedusa lopadusae nodulosa Monterosato, 1892														X		Liberto et al., 2010; Lo Cascio & Pasta, 2012
Siciliaria (*Siciliaria*) *scarificata* (Pfeiffer, 1857)			X													Liberto et al., 2015
CHONDRINIDAE																
Rupestrella rupestris coloba (Pilsbry, 1918)		X														Beckmann, 2002
COCHLICOPIDAE																
Hypnophila emiliana (Bourguignat, 1858)	X		X													Liberto et al., 2010
Hypnophila incerta (Bourguignat, 1858)					X		X	X		X	X					Giusti, 1973; Liberto et al., 2010
HELICIDAE																
Marmorana (*Murella*) *muralis frivaldszkyi* (Calcara, 1846)															X	Calcara, 1846
Marmorana (*Murella*) *muralis insularis* (Benoit, 1857)			X													Fiorentino et al., 2008a, b

Table 1/6. Endemic taxa of circum-sicilian island listed by alphabetic order and relative distribution. For the abbreviation of the islands see Table 2. The species followed by * have not been taken into consideration for the elaboration of the Tables.

TAXON	FA	LE	MA	US	LI	VU	ST	SA	AL	FI	PA	LM	LN	LA	PN	REFERENCES
HYGROMIIDAE																
Cernuella metabola (Westerlund, 1889)												X				Bank, 2011; Manganelli et al., 1995
Helicotricha carusoi Giusti, Manganelli et Crisci, 1992					X	X	X	X	X	X	X					Giusti et al., 1992
Schileykiella bodoni Cianfanelli, Manganelli et Giusti, 2004			X													Cianfanelli et al, 2004
Trochoidea cumiae (Calcara, 1847)												X		X		Cianfanelli, 2002
LIMACIDAE																
Limax aeolianus Giusti, 1973								X		X						Giusti, 1973; Lo Cascio & Navarra, 2003
ZONITIDAE																
Oxychilus (*Hyalocornea*) *alicurensis* (Benoit, 1857)									X							Benoit, 1857-1862*; Giusti, 1973
Oxychilus (*Hyalocornea*) *egadiensis* Riedel, 1973	X	X														Manganelli et al., 1995
Oxychilus (*Hyalocornea*) *nortoni* (Calcara, 1843)				X												Calcara, 1843; Liberto et al., 2010
Oxychilus (*Hyalofusca*) *denatale* (Pfeiffer, 1856)			X													Manganelli et al., 2007
Oxychilus (*Oxychilus*) *diductus* (Westerlund, 1886)												X				Giusti, 1973; Corti et al., 2002
Oxychilus (*Oxychilus*) *lagrecai* Giusti, 1973										X						Giusti, 1973*

Table 1/7. Endemic taxa of circum-sicilian island listed by alphabetic order and relative distribution. For the abbreviation of the islands see Table 2. The species followed by * have not been taken into consideration for the elaboration of the Tables.

CONCLUSIONS

The study of the populations of the circum-sicilian islands, as we have seen, is particularly complex (see also Francini Corti & Lanza, 1973 and Massa et al., 2011), as these islands vary substantially for their origin (volcanic or sedimentary), paleogeography (some have been connected to Sicily or the African continent during pleistocenic regressions, other have remained isolated), distance from the main source of colonisation (Sicily or Africa), surface (Malta, the biggest island, has a surface of 245.7 km^2 but most of the islands are smaller than 30 km^2) and environmental conditions. Besides, their position at the border between Europe and Africa makes their faunistic composition a mosaic of European and African elements (Francini Corti & Lanza, 1973; Massa 1995b, 2011) with important implications of preservation (Fattorini, 2008, 2011).

The conclusions that we draw by analysing as a whole the endemic contingents of circum-sicilian islands and the main factors that have determined the insular differentiation are similar to those proposed by Fattorini (2011) who took into consideration only Tenebrionids:

- in the case of the Aeolian Islands, the new endemic species might have originated by propagules arrived from Sicily especially during the periods of marine regression, when the distance between these islands and Sicily reduced but not annulled; these propagules might have rapidly differentiated due to a marked “bottleneck”, accentuated by the volcanic instability of the area. The origin of paleoendemic species is more complex: their genesis is allegedly to be found in the complex geological history or “paleo-Aeolian islands”

- for the Egads we can suppose a substantial colonisation via land for Levanzo and Favignana, while the populations of Marettimo have a prevalently relictual connotation.

- Ustica, Linosa and Pantelleria, of volcanic origin, are very distant from continental areas, with which they would never have gotten into contact, which can explain the fact that they show, almost exclusively, endemic species of new formation.

-Lampedusa and Lampione are very isolated and of ancient origin; we can therefore presume that

their endemic contingent derives substantially from a relictual population, above all for the endemic genera (as in Lampedusa), and the oldest species to which other ones (arrived during quaternary contacts with Northern Africa and differentiated during more recent times) have added.

Lastly, we need to consider that all of the circum-sicilian islands have, more or less intensely, undergone profound changes in their natural asset due to anthropic impact, particularly with the destruction of most of their original woods. This, presumably, has led to the extinction of some taxa and to the high rarefaction of others.

The ecological and biogeographical importance of point endemic species is proportional to their fragility, therefore we believe that it is particularly important and urgent to adopt specific protection measures such as the already mentioned Direttiva 92/43 CEE ("Direttiva habitat"): "*they are endemic and need particular attention, considered the specificity of their habitat and/or the potential incidence of its exploitment on their state of conservation*".

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